REFINING CULTURAL AND ENVIRONMENTAL TEMPORALITIES AT THE LATE ARCHAIC–EARLY WOODLAND TRANSITION ON THE GEORGIA COAST, USA

by

KATHARINE G. NAPORA

(Under the Direction of Victor D. Thompson)

ABSTRACT

The Late Archaic in the Southeast U.S. (c. 4500–3100 B.P.) was a time of increased sedentism and social complexity, long-distance trade, and relatively large-scale societies. Along the coast, societies constructed monumental shell rings that functioned as persistent places on the landscape and the focal points of village sites that were occupied year-round. Estuaries provided bountiful resources for these villages, including the oysters whose shells comprise the majority of the ring sites. In the terminal Late Archaic, however, a major cultural shift occurred. Shell ring sites were depopulated, and groups became smaller and more mobile. Evidence from various world regions points to a global climatic transition occurring in the mid-Holocene whose regional timing and manifestations varied. On the Georgia Coast, evidence has long pointed to the localized effects of this climatic shift as including one or more sea-level shifts. In this examination of culture and environment at the end of the Late Archaic, we model new and existing radiocarbon dates from shell-bearing archaeological sites and interpret use and depopulation dates within the framework of a high-resolution paleoenvironmental proxy data source – a 5,177-year tree-ring chronology, a site-level standardized representation of annual tree growth, (and an earlier 529-year floating chronology) derived from ancient buried bald cypress (*Taxodium distichum*) trees at the mouth of the Altamaha River that provides insight into annual environmental conditions on the North Georgia Coast. This chronology and associated analyses indicate that Late Archaic societies weathered a 493-year period of enhanced environmental fluctuation that lasted from 2355 – 1863 B.C.E. and included salinity intrusion events, unreliable rainfall patterns, numerous drought years, and possible hurricanes, speaking to the resilience of both Native American societies of the ancient Southeast as well as the estuary ecosystems that provided their resource base.

INDEX WORDS: Coastal Archaeology; Environment; Late Archaic; Southeast U.S.; Paleoclimate; Tree Rings; Shell Rings; Radiocarbon; Mid-Holocene

REFINING CULTURAL AND ENVIRONMENTAL TEMPORALITIES AT THE LATE ARCHAIC–EARLY WOODLAND TRANSITION ON THE GEORGIA COAST, USA

by

KATHARINE G. NAPORA

B.A., The University of Virginia, 2011

M.A., The University of Chicago, 2012

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2021

REFINING CULTURAL AND ENVIRONMENTAL TEMPORALITIES AT THE

LATE ARCHAIC–EARLY WOODLAND TRANSITION

ON THE GEORGIA COAST, USA

by

KATHARINE G. NAPORA

Major Professor: Victor Thompson

Committee: Suzanne Pilaar Birch
Ervan Garrison
Elizabeth Reitz

Electronic Version Approved:

Ron Walcott
Dean of the Graduate School
The University of Georgia
May 2021

DEDICATION

Dedicated to my wonderful parents, Angela Presson and Casimir Napora.

ACKNOWLEDGEMENTS

I am grateful to many people for their help and support with this dissertation research. I thank my advisor, Victor Thompson, and my committee members, Suzanne Pilaar Birch, Ervan Garrison, and Elizabeth Reitz, for their excellent guidance and feedback. Many thanks to the faculty and staff of the Laboratory of Tree-Ring Research at the University of Arizona, especially Paul Sheppard, Ron Towner, Rebecca Renteria, Jim Parks, and Chris Baisan, for their training with tree-ring methods. *Je remercie aussi le Laboratoire Romand de Dendrochronologie, surtout Marianne, Aurelio, & Manon Reggiani et Bertrand Yerly, ainsi que Phyllis Pritchett*. Thank you to my friends and colleagues with the Georgia DNR, without whom this work would not have been possible, especially Robert Horan, Craig Jacobs, Blaine Tyler, and Nick Crosby. I also thank the Center for Applied Isotope Studies at UGA, especially Alex Cherkinsky, Sarah Jantzi, and Carla Hadden. Special thanks to Jeff Speakman. I thank the UGA Archaeology Lab for their support, especially Amanda Roberts Thompson, Kristine Schenk, and Carey Garland. Thank you to my friends and colleagues in and graduated from UGA's Department of Anthropology, especially April Smith, Justin Cramb, Brandon Ritchison, Christina Lee, Melanie Narcisco, Matt Colvin, Ed Alarcon, Jon Micon, and Shane McShane; also many thanks to Susan Tanner, Margie Floyd, Brenda Yuhas, Clark Harwell, Terria Pittard, and Marilyn Rodriguez for their help through the years. Finally, I thank my parents, Angela Presson and Casimir Napora, for their continual support.

A huge thanks to you all.

TABLE OF CONTENTS

APPENDICES

CHAPTER 1

INTRODUCTION

In the twenty-first century, societies around the globe grapple with questions of cultural resilience and sustainability in the face of increasing climatic instability. People living on coastlines are being forced to consider the ramifications of many facets of climate change, including rising sea levels, increasing storm activity, temperatures trending upwards, and enhanced environmental fluctuation. Confronted with this barrage of environmental blows, will we be able to adapt? Or, will we find it necessary to reconfigure our ways of life?

These considerations have special urgency today, as the global population hits 7.8 billion, and human-exacerbated climate change continues to accelerate. One third of the global population lives within sixty miles of a coastline (Nagaraja 2020). As we look towards an uncertain climatic future, the value of the information that can be gleaned from ancient societies that experienced comparable environmental conditions, and perhaps employed to help bolster twenty-first century resilience, becomes clear.

Four thousand years ago on the Georgia Coast, Indigenous societies flourished. Monumental shell rings functioned as persistent places on the landscape, representing centuries-long continuity of lifeways focused on the estuaries between the barrier islands and the mainland. The rich bounty of these estuaries provided reliable resources for the first settled villages in North America. The villages at the shell rings, however, were no longer inhabited after the Terminal Late Archaic, and the data indicate possibly more mobile societies as the norm after this period. Did environmental aspects play a role in this cultural shift? Were these coastal hunter-gatherer societies resilient in the face of major environmental upheavals? Here, I examine this question via an integrated study combining paleoenvironmental proxies with direct radiocarbon dating and modeling of archaeological sites.

The second chapter of this dissertation introduces the theoretical and methodological frameworks by which this study analyzes cultural resilience in periods of environmental upheaval. I also discuss the site history of Butler Island in McIntosh County, Georgia, a former plantation site from which the vast majority of the ancient trees derive as well as the fieldwork undertaken for this project.

In the third chapter, I present the new 5,177-year tree-ring chronology for the Georgia Coast developed from a deposit of ancient bald cypress (*Taxodium distichum*) trees buried at the mouth of the Altamaha River as well as an earlier 529-year floating segment. I discuss the importance of this chronology to high-resolution paleoenvironmental and archaeological analyses in the Southeast U.S.

The fourth chapter considers the environmental drivers of the tree-ring chronology and discusses the results of the Optical Emission Spectroscopy (OES) elemental tests on trees, tree life histories, and environmental fluctuation and downturns visible in the multimillennial chronology. I compare tree ring-based insights into salinity intrusion events with existing sea-level curves for the Southeast Coast.

The fifth chapter delves into the use-lives and depopulations of the Late Archaic shell rings of the North Georgia Coast, modeling previously existing and new radiocarbon dates and considering them in light of the tree-ring chronology.

Finally, I conclude this dissertation with a summary of the main findings and a brief discussion of the relevance of this work to our own societal resilience in the twenty-first century.

References

Nagaraja, Mamta Patel. 2020. Living Ocean. NASA Science: Share the Science. https://science.nasa.gov/earth-science/oceanography/living-ocean. Accessed November 9, 2020.

CHAPTER 2

LITERATURE REVIEW

Are coastal hunter-gatherer societies resilient in the face of major environmental change? How long after the onset of ecological and climatological disruption can estuarine-dependent societies continue their lifeways? This dissertation investigates the answers to these questions by examining the continuity of and shifts in littoral lifeways on the Georgia Coast during the transition from the Late Archaic (c. 4500–3100 B.P.) to the Early Woodland (c. 3100–2400 B.P). This study frames the archaeological and paleoenvironmental evidence for temporally variable cultural transitions during this period within a new environmental proxy—a 5177-year tree-ring chronology (i.e., a site-level representation of tree growth (Speer 2010: 4)) spanning the years 3161 B.C.E. to 2016 C.E., as well as an earlier floating (i.e., unconnected to the present) 529-year tree-ring chronology we have developed for the Georgia Coast. This background chapter discusses the theoretical framework for analyses, the cultural and environmental context of the study, dendrochronology as it has been employed in the study area, the paleoenvironmental field site, and the methods employed in this research.

Beyond Collapse: Resilience Theory and Archaeology

In recent years, archaeological research focused on major cultural change has moved beyond the idea of societal collapse, instead analyzing the temporalities and interactions, both cultural and environmental, that contribute to differing occurrences and experiences of societal change. Rather than a singular linear and overarching shift as explanation, diversities and nuances (e.g., geographic, temporal, etc.) are now recognized as crucial to the conceptualization of cultural change. A major approach to understanding transformative change in adaptive cultural-ecological systems is resilience theory, at its base conceptualized by the ‘figure eight’ adaptive ecosystem cycle model composed of growth, conservation, release, and reorganization (Hollig and Gunderson 2002). Rather than the loss implied by the term ‘collapse,’ resilience instead focuses on variation through time in complexity and form as well as continuity (Faulseit 2015; Tainter 2015). At the same time as it informs studies of the ancient past, resilience theory also holds the potential to elucidate and contribute to contemporary issues such as the ramifications of increasingly dramatic climate change (Redman 2005).

Resilience theory has recently been applied to the case of the Georgia coast at the time of the Archaic-Woodland transition. Turck and Thompson (2016; see also Thompson and Turck 2009) analyzed what they termed differential community resilience, the idea that communities in periods of transition may experience, understand, and respond to change in diverse ways, based on varying societal and environmental parameters. On the terminal Late Archaic Georgia coast, differential resilience appears to have been tied to the presence or absence of deltaic sediment deposition, which may have buffered river deltas against the deleterious effects of a drop in sea level. Russo (2010) also noted differential community resilience along the Florida coastline during the Late Archaic-Woodland transition, emphasizing that the interplay of social factors and localized environmental conditions led to a highly diverse cultural landscape during this period. In southern Florida, Russo states that shell ring formation continued through the Late Archaic-Woodland transition, probably supported by still-productive estuaries of the gradually sloped coastline. By contrast, the steeper drop-off of the continental shelf in northeast Florida may have disrupted estuary productivity (Russo 2010:161, 171). However, even in these more trying environmental conditions, sedentary lifeways, public mound building, and differentiation in social status continued, indicating that cultural resilience is not entirely dependent on environmental parameters. The analyses of both the Georgia and Florida coastlines indicate the importance of multiscalar analyses to resilience theory. While a general trend may seem evident over a large area, case studies can provide invaluable insights into different experiences of and approaches to resilience.

Resilience and Scale

Multiscalar approaches and cross-scale interactions are central to resilience studies in archaeology (Redman and Kinzig 2003). The adaptive cycles central to a resilience approach may be viewed as complex nested entities within a broader spatial and temporal framework (Redman and Kinzig 2003:1). Interactions across scales of space and time are therefore crucial to the understanding of resilience. Deep time approaches, which strive to understand the causes of change and transformation over very long time scales, have been put forth as a central element that archaeological research has the ability to contribute to the study of resilience (Redman and Kinzig 2003). By contrast, however, small-scale analyses are also vital to the study of resilience, as discussed in the Archaic-Woodland transition examples from the Georgia and Florida coasts. This study delves into the short-term temporal diversity and the localized nuances of a particular event—the cultural transition from the Archaic to the Woodland and associated environmental shifts— as visualized within what Simiand (1960) termed *histoire événementielle*, the conceptualization of time as punctuated by episodes of change. The critique that analysis centered on such a perspective overlooks the importance of the “slow, sometimes motionless currents” of deep social structures in favor of a focus on the “surface flurries” of “short-term crises” (Braudel 1949: 1241-1242), however, is addressed here by situating ‘the event’ of focus within a multimillennial timescale that allows for the identification of short-term anomalies as well as more enduring state shifts. Long- and short-term conditions on the Georgia Coast are conceptualized in this study within a press-pulse dynamics framework, which aids in defining and identifying normative and deviant conditions for the locale. This project elucidates long-term trends and changes in decadal and yearly conditions at the mouth of the Altamaha River, providing a multiscalar dataset on the ancient coastal environment and employing a pulse-press dynamic framework to illuminate human responses to long- and short-term events.

The incorporation of tree-ring data into a study of differential resilience allows a unique opportunity to focus on a variant of the microscale usually invisible in the archaeological record—that of a year-by-year analysis—while conceptualizing this zoomed-in approach within the overarching framework of a multimillennial *histoire événementielle*, with both deep currents and surface movements illuminated. Tree rings provide one of the only annual, and positively dateable, records of locale ecological conditions available. Ringwidth chronologies, meanwhile, present this annual data as a temporally macroscale analysis. This bald cypress tree-ring study has developed a record of annual environmental conditions along the Georgia coastline extending back to 5161 B.P., before the time of the Archaic-Woodland transition. This ringwidth sequence is by far the longest tree-ring chronology on the East Coast and provides year-by-year information about ecological and climatic press-pulse dynamics.

Cultural and Environmental Context

This project examines human-environmental relationships before, during, and after the depopulation of the Late Archaic shell rings of the Georgia coast. By examining ancient remnant trees buried near the mouth of the Altamaha River, this study is able to delve into climate and environment in the region at a much finer scale than has previously been possible for this period of major cultural change.

Coastal Georgia's Terminal Late Archaic Period and the Transition to the Early Woodland

The Late Archaic is generally described as a period characterized by population growth, shifts in subsistence strategies, technological innovations, and increased social complexity (Anderson and Sassaman 2012; Jefferies 2008; Sassaman 2010). The societies of this period appear to have been linked by long-distance trade routes (see, for example Sanger et al. 2019) and to have shared certain cultural aspects, including the construction of monumental architecture and burial rituals (Kidder 2010: 24). Along the southeastern Atlantic Coast, shell rings are among the most well-known Late Archaic period sites. Geoarchaeological, faunal, and isotopic evidence indicates that these shell rings represent habitation sites utilized year-round by sedentary people (Colaninno 2012; Thompson and Andrus 2011; Turck and Thompson 2016) Shell ring sites also appear to have served as 'persistent places' on the Late Archaic coastal landscape, promoting continuity of some cultural practices with repeated reuse (Thompson 2010: 218). Most Atlantic coast shell rings appear to have been occupied for 500 years or less (Thompson 2010: 222). Between c. 3800 and 3500 B.P., during the terminal Late Archaic period, occupation of the Georgia coast shell rings ceased, as did a general exploitation of shellfish species in some areas (Thompson and Turck 2009; Turck and Thompson 2016).

Contemporary research on the Late Archaic- Early Woodland transition in the southeastern U.S. has moved beyond an overly-broad categorization of the period as one of general decline—decline in population density, long-distance networks and connectivity, and measures of cultural complexity—instead focusing on the considerable variability of cultural trajectories of this era (e.g., Kidder 2010; Marquardt 2010; Turck and Thompson 2016). Many societies, however, did experience dramatic changes, some of which appear to have been accompanied by major climatic events.

The Mid- to Late-Holocene Climate Change Event

Around 3000–2600 B.P., a major climatological event affected different regions of the globe. The cause of this climate episode appears to have been a change in cosmic ray intensity and solar irradiation (Dergachev et al. 2004; van Geel et al. 2000). Variability within the localized manifestations of this climatic episode most likely relate to differential solar forcing and variation in the planet's geomagnetic field and variations in underlying atmospheric and oceanic circulation patterns between regions (Debret et al. 2009; Kidder 2006: 212; Turney et al. 2005).

Kidder's Climate Hypothesis (2006, 2010:25) compiles evidence for the decline of much of the southeastern Late Archaic being entangled with the global changes in climate that appear to have altered weather patterns, precipitation, and hydrology. The Climate Hypothesis was originally based upon events in the interior riverine Southeast, particularly the demise of Poverty Point, Louisiana. Massive floods impacted this major Late Archaic site during its terminal phase from 3100–2500 B.P. (Kidder 2010: 26). A large number of studies indicate that climatic events that appear to have accompanied the Archaic-Woodland transition in the Southeast U.S. were the regional manifestations of the major worldwide climatic transition of the mid-to-late Holocene with highly variable expressions globally (e.g., Dark 2006; Drysdale et al. 2006; Maher and Hu 2006).

The ramifications of this global climatic downturn on the coastal regions of the Southeast, however, are still little understood, but a regression in sea level at some time during this period appears to have occurred. Evidence from Murrells Inlet, South Carolina based on foraminifera from within vibracore samples indicates rising sea level until around 4200 B.P., followed by a fall of around two m lasting until 3600 B.P., at which point sea level began to gradually rise again (Gayes et al. 1992). Another study of marsh stratigraphy and archaeological sites suggests a series of sea-level fluctuation during the Late Archaic (Colquhoun and Brooks 1986), though the multiple dramatic fluctuations posited here are not supported by other studies. The most comprehensive recent study from the Southeast, Balsillie and Donoghue (2011), which compiles all available geochronological sea-level datasets from the Gulf Coast, finds evidence for a lowstand occurring at 4800 B.P. as well as a highstand at approximately 4200 B.P. followed by a subsequent, though less pronounced, regression and a relatively slow transgression. Archaeological occupational evidence indicates that by 2400 B.P., the productivity of the marsh system appears to have been restored (DePratter and Thompson 2013: 148), which coincides with a return to modern sea-level as well as much less pronounced fluctuation in the Balsillie and Donoghue (2011) model.

Dendrochronology in the U.S. Southeast

Bald cypresses, some of the longest-lived trees in the Southeast and Mid-Atlantic regions of the U.S. (Edwards et al. 2013: 470), are ideal for creating paleoclimatic reconstructions derived from tree-ring analyses. Although comparatively little tree-ring research has been undertaken in the Southeast U.S., some research does focus on the growth patterns of bald cypress, including the reactions of this species to certain climatic events and ecological conditions as well as differences in growth patterns between individuals growing in different environments. A series of bald cypress chronologies have also been created from some locales in the region. Some studies have investigated the effects of hurricanes on both annual ring patterns and on other tree ring characteristics (Collins 2014; Lewis et al. 2011; Miller et al. 2006; Tucker 2015). Finally, some extant tree-ring chronologies in the Southeast serve as proxies for rainfall in the region, suggesting environmental conditions that may have affected prehistoric and historic cultures and settlements.

Bald Cypress Tree-Ring Chronologies

Bald cypress has been successfully employed in the construction of numerous ringwidth chronologies, extending spatially from the upper limit of the species' modern range (southern Delaware) to the lower limits in southern Florida (Stahle et al. 2012). Stahle and colleagues have created a network of these chronologies, several covering over 1000 years. The longest southeastern chronology is from the Black River of North Carolina, which extends back into the late 300s A.D. As Stahle et al. (2012) note, however, the length of these chronologies is limited by the availability of appropriate samples. Buried bald cypress logs are present throughout the Southeast, but the difficulty of locating and sampling them constrains many studies. Fortunately, with the help of the Georgia Department of Natural Resources, this project obtained over 100 once-buried samples dating to the period of interest, as is discussed in the “Field Methods” section. This rich data source provides a unique opportunity to construct sequences dating back into the deep past in the Southeast U.S.

The work of Stahle and coauthors shows that ringwidth in bald cypress is closely tied to precipitation, with growing season moisture the major driver of growth, accounting for as much as 50–70 percent of ringwidth variability in some locales. Seasonal climatic anomalies in the region as well as the zonal positions of the Bermuda High, North Atlantic Oscillation, and Southern Oscillation are also contributing factors to the width of bald cypress tree rings in the Southeast (Stahle et al. 1985; Stahle and Cleaveland 1992; Stahle and Cleaveland 1996), indicating the value of bald cypress chronologies to both paleoclimatic reconstructions of the local environment as well as analyses of larger climate patterns and shifts.

Bald Cypress and Salinity Stress

Chemical analyses of wood may record the salinity level of water taken up by bald cypresses, thus serving to elucidate certain types of salinity intrusion events during the lifetimes of ancient trees. These analyses may potentially be used to identify events which would have affected coastal societies, including sea-level rise and storm surge.

Studies of bald cypress sapling responses to freshwater inundation regimes (Young et al. 1993; Young et al. 1995) and a few studies on salinity intrusion (Allen et al 1996; Krauss et al. 2009) provide data on the types of environments that young individuals of this species can and cannot tolerate. Since nearly all of the published research and chronology construction involving bald cypress growth patterns focuses on freshwater environments, little is known of this species' reactions to ecological conditions and shifts in oligohaline brackish coastal environments where salinity varies from 0.5 to 5.0 parts per thousand (The Venice System 1958). The few published studies on bald cypress growing in non-freshwater environments find that salinity as well as prolonged freshwater flooding decrease adult bald cypress growth and kill saplings (Thomas et al. 2015). Mature trees, however, can persist for decades, particularly on raised hummocks very similar to those along the Georgia Coast, before dying under conditions of persistent salinity stress such as those caused by rising sea levels (Hsueh et al. 2016; Krauss and Duberstein 2010).

Chemical analyses can help identify tree death from increased salinity levels. Yanosky et al. (1995) finds that the detection of chloride, sodium, and bromide in the outer tree rings of bald cypress is positively correlated with saltwater stress. Furthermore, this study finds that the longer the tree is exposed to and survives under salt-stressed conditions, the farther back into the sapwood these three elements penetrate. Bald cypress trees that survive salinity intrusion events, however, expel these salts from their wood. Thus, the presence of elevated levels of sodium, chloride, and bromide in the sapwood of dead bald cypress trees can provide evidence of salinity-induced mortality as well as an indicator of survival time under salt-stressed conditions. Yanosky et al. (1995) by extrapolation thus indicates that relative salinity levels during salinity-induced tree mortality events are possible to ascertain from elemental analyses: the longer a tree survives in increasingly saline conditions, such as those created during sea level transgression events, the farther back into the sapwood chloride, sodium, and bromide will penetrate. By contrast, an event during which water very high in salt rapidly impacts coastal bald cypress forests, such as hurricane storm surge or a rapid sea-level transgression event, should induce relatively rapid mortality in trees, leaving them with very high levels of salts in the outer rings but little penetration into the sapwood.

Southeastern and Mid-Atlantic Archaeological Enquiries Employing Tree-Ring Data

Extant bald cypress chronologies have been employed in the Southeast and Mid-Atlantic regions to examine archaeological questions. Since, as noted, bald cypress ringwidth, at least in non-brackish environments, is closely tied to growing season precipitation, these enquiries have focused on the possible role played by drought in cases of cultural change. Blanton and Thomas (2008), using Stahle's 1985 chronology from the Altamaha, analyzed precipitation over this sequence, determining that the St. Catherines Period Drought (A.D. 1176–1220) had a major impact on Indigenous Mississippian societies in the area. This study also found another major dry period beginning around A.D. 1360 and a late 1500s megadrought coinciding with the arrival of European missionaries on the East Coast of America. Jesuits arriving on the Georgia Coast recorded the latter event. Stahle (1998) analyzed bald cypress from Jamestown, Virginia, concluding that the settlement of this colony coincided with a major, though apparently localized, dry period that would have affected the settlers' ability to support themselves—a fact reflected in the colonists' epithet for these years, the Starving Time. These archaeological studies show the value of dendrochronological analyses for the investigation of cultural inquiries in the Southeast, a method that this project will also employ.

Paleoenvironmental Field Site: The Altamaha Wildlife Management Area

The paleoenvironmental samples used in this study are cookies (lateral slices of trees) obtained from the Altamaha Wildlife Management Area (WMA) in Darien, Georgia. The Altamaha WMA includes three islands in the Altamaha River Delta (Butler, Champney, and Rhetts) managed by the state of Georgia's Department of Natural Resources for waterfowl hunting (Figure 2.1). We obtained the majority of tree samples from Butler Island while some others were recovered from Champney; no samples were obtained from Rhett's, although it was surveyed in the course of this project.

Plantations were developed beginning in the late 18th century that operationalized the unique tidal aspects of Southeast U.S. delta coastal banks and river islands, including the Altamaha WMA islands, for rice paddy agriculture. Only a small geographic area in the region was suited for such agriculture. Rice fields needed to be located far enough upstream to avoid the detrimental effects of saline water on the rice crop, yet far enough downstream to take advantage of the river's tidal rise and ebb (Wilms 1972: 45). The Altamaha WMA tidewater islands are subject to twice-daily tidal shifts ranging from approximately 1.5 to 2.5 meters (Champney Island Tides 2021), within the necessary tidal range for rice agriculture (Wilms 1972: 53). Rice plantations on these islands used this dramatic tidal flow and complex systems of dykes, canals, and irrigation ditches to manage the input of fresh water and prevent the intrusion of brackish water into the rice fields during high tide (Bell 2010: 167).

Butler and Champney islands, which are easily and quickly reached by vehicle from the WMA office buildings, consist of large, rectangular "ponds"—the former plantation-era rice fields that are usually kept flooded with a few inches of water – each surrounded by deep canals. The ponds are drained on a DNR-determined schedule. Elevated earthen roadways run between these ponds and are currently used by state employees in vehicles and/or large earthmover equipment for site access and maintenance work as well as by members of the public, generally on foot, in periods of the year during which the WMA is open for hunting. The earthen material used for the construction of these elevated roadways is hauled out of the canals. During maintenance work at the Altamaha WMA, which is largely continuous due to erosion of the earthen roadways as well as the impact of hurricanes and strong storms, numerous stumps and trunks of trees are hauled up from the canals, which staff say can be up to 30 feet in depth. Some newly-piled earthen roadways appear to be composed largely of plant material (mainly roots and knees of baldcypress), attesting to the number of specimens that must be present in the site strata.

While many of the trees recovered from the coastal mud are now simply lying on the surface along the roadways, many others are located within the impoundments themselves, which are periodically and systematically burned to encourage the growth of plants attractive to waterfowl. Although this burning has destroyed the parts of the trees above the waterlogged ground, the portions still in the mud are almost perfectly intact.

Rhetts, which is only accessible via watercraft, is a large swampy island encircled by an elevated earthen road. Rhetts Island was visually surveyed for exposed stumps and logs by the P.I. and Craig Jacobs on a 4-wheeler. The extreme plant overgrowth at the site and presence of numerous nesting alligators along the roadway meant that little on-foot survey could be undertaken. A number of *in situ* stumps which appear to be highly degraded due to exposure and thus likely not appropriate for dendrochronological analysis were noted to be present in the canal between the road and swamp area, but it was not possible to reach these *in situ* stumps. To obtain samples from these *in situ* stumps, which could probably be radiocarbon dated and elevation-mapped to contribute to studies on sea-level rise in the locale, it would be necessary to bring a small watercraft to Rhetts Island.

Field Site History

Butler Island is the site of the former Butler Plantation, a large agricultural operation largely focused on rice, sugarcane, and cotton where hundreds of enslaved people were forced to labor during the last decades of the 18th and first half of the 19th centuries (Bell 1987). The persons sold at the May 1859 auction in Savannah referred to as "The Weeping Time"—one of the largest sales and family separations of enslaved persons to ever occur in the United States— were men, women, and children from Butler's Island Plantation as well as from Hampton, the other Butler-owned plantation on nearby St. Simons Island (Bell 1987: 106). Apart from the 1978-'79 dissertation fieldwork by Dr. Theresa Singleton, which surveyed the island to locate historic sites (particularly the four settlements of enslaved individuals) and conducted some testing and artifactual/zooarchaeological analysis at one of the villages (Singleton 1980), no further archaeological work has been undertaken at this part of the site.

The buried trees that were employed for this dissertation project on environmental change in the ancient past are some of the same deposits that first prompted the concept of sea-level fluctuation. Charles Lyell, often called the "father of geology," visited Butler Island Plantation in the 1840s, remarking upon his approach to the island that:

> [S]till we saw the buried stumps and stools of the cypress and pine continuing to show themselves in every section of the bank, maintaining the upright position in which they originally grew. The occurrence of these in the salt marches clearly demonstrates that trees once flourished where they would now be immediately killed by the salt water. There must have been a change in the relative level of land and sea, to account for their growth (Lyell 1850: 249)

These buried trees had long been noted by agriculturalists in the region. Famed naturalist William Bartram, who visited the Altamaha delta and other regions of the Southeast, stated that:

> [I]t is plainly to be seen by every planter along the coast of Carolina, Georgia, and Florida, to the Mississippi, when they bank in these grassy tide marshes for cultivation, that they can not sink their drains above three or four feet below the surface, before they come to strata of cypress stumps and other trees… (Bartram 1792, quoted in Lyell 1850: 250)

These buried forests noted in the 18th and 19th centuries, then, may be extremely widespread throughout the tidewater Southeast, but the difficulty of locating and sampling them has prohibited much dendrochronological work on these valuable deposits from being conducted. With the help of the Altamaha WMA staff, we had the opportunity to locate and sample a number of these ancient trees whose analysis has provided the longest tree-ring chronology in the eastern U.S. to date.

Developing the Chronology: Field and Laboratory Methods

Field Methods

Sampling of specimens was largely constrained by the maintenance schedule of the WMA and the availability of WMA staff, who could usually only step away from their typical work for a few hours at a time to cut the samples with a 4.5-ft long chainsaw. Sampling thus took place over two years at short intervals. The PI and colleagues also traveled to the site to locate and mark (with tall pvc pipes and flagging tape) trees and stumps, which were later sampled with the help of WMA staff. Ponds were generally only accessible on foot, since the ground was too wet to support vehicles, so in order to obtain the most trees possible in a short period, our sampling focused on ponds with large numbers of ancient trees. We also obtained a number of specimens from beside elevated roadways.

Bald cypress trees growing in wetland areas swell outwards at the base of the trunk into the buttress (Walsh and Dawson 2014). Combined with an extensive root system, including protruding conical structures called "knees," bald cypress buttressing ensures that even hurricane-force winds are generally incapable of overturning these trees (Fowells 1965). In this lower buttressed portion of the tree, annual growth rings are less regular than higher up in the trunk. When possible, we obtained samples above the basal swell of logs (typically between 1–2 meters above the swell). Sometimes, however, only the upper basal swell or the lower portion of the trunk was present, so we had no choice except to sample in an area where buttressed growth was present. The first sampling method attempted was coring, which we hypothesized was viable due to the high level of preservation. Although cores emerged with every appearance of freshly-cut wood, including scent intact, they oxidized, blackened, and turned to dust within one day. This was a similar, though much more rapid, process to what we observed in newly recovered stumps and logs. Although these trees had the appearance and scent of freshly-cut cypress (including, in some cases, the presence of bark and sap), within a few weeks of exposure to air, drying, and temperature fluctuations, the specimens blackened and oxidized. After the coring attempts failed, we turned to whole or partial cookies from tree trunks, which have a better survival record. These appear to maintain their high preservation level due to the structural support of the lateral slice as well as slow drying in the (relatively) temperature-controlled environment of the laboratory and/or the woodshop where most of the samples were sanded.

Since most cookies had to be pried out of the ground with crowbars and carried out of the ponds by hand or in a backpack (sometimes hauling them the distance of 400 meters), the size of samples obtained in these locations was also limited; we usually could only obtain ¼ cookies from trees within ponds. Since, as noted, the ponds are periodically burned, destroying the portions of trees not protected by the mud, some of the cookies obtained from the ponds contained only the outer rings (usually ~200-400 annual rings) of what were clearly extremely large and long-lived individuals; based on ring curvature, some of these trees likely lived over 2,000 years. By contrast to the generally smaller samples obtained from within ponds, we were able to recover very large samples (i.e., whole or ½ cookies) from some of the complete or nearly complete trees lying by the elevated roadways, which were accessible by 4-wheeler and/or truck.

We also obtained cookie samples from modern bald cypresses in the Altamaha River mouth area to determine environmental correlates of ringwidth and extend the chronology to the present. Our sampling strategy avoided felling any living or dead standing trees for this project. Bald cypress trees represent a keystone species for several coastal environments and standing dead trees are important wildlife habitat. We thus sampled only recently dead trees that were fallen or leaning, including one on Butler Island knocked over during maintenance work and twelve on Sapelo Island, the nearest barrier island to the WMA.

Lab Methods

Samples were dried in the climate-controlled laboratory and/or woodshop for six weeks before preparation. They were subsequently sanded to reveal the cellular structure using either a handheld belt sander in conjunction with hand sanding or a large table-mounted belt sander followed by various grits on an orbital sander and finally, a handheld metal scraper, which opened up the cellular structure.

Tree rings were measured at .001 mm precision from high-resolution photographs obtained with a macro lens and camera extension tubes used with a Canon DSLR camera as well as a Velmex stage advancer and microscope in areas where photographs could not provide appropriate detail. Both the Image J extension of Object J, developed for tree ring and otolith measurements and funded by the Institute for Marine Research in Norway (Vischer & Nastase 2020), and Measure J2X were used to obtain measurements. Since photographs can distort images, only the central portions of photographs were used for measurements. Randomized measurements of tree rings from each sample obtained from photos and Image J were checked with the Velmex stage advancer to ensure measurement accuracy.

A combination of hand-drawn skeleton plotting (Speer 2010: 156) and computer programs was employed for crossdating. COFECHA (Grissino-Mayer 2001) was used to support and conduct quality control checks on the crossdating results obtained through skeleton plotting, while ARSTAN (Cook and Holmes 1996) was used to construct the chronology following crossdating. A 5,177-year tree-ring chronology anchored to the present as well as an earlier 529-year floating (i.e., unconnected to the present) chronology were developed from the Altamaha WMA and Sapelo Island samples.

References

Allen, James A., S. Reza Pezeshki, and Jim L. Chambers
1996 Interaction of Flooding and Salinity Stress on Bald Cypress (*Taxodium distichum*). *Tree Physiology* 16(1-2): 307-313.

Anderson, David G.
2001 Climate and Culture Change in Prehistoric and Early Historic Eastern North America. *Archaeology of Eastern North America* 29: 143-186.

Anderson, David G. and Kenneth E. Sassaman
2012 Chapter 3: Archaic Diversity. In *Recent Developments in Southeastern Archaeology: From Colonization to Complexity*. Society for American Archaeology Press, Washington, D.C.

Anderson, William T., Leonel da Silveira Lobo Sternberg, Maria C. Pinzon, Tiffany Gann-Troxler, Daniel L. Childers, and Michael J. Duever
2005 Carbon Isotopic Composition of Cypress Trees from South Florida and Changing Hydrological Conditions. *Dendrochronologia* 23(1): 1-10.

Bell, Karen B.
2010 Rice, Resistance, and Forced Transatlantic Communities: (Re)envisioning the African Diaspora in Low Country Georgia, 1750–1800. *The Journal of African American History* 95(2): 157–182.

Blanton, Dennis B. and David Hurst Thomas
2008 Paleoclimates and Human Responses Along the Central Georgia Coast: A Tree-Ring Perspective. In *Native American Landscapes of St. Catherines Island, Georgia*, edited by David Hurst Thomas, pp. 799–806. AMNH Anthropological Papers No. 88. American Museum of Natural History, New York.

Braudel, Fernand
1966 *The Mediterranean and the Mediterranean World in the Age of Philip II*. Translated by Siân Reynolds. Harper & Row, New York.

Colquhoun, Donald J. and Mark J. Brooks
1986 New Evidence from the Southeastern United States for Eustatic Components in the Late Holocene Sea Levels. *Geoarchaeology* 1(3): 275-291.

Colaninno, Carol E.
2012 Evaluating Formational Models for Late Archaic Shell Rings of the Southeastern United States Using Vertebrate Fauna from the St. Catherines Shell Ring, St. Catherines Island, Georgia. *Journal of Island and Coastal Archaeology* 7(3): 338-362.

Collins, Savannah A.
2014 Detecting tropical cyclone signals in tree rings of longleaf pine (*Pinus palustris* Mill.), Valdosta, Georgia. U.S.A. Unpublished master's thesis. University of Tennessee, Knoxville. https://trace.tennessee.edu/utk_gradthes/3142/ (accessed 2 August 2020).

Collins, Scott L., Stephen R. Carpenter, Scott M. Swinton, Daniel E. Orenstein, Daniel L. Childers, Ted L. Gragson, Nancy G. Grimm, J. Morgan Grove, Sharon L. Harlan, Jason P. Kaye, Alan K. Knapp, Gary P. Kofinas, John J. Magnuson, William H. McDowell, John M. Melack, Laura A. Ogden, G. Philip Robertson, Melinda D. Smith, and Ali C. Whitmer
2011 An Integrated Conceptual Framework for Long-Term Social-Ecological Research. *Frontiers in Ecology and the Environment* 9(6): 351-357.

Cook, Edward R. and Richard L. Holmes
1996 *User's Manual for Program ARSTAN*. Laboratory of Tree-Ring Research. Tucson, Arizona: University of Arizona.

Dark, Petra
2006 Climate Deterioration and Land-Use Change in the First Millennium BC: Perspectives from the British Palynological Record. *Journal of Archaeological Science* 33: 1381-1395.

Debret, Maxime, David Sebag, Xavier Crosta, Nicolas Massei, Jean-Robert Petit, Emmanuel Chapron, and Viviane Bout-Roumazeille
2009 Evidence from Wavelet Analysis for a mid-Holocene Transition in Global Climate Forcing. *Quaternary Science Reviews* 28(25-26): 2675-2688.

Dergachev, Valentin A., Oleg M. Raspopov, Freddy Damblon, Högne Jungner, and Ganna Zaitseva
2007 Natural Climate Variability during the Holocene. *Radiocarbon* 49(2): 837-854.

DePratter, Chester B. and James D. Howard
1980 Indian Occupation and Geologic History of the Georgia Coast: A 5000 Year Summary. In *Excursions in Southeastern Geology: The Archaeology of the Georgia Coast*, edited by James D. Howard, Chester B. DePratter, and Robert W. Frey, pp. 1-65. GSA Guidebook Series Vol. 20. Geological Society of America, Atlanta, Georgia.

DePratter, Chester B. and James D. Howard
1981 Evidence for a Sea Level Lowstand Between 4500 and 2400 Years B.P. Based on the Southeast Coast of the United States. *Journal of Sedimentary Petrology* 51(4): 1287-1295.

DePratter, Chester B. and Victor D. Thompson
2013 Chapter 6: Past Shorelines of the Georgia Coast. In *Life among the Tides: Recent Archaeology on the Georgia Bight*, edited by Victor D. Thompson and David Hurst Thomas. AMNH Anthropological Papers No. 98. American Museum of Natural History Scientific Publications, New York.

Drysdale, Russell, Giovanni Zanchetta, John Hellstrom, Roland Maas, Anthony Fallick, Matthew Pickett, Ian Cartwright, and Leonardo Piccini
2006 Late Holocene Drought Responsible for the Collapse of Old World Civilizations is Recorded in an Italian Cave Flowstone. *Geology* 34: 101-104.

Edwards, Leslie, Jonathan Ambrose, and L. Katherine Kirckman
2013 *The Natural Communities of Georgia*. The University of Georgia Press, Athens, Georgia.

Elliot, Daniel T. and Kenneth E. Sassaman
1995 Archaic Period Archaeology of the Georgia Coastal Plain and Coastal Zone. *Laboratory of Archaeology Series Report* 35. University of Georgia, Athens, Georgia.

Engelhart, Simon E. and Benjamin P. Horton
2012 Holocene Sea Level Database for the Atlantic Coast of the United States. *Quaternary Science Reviews* 54: 12-25.

Falseit, Ronald K.
2015 Collapse, Resilience, and Transformation in Complex Societies: Modeling Trends and Understanding Diversity. In *Beyond Collapse: Archaeological Perspectives on Resilience, Revitalization, and Transformation in Complex Societies*, edited by Ronald K. Faulseit, pp. 24-47. Southern Illinois University Press, Carbondale, Illinois.

Fowells, H.A.
1965. U.S. Department of Agriculture, Forest Service. *Silvics of forest trees of the United States*. U.S. Department of Agriculture, Agriculture Handbook 271. Washington, DC.

Gagen, Mary, Danny McCarroll, Risto Jalkanen, Neil J. Loader, Iain Robertson, and GHF Young
2012 A Rapid Method for the Production of Robust Millennial Length Stable Isotope Tree Ring Series for Climate Reconstruction. *Global and Planetary Change* 82: 96-103.

Gayes, Paul T., David B. Scott, Eric S. Collins, and Douglas D. Nelson
1992 A Late Holocene Sea-Level Fluctuation in South Carolina. In *Quaternary Coasts of the United States: Marine and Lacustrine Systems*, pp. 155-160. SSG Special Publication No. 48. Society for Sedimentary Geology, Tulsa, Oklahoma.

Glasby, Tim M. and Antony J. Underwood
1996 Sampling to Differentiate Between Pulse and Press Perturbations. *Environmental Monitoring and Assessment* 42(3): 241-252.

Grissino-Mayer, Henry D.
2001 Evaluating Crossdating Accuracy: A Manual and Tutorial for the Computer Program COFECHA. *Tree Ring Research* 57(2): 205-221.

Hollig, Crawford S. and Lance H. Gunderson
2002 Resilience and Adaptive Cycles. In *Panarchy: Understanding Transformations in Human and Natural Systems*, edited by Hollig and Gunderson, pp. 25-62. Island Press, Washington, D.C.

Hsueh, Yu-Hsin, Jim L. Chambers, Ken W. Krauss, Scott T. Allen, and Richard F. Keim
2016 Hydrologic Exchanges and Bald cypress Water Use on Deltaic Hummocks, Louisiana, USA. *Ecohydrology* 9: 1452-1463.

Jefferies, Richard W.
2008 *Holocene Hunter-Gatherers of the Lower Ohio River Valley*. University of Alabama Press, Tuscaloosa, Alabama.

Kidder, Tristram R.
2006 Climate Change and the Archaic to Woodland Transition (3000-2600 cal B.P.) in the Mississippi River Basin. *American Antiquity* 71: 195-231.

Kidder, Tristram R.
2010 Chapter 1: Trend, Tradition, and Transition at the End of the Archaic. In *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*, edited by David Hurst Thomas and Matthew C. Sanger. AMNH Anthropological Papers No. 93. American Museum of Natural History Scientific Publications, New York.

Krauss, Ken W., Jamie A. Duberstein, Thomas W. Doyle, William H. Connor, Richard H. Day, L. Mayne Inabinette, and Julie L. Whitbeck
2009 Site Condition, Structure, and Growth Of Bald cypress Along Tidal-Non-Tidal Salinity Gradients. *Wetlands* 29(2): 505-519.

Krauss, Ken W. and Jamie A. Duberstein
2010 Sapflow and Water Use of Freshwater Wetland Trees Exposed to Saltwater Incursion in a Tidally Influenced South Carolina Watershed. *Canadian Journal of Forest Research* 40: 525-535.

Kress, Anne, Matthias Saurer, Rolf T. W. Siegwolf, David C. Frank, Jan Esper, and Harald Bugmann
2010 A 350 Year Drought Reconstruction from Alpine Tree Ring Stable Isotopes. *Global Biochemical Cycles* 24(2).

Lewis, Daniel B., David B. Finkelstein, Henri D. Grissino-Mayer, Claudia I. Mora, and Edmund Perfect
2011 A multitree perspective of the tree ring tropical cyclone record from longleaf pine (*Pinus palustris* Mill.), Big Thicket National Preserve, Texas, United States. *Journal of Geophysical Research: Biogeosciences* 116(G2). https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2009JG001194.

Loader, Neil J., Danny McCarroll, Mary Gagen, Iain Robertson, and Risto Jalkanen
2007 Extracting Climatic Information from Stable Isotopes in Tree Rings. *Terrestrial Ecology* 1(25): 27-48.

Loader, Neil J., PM Santillo, JP Woodman-Ralph, JE Rolfe, MA Hall, Mary Gagen, Iain Robertson, R Wilson, CA Froyd, and Danny McCarroll
2008 Multiple Stable Isotopes from Oak Trees in Southwestern Scotland and the Potential for Stable Isotope Dendroclimatology in Maritime Climatic Regions. *Chemical Geology* 252(1-2): 62-71.

Lyell, Charles
1850 *A Second Visit to the United States of North America*. New York: Harper and Brothers.

Maher, Barbara A. and Mengyu Hu
2006 A High-Resolution Record of Holocene Rainfall Variation from the Western Chinese Loess Plateau: Antiphase Behavior of the Africa/Indian and East Asian Summer Monsoons. *Holocene* 16: 309-319.

Marquardt, William H.
2010 Chapter 14: Mounds, Middens, and Rapid Climate Change During the Archaic-Woodland Transition in the Southeastern United States. In *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*, edited by David Hurst Thomas and Matthew C. Sanger, pp. 253-271. AMNH Anthropological Papers No. 93. American Museum of Natural History Scientific Publications, New York.

McCarroll, Danny and Neil J. Loader
2004 Stable Isotopes in Tree Rings. *Quaternary Science Reviews* (23)7-8: 771-801.

Miller, Dana L., Claudia I. Mora, Henri D. Grissino-Mayer, Cary J. Mock, Maria E. Uhle, and Zachary Sharp

2006 Tree-Ring Isotope Records of Tropical Cyclone Activity. *PNAS* 103(39): 14294-14297.

Milne, Glenn A., Antony J. Long, and Sophie E. Bassett
2005 Modelling Holocene Relative Sea-Level Observations from the Caribbean and South America. *Quaternary Science Reviews* 24: 1183-1202.

Napolitano, Matthew F.
2012 The Role of Back Barrier Islands in the Native American Economies of St. Catherines Island, Georgia. Technical Report. University of Georgia, Athens, Georgia. Laboratory of Archaeology Series. Report Number 85.

Redman, Charles L.
2005 Resilience Theory in Archaeology. American Anthropologist 107(1): 70-77.

Redman, Charles L. and Ann P. Kinzig
2003 Resilience of Past Landscapes: Resilience Theory, Society, and the *Longue Durée*. *Conservation Ecology* 7(1): 1-14.

Russo, Michael
2010 Shell Rings and Other Settlement Features as Indicators of Cultural Continuity Between the Late Archaic and Woodland Periods of Coastal Florida. In *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*, edited by David Hurst Thomas and Matthew C. Sanger, pp. 149-172. AMNH Anthropological Papers No. 93. American Museum of Natural History Scientific Publications, New York.

Sanger, Matthew C., Brian D. Padgett, Clark Spencer Larsen, Mark Hill, Gregory D. Lattanzi, Carol E. Colaninno, Brendan J. Culleton, Douglas J. Kennett, Matthew F. Napolitano, Sebastien Lacombe, Robert J. Speakman, and David Hurst Thomas
2019. Great Lakes Copper and Shared Mortuary Practices on the Atlantic Coast: Implications for Long-Distance Exchange during the Late Archaic. *American Antiquity* 84(4): 591-609.

Sassaman, Kenneth E.
2010 *The Eastern Archaic, Historicized*. Issues in Eastern Woodlands Archaeology. Rowman and Littlefield, Lanham, Maryland.

Simiand, François
1960 Méthode Historique et Science Sociale. *Annales: Économies, Sociétés, Civilizations*: 15(1): 83-119.

Singleton, Theresa
1980 The Archaeology of Afro-American Slavery in Coastal Georgia: A Regional Perception of Slave Household and Community Patterns. Unpublished dissertation. The University of Florida.

Speer, James H.
2010 *Fundamentals of Tree-Ring Research*. The University of Arizona Press, Tucson, Arizona.

Stahle, David W.,
1998 The Lost Colony and Jamestown Droughts. *Science* 280: 564-567.

Stahle, David W., Edward R. Cook, and James W.C. White
1985 Tree-Ring Dating of Bald cypress and the Potential for Millennia-Long Chronologies in the Southeast. *American Antiquity* 50(4): 796-802.

Stahle, David W., Dorian J. Burnette, Jose Villanueva, Julian Cerano, Falko K. Fye, R. Daniel Griffin, Malcolm K. Cleaveland, Daniel K. Stahle, Jesse R. Edmondson, and Kathryn P. Wolff
2012 Tree-Ring Analysis of Ancient Bald cypress Trees and Subfossil Wood. *Quaternary Science Reviews* 34: 1-15.

Stahle, David W. and Malcolm K. Cleaveland
1992 Reconstruction and Analysis of Spring Rainfall over the Southeastern U.S. for the Past 1000 Years. *Bulletin of the American Meteorological Society* 73: 1947-1961.

Stahle, David W. and Malcolm K. Cleaveland
1996 Large-Scale Climatic Influences on Bald Cypress Tree Growth Across the Southeastern United States. *Climatic Variation and Forcing Mechanisms of the Last 2000 Years*. NATO Advanced Science Institute Series Vol. 41: 125-140. Springer-Verlag, Berlin.

Stahle, David W., R. Daniel Griffin, Malcolm K. Cleaveland, and Falko K. Fye
2005 Ancient Baldcyress Forests Buried in South Carolina. Preliminary Report from the University of Arkansas Tree-Ring Laboratory, Fayetteville, Arkansas.

Saunders, Rebecca
2010 The Archaic above Choctawhatchee Bay: Hydrodynamics, Adaptation, and Abandonment. In *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*, edited by David Hurst Thomas and Matthew C. Sanger, pp. 103-112. AMNH Anthropological Papers No. 93. American Museum of Natural History Scientific Publications, New York.

Tainter, Joseph A.
2015 Why Collapse is So Difficult to Understand. In *Beyond Collapse: Archaeological Perspectives on Resilience, Revitalization, and Transformation in Complex Societies*, edited by Ronald K. Faulseit, pp. 48-61. Southern Illinois University Press, Carbondale, Illinois.

Thomas, Brenda L., Thomas Doyle, and Ken Krauss
2015 Annual Growth Patterns of Bald cypress (*Taxodium distichum*) along Salinity Gradients. *Wetlands* 35: 831-839.

Thompson, Victor D.
2010 Chapter 10: The Rhythms of Space-Time and the Making of Monuments and Places During the Archaic. In *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*, edited by David Hurst Thomas and Matthew C. Sanger, pp. 217-228. AMNH Papers No. 93. American Museum of Natural History Scientific Publications, New York.

Thompson, Victor D. and C. Fred T. Andrus
2011 Evaluating Mobility, Monumentality, and Feasting at the Sapelo Island Shell Ring. *American Antiquity* 76(2): 315-343.

Thompson, Victor D. and John A. Turck
2009 Adaptive Cycles of Coastal Hunter-Gatherers. *American Antiquity* 74(2): 255-278.

Thompson, Victor D. and John A. Turck
2010 Island Archaeology and the Native American Economies (2500 BC- AD 1700) of the Georgia Coast. *Journal of Field Archaeology* 35(3): 283- 297.

Tucker, Clay S.
2015 Dendrotempestology: Identifying the Statistical Relationship between Hurricanes and Trees Growth in the Pine Savannas of Coastal Mississippi. Unpublished master's thesis. Louisiana State University. https://digitalcommons.lsu.edu/cgi/viewcontent.cgi?article=2428&context=gradschool_theses (accessed 2 August 2020).

Turck, John A.
2011 *Geoarchaeological Analysis of Two Back-Barrier Islands and their Relationship to the Changing Landscape of Coastal Georgia, U.S.A.* Doctoral Dissertation. University of Georgia, Athens, Georgia.

Turck, John A. and Victor D. Thompson
2016a Revisiting the Resilience of Late Archaic Hunter-Gatherers along the Georgia Coast. *Journal of Anthropological Archaeology* 43: 39-55.

Turck, John A. and Victor D. Thompson
2016b Human-Environmental Dynamics of the Georgia Coast. Paper presented at the 81st Annual Meeting of the Society for American Archaeology, Orlando, Florida.

Turney, Chris, Michael Baillie, Steve Clemens, David Brown, Jonathan Palmer, Jonathan Pilcher, Paula Reimer, and Hans Hubert Leuschner
2005 Testing Solar Forcing of Pervasive Holocene Climate Cycles. *Journal of Quaternary Science* 20: 511-518.

University of Florida School of Forest Resources and Conservation
2015 4-H Forest Resources: Bald Cypress. Electronic document, http://sfrc.ufl.edu/extension/4h/trees/Bald_cypress/index.html, accessed April 22, 2017.

van Geel, Bas, Calvin J. Heusser, Hans Renssen, and Cor J.E. Schuurmans
2000 Climatic Change in Chile at Around 2700 BP and the Global Evidence for Solar Forcing: A Hypothesis. *The Holocene* 10: 659-664.

Vanstory, Burnette
1981 *Georgia's Land of the Golden Isles*. Reprinted. Originally published 1956. University of Georgia Press, Athens, Georgia.

The Venice System for the Classification of Marine Waters According to Salinity
1958 *Limnology and Oceanography* 3(3): 346-347.

Vischer, N. & Nastase, S.
2020 Otoliths and tree rings. Institute for Marine Research, Norway. University of Amsterdam. https://sils.fnwi.uva.nl/bcb/objectj/examples/TreeRings/TreeRings-9.htm.

Walsh, Christina and Jeffrey O. Dawson
2014 Variation in Buttressing Form and Stem Volume Ratio of Baldcypress Trees. *Transactions of the Illinois State Academy of Science* 107: 5–11.

Yanosky, Thomas M., Cliff R. Hupp, and Courtney T. Hackney
1995 Chloride Concentrations in Growth Rings of *Taxodium distichum* in a Saltwater-Intruded Estuary. *Ecological Applications* 5(3): 785-792.

Young, P. Joy, Bobby.D. Keeland, and Rebecca R. Sharitz
1995 Growth Response of Bald cypress [*Taxodium distichum* (L.) Rich.] to an Altered Hydrologic Regime. *The American Midland Naturalist* 133(2): 206-212.

Young, P. Joy, J. Patrick Megonigal, Rebecca R. Sharitz, and Frank P. Day
1993 False Ring Formation in Bald cypress (*Taxodium distichum*) Saplings Under Two Flooding Regimes. *Wetlands* 13(4): 293-298.

Figures

Figure 2.1. Location of the Altamaha WMA and the islands of Butler, Champney, and Rhetts in the coastal Southeast U.S. The plantation-era system of ponds and dykes still demarcates both Butler and Champney Islands.

CHAPTER 3

A 5177-YEAR TREE-RING CHRONOLOGY FROM THE SOUTHEAST COAST, USA[1]

[1]Napora, K.G., A. Cherkinsky, R. Horan, B. Tyler, C. Jacobs, and V.D. Thompson. To be submitted to *Nature*.

Summary

While tree rings provide one of the best annually resolved climatic proxies available, dendrochronology in eastern North America has long been limited in its temporal scope because of poor tree preservation as well as the difficulty of recovering appropriate specimens for analysis. Here we present a new ringwidth chronology based on specimens recovered from a deposit of buried bald cypress (*Taxodium distichum*) on the Southeast Coast of the U.S. This 5177-year chronology, plus an additional earlier 529-year floating chronology, now represents the longest in eastern North America. Bald cypress chronologies have provided important information about rainfall and droughts and context for archaeology. This chronology pushes the timespan back an additional 2556 years for the Southeast U.S., providing insight into both environmental and cultural shifts in the region.

Abstract

We present a new 5177-year anchored tree-ring chronology and an earlier 529-year floating chronology separated by a gap of less than 80 years from ancient bald cypress (*Taxodium distichum*) trees. We recovered these samples from buried anoxic conditions at the mouth of the Altamaha River on the Georgia Coast. Crossdating of samples was facilitated with 139 radiocarbon dates. The Altamaha coastal chronology presented here is the longest tree-ring chronology developed for eastern North America. This chronology extends existing tree-ring paleoclimate records by 2556 years and provides insights into drought periods and cultural changes on the Southeast Coast of the U.S..

Keywords: dendrochronology, bald cypress, Southeast U.S., paleoclimate

Introduction

Dendrochronology, the scientific study of tree rings, provides high-resolution proxy records of environmental change dateable to calendar years and constitutes an important tool for the development of Holocene climate records. Long tree-ring chronologies created from well-preserved remnant or buried deposits of trees and wood from archaeological sites as well as exceptionally long-lived extant individuals exist for various locales around the world (e.g., Ferguson et al. 1985, Friedrich et al. 2004, Shao et al. 2007). These multimillennial chronologies, often paired with complementary methodologies like chemical and stable isotope analyses of tree rings (Pearl et al. 2020b), facilitate reconstructions of paleoenvironmental conditions across the Holocene. In North America, most of the long chronologies exist for the western portion of the region; however, a few do exist for the eastern United States. For example, a 2427 year-long chronology is available in the Northeast U.S. from subfossil wood (Pearl et al. 2020a). Relatively few, however, exist for the Southeast U.S., with the longest from this region spanning 2624 years (Stahle et al. 2019).

This study provides a temporal expansion of the tree-ring record in the Southeast U.S. and a year-by-year record of ecological conditions in a zone rarely covered by dendrochronological analyses. The development of this chronology has important applications for both paleoclimatology and archaeology in the region. Comparatively few tree-ring chronologies have been developed in the sub-tropics in general (see Pearl et al. 2020), and few tree-ring chronologies derive from locales directly adjacent to coastlines, including only a single study from the Southeast U.S. (Carr 2010) available through the International Tree-Ring Databank at the National Center for Environmental Information

(NOAA) Paleoclimatology website. Long, high-resolution records of Holocene environmental conditions in the Southeast are therefore lacking, largely due to environmental conditions detrimental to the preservation of ancient wood. In arid locales like the U.S. Southwest, millennia-old trees and wooden archaeological materials often remain uncompromised on the surface and are accessible for chronology-building (e.g., Bannister 1965; Ferguson 1969; Salzer et al. 2019). Meanwhile, in places like Western Europe natural and human-altered samples employed in tree-ring chronology construction and dendrochronological dating have been found preserved in acidic bogs, frigid alpine lakes and river gravels that hinder decomposition (e.g., Becker 1993; Leuschner & Delorme 1988; Pilcher et al. 1977, 1984; Winiger 2008). The humid subtropical climate of the Southeast U.S. (Peel et al. 2007), however, requires different conditions for preservation that occur more rarely. The development of multimillennial tree-ring chronologies in the Southeast U.S. similar in scope to those in other world regions is limited by the amount of preserved, recoverable trees available to researchers, with surface wood decaying rapidly in the humid environment and subsurface material usually difficult to locate and sample (Stahle et al. 2012). For this study, we obtained samples from buried ancient trees from a state-managed site, the Altamaha Wildlife Management Area (WMA), at the mouth of the Altamaha River on the Georgia Coast, as well as modern trees from Sapelo Island, the nearest barrier island to the Altamaha WMA (Figure 3.1). Tree samples from the WMA date back almost 7000 years and reach into the modern era. The anoxic waterlogged conditions from which the samples were recovered preserved these trees almost completely intact (Napora et al. 2019). Many of the trees seeped resin when cut, and bark is still present after millennia underground on a number of trees.

Tree-ring chronologies of the Southeast U.S. provide information about environmental conditions, including droughts, and also contextualize cultural shifts in the archaeological and historical records. Studies have shown that bald cypress growth in the Southeast corresponds strongly to early growing season precipitation (Stahle et al. 1985), making cypress tree-ring chronologies a particularly useful tool for rainfall and drought reconstructions. Existing bald cypress tree-ring chronologies contribute to an understanding of the impact of drought periods on Native American agricultural societies (Anderson et al. 1995) as well as environmentally contextualize the experiences of European-sponsored colonization of eastern North America. Both the disappearance of the Roanoke Colony in North Carolina and the worst hardships of the Jamestown settlement in Virginia were found to have coincided with major droughts in these records (Stahle et al. 1998). More locally, the depopulation of the Savannah River Valley and influx of migrants to the Georgia Coast are also through to be in influenced, in part, by a series of droughts (Anderson et al. 1995). The existing Altamaha River tree-ring chronology, derived from living and remnant trees from approximately 45 km upriver from the Altamaha WMA and covering the time period 929–1985 C.E., has also been used to reconstruct the impact of drought over the last millennia (Stahle & Cleaveland 1992) and its relevance to the archaeology of St. Catherines Island on the Georgia Coast (Blanton & Thomas 2008). This study extends the Altamaha tree-ring chronology by several millennia and provides an important tool for conducting high-resolution paleoclimate analyses.

Results

We developed a 5177-year anchored tree-ring chronology (3161 B.C.E. – 2016 C.E.) from the mouth of the Altamaha River as well as an earlier 529-year floating segment. Radiocarbon dating of every tree sample supports the accuracy of this chronology (Table 3.1). For the anchored chronology, the series intercorrelation (i.e., the average correlation of each series with the master chronology derived from all other series) is 0.248, with a mean sensitivity (i.e., the degree of annual variation) of 0.474. The mean length of a series is 321 rings with a maximum of 1078 rings. The earlier floating segment, which the four floating chronology radiocarbon dates combined with the anchored chronology absolute dates indicate is separated by a very small margin of less than 80 years, consists of only two trees. For this floating segment, the series intercorrelation is 0.321, with an average mean sensitivity of 0.558 and a mean series length of 276.

Number of radii providing replication at any given year peaks at 23 (from 15 trees) in the early 1600s C.E. Replication varies throughout the timespan of the chronology, and there is correlation of increased variability in tree ringwidth with low sample numbers in parts of the chronology, which we account for by detrending with a smoothing spline with a 50% frequency response of 100 years and by detrending the variance of the robust mean chronology with a 100-year spline to minimize the variance changes due to fluctuating sample size (Figures 3.2, 3.3; Tables 3.2, 3.3). These same standardization methods have been used for other bald cypress chronologies on the East Coast (see Stahle et al. 2012). Other methods of variance stabilization (e.g., stabilizing the variance of both the series and chronology; normalizing the detrended series to a mean and standard deviation of 1 (Figures 3.4, 3.5; Tables 3.4, 3.5) were also tested. The chronology retained most overall characteristics with these other methods but best minimizes differences in periodic variance shifts based on sample size with the normalization of individual series.

Correlation of the Altamaha standard chronology mirroring the detrending of Stahle's 929 – 1985 C.E. chronology (Stahle 1985) is 0.171 and visual comparison strongly supports this crossdating. Differences in the chronologies are likely due to the specific ecological factors operating at the coast compared to those impacting forests farther upriver (e.g., the more-pronounced impact of salinity at the river mouth).

Discussion

This multimillennial tree-ring chronology is currently the longest in eastern North America and provides an important tool for reconstructing the coastal paleoenvironment and contextualizing cultural change over a span of five thousand years. As indicted by the high correlation between bald cypress ringwidth and early growing season precipitation reported by other studies (Stahle et al. 1985), this chronology is particularly useful for reconstructing spring rainfall patterns and droughts on the Georgia Coast. Its deep time span means that societal shifts in the Southeast U.S. beginning as early as 3000 B.C.E. can now be interpreted against annual environmental conditions for a better understanding of coupled human-environment systems, the impact of environmental factors on societies, and the resilience of Native American cultures in the face of large-scale shifts in the coastal ecosystem.

Previous research links cultural shifts on the coastlines of the Southeast U.S., including alterations in landscape and resource usage and differential community resilience, to environmental changes. For example, Thompson and colleagues find connections between the depopulation of monumental shell ring village sites in the Late Archaic (c. 3000 – 1000 B.C.E.) and possible climate shifts, leading to disruptions of estuary ecosystems and resource bases. At the same time, other, coastal settlements in the region during this period continued to be inhabited, speaking to diverse experiences of climatic change (Ritchison et al. 2020; Thompson & Turck 2009; Turck & Thompson 2016). The new tree-ring chronology suggests periods of enhanced environmental fluctuation during the Late Archaic, which may shed light on the timing of site depopulations. Changes in settlement patterns and estuary resource usage in this and later periods on the Southeast coastline may also be related to shifts in freshwater availability (Russo 2013: 159–161; Sanger 2013: 231–232; Schwadron 2013). The understanding of the temporal correlations between these societal and environmental changes on the shorelines of the Southeast U.S. can be enhanced with the addition of the high-resolution insights into environmental fluctuation, flood conditions, precipitation, and salinity intrusion events provided by this coastal tree-ring chronology (Napora & Jantzi, in prep).

In addition to being a source of information for Holocene coastal paleoenvironment, this tree-ring chronology also provides a tool for dating wooden artifacts or materials excavated on the Georgia Coast and nearby locales. While wood is generally best dated against a tree-ring chronology developed from the same species, dates obtained on pine (*Pinus* sp.) and eastern redcedar (*Juniperus virginiana*) samples recovered from the Altamaha WMA indicate this bald cypress tree-ring chronology's utility to other species endemic to the region. This cross-species correlation of growth patterns is reasonable given that precipitation is the major environmental driver of ringwidth for trees across the Southeast U.S. This chronology will allow for the annual of dating a wide variety of wooden archaeological materials, including wooden artifacts, posts with preserved tree rings, and carbonized wood from hearths and other features, if sufficient annual rings are present. The presence of a final growth ring could provide an exact cutting date, while the lack of an outer ring would still give a *terminus post quem* for the use-life of a site or the creation of an artifact. Numerous wooden artifacts including canoes (Setzler 1933; Wheeler et al. 2003), wooden posts (Keene & Garrison 2013; Sears et al. 1994), stakes (Clausen et al. 1979; Doran 2002; Duggins et al. 2018), and carvings and masks of animals (Cushing 1896; Spivey-Faulkner 2018), are recovered from waterlogged contexts throughout the region (Wheeler & Ostapkowicz 2019).

Mean sensitivity is high for the Altamaha coastal trees, but the crossdating is strongly supported by the radiocarbon dates from each tree. The relatively low interseries correlation (0.248, compared to a standard of around 0.4 [“International Tree-ring Data Bank” 2020]) is almost certainly due to the combined effects of the tidewater location as well as the characteristics of many of the samples used in this study. The single publicly available coastal bald cypress chronology previously developed in the Southeast U.S. (Carr 2010) has significantly lower correlation than chronologies even slightly further inland (e.g., Carr & Stahle 2010), even with ideal sampling methods. The interseries correlation of Carr’s 2010 chronology is similar to the correlation of the modern Altamaha samples, from which we were able to obtain ideal samples, with the tree-ring chronology. Sampling in living baldcypress is often undertaken approximately three meters up the trunk to obtain core samples above the basal swell, where growth is less regular (Stahle et al. 2019). The samples we recovered were often the lowest section of the cypress trunks, including the basal swell. These limitations are partially overcome with replication across radii and specimens and could be lessened further with further sampling at the Altamaha WMA. The radiocarbon dates that we ran on every tree provide strong support for the accuracy of the chronology.

The oldest sample recovered from the Altamaha WMA is a large knee (ALT028), an aboveground projection of the bald cypress root system, with an inner raw radiocarbon age of 5940 BP ± 25, which, when calibrated, yields a two sigma date range of 4900 – 4720 cal. B.C.E. The WMA therefore clearly contains buried trees dating back to at least this time. Thus, there exists the potential to extend the anchored Altamaha coastal chronology by at least another 2,000 years through the recovery of additional connecting samples. Increased replication would also bolster the crossdating and development of this chronology, particularly in less well-replicated periods (see Esper & Gärtner 2001). There are many more trees still buried at the Altamaha WMA that could extend and refine this chronology. These should be collected before this area is lost to sea level rise, as it is one of the many threatened sites on the Georgia Coast (Anderson et al. 2017).

Conclusion

The Altamaha WMA bald cypress samples have allowed for the development of a 5,177-year anchored chronology (3161 B.C.E.– 2016 C.E.) and an earlier 529-year floating chronology separated from the main chronology by less than 80 years. Radiocarbon dating of all samples supports the accuracy of this chronology. The Altamaha coastal chronology greatly extends the time period over which paleoclimatic variables, particularly precipitation and droughts, can be studied and provides annual environmental context for cultural changes and continuity over a much longer timespan than was previously available to researchers. It also provides an opportunity for annual dating of wooden artifacts and features found in the area. Continued fieldwork at the Altamaha WMA has the potential to extend this chronology even further into the past.

Acknowledgements

This research was supported in part in association with the National Science Foundation Grants OCE-0620959 and OCE-123714 and DDRI Award #1834682 as well as the Georgia Coastal Ecosystems LTER project. We thank the Georgia Department of Natural Resources as well as the Department of Anthropology, the Graduate School, the Laboratory of Archaeology, and the Center for Applied Isotope Studies at the University of Georgia for institutional support. The authors thank Paul Sheppard, Ron Towner, Suzanne Pilaar Birch, Ervan Garrison, Elizabeth Reitz, and Robert J. Speakman for their aid in this research.

References

Anderson, D. G., Bissett, T. G., Yerka, S. J., Wells, J. J., Kansa, E. C., Kansa, S. W., Myers, K.N., DeMuth, R.C. & White, D. A. Sea-level rise and archaeological site destruction: An example from the southeastern United States using DINAA (Digital Index of North American Archaeology). *PloS one*, **12**, 11, e0188142 (2017).

Anderson, D.G., Stahle, D.W., & Cleaveland, M.K. Paleoclimate and the Potential Food Reserves of Mississippian Societies: A Case Study from the Savannah River Valley. *American Antiquity* **60**, 2, 258 – 286 (1995).

Bannister, B. *Tree-Ring Dating of the Archaeological Sites in the Chaco Canyon Region, New Mexico*. Southwestern Monuments Association, Globe. Technical Series 6, 117 – 206 (1965).

Blanton, D.B. & Thomas, D.H. Paleoclimates and Human Responses along the Central Georgia Coast: A Tree-Ring Perspective. In *Native American Landscapes of St. Catherines Island, Georgia* (ed Thomas, D.H.). Anthropological Papers of the American Museum of Natural History 88, II, 799 – 824 (2008).

Becker, B. An 11,000-Year German Oak and Pine Dendrochronology for Radiocarbon Calibration. *Radiocarbon* **35**, 1, 201 – 213 (1993).

Carr, D. NOAA/WDS Paleoclimatology - Carr - Lower Withlacoochee River - TADI - ITRDB FL007. Correlation Stats. NOAA National Centers for Environmental Information. https://doi.org/10.25921/sse5-ev65. (2010). Accessed October 2nd, 2020.

Carr, D. & Stahle, D.W. (2010-02-10): NOAA/WDS Paleoclimatology - Carr - Middle Withlacoochee River - TADI - ITRDB FL008. Correlation Stats. NOAA National Centers for Environmental Information. https://doi.org/10.25921/x6t5-mr27. Accessed October 2nd, 2020.

Clausen, C. J., Cohen, A.D., Emiliani, C., Holman, J.A., & Stipp, J.J.. Little Salt Spring, Florida: A Unique Underwater Site. *Science* **203**, 4381, 609-614 (1979).

Cook, E.R. A Time Series Approach to Tree-Ring Standardization. Dissertation. Tucson, University of Arizona (1985).

Cook, E. & Briffa, K. Data analysis. In *Methods of Dendrochronology* (eds Cook, E.R. & Kairiukstis, L.A.) (Dordrecht , Kluwer Academic, 1990).

Cook, E.R. & Holmes, R.L. *User's Manual for Program ARSTAN*. Laboratory of Tree-Ring Research. Tucson, Arizona: University of Arizona (1996).

Cushing, F.H. *Exploration of Ancient Key-Dweller Remains on the Gulf Coast of Florida*. Proceedings of the American Philosophical Society **35**, 153 (1896).

Doran, G.H. ed. *Windover: Multidisciplinary Investigations of an Early Archaic Florida Cemetery*. Gainesville: University Press of Florida (2002).

Drake, D.C. & Naiman, R.J. Reconstruction of Pacific salmon abundance from riparian tree-ring growth. *Ecological Applications* **17**,1523–1542 (2007).

Duggins, R.M., Price, F.H., Price, M.R., Mollema, I.R., & Puckett, N.N. Manasota Key Offshore: A Prehistoric Cemetery in the Gulf of Mexico. Presented at Society for Historical Archaeology, Albuquerque, NM (tDAR id: 441856) (2018).

Esper, J. & Gärtner, H. Interpretation of Tree-Ring Chronologies. *Erdkunde: Archive for Scientific Geography* **55**, 3, 277 – 288 (2001).

Ferguson, C. W. A 7104-year annual tree-ring chronology for bristlecone pine, Pinus aristata, from the White Mountains, California. *Tree-Ring Bulletin* **29**, 1−29 (1969).

Ferguson, C.W., Lawn, B. & Michael, H.N. Prospects for the Extension of the Bristlecone Pine Chronology: Radiocarbon Analysis of H-84-1. *Meteoritics*, **20**, 2, 415 – 421 (1985).

Friedrich, M. *et al*. The 12,460-Year Hohenheim Oak and Pine Tree-Ring Chronology from Central Europe—a Unique Annual Record for Radiocarbon Calibration and Paleoenvironment Reconstructions. *Radiocarbon* **46**, 3, 1111 – 1122 (2004).

Grissino-Mayer, H.D. Evaluating Crossdating Accuracy: A Manual and Tutorial for the Computer Program COFECHA. *Tree-Ring Research* **57**, 2, 205 – 221 (2001).

Hally, D. *King: The Social Archaeology of a Late Mississippian Town in Northwestern Georgia*. University of Alabama Press, Tuscaloosa (2008).

"International Tree-Ring Data Bank: correlation-stats readme file." 2020. World Data Center for Paleoclimatology, Boulder, and NOAA Paleoclimatology Program. ftp://ftp.ncdc.noaa.gov/pub/data/paleo/treering/measurements/correlation-stats/readme_correlation-stats.txt (2020).

Keene, D.B. & Garrison, E.G. Chapter 11: A Survey of Irene Phase Architecture on the Georgia Coast. In *Life Among the Tides: Recent Archaeology on the Georgia Bight* (eds Thompson, V.D. & Thomas, D.H.). Anthropological Papers of the American Museum of Natural History 98, 289–316 (2013).

Leuschner, H.H. & Delorme, A. Tree-ring work in Göttingen. Absolute oak chronologies back to 6255 BC. *PACT* **22**, 123 – 132 (1988).

Napora, K.G. et al. Radiocarbon pretreatment comparisons of Bald Cypress (*Taxodium distichum*) wood samples from a massive buried deposit on the Georgia Coast, USA. *Radiocarbon* **61**, 6, 1755 – 1763 (2019).

Pearl, J.K., et al. A Late Holocene Subfossil Atlantic White Cedar Tree-Ring Chronology from the Northeastern United States. *Quaternary Science Reviews* **228** (2020a).

Pearl, J.K., Keck, J.R., Tintor, W., Siekacz, L., Herrick, H.M., Meko, M.D. & Pearson, C.L. New Frontiers in Tree-Ring Research. *The Holocene* **30**, 6, 923–941 (2020b).

Peel, M. C., Finlayson, B. L., and McMahon, T. A. Updated world map of the Köppen-Geiger climate classification, *Hydrol. Earth Syst. Sci*., **11**, 1633–1644, https://doi.org/10.5194/hess-11-1633-2007 (2007).

Pilcher, J.R., Bailie, M.G.L., Schmidt, B. & Becker, B. A 7,272 year tree-ring chronology for western Europe. *Nature* **312**, 150-152 (1984).

Pilcher, J.R., Hillam, J., Baillie, M.G.L., & Pearson, G.W.A Long Sub-Fossil Oak Tree-Ring Chronology from the North of Ireland J. R. Pilcher. *The New Phytologist*, **79**, 3, 713 – 729 (1977).

Porter, J. W. The Mitchell Site and Prehistoric Exchange Systems at Cahokia: A.D. 1000 +- 300. In *Explorations into Cahokia Archaeology*. Illinois Archaeological Survey, Inc., Bulletin 7 (1969).

Ramsey, C.B. Bayesian analysis of radiocarbon dates. *Radiocarbon* **51**, 1, 337–360 (2009).

Reimer, P. *et al*. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* **62,** 4, 725 – 757 (2020).

Ritchison, B.T., V.D. Thompson, I. Lulewicz, B. Tucker, & Turck, J.A. 2020. Climate Change, Resilience, and the Fisher-Hunter-Gatherers of Late Holocene Georgia Coast. *Quaternary International* **584**, 82 – 92 (2020).

Salzer, M.W., Pearson, C.L., & Baisan, C.H. Dating the Methuselah Walk Bristlecone Pine Floating Chronologies. *Tree-Ring Research*, 75, 1, 61 – 66 (2019).

Sanger, M.C. Chapter 9: Ever-Shifting Landscapes: Tracking Changing Spatial Usage along Coastal Georgia. In *Life Among the Tides: Recent Archaeology on the Georgia*

Bight (eds Thompson, V.D. & Thomas, D.H.). Anthropological Papers of the American Museum of Natural History 98, 211–234 (2013).

Schwadron, M. Chapter 6: Prehistoric Landscapes of Complexity: Archaic and Woodland Period Shell Works, Shell Rings, and Tree Islands of the Everglades, South Florida. In *Life Among the Tides: Recent Archaeology on the Georgia Bight* (eds Thompson, V.D. & Thomas, D.H.). Anthropological Papers of the American Museum of Natural History 98, 113–146 (2013).

Sears, W.H., Sears, E.O., & Steinen, K.T. *Fort Center: An Archaeological Site in the Lake Okeechobee Basin*. Gainesville: University Press of Florida (1994).

Setzler, F.M. Salvaging an Aboriginal Dug-Out Canoe, Cumberland Island, Georgia. *Explorations and Field Work* **1**. Washington, DC: Smithsonian Institution (1933).

Shao X.M. *et al*. A 3500- year Master Tree-ring Dating Chronology from the North-eastern part of the Qaidam Basin. *Quaternary Science* **27**, 477−485 (2007).

Singleton, T. The Archaeology of Afro-American Slavery in Coastal Georgia: A Regional Perception of Slave Household and Community Patterns. Ph.D. Dissertation, Department of Anthropology, University of Florida, Gainesville (1980).

Spivey-Faulkner S.M. Fort Center's Iconographic Bestiary: A Reanalysis of the Site's Carved Wood Assemblage. *Arts & Sciences Electronic Theses and Dissertations*. 1587. https://openscholarship.wustl.edu/art_sci_etds/1587 (2018).

Stahle, D.W & Cleaveland, M.K. Reconstruction and Analysis of Spring Rainfall over the Southeastern U.S. for the Past 1000 Years. *Bulletin of the American Meteorological Society* **73**, 12, 1947 – 1961 (1992).

Stahle, D.W., Cleaveland, M.K. Blanton, D.B., Therrell, M.D., & Gay, D.A. The Lost Colony and Jamestown Droughts. *Science* **24**, 280, 564 – 567 (1998).
Stahle, D.W. *et al*. Tree-Ring Analysis of Ancient Bald cypress Trees and Subfossil Wood. *Quaternary Science Reviews* **34**, 1 –15 (2012).

Stahle, D.W., Cook, E.R., & White, J.W.C. Tree-Ring Dating of Bald cypress and the Potential for Millennia-Long Chronologies in the Southeast. *American Antiquity* **50**, 4, 796-802 (1985).

Stahle, D.W. *et al*. 2019. Longevity, Climate Sensitivity, and Conservation Status of Wetland Trees at Black River, North Carolina. *Environmental Research Communications* **1**,4. https://doi.org/10.1088/2515-7620/ab0c4a (2019).

Thompson, V.D. & Turck, J.A. Adaptive cycles of coastal hunter-gatherers. *American Antiquity* **74**, 255-278 (2009).

Turck, J.A. & Thompson, V.D. Revisiting the Resilience of Late Archaic Hunter-gatherers along the Georgia Coast. *Journal of Anthropological Archaeology* **43**, 39-55 (2016).

Vischer, N. & Nastase, S. Otoliths and tree rings. Institute for Marine Research, Norway. https://sils.fnwi.uva.nl/bcb/objectj/examples/TreeRings/TreeRings-9.htm (University of Amsterdam, 2020).

Walker, W. M. *The Troyville Mounds, Catahoula Parish, Louisiana*. Bureau of American Ethnology Bulletin 113. U.S. Government Printing Office, Washington, D.C. (1936)

Wheeler, R.J., Miller, J.J., McGee, R.M., Ruhl, D., Swann, B. & Memory, M. Archaic Period Canoes from Newnans Lake, Florida. *American Antiquity* **68**, 3, 533–351 (2003).

Wheeler, R. & Ostapkowicz, J., eds. *Iconography and Wetsite Archaeology of Florida's Watery Realms*. Gainesville: University of Florida Press (2019).

Winiger, A. *La station lacustre de Concise: Stratigraphie, datations et contexte environnemental*. Lausanne: Cahiers d'archaéologie romande 111 (2008).

Figures and Tables

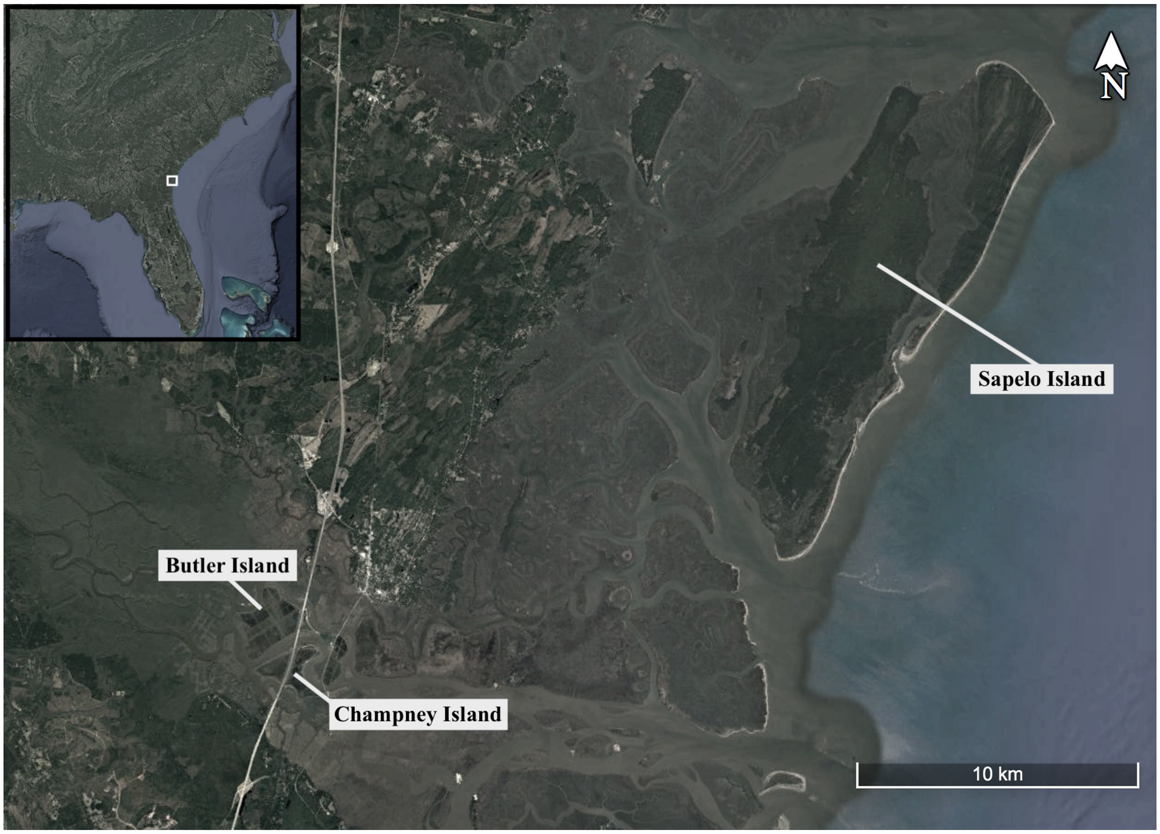

Figure 3.1. Field site map. All bald cypress (*Taxodium distichum*) samples used to construct this tree-ring chronology were obtained from the islands of Butler and Champney in the Altamaha Wildlife Management Area (WMA) and Sapelo Island on the Georgia Coast in the Southeast USA.

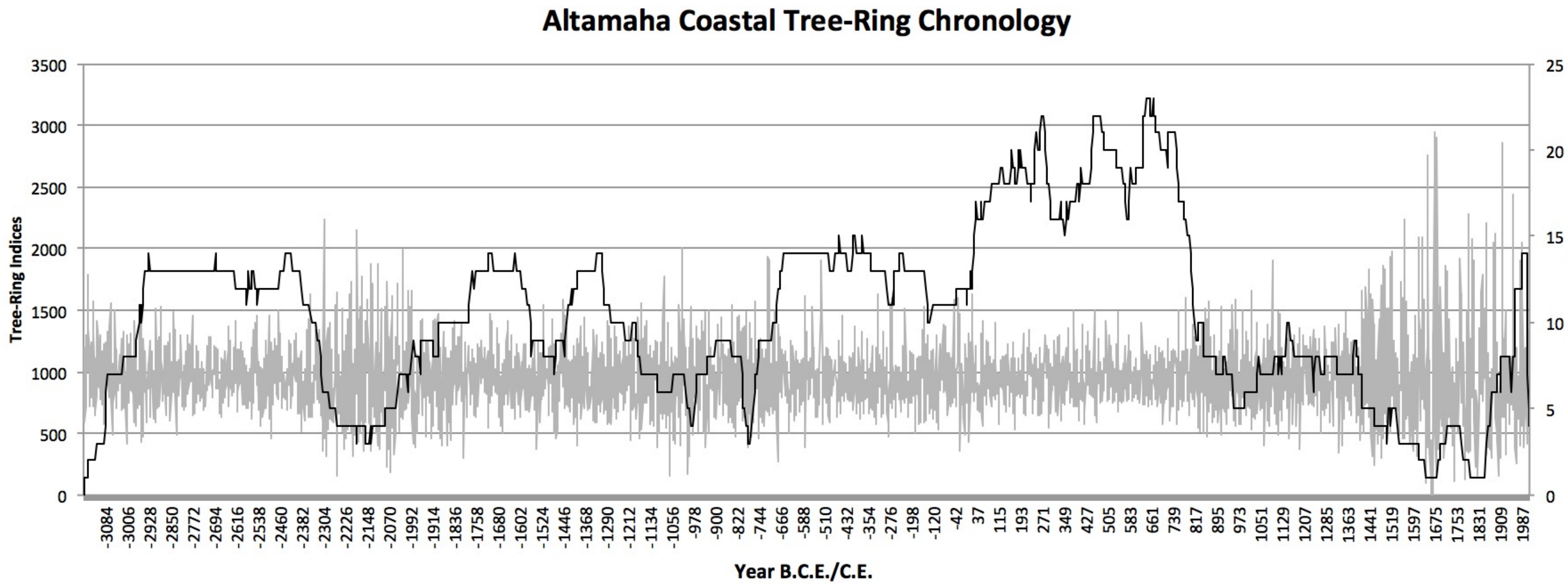

Figure 3.2. 5177 year chronology from the mouth of the Altamaha River, Georgia, USA, also showing the number of radii (1 or 2 per tree) covering each year of the chronology. Here, the chronology has been detrended using a smoothing spline with a 50% frequency response of 100 years and by detrending the variance of the robust mean chronology with a 100-year spline to minimize the variance changes due to fluctuating sample size.

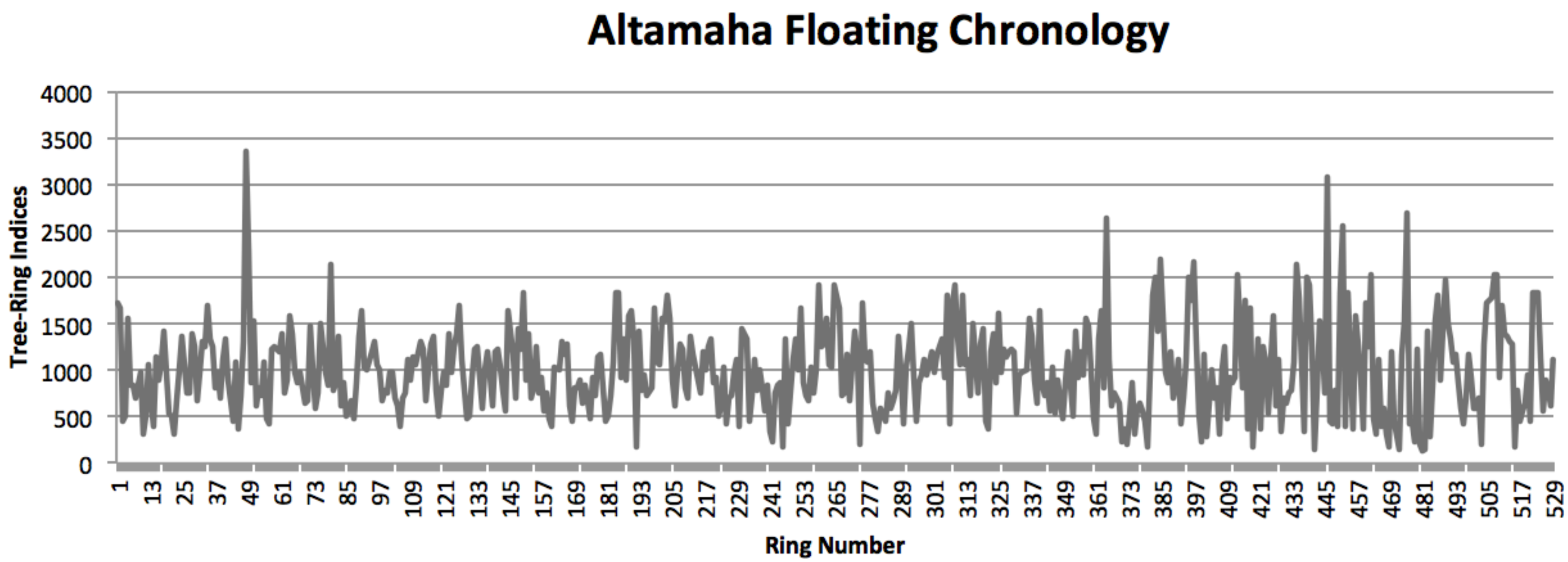

Figure 3.3. 529-year floating chronology based off of the 2 oldest trees from the Altamaha WMA; as in Figure 1, the chronology has been detrended using a smoothing spline with a 50% frequency response of 100 years and by detrending the variance of the robust mean chronology with a 100-year spline.

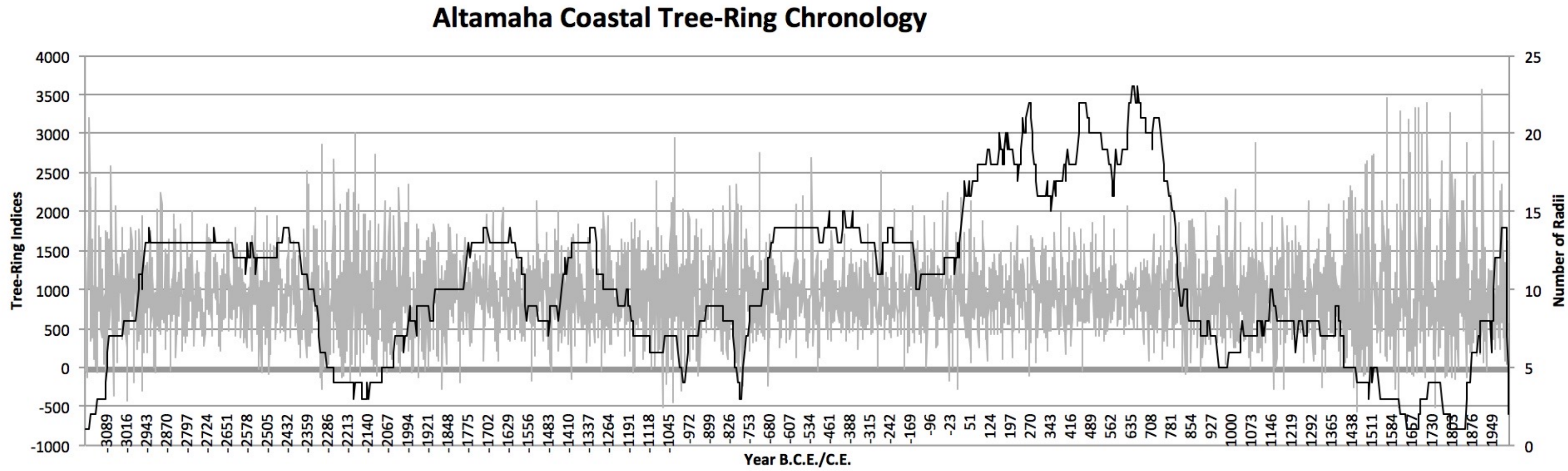

Figure 3.4. The 5177-year tree-ring sequence detrended using a smoothing spline with a 50% frequency response of 100 years and by normalizing the detrended series to a mean and standard deviation of 1 to minimize the variance changes due to fluctuating sample size. Many of the same general characteristics as in Figure 1 are evident, while changes in periodic shifts in variance have been minimized.

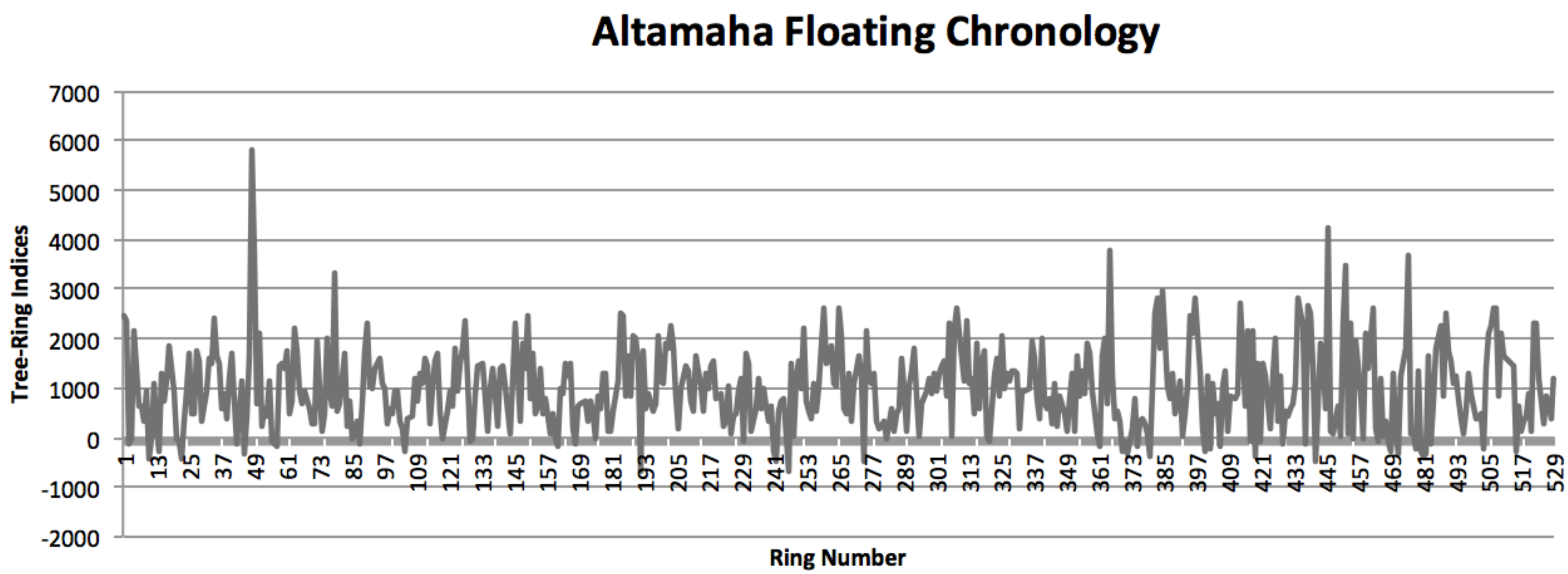

Figure 3.5. 529-year floating chronology; as in Figure 3, the chronology has been detrended using a smoothing spline with a 50% frequency response of 100 years and by normalizing the detrended series to a mean and standard deviation of 1 to minimize the variance changes.

Table 3.1. Information on all tree specimens from the Altamaha WMA as well as modern specimens from northern Sapelo Island (ALT #s 113 – 123). Locational data is not available for several samples because they were obtained either after having been previously cut at unknown locations or dredged from the river; these samples were taken from piles behind the main ranger building at the Altamaha WMA. Radiocarbon dates for each sample were run at the Center for Applied Isotope Studies at UGA, with two sigma date ranges calibrated using OxCal Version 4.4 (Bronk Ramsey 2009) and employing the IntCal20 Northern Hemisphere curve (Reimer et al. 2020) (rounded off by 5 years). For the "In Chron" column, trees that were incorporated into the final chronology are marked with an asterisk (*), and those not incorporated into the final chronology are marked with an "X" as well as a superscript number explaining the reason for the exclusion (1=non-cypress specimen; 2=knee; 3=dateable but poor correlation with chronology due to irregular growth patterns; 4=not dateable due to irregular growth). The dendrochronological dates for all trees correspond with the calibrated radiocarbon date ranges. In the cases of slight discrepancies between the dendrochronological and radiocarbon dates, it was always either the case that 1) the tree either began earlier than the measurements or that there were more rings than the measurements which in either case matched the associated radiocarbon date; in these cases, unmeasured rings were either indiscernible or showed abnormal growth patterns inappropriate for chronology integration; or 2) for a few trees, the date fell within the 99.7% confidence interval but not within the 95.4% interval.

	Locational Data		Inner Ring Radiocarbon (14C) Dates					calibrated dates		Outer Ring Radiocarbon (14C) Dates					calibrated dates		Dendrochronological Dates			
ALT #	Northing	Westing	Sample	UGAMS#	Raw 14C (BP)	±	δ13C,‰	*from*	*to*	Sample	UGAMS#	Raw 14C (BP)	±	δ13C,‰	*from*	*to*	Inner Date	Outer Date	# Years	In Chron
1	31.3595	-81.4661	ALT Date 1	26913	3640	25	-27.5	-2135	-1925	ALT Date 4	27104	3140	25	-24.3	-1500	-1305	-1981	-1414	568	*
2	31.3588	-81.4753	ALT Date 3	27103	2430	25	-23.6	-750	-405	ALT Date 2	26725	1700	25	-24.5	255	415	-743	190	933	*
3	31.3599	-81.4762	ALT Date 5	28491	1630	20	-23.52	405	540	ALT Date 6	28492	1220	20	-24.08	705	885	454	686	233	X[3]
4	31.3618	-81.4622	ALT Date 7	28493	3930	25	-27.71	-2560	-2300	ALT Date 8	28494	3760	25	-23.9	-2285	-2040	-2560	-2280	281	*
5	31.3588	-81.4757	ALT Date 9	28495	4040	25	-26.49	-2630	-2470	ALT Date 10	28496	3840	25	-25.09	-2455	-2200	-2572	-2153	420	*
6	31.3667	-81.4662	ALT Date 11	28635	3590	25	-27.79	-2030	-1880	ALT Date 12	28636	2950	25	-24.64	-1260	-1050	-1781	-1232	550	*
7	31.3681	-81.5362	ALT Date 13	28637	310	20	-26.47	1500	1650	ALT Date 14	28638	170	20	-25.89	1660	…	1522	1786	265	*
8	31.3614	-81.4595	ALT Date 31	29295	1840	25	-25.07	125	305	ALT Date 32	29296	1520	25	-24.96	435	605	233	570	338	*
9	31.3613	-81.4594	ALT Date 27	29291	2470	25	-25.47	-765	-425	ALT Date 28	29292	2210	25	-24.79	-375	-180	-679	-281	399	*
10	31.3566	-81.4607	ALT Date 33	29297	3630	25	-28.28	-2130	-1900	ALT Date 34	29298	3190	25	-24.44	-1505	-1420	-1954	-1442	513	*
11	31.3558	-81.4609	ALT Date 41	31781	140	20	-25.68	1670	1945	ALT Date 42	31782	10	n/a	-23.98	1895	1905	1787	1909	123	*
12	31.3558	-81.4609	ALT Date 19	29283	4390	25	-26.47	-3095	-2915	ALT Date 20	29284	4030	25	-25.78	-2625	-2470	-2964	-2549	416	*
13	31.3549	-81.4625	ALT Date 43	31783	3850	25	-24.89	-2460	-2200	ALT Date 44	31784	3390	25	-24.37	-1750	-1615	-2181	-1692	490	*
14	31.3617	-81.4624	ALT Date 35	31641	4420	25	-25.16	-3320	-2920	ALT Date 36	31642	3880	25	-23.13	-2465	-2235	-2942	-2313	630	*
15	31.3613	-81.4630	n/a	n/a	n/a	n/a	n/a	n/a	n/a	ALT Date 57	34994	4060	20	-24	-2835	-2490	-3080	-2577	504	*

16	31.3617	-81.4263	**ALT Date 17**	29281	4490	25	-26.09	-3350	-3090	**ALT Date 18**	29282	3670	25	-25.09	-2140	-1960	-3018	-2255	764	*
17	31.3580	-81.4677	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 58**	34995	1980	20	-23.48	-40	120	-372	41	414	*
18	31.3552	-81.4655	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 59**	34996	2880	20	-24.81	-1190	-980	-1424	-1107	318	*
19	31.3595	-81.4599	**ALT Date 29**	29293	4980	25	-26.32	-3905	-3650	**ALT Date 30**	29294	4610	30	-23.41	-3515	-3195	n/a	n/a	293	*
20	31.3550	-81.4654	**ALT Date 23**	29287	4740	25	-24.59	-3635	-3375	**ALT Date 24**	29288	4500	25	-24.09	-3350	-3095	n/a	n/a/	398	*
21	31.3663	-81.4665	**ALT Date 45**	31785	1060	20	-24.92	895	1030	**ALT Date 46**	31786	1100	20	-23.59	890	995	1005	1069	65	X[1]
22	31.3655	-81.4665	**ALT Date 21**	29285	940	25	-25.92	1030	1165	**ALT Date 22**	29286	610	25	-24.24	1300	1400	1129	1394	266	*
23	31.3444	-81.4438	**ALT Date 47**	31787	4350	25	-24.9	-3075	-2900	**ALT Date 48**	31788	3710	25	-23.88	-2200	-2025	-2951	-2307	645	*
24	31.3442	-81.4582	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 60**	34997	3010	20	-23.68	-1380	-1130	-1616	-1222	395	*
25	31.3427	-81.4589	**ALT Date 37**	31643	3540	25	-27.98	-1955	-1770	**ALT Date 38**	31644	3040	20	-23.89	-1395	-1220	-1712	-1304	409	*
26	31.3398	-81.4572	**ALT Date 39**	31645	4120	25	-24.37	-2870	-2575	**ALT Date 40**	31646	3600	25	-24.74	-2030	-1890	-2534	-1909	626	*
27	31.3383	-81.4560	**ALT Date 25**	29289	2960	25	-24.98	-1265	-1055	**ALT Date 26**	29290	2460	25	-24.3	-760	-415	-1231	-781	451	*
28	31.3360	-81.4598	**ALT Date 49**	31789	5940	25	-25.3	-4900	-4720	**ALT Date 50**	31790	5520	25	-24.14	-4445	-4330	n/a	n/a	n/a	X[2]
29	31.3401	-81.4640	**ALT Date 51**	31791	310	20	-24.08	1500	1650	**ALT Date 52**	31792	230	20	-23.46	1640	1800	1509	1642	134	*
30	31.3413	-81.4620	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 61**	34998	2070	20	-24.98	-160	5	-668	-138	531	*
31	31.3489	-81.4634	**ALT Date 15**	29279	2250	25	-26.71	-390	-205	**ALT Date 16**	29280	2010	25	-23.58	-55	80	-259	53	313	*
32	31.3572	-81.4803	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 62**	34999	modern	n/a	-23.77	n/a	n/a	1911	1957	47	*
33	31.3556	-81.4797	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 63**	35000	3210	20	-23.54	-1510	-1430	-2038	-1515	524	*
34	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 64**	35001	3660	20	-22.95	-2135	-1950	-2460	-2131	330	*
35	31.3624	-81.4635	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 65**	35002	3340	20	-23.52	-1690	-1530	-2032	-1591	442	*
36	31.3587	-81.4687	**ALT Date 53**	31793	2040	20	-24.07	-105	30	**ALT Date 54**	31794	1690	20	-25.6	260	420	12	349	338	*
37	31.3647	-81.4685	**ALT Date 55**	31795	3190	25	-22.91	-1505	-1420	**ALT Date 56**	31796	2950	25	-23.69	-1260	-1050	-1414	-1276	139	*
38	31.3644	-81.4625	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 66**	35003	3810	25	-24.52	-2345	-2140	-2927	-2327	601	*
39	31.3623	-81.4717	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 67**	35004	2780	20	-24.06	-1005	-840	-1194	-1000	195	*
40	31.3632	-81.4746	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 68**	35005	320	20	-24.46	1495	1645	1100	1505	406	*
41	31.3587	-81.4642	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 69**	35006	modern	n/a	-24.66	n/a	n/a	1865	1951	87	*
42	31.3601	-81.4639	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 70**	35007	1550	20	-24.77	430	580	160	491	332	*
43	31.3593	-81.4648	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 71**	35008	920	20	-24.23	1035	1200	n/a	n/a	118	X[4]
44	31.3576	-81.4701	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 72**	37933	2150	20	-23.77	-350	-55	-472	-223	250	*
45	31.3532	-81.4783	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 73**	37934	2670	20	-23.59	-900	-795	-967	-791	177	*

46	31.3605	-81.4712	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 74**	37935	1100	20	-24.47	890	995	630	930	301	*
47	31.3602	-81.4718	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 75**	37936	1590	20	-23.93	425	545	242	534	293	*
48	31.3601	-81.4723	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 76**	37937	1710	20	-24.10	255	410	-123	302	426	*
49	31.3603	-81.4724	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 77**	37938	1990	20	-22.67	-45	110	-456	17	474	*
50	31.3613	-81.4738	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 78**	37939	2100	20	-23.49	-175	-45	-757	-143	615	*
51	31.3616	-81.4733	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 79**	37940	2100	20	-22.72	-175	-45	-655	-147	509	*
52	31.3616	-81.4733	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 80**	37941	1400	20	-22.74	605	665	64	658	595	*
53	31.3606	-81.4725	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 81**	37942	1230	20	-23.58	700	885	608	846	239	*
54	31.3609	-81.4726	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 82**	37943	1690	20	-24.34	260	420	24	366	343	*
55	31.3588	-81.4759	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 83**	37944	2200	20	-23.71	-365	-175	-766	-261	506	*
56	31.3618	-81.4622	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 84**	37945	350	20	-24.56	1470	1635	1121	1545	425	*
57	31.3694	-81.4720	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 85**	37946	1240	20	-24.83	680	880	449	850	402	*
58	31.3690	-81.4718	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 86**	37947	1220	20	-23.27	705	885	633	760	128	*
59	31.3682	-81.4731	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 87**	37948	660	20	-23.61	1280	1390	1146	1266	121	*
60	31.3684	-81.4732	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 88**	37949	550	20	-24.49	1320	1425	1282	1413	132	*
61	31.3678	-81.4729	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 89**	37950	870	20	-23.75	1050	1225	920	1126	207	*
62	31.3673	-81.4725	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 90**	37951	590	20	-24.51	1305	1410	397	1404	1008	*
63	31.3677	-81.4726	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 91**	37952	600	20	-23.13	1300	1405	1256	1381	126	X[3]
64	31.3666	-81.4725	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 92**	37953	1220	20	-25.42	705	885	585	749	165	*
65	31.3677	-81.4720	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 93**	37954	1230	20	-24.44	700	885	721	816	96	*
66	31.3667	-81.4725	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 94**	37955	880	20	-22.94	1050	1220	832	1159	328	*
67	31.3675	-81.4713	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 95**	37956	990	20	-23.77	990	1155	336	1048	713	*
68	31.3676	-81.4716	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 96**	37957	1190	20	-23.58	770	890	246	792	547	*
69	31.3675	-81.4717	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 97**	37958	1100	20	-24.44	890	995	451	958	508	*
70	31.3686	-81.4716	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 98**	37959	1390	20	-23.96	605	670	537	647	111	X[3]
71	31.3686	-81.4700	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 99**	37960	160	20	-24.79	1665	…	1688	1778	91	*
72	31.3685	-81.4694	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 100**	37961	270	20	-23.27	1520	1795	1386	1542	157	*
73	31.3686	-81.4699	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 101**	37962	210	20	-23.77	1645	…	1724	1800	77	*
74	31.3636	-81.4720	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 102**	37963	3180	20	-24.50	-1500	-1415	-1893	-1479	415	*
75	31.3610	-81.4701	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 103**	37964	4390	20	-25.42	-3095	-2915	-3160	-2925	236	*

76	31.3557	-81.4659	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 104**	37965	2600	20	-23.82	-810	-775	-926	-804	123	*
77	31.3613	-81.4717	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 105**	37966	980	20	-24.19	1020	1155	360	1117	758	*
78	31.3613	-81.4717	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 106**	37967	1180	20	-25.37	770	945	355	802	448	*
79	31.3617	-81.4726	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 107**	37968	2410	20	-25.43	-720	-400	-760	-493	268	*
80	31.3617	-81.4717	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 108**	37969	1100	20	-23.68	890	995	n/a	n/a	271	X[4]
81	31.3607	-81.4708	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 109**	37970	1760	20	-23.08	235	355	4	230	227	*
82	31.3643	-81.4679	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 110**	37971	3910	20	-23.35	-2470	-2305	-3116	-2415	702	*
83	31.3644	-81.4680	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 111**	37972	2110	20	-24.27	-195	-45	n/a	n/a	308	X[4]
84	31.3644	-81.4680	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 112**	37973	3310	20	-24.49	-1625	-1515	-1774	-1558	217	*
85	31.3644	-81.4680	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 113**	37974	2290	20	-23.28	-405	-230	-1472	-395	1078	*
86	31.3615	-81.4804	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 114**	37975	3590	20	-22.88	-2025	-1885	-2134	-1957	178	*
87	31.3507	-81.4705	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 115**	37976	2960	20	-23.00	-1265	-1055	-1469	-1167	303	*
88	31.3603	-81.4730	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 116**	37977	760	20	-23.79	1225	1285	1042	1241	200	*
89	31.3600	-81.4736	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 117**	37978	570	20	-23.54	1315	1420	1230	1303	74	X[3]
90	31.3592	-81.4743	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 118**	37979	930	20	-23.81	1035	1165	995	1131	137	*
91	31.3589	-81.4746	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 119**	37980	1140	20	-22.65	770	990	583	958	376	*
92	31.3596	-81.4744	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 120**	37981	1170	20	-24.78	770	960	370	810	441	*
93	31.3599	-81.4751	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 121**	37982	1690	20	-24.68	260	420	28	340	313	*
94	31.3600	-81.4751	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 122**	37983	1190	20	-23.51	770	890	647	804	158	*
95	31.3601	-81.4745	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 123**	37984	450	20	-24.15	1420	1460	1245	1460	216	*
96	31.3604	-81.4749	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 124**	37985	850	20	-22.93	1160	1260	1164	1234	71	X[3]
97	31.3607	-81.4755	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 125**	37986	1540	20	-24.31	435	595	185	591	407	*
98	31.3611	-81.4751	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 126**	37987	1700	20	-23.41	255	415	122	297	176	*
99	31.3610	-81.4750	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 127**	37988	1840	20	-23.33	125	245	-406	198	605	*
100	31.3611	-81.4750	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 128**	37989	1610	20	-24.40	415	540	21	482	462	*
101	31.3617	-81.4736	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 129**	37990	2200	20	-24.63	-365	-175	-975	-342	633	*
102	31.3615	-81.4735	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 130**	37991	1180	20	-23.57	770	945	162	758	597	*
103	31.3612	-81.4734	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 131**	37992	1300	20	-23.76	660	775	406	717	312	*
104	31.3577	-81.4760	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 132**	37993	2020	20	-23.83	-55	65	n/a	n/a	286	X[4]
105	31.3580	-81.4756	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 133**	37994	1910	20	-23.63	65	210	-241	134	376	*

106	31.3579	-81.4755	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 134**	37995	1750	20	-23.49	240	375	-37	252	290	*
107	31.3549	-81.4755	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 135**	37996	4050	20	-24.00	-2630	-2475	-3083	-2541	543	*
108	31.3557	-81.4737	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 136**	37997	2810	20	-25.10	-1015	-905	-1406	-990	417	*
109	31.3558	-81.4736	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 137**	37998	1280	20	-22.98	670	775	629	758	130	X
110	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 138**	37999	130	20	-25.63	1680	1940	n/a	n/a	167	X[1]
111	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**ALT Date 139**	38000	240	20	-24.51	1635	1800	1691	1737	47	X[1]
112	31.3523	-81.4785	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1991	2016	26	X[3]
113	31.4566	-81.2443	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1962	2010	49	*
114	31.4563	-81.2438	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	74	*
115	31.4561	-81.2441	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	98	X[4]
116	31.4559	-81.2440	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1968	2016	49	X[3]
117	31.4724	-81.2491	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1949	2008	60	X[3]
118	31.4720	-81.2494	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	67	X[4]
119	31.4712	-81.2490	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1965	2006	42	*
120	31.4712	-81.2490	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1958	2013	56	*
121	31.4712	-81.2490	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1878	2008	131	*
122	31.4712	-81.2490	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1954	2015	62	*
123	31.4717	-81.2496	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1862	2009	148	*

Table 3.2. Version 1 of the 5177-year tree-ring chronology indices in Tucson compact format; the chronology has been detrended using a smoothing spline with a 50% frequency response of 100 years and by detrending the variance of the robust mean chronology with a 100-year spline to minimize the variance changes due to fluctuating sample size. The 3 versions of this chronology shown respectively in the table are 1) the standard chronology (ALT1Std), with no autoregressive modeling, 2) the residual chronology (ALT1Res) (which removes autocorrelation with autoregressive modeling), and 3) the ARSTAN chronology (ALT1Ars) (which reincorporates pooled autoregression into the residual chronology). Note that in decadal format a "Year 0" is automatically inserted between -1 (1 B.C.E.) and 1 (1 C.E.), throwing off labeled dates by 1 year.

```
5177=N   -3160=I ALT1Std                                        -5(13F6.0)~
106467 67296119418108542 86345 63638 75833 93955 82657101373102153133576109949
129767105732138380184389140703149955133849137206113599123658 81353 89535103049
101585127267 82908 88515 96997 97495106786 99635 74200 72543156397128497101745
 77942 69944111354 66573 69489 72059105072 91414 97328103289101587148444140491
 94784100555102401 91768114056105235128635 86500 82194113311111887 98282 91242
112101 81657 88412 72118 73080 90336 97562103092135727127518 61673106446 90818
 81307129081 67284 91053102433120294100814135188115476105345108133 84950 96265
138939121478140602146983171621104744 79800102754116305119327 93794 47859109676
 87481 88905 98213 78445 94572101615150229111842 96582152593 79975 76731 62744
 81404 94775121256105435 83854 87171105431105528100699101300118682127051108598
101704106609 93550140565107254 81448 75074 98727107063 99541113126107171129812
 76739113176109580 90121 84352 96432 87160 79067 75252 69341 38137 64758 97286
129203128873101072100330125500 76464117238121989102273 91686124291 90870134206
125782 95873111478100571 91440115234101222107104114875 66757104951105682109259
129527141691110159135400116308 64441102564 87825126472101338 91984 76746101427
 71519 95484 98753144193123341 98132 95841 74710 95045 97935127109 44343150493
133816 91769 96628 63588 86148 69731 97354128700 99246 95737117705100374100284
 91172116642119495 62925 77538 71096 98215 92761108879109579107619 90471 97114
113511141746140193119010 97300 73022 81828 86915 90974126331 94314110445117994
 97693 64965 82842 95777 93860 96941 99004 80948 73325 59917 84471 76018111586
153249101349133823 97008 80669103705 78571105418 85270109708129582132070 86504
 75550 90181100395136442163148156106129493109912 85609 91163 98374 95666 98659
 87460 85749100903 82026128779124733104619 65824 85113 99140 79409 91902121917
105920 88170128175105697 86862124058 97396136506109314 96980 96157 72510 61499
 81384 95076108113110985 82943104675101719103085119349 90926 97583 89520153597
107143120233143058116754129428102519 60245 85135108323 93278 75544100610102270
110835104062112382114656 96397 87592119013120117119658118204 99054142469 95250
 82933 92066 67324 92339 97455101290 73756102830 86303 76734 89403 95521 73427
117557 73072 89615 96735 78359112037 91342126724 86023133940 84028 87963 90002
112024126073 96780106547101374 98053110100 99547127801113079124697149239117569
 79039108907121135124713 89615 98903 97169 94347 68363103702103621112803 91132
 76508 93623117315115632 85475120476118877117034 93904118555 93871107367 94656
 99946105587101620 77980 88002 85402102414 84755 85153 73510 97791 92601 90677
 88368 72204 66693 69066 76656 60997 73436 87622 87398 74879113544 97034142417
 92434 95433112799100724108585 98505108376 87493137721110813114515116453135582
105031130307101186 90103 83116 74853102449103386 79577104158104729102142101782
111308122464119087115002127500117415124306124958 97311 95925114238110623 97413
 88322122316 82577 94854 93029 71583 68125 89399 64592 90828 64313 99403 86224
112649105575 93837 83030 77053111260114939104030 94749126010 98977 84842 96961
 97168 85737101430 91437 91573114057107208106991109728122290110528128960108173
102907 84029 81247135824102324113334105023 90477 88740107972 94021 85934 85323
 96865103422 89301105096100994 90695118467111960130880111300101590111294144889
109452106537124278 73388133420107247114456 86300104184103278 94663110252118859
107420 92279108685 93789128467108268 99764104573 73811 94398 94792112813109633
 98669115294 87815 85990 70804111130 76390 96500 87513108485 96172100109 74441
 76968 61015 90112 89811 82512 77906103275 86629102440105931 81291 91223 97540
108375 96800118881114948109169 96425 64579136418 97203127153 71712116197101027
 99908102551115900109912121752119806147578113111141685152779 96516104662129896
 82453109496 75191118257 91866 87934105489 93316 57948 97291 90824109890 82685
 88512100330 94699 68530 63316 66282 74211 97766 86871112187112394 81432 82192
114671134694132330101474 95933 71029102365115295 89563 94953 96310 97571150696
123832 69317106310105486 88006 94527 85748 50080 82280 63526 98298128692 84810
 75378112491 95507122825101612123102123039 97848133890101270112003 94725 97178
117076130920121566 99884 85978 78847 92407 96254 82551108938151247101827127296
122083107069116921135881114787115981100472104548114568 75224101358 81496 97457
 94600108612 97405 86497100349 96085 92025 83243 77369 79735 84949107369 90803
 83378 91039 71155101546 97162 93094 90851 91963120922124988134261 97834 98848
124614109273103128 71764101555101820103266 78192106174110205119688107993123743
108525131725139025106142 93797125902101009102825117402129368103266 78817 83806
```

```
 97208 88141103838 99298110250 81302 85950 67420 92560110972123915 98756109451
 91277 59101 93962 87816 97376 73862 79969 80628 87967 75412 69536 84086 90886
 82092 95119114014 88961138530101379 78220125361114317110410 76364 63821107667
156919173329 79697149132165944 93592 88576 65784 78916 76573 67924 84465 73215
 94045 88560 98600 98824105200 80270 92568 78680108806107033 98554113845112549
113420142263 88406111845136630139282104470128928126190111046141471104417 81723
116688121810119278 96664 98627 74039 61444 78574 77614 55420 74086 99452 91456
 36976104905225658100399 58685113210100646 67349 88762 41565 92296 47185108119
116950153915 77592 57869 88639 64977 51349 71032 65353114806109786118117 56911
 62830114407 73569 90523 56040 90072 87579 86273 80782 61010 87916 99385130283
 85441116893118764113730150387164126122030127591 63971194427127924133967152110
 83165108622 82030 74673110977 64334 77166 80563 85137 88830113356 68158 66153
110038 67148 88047 52060151545163567125005105860 39985 72140114865106908100571
 93995 41508107705 83589 34291126010 99759 61608 98666 47280112005 63290154365
114746111641 64192107047177746104430139980 72989132544121122179787127025134329
 41758118318 72851 40407 66088 57065 72547123477 46632 88481 62672 97887101496
165487139961166576166770 76597223643112498149707 49554 77054 98977 62595 52929
 88098111535146639 78187127869150745168516135882112572 61256 58010 86135 41677
114691 71012125164107208133717 98683 90137106877118441137274 50945145536109019
161880100289161738122515139861117229108899 77840117492 61263 66974 64266 69377
 89184 67930 70685161913 59079151077 82986162824 93503105409163459 91587 61780
 90268112078 93907 91721 93563 46942 65536 80588 61877 84126 82552 34352143804
150976181215227685 33137 47621115764100229124338 22221 54977 60666152385 71663
 56201 80989 69739100977 95741111242112248 90886 90071 84867107800130781 79969
 95722 59815116483142903122122 62132 45308 88045128493194029116615 40068139255
 61106104925118724 59434 76216 31936 81203 96130 95307140346145214 63919153237
149303172272139380109608 90192 58837 36852 66049 42130 57651117916102101 59274
140122130917 74815100716112741171342102258 99272113591130651 78719120710 67739
100448 83109 78420 88903 82870 60922 85443 98151 65204 70258122814196963154074
 76101 52840 98876 38115114966109694 79308 90447 62755 73445 88642132888 90147
108363103200122683 84901 95322122259159908 84150 92170136749111029113331120017
159199128621 89279 72011185533146272104925 84726 53700110288 76979 65789 78276
107586 83354 86291 80191 67321 34883 73178 79008 90102 92792 75763 71300 46773
117271 63918 92000 72196 75380 89391103206 79536102445164980129927147174121582
133619 69354146220 96139 94085 57949 90579 99326 98118109291123846 99372112448
 80698 97458 67798 53661115171 51461125520 98945114388117828106501110669 82582
127796 93544104986 82010100554 81583134300105125 87447 82293 61537 50177 99937
102769119077139887105083127132 56601122725114806136933125445148480 89307104953
 97294106013 78853 95557 81555141781148171 60739146455141049 92879132711130124
100090129689 85455 53054 76841 62627 74618102945 49364 92746 80919 99529138206
 78186113293 95962 96884108010 99783 76050105237114410 90111 98094121920 43749
112025 69480 92346 94179107895 98277109721 61748 99850101813114183 78184 47039
 86595100161 93619123124 86258 75552127655127602135577150367114162 87389104260
112851109483139270150680102568 94624 79772101005134541130063 79576110110102928
122775103275131522110449 93451107192 97734108983130519121722 97127146014117981
101984115150 99403 86141 82689 89357 70813 65266106158 98381 34702110693103863
122845113674104105 92197 82017 97454109401 68914 87094107946104647127003104235
148547120562102191112090 87961106270103818 76975 91447110923 90048103815105640
 84879 93973122292 94526103495 95996 66349110898116336 76113 96153119637 97132
 87154 65663 95651 95593 86520122964 90120106951111734 77279 78957 99896121868
108615109762128596110411106756106146 94825101406113585127942101225 98635112738
103373118384 98832112250125156 94249108254 92299114902113338107962 89664 97671
 95847 97687111676123464 93293 93175 91866 51114110668101272 91772 77959 94236
104272155395114235141981105534106798 96789 88814103451 95475 97083 89151 98245
121139106883 99771 84864 87666 93670104269106433115717102012 90630112248163554
102431121080 99979125479 83172115779 70631 96679 90585 93001 68005 99953 78664
 65778 60805 71019109567 82826 54166 74428 94694 81841 91760 73866 87768112969
108338110877 96757100764107105122274 99674132739148220152216157843139006117100
 88115109513 99256122972111128 91970103919104817 74967119033 97971128086 97888
 94422108105 73867101148 86001 91070 70067 86188 83150 89825118229 93576 66867
 86085 89839 93527109296122174117626104864107447 76405112983116138 94485110888
109354 81838 69068 69142 84834 90461 78759 84557 89899104394114825 93805 94203
125585103368123696 91391106044 92085 98018 74487124265 93294108338 89279 91935
 75678 94018 76440 67239100367 68532110225103734113820111241101581 90156 68425
 86833110354 98998105687110319 88813116261113226 97461116499 91283104236111831
118475131854 87834 86556121976118163 82403 85877 81209 70635 97492 42146 80850
118285 86006121643127181 81745116343 78979112546106151 91698118741 59012103753
 85852114266118678104732 89595 84128159161 88645127868131935109389129662 99947
117154 95504122421106124 99057112581103655103796113112 99152107268 97657 68724
 94093 76359 74577 88892123577110662125276126218108371104017110304101168129343
133552145278 71556 93508123152 98093 65090 55805 93317 80273103725105596 96131
 71667 98161 54386 57949 60837112097 98139 76741 92918 95228107119115562 94636
112393 93417 81770 94021144230133139131781 82054139744127852104164100469111105
 99917 94222105082153819131715151526 68640 95868 73613 97382100552110921 80243
134351 99182 92707 79938 98641 68010 71470 91291114517 90473 78605114176103505
 84024 69308 88787 89752 81341111568102966 97958 97072 94425113705119108131549
105846106191 67027 80024 72574106656115473 91976 83487128412 91629 40353100889
136531107454128189104133134293113047110000 85123111055142176123351 91244 83534
 79467 63222 88575 81394114698101572110746 99648104450 81715101175125895118665
146684 84626 87902 90052105178117772106508 95207 74781104761107517101179108622
115055116414 95807 94462 77173 83999100469 80368 87835 95750 86795 95946 94339
```

99104110567130505 89105113572 59244112019138807115802109470113499 78839 74723
65182142007116420102343133396108264 76242 88239 81497115923 90784 83490 97849
97579116158 88804 85591 69733 92118 74086 74440 77125 94101 87138112262129843
96781136292118075 84332107114 68422 78293 78566101630 79046 89409103375 90747
106231 80137113175 70425 89242 58410152341107678 66988 95100141066 79144 75653
142584153973139030111752125964117511 56157100456 79484 98008 75545 95015100397
106155102640150437125893 94801 68906114675109438133772 79894 68321128244 61729
112431 71023104254 68953116431 84352101736 90769101711 88265110197 88141101656
87625 92304 88381 83793 95037 88012117899102723122804 96035 94078 67564104650
84856119962136261107519 84939102773101746 79112127061105156 82904116698105072
83995102336138428 90688 99476 97206109579 91134121246 93812 50287116104 80872
140122100385131152 87510 82701 78649133042 99466132404108008 83452 79397 91727
97017 86564 70628 82678 63552 82767 76408 89792114888127142145844111612102013
93677117108 73076139311 49728120070135785148949 94193127160 47002 75779102881
94917 74707129771104613128094 78605125325 96386 93146139015 76589111291 82272
149626103732103433 96495114628122997106375 87991 90717 78459 89751102410 41360
104658 73259119207 99569 87448114890 58062 80047 80832 98272 84246 77691115625
96033117522 69314138442100296100823114566126239 95141100477111333114465129060
87656 61508 65416 94039 58191 57501133944 53611 91431 85936115221102221133289
79004 94543 91443 88950 91647121871 54532129537180862182412165581128893104408
62710148757 90002 65443 57614 65875 78642102392107360 60771109006106914 97002
139917 85460118204118181 92178 11807 89890 93921 57167115287104797 95914126160
67550106805107028106475 77825101587 92579 41743121285 86875 68096 73549 46664
129185 68252 99921 87341 78935103956 92218111114 97693136164150165 89854104629
51533169134125282 99222117441145085 26417131200102482106794 81521212088133941
116082 99566136744140939 81984133398 83377137826104207 59255116593114394 84612
103141 89557100310117171118159 94983 86835 19950 96905 27311 90370116657123783
86554160320118045 85088 83654102074100657117623 97394 43742107366 66711120977
94917 86000 83962 75918 79254 84218 89307 99419135468 70213169035149770 99004
89598 53661115068120742 87147103130103222116548 77334121984 63110112266113600
115702125173101381133302101908142365124195102621117548 80733 52791103519 88303
149290 89674137777109389 73263 41295 81897 73365 69296 87154 91208 86140 83963
53722 95911104862 69188144968120415 97306108824121382 92104114896 84730111075
106822 96725 90740 99173107947110858108866 91974110924 98344 75267 80511 95253
90831 87314 87819 91218 94587132109114750 98543 96755 85583107261133764 78776
116751112436119994 97538 83928137314129748122989155744132553130683111302127608
106041 98107 65070 69950 89015100538108978 75582 98753109903 98266 72814115286
82864 94159 86804 76438 91654 79892127542102967 88952 69710108588 60103 93260
105604115919111948122430115521 60033152593159187 96545 75014133282119600101057
94888 94969 61752 82001 77070102436 65802 55667 56548 86458104663 80233142478
146706106494 69615 67138 71428133589115149 88707 78836130417118614133841 94162
111729 79611 87648 99609 97894151313134269154373 64308 56261115141137189113325
43871125647 92922183665110291147516157648 99959 77535 96125 42975 65849 75797
93636 99495 72428 85293107363161502105413100316 75620 75735 44195 88486117320
46895 82383 80667 77638 83192105891 86859 56526153288141185106653121246109528
98244150501105799 99569121429 98377105682 83923115989 90589 81804 53415 72755
74771123852106686 73359130291112056124971129383 70004 85126 59085 75307 68838
117102 80643 91058102411 95534102993116297 62456 99997 92178 86496 93408 69017
117145 98153 89420111757 70277 76796132070212387204191175815110428129198 71607
86039 87991 94666 97446 83658 74648 90671 91163 68478109893 95962136368100852
130870 75087 64609137942117831103852108819 99281104447105335 79357 84568 81269
63127 26488 95900 66530 99867 86953143883 96276 85470127092134094109469136763
118848107347 88290 83499 95273118236119132125424105128119395106933122543118026
106544 90452115992115348 97034 83064102848106364 99537 94434 80476113617 98713
87382 88855 73178 58938 77003 60641 84121 74283 66585108754 75124129840 83218
103087 96380 80584106011105605114648108875118556104234 80875 88965 90807 61664
116086 67233 84061 94006 81374103373 89645112201105767103717106624 97691109247
69476 87669 66249 76773 98833106624 93544109182107771100365 75461 90969 82400
75320111974122522113969 86378 99208 80698102531105343166374111874 51383134402
124239122057118035 98640115254106244 97505103267 82270 90251105686 83897 91223
83872 81740103520 92998110370 85801 95691131942123502110578173022118358110944
101596 80897 88067128846 85707 98158104088 66008 91644 94161100157 64758 63555
74912 95099 57779 76829 64899 96451 80451 87211 69962 79719 98313104149113142
103328145957144183201068129516127761 82613 77710100723 59129 87273 80948105595
85252 86281108603115647 86916104892 78528125874128536136365115289127753103732
59392101337 87824 69529 52914 88681 85256 87639 89869114171102488103941120450
100370102618100822 88188107254107319109048100741 96921102952117938101530109670
110751123728100354 96347 89293 73382 86966 61623 83054 73151101285121930 91051
130290105687 88137 97662 97365 62928 86918 97149114171100399139758133860114736
107390100838 81990 77356108346 95916 81080 89143 98811 90134 92865 88310103714
101571111307 88152 96547 97921 99468 87690 93087 83619 76394 87437 84246 87710
113544106124103972 70842 97942105175 93015 85897 89095126419103228115999 96636
124848 75683113520132881110641110956 86625 90321 85148 94501 64521 92275 72918
101893 67413108054114220103369 91245 95619121959101556 76435102371 67085 90424
88174113416 95218132606107526111894113736 84809106782 94919100177 76087115770
90143 90076 91167 90904 78540100491 97662 95711 88497 81385125887 94073 85940
90870 89157101217 54799113236 90183 79027113444102941110111 84606 64354 94619
83838131043 90791 98314 70462 63220 89616 94089104282 89333 77769 72254 93182
85980124652124243 66979 94342106292103829123557 78423133041138322153777125620
121348100170 98835104858 94311115774112656 85245 77561 89703 68626 98850111525
72164 99825102323132954131437 88276108809 90060 97217102479110485 94456100096

104999 79083102366115675 84290 79504 70430 59049 65662 39941 59452 84994 96211
74785 84214 79812166883102588147682 71960144338129971190860 93296130738104571
125197 84211103171114884 94647 89288 68434101606 97376 80639114399102519 97494
108013 81772 91119 90950 83207 82456105902 85990 93201 89777 78506 88010 69278
88232 86272 70449 93110 97546 98914116965109807 80585124837 96926 80111101983
94468124277121266 97297163183125694 86637105279102552103952 94188 90533 94286
94095 84039 67216 85970 75128 92578 92718 96294106461117412105170113479 74285
95579115841100477101279102218117785124078 86097118438114503 86092 91946 89280
95253 48058 90852 98916 95668113063 91851114906113484110610 80817 84170 54940
75216 77564107638111576 73492 61299 80052 90748 91832116179104810149740129060
122138115823121168103902112605157963111784 73575102567 79544120567 82638 66585
98522108765124790117407 99401136585128727 97580134780 90340102827106198110684
103832118299 69438 88230 73579 78236 98308114349119097105613 96847 67595109565
99999118213 97407101891 86372 89014 74637 94511 96046122562132551145130 78724
91746 93792 89981 94227 51067 78443 78761 95356 97532126149 78507112191 94481
83701 91723 99600108304117466112375 96779121498132120123625129834129739110690
97220102578 98312 88489112811148738106148101463 85750100546 93784116352 80263
89849 64257 74548 99148108052 74171 90934114870107890 94750115382 86794 87565
86459109308 92866 85452101100114062 96332 90230167096123103141850104435104974
83221 88608 75318 98902102516101435 99019117228107488124626115953126591135400
165894 98467163502123728101589 97964 46611 98043 85466106566 99774107733 75125
110495 81609 84440 74909 84297 77501 71035 50779 71417 79956 95645110326119509
81421103549 87699111601101949101054111034111703126472137433 82776 95049 42931
83076 86570 89510127494112496121043114089133017 96972 90569130652151306108512
82729103465 99205100993 88065111292110128101115 96273 84768105578138559100775
93854 78338 93815 76637 71959 94842 88944 74621 77287 85314 72704 84757 92605
115233123875118775141230 98683 70905 65002 58744 92861126394156875117532 85384
112426113814100528 88176 92077103045 99195 91831128629102087 84145105518126623
94328121897107636 93393102881121374113408115066 95867105032 77746 66165 77500
92123101675100256113851104024 87796 88727106754116906108830102772 84929102201
142302142086139854121788110827 83904107015100145 93501 94074 97243 93965105388
70936 82028 63977101790102910 99169 85544 83861 89784107234 94805110615116278
109651 91387 95705116108 76108108657108992 91284116262107776117593 93432 94501
73259 91643 95634116304 87249127704 90093107175101256114933 97547100811 99723
95929 74335104093104542113935104330125826109070 98164 98458110451128531 99539
76800119605105565 99840 95340 97900 85531 59733120270 94053 98940 97289 82410
99592 83604 92790105110105179118075 89163114382 97524106466 95548104558107762
81242 92535 94868 83140100331 97922110424113920 86277137425116606 95812112680
108764108909 68029 99518 74924 91926 62002 84764 78499 79206103525110959125175
121075108709110314104642103016121627111085144723112900119468 95923111933 95902
103653116249106683 97561 75782103260 92127110633106044107757 94210119990 86733
87534108636119224102807118786111648100398101737 97090109326110063 76869 96089
82829 83102 66268 92695 95894123719 80472105730 86960 78257 93664 92254 68543
107738103226 94532 75384100238 82576111086 93618136960118069114342129091117729
132912105076101887128305121313103058107263121881107844102829 56916 80608 93662
91922 88531104785 86965110558 91611 71056 93095102039 99640 89455105545106665
102813 93566122118119380105657114451136131 78904126549117152 97401 99577 86886
107326130988126571109712 76930 80187 72562 88269100998132460119355106651 89462
107489 90206 66170106434 92782103201118744 97804 85899 76316103617100415 96019
75738109401 82673 90310108241111017122248 99411102171 90852101233 91268106916
122825120429144453101437118147110612112737 99076118408 87970 79664 93605 92089
96955101387 82837 99966 83687 95596101354 75407109625135077153924141514 81927
132858113512 96770125230128271110963 95182 76879117419 90895106099 82257 92510
65777 83641 89603 60974 91082 73359 85203101039 92814107222 79288121022 83537
103164108339143284 98633115175 97748 62906 91154 67397 84449 65634 83964 95641
109143 88769123777 91514114544101549 95223136221106485144241128165130353104906
131983 97336 94441 96035 83699 87179103121 80695 98065 97317 88322116372 97027
99335 80991114138 99912138644112229 83760117108 95392 90533 57428 88492 95739
94709 87767 94077 80239105383 93761126657128396 96137106175112530 82436 90492
80309110356 81370100706 88396 90620 99651 87061 94181 78683103063 85701 93561
11241110205011565311485611320135397108570108702127432148911124064109551 83519
110342 88632113528 96441 78406 93968102782100976141780 73567114674 86163115330
98567119325111183 99324 91251 73795110787102161116217 91664 88429 78032 81921
89133112457 95280 86621 88435 93205 87706 97121128798106173 70990105233145450
99027120367 84278102991107659 85282 97500 77229 97183 99445 94510 83217 81703
77498 93431107057 89419110054 90000112609 80323124349 99949118593 90962115045
94534116547 83796105935106475 90566 95434105863125903 99666131523142309 87779
117030114367105224122948102106101237103542104699 96451 89636101710 75443 82669
87717 90634104084 99098 79518 89579 99407101464 92648 87749111877114973112060
85064 93210108058 96615100433 88463 75038 95137 79985 87688 83564 90546 97919
73438 94993105365100663129690136528155904123065111073107636 88760 98683 97378
74473 96970106970100375114177102942 84588 89316107889 94073 83878 79330114200
91876 76154109053 94389 92822 82190102896119703 88593118012106563107135 87102
96099 95548 79284 78489 88078 93593 95768 93999101614 90690100266105616 98819
91796122448 83097 97006101041 9858110229111026111025105222 82871 64072 77388
97746123604120030109577105257110902 89687107571109819100981 98777110599118801
118149 99636109894 93019 53225 81641 78144 73835 93204113403107121105587 89681
89236 79283 97594 99725 76481 92689103883103776109097137107 99490115273 96821
59941 99567103818117099 74526 88553 70210 93377119354 73486 94498 84535 90264
73306120131104510 88695111485120245118311120491115160114948131150112425117765
79394 58704106947 76131 85654 99032 67845 96878 70930153108111175115637 98433

```
 86326108970 74500104322107940106953 65112116685112081 98148 79471 93859 97940
114220128277 84543 97031 98117127173112351113447172797103040132194 86831103974
 80560 98682 95814 79484 91703 63582 83961 86685 96885 81564118324 92802 78843
104411 94237 83199 91374 84269116416116342123542146711119167106195135730111179
109105 80835 90341121926 92609 92404 90342 87704 96920 73461 55097 75087112998
 93315 73829 80273 78434117773 75055 76425 42825 83933115063 87898111208140884
114999 94287 94624104059 57840 67644128030124464149971133088107678104294151295
 88715136314 80888100687 48577 96275112853109511150806 97931159840115763 98482
 70645114094112881141673100417128199 94005 81467100969105109 88221 59757 90359
 84738 73020 61120107812 88423130684124776112681102846 94377 92874 71258 87332
 93123 66012111403 93675111948101670 80127 53639 69592 95592 85877 89389 78693
112557 60277110775 61459119916 89721152012 95317115600 96605103310115956 77915
 92198 66412 99567 74747 89104102639103393 60869 77634 78815 98033104470 80639
101220 81449114294102678104161 77693110750 81059112439124496 71145 96384131480
134482 80980 89872114410133394 82301149588 93769 82718106538 67768110657119808
115868 95743 99843145482103880 89871 34023 87259128302125147104117118805 93551
 80986 85623 69017 93624 85330 90430 75267105563 72096 71929 50148111550 89870
 82198160507161406 87977137549119630121101 91022 96234118900106131102719 90296
 95931121693114027 77684 64862 88102 79916125394 88342 87957102788 70725 92047
 62892 62718 92691 84326 82388109227101703167709143893116669 58073102350 81766
 78568 81988 99941 62925 89945 91659 85143 94223 60721 93880 90481106930121553
 88861130370121863127353 95443102454105051121796 94809 84513106497 66497 89168
 90869107638109882 86817 78471 97156 68270103786 66208 93584 85315114175 74957
122824 85162122189 54594101067 78647112970 72155100148 81755 99754113451115446
 45763110594115937117236114298 60195116041126748106049118331104748 90872108597
 76374122334139458 94691200255154820142726108228 95605100082 87578 65898 89749
 86810115649110783 92969102145 57454 90150 69394104734 73325 70468121624 83639
153384 87507 60681149280122609113745115678 75560 96014 94111113833 90226 72045
106750 79423102152103639 82211 85291105505113667 91501 97549 96708 92969 94437
 94132 94414 92988105125 77262 85482 94723135498110346 92757138618141381106798
158341123935 51241110318 98312100160 96784 96341 83531113254118470 94747 99401
 60474 62071 99812 99700106105131472 86662 97900105280 87481 98891 93101119884
121435 74724115222 77560 93026 82183 92128127554 89012109153122311150607129705
 83668 44908108553 90804 81113 83464 74213 83000 72771 82862 78112103515 75925
137275102332129100110969125621119471109794133763105319132695111262 93239 93620
 91734 96617 84903105133 98954 77014 91912121972 83136132274 94750102185 93536
 79231 99448108688 81257108136100564122607116699145787 74654 80620110643115823
128274 95395107106137733105461 80591112707 99409106694102532 73663103703107201
128823 91645101909 89283106171129553106337 97940 64305118577 99534 57941 81799
 94854 88779 85527103205 70877 95390 68248 85874101955 75260115608 92210152609
142128 96978109119 74323122762 92798106449 80081105264119961110366104718 79374
 89378 96220 83343 76109 57216 84516102368124737 95254 88896126891116013105192
 53393111150118425104082127488134576102040115352116554124111117215140238100578
 97008104433 84184101857111479110217 82889116667 73216115500 66951 31933 86792
 94638 78517114042 87417104827119707 93931 62380 82605 48210 85568 96959 90340
130118 65349 85973139439105850127972 93389164819 85679142636134641 92429 91777
101653145781123965 69678128010 84128128689122892 80817 70164107795 91863133103
113601117571107900 68277114635 83955 96971123529 97204 95478119083111305 84539
107974 93138101271106325 71974 83353 86242 85045 60597106070 64066 86452 94436
 60079105429 81940120330 97321 83771103717 87996100003 61283113102 66559134711
169004111199 66544121262 51125108421 50047125487 85130147999 63530105708 96313
101372 80713124631186588131748 81253 95590 84525121167 81820156470167074169084
 75746129339 66965130478165596109984166546112258 61395 50494 21508 78278110490
 54666160820150400126507124113133853 37513144533 19205123019 51147137950 87510
 95117 89145 62816 76110 48668 74237 50643 88486122531142590 43578 80799 57360
 66307101870 91919163587 88418 43050 74694 57644 45672 57782 39458 93110185493
 77693114491103568 87153190762113468 94617102438 64023 99828116030114070 55798
152052144208 99667 49094 57447 40909 99431 43871 82811 79947 73577 48785139201
198828110696193769162194242665143738111049 90824133782116619 79389 95115 81913
 90946 73291 70512 79732111583 75558 66605 86526 94022 76343 84380 98966114205
121591 62816 78245 93050 80141 73927 84525 84445 90308124835162628159915147333
116143170151127579141608148252 62159113090 60698 36683 51902 57210222473168310
168405 90718117737164905150703 85479113117 62470 83702122689132513 71715 95154
 41680 98596102143 72566 91018 84899 78873 94276 75539 91331 68944102817 55430
 41181 66145 87450 84391114342 85307 86188 41681118307116968160471 79226112560
 88885 99150 84025 88285 98364 30732 95119 84429214560134360188225123339159964
135000138939127701 74890 99982146342 83993 80354110257206544116456127032124104
162477 71815165118 77407126405 72399 63113 17180 17229 61162 24434112549133511
283123 77262156632 38671247920190645 42450103773 90502 38982 73360 44608 21806
 52919 14112 57521 27816 16679 38614 13391 57547 94194 43995140131123512263579
295677165845138814131833 46359 16158 92903 48742116869142221295818122504150124
101999152202122940110331 52691 78576 64828 88382 92031119638200974140509118359
 77290 96205 61974 52652 74318 45079 51813143624 59833 57886 40298 51807141966
157399220039163088 91512133057199087136701 72952 84458 70686 79348 92770 86716
 93816 99583 72346167652 76465 77825 92743102991102753 94573107358104292 99680
 55631 56369 64635 97037 62141 11211 56544 56659 93936 60247 95586 87389 81082
100659133080 89386 80519 53550108659112782 74882 67024 66024105776162780172142
139206 84875194790165985167498 76039 72186 78238 75004111912107160 92129 66439
 72358107726131720 57757 23214 56901 30389 42629 71199 85234105267 37092161678
143691 96599120822126739 44678 42754226018245257 94775 69571 97996108671 38164
149969 76362129420165199188773159362139196 99519 68379100448136008185593 89823
```

```
116547 57868 36138 65777 81692 59022 72291110978 98334 82390 67263 44836 45409
 69875 49888103092111135112404138378 95854 86338 89674 93876146280135590105817
 83572169754162188 72300169124109218 86533 78636162646132527 80869119695132882
 99837 88729 37933 72801213159257332 35378 95345 56301 78865131345 51567 67742
 58040 57535 91019 91903 92572 55135 37455 98921 52825118565 84419 45240 64352
 86811107041208328 55306139595 92556106376194459131631150259212507 66894 96291
 85605 40878 83760162958 59347 91695 71612 34821111407 86016 64799 92213133765
121182 36048108678 55793 64866121016 88879 86948 67339300436161959 36072128079
 79269127373 74605 89570 60069100139152668 57095 98527 34366 85847 84276103157
 73457 92196120726110675 88220 90674 95206116403 95399 72924 84556122634101545
110671105319122466107846116108 65606 93755119745 73269 75555254952 52573130127
102557 88015 85931 70695 91514 47868 41697126444130042 89462 76297 84653 76897
 85647 93637103731107218 63491109636 48062181384112579197551103587 68621 99312
100329 70048 87493208369180803 98220130671 97989 58949 67607 97146 44097101758
101803 96946123776118370 81656 56018110518 98016 50050 63785105607123153117915
143137 70334 88610
   5173=N   -3156=I ALT1Res                                         -5(13F6.0)~
 77493 61748 84390105205 87070103809103212130217 99499117159 94294127740172136
 91894121641108172112318 91545107533 69968 86390108543101961124436 74057 83384
101213 98911106431 97340 71583 77944167766120669 79129 67556 72770122464 69364
 72363 92290118861 89700100736103618 92587143243115696 86087 85972106361 89372
 94718 87790134187 86372 76028125956108959112401 73907110248 79045 92088 79456
 83182 93583103666110245109476119509 50256105233 95571 77749131780 81955 99714
110009129343 95269127355113316 80467104606 79506 98527115608113188123461127410
143925 67569 72361109473117126 90894 76908 54312121186 92608 91520100604 77748
 87896102599145314 96636 93720149420 82124 79084 75023 99640109410118854 94087
 82612 87377102707100503 97522 97548114669108489100458 92493103621 91364128505
 86277 71558 76227108072109181 87974109556104238131241 61754108980115575 90626
 83334100937 87539 76034 82009 83048 51792 90990118720131668114223 81906 91931
125384 71120113685117454 93365107856108860 81756133240117534111416 91970 94560
 83833115877 94070 96889108351 58227103489104473103204138959132128 86633118051
 90912 54336101002 90636100923 88118 82955 85602108107 72655102883103295142112
111106 78750 93114 76592101181100561122309 38025160397121096 63678 95355 52854
 96977 78545104649131746 89669 84420120363 88893 93574 86484122012115055 57057
 85619 69098103634 91004108114107786102234 84611 95215105912125177115923 91163
 78439 67526 89391 96546 99970120483 88889 99110 99804 93359 63731 95538108536
 98777101559100473 78361 78384 68278 96495 84669119936152386 82345120255 84604
 69416100611 78632111287 84045112734128105114672 67142 74831101987110428131065
145045119438 94758 93856 74656 83791 94702100508 96695 87171 86723110627 84932
124993114019 90138 63968 91424112460 83142 93818126486 93698 78573129303101914
 79534125938 87215130942 95067 84961 92871 69693 69840 93953105561111744108120
 78107 99564 98307 99936115644 80990 94131 87233153422 88516101493132233104329
100879 78541 51632 96688118738 90887 75546105494104833105920 98153109060106660
 83545 83310120864118745109252106025 89801129451 78883 80071103654 75269 95797
103119101480 70258112234 84583 77370 97555101224 81093121915 71524 92828 91718
 85581109268 89823121357 89246129141 75468 84468 97083118425119898 87229 94985
 96648 96821105822 91545122613102094109292141618 96583 56247111673118298105549
 79766 98602105843 89717 67752101363106291 96140 93273 77622 99586125570107252
 76823119527113601109191 81469113693 89669 99242 90183 98037105240102180 75807
 92271 99290112019 88002 89673 83493109056101033 86898 88795 76410 78022 82113
 90202 80504 84946 99004 92331 76866123144101789118414 79587 92045114044 88992
103880 91540103478 90457130397100090 98718106888125345 94272120213 88061 84169
 85224 85387105440102571 81633105527104774 97168 98845109661119785109239102104
116160105952114238110416 80205 91910116324105962 91025 87278121461 89278 93084
 88997 78282 74518102868 73483 98449 69625116446 86149113747101587 90577 81947
 79832118370109891 90763 86225120388 92862 78878104330100844 86209 92857 96626
 93231109046108333 97395105896116348 93754134529 87532 92107 73259 78928135828
 99672 94892 95829 89017 88441105612 96615 84479 85177101623105243 84122104038
103066 86676122532104027119418 95221 87062106992140722 90495 92481116935 64497
123595102144 98657 83464 94869 98369 91833115677117200 95276 87533106460 99145
123069101170 92270100848 73306 98609 97861119335103827 90008104631 77260 90054
 79402119952 78642 96696 94209109282 93900 93961 73003 96142 81160 97115 96859
 76454 77561110535 82035103020105684 76211 97258 93245111860 91266120505112815
 99070 92027 62226144235107220112252 68793123318107170 95345 99076109037102906
109912109099135967 95539129148136298 73729 99019123671 68614106795 71331115487
 86156 86086107672 92699 58330108703 95327106373 64256 85616112261 87402 66811
 73539 78271 83859108589 90582112423110435 74565 84486102717129078115356 94096
 91670 71396107800116971 77965 94618 99445 92536148996104203 52599101102103121
 79974 92482 88133 51587 93993 73417105911130758 72055 75937114853 89033119912
 89367118215118882 86834125108 89050103299 89985 93634113681119421105606 95569
 80469 81291 99200 97960 88384109312151381 78880118960106411 86605112681128954
 98595106108 90497 98739110053 68948105904 82495100904 93774100006101977 79933
103598 86114 92685 84562 86799 84896 92610104984 88328 84119100158 73048110195
 96601 93520 94524 92363111307116970120440 73541102193124767103918 94618 69830
109243102771104308 79227110747 98205110615 95778113457101141113648120436 89411
 90300133505 99097108176 97264115909 86360 66810 84626100189 90074115519100107
109803 79807 90025 71574 98138116777115451 92821105357 87011 53989103789 92274
 96732 74149 85154 91227 96103 77465 68123 92887 95229 80952 89177110066 84420
138048 92435 69881134819 99997 94646 67876 71122119451145856130472 52428112519
164803 62566 86227 69163 82862101893 69685 96559 79470 99602 89681 98547 95526
104197 76588 97699 79371112429106141 92559107434105878102172132079 69050113561
```

131361118927 90501119664111741 91177131767 83841 73206113675110844 97977 84793
95518 85629 69333 81948 83364 71141 85233114432 95763 37177122534230150 61562
32321109093 98367 77448 79591 41301112236 57595124365128512128859 57961 55945
100482 91975 67789 88404 81035 95313140188133172 74440 59475129171 61065 98651
89287 87032 87153 67284 79691 71100100981 93415 82154 77675109754115929104713
143064142444 96523 62887 20561187928 84061108216149918 60841 91258 74982 83085
123241 66161 89818 83756 97358 82738103628 61191 81861116542 69226 95189 59534
152212148298 92193 97898 34649 84011114528121090103508102630 43775131438 96907
60273140301 98128 58681101962 60019112440 77489149322 93558105209 54668113096
167493 65824119353 48054125105111718168911 94535110169 24169120364 70768 51896
83912 80373 96049126862 46858 90292 86649115642100041165258106745146097197596
46625203796 69360129081 34070 80336107906 56735 61976 77857113633158589 77137
131865138281161370117638 89508 52480 67169 92871 46140126956 91812121160105415
118844 93448 95909 93772123808136796 46111143629117679140863 86242152619109545
126603103979 96152 67374116370 60050 67417 71852100299 96317 71983 82700198719
18827175857 80321142702 78985 68411131532 68930 66754103567101154 80665 84641
131425 48044 83750 87530 74877 97594 86584 46536162966133894149563167533 11102
64673131644 75676114307 38239 84830 81838162699 67720 70353 90826 76234 94599
65979110134 94483 78831 88538 95598111075106412 84721 87587 98079108089153000
108917 55041 27842128032133874166670 58862 32530145990 88548105857116668 82721
79852 25128102998104682 94212127992141074 41245117148123332155141 42798111250
106286 61643 59735 92041 45575 69623125023 86649 61123132911129152 94816102769
124105164930 99430110752109553113546 49438107801 56916110191 88427 81715 88932
80741 71670 93759 96009 69229 85451129855197144116217 39766 66600129824 79282
118634111936 82761 92292 72375 79019 92594132141 81913100846 96593103310 87563
93240125052162426 57008 88469137615 99184104757116389147180106499 74470 71100
175143108002 78152 62511 51784130657 79399 69836 98308119773 84898 82567 85575
74675 48925 92929 89434 96267101576 82829 84374 57863129033 68534 99869 74419
78972 96979103220 87019103643132213118808131138 99265121532 56047147024 84926
94209 68573 99696105157100162102216115082 85338109475 77931 98877 82738 70135
119642 50208135333101196114493113225 98386101370 79141129636 91477101168 79816
105835 77314114066 87095 88655 78114 62670 60266113624120244107080137935 89015
118199 50377124784117591182931097651365 05 72164 97937104035103365 71525113497
83566143258139308 37488146183128683 68996123756127221 83584117096 71388 49540
86024 74466 71491102384 49189101848 85305100330138297 62560109283 96207 95733
107706 97841 78947113752118229 80334 88896123773 37637122394 70429 94122 94863
107364 99038110740 57103101380104522111573 78283 47617101062106355 90805119917
79037 75523131919118186112976128047 94069 76532101345111647104336129356132920
77198 86055 78921 95968127687115300 66592109681100713116944 90694127957100100
80361 92022 92414110078128769111516 91764135633 96848 89648111809 91242 79688
82045 93365 73003 68159113962 98686 32005124273112408122474103682 97265 88013
81889 97343105808 64172 79555113894101011121793 95051117788 98395101084106902
84316106569 95607 73854 93589114085 89140104453103912 81303 94713123099 89473
94693 95729 67495119434111312 67555 98959112286 89323 78659 70215105057104184
82896127406 85560101986105552 71028 79334108356122733101625 93403113298 95487
93948102503 91385 98640113937123002 90042 93353107149 94794111744 93770104609
118305 79394100141 85660113321105534 99297 81336 95540 91278 99412110463115567
63701 87398 93375 60445115308102375 89440 78411105663110570145305 95887132818
89095 95891 90314 83120104686 96805 92678 92306 96804116894 96698 93776 85408
89522 96441106705103563 98922 90129 83948 86205143247 77385108944 90516122893
75077102391 66346101531 96089 97429 72497103832 83448 61219 74955 98370115747
83757 52994 85106106293 86493 96187 78729 94458115630103566109501 88023 99392
105546115523 77532126926130898129430126813110071 92219 69942105930 98870117821
108170 87117102749104477 68991121990 95621128939 92905 88365103739 70847107198
82067 89430 76748 78912 93509 90772118207 85674 64320 93221 94839 97477109223
122561109929 97648100272 72746117746114048 90249115126 99455 77840 67896 77112
95808 97736 79049 93275 96159107613108818 90483 87707126402102030109398 82133
113417 96708 97935 68901130320 86608108290 83318 93060 76037 98805 82781 75420
113022 71929112682 86465105253 96228 94565 81610 73979 90724110701 88912 98429
104368 87003113755107619 79420104795 82899100767104244111599121173 78994 68739
123477113129 71326 82405 79934 74769109034 42634 88739123876 83556122393122751
76797115251 74354111235102226 84723116296 58238104662 84457117348115907 96561
84165 84053161123 78421113997126395101894123864 80009104463 87206115173108214
88445103014 99382 96615101480 95902102140 88919 67125 99618 86945 75024109261
123909 96940113336117750 89509 89338106973 96466124135125872132165 53318 96351
128221 87289 59771 60462 96490 83106110814101640 87446 71401101109 58147 58845
72493122459 97251 72855 91506 97483102637109561 87113110455 91172 76824101435
136244125076 94624 94943130576 99045 90895 88285104883 96529 88349104196160286
107698132576 57145 94098 85554 95500100225107251 72400141443 96826 86943 82274
106763 74643 78011107352113840 85242 69336117776101551 83060 76656 92902 93805
85003116710 98437 94159 96418 94794112400112194116593 81969 94110 60057 86432
75176115669115523 85834 81670132652 88038 39455107745134089 86203107309 87824
124545 99044 97981 74098108714139595106257 75835 78499 83063 70813 90432 98061
118415100653104618 90644 98418 72557 96698123151110522139321 73574 82704 95741
111467118969 94338 84448 71724123938102599 95285113426 92814 83618 86329 93863
75451 79454 97014 78522 89230101858 89005 90550103047 88364 96420122778 79575
107595 60505115655138074104489101321106844 79765 61750 80784141909104348 80612
117047 91187 59122 88943 83880119641 89493 83627100601 96117117606 85259 87947
71953 97241 80516 81202 87410102385 91157110869123385 86986112719 98505 65837
109443 69498 95762 83019111609 71285 93014104857 91806103518 82548105685 69977
90136 65668153365 95513 54047 94048145607 63317 64893137093126459115945 93289

114557 99812 54474108190 85252108087 82755 92967103410107504102310134973 89743
75354 74991109146 99432129318 69254 63817133682 71434105912 75586108910 70314
121582 94339100512 89512100983 84998121152 87660100340 87971 92308 97461 85818
107183106655111606107456119502 86761 94159 70185106369 81971114059126237 97436
70790 95186102950 92393108024 90832 86320117721101903 91858 99642138445 80811
95070 97032104851 82552118316 88269 45631126263 80352139945116329118231 76159
69383 80774129922 91437126538 99130 70445 78625 92245 89560 90524 75688 86672
71563 90542 84138 94978120554132857134682 94899 82264 83473114144 67732132587
43263124217138922145490 67835120307 48800 80872111749 98778 81017132841105103
124129 66544123500 90428 91082139695 74683104607 76480146318 87775 82495 86263
109399114836110221 76256 87103 87610 96053107699 58783108701 83957126623 89397
84617114843 60470 69598 89797104561 86807 88524 91234 93701106579 57371127261
112059 89755107661124393 93370 93980101183107561122804 89156 36886 80300105766
75587 59801120931 67469103385 70662122286106702120676 59723 74726 94207 83118
93291134276 57737109837143432167896137321105419 93145 60253150415 90167 58967
64437 81764 95223110706109935 62360112069108699 91492140903 67483104264 82958
80152 23826105795105926 61884125396107806 91963119775 63877114635107893102558
77253 91195101440 46927116484 89648 64254 80565 54128130676 73732105072 97320
82569112361103257109401 97450125767131616 73276 97676 65756162652115279 76812
102837132861 32151137356 99998101524 74234205811116268 90581 89091122015137928
75814134441 83396128134 97150 59571108587123536 66141100475 84710 94794 85495
108556 94445 87016 20747106128 45982103199131592111889 82109153675110877 79861
61509 95534103398109007 85562 51071125164 81914130772102447 91345103389 83131
82429102836 96894 97157100507 75967123455136027 76563 80102 58258127544129493
80794100979 93921105792 69293131816 67094 95830118352101016113815 94531127781
95628136356113595 86237130866 66938 52658111445 98660151043 89963137385 89449
58559 47188 95175 87738 77299 87554 96438 92201 95030 54348103392109435 70904
157651117164 83626101799113972 94786117950 81765 95708104867 88736 86823100707
103467106176100161 91244106926 72753 68856 81258110305 94797 87102 94909 93447
65952110476111750 85214105605 99265 98783139008 66130109276111862108162 81874
75191130868112702111428137646120628109157101254116956103478 83199 65512 78436
110115108077113958 71304103457117729 97874 87296114776 83959 93499 76924 82349
112272 74585125157 97420 79119 63797111907 68862 92168115227 95592106280118782
103861 54366150068149387 66625 70418128169122742 79859101066 98381 54868100835
72243107302 67653 56681 70400 83240120265 76952135925140024 99371 65062 88543
101414149381 86351 74641 81470127586117550126306 77592111368 78167 86345106083
85617138951120970121479 64038 62862123551138794 83393 60608137292122035111084
79000139055141609 76332 66248111337 41543 79228 91963 90699117689 94479 93326
115596137579 80432103096 66084 86879 56928105749136024 43770 81798 90519 72598
71172 91222117954 65927 85245110270105168108961 93625105237156060 79649 86797
120936 88753108400 85695115627 89647 87534 50915 86761 92663126648 97122 63878
134846117641103740113544 57890 86283 68815 85652 81763128415 82405 87657106770
97603101094112107 53094110455100480 87730 98702 71951126000 95415 76335126590
65965 80472125554193344165845114650 68562112349 62585 93048 97000 99170109229
93574 72006 97259 93035 70188120070 85952141766 79519117496 70976 73021161136
107373 85310 95520 97896108895 92902 78514 86255 88875 69159 37946117735 76681
101172 86871144672 93795 78118113071127492 97388123520 98177 88234104136 87200
82279122139117802113753 94044111384103621107897103560 98145 83986118241115701
87564 80637107922109680106942 86333 76478115461 95899 80089 88640 74422 60353
92919 75721 96598 84822 75318118306 76231130622 77813 96803 91649 85936111682
115736116593 96333104940 96397 74705 93455 95156 64813126998 65824 91504104334
89509 97081 89674109389104555 84465112382 94881106059 67210 92323 77378 97778
105661106022 87281102878110435 95461 72211 99464 81540 81630119718109645105190
80218 97537 82252108897105872160271 83128 31416146731119134100749108282 89480
109329100883 93038 99150 79378 92329113863 79645 91342 88222 90362106918 96286
112906 96755 93868133464108003115736146095 82877 92375 84570 83416 98922124379
78753 94671104522 64473 94311104760100689 76312 71403101201109887 63847 95495
72765111466 88811 95948 76714 89084111170104688102986100858145887123039175921
83291 96624 76732 73051101006 62883101118 90708117639 79083 90365115344111852
72119 96908 79441122777119253112108111199106599 95669 67103111501 99063 65816
67361123066 95125 83036 93374118033101705 97191109827 93686 92833 89865 85115
105896 92441103200 95555 99788 98199109491 99414101009109453106796 93959 89520
88891 67872 92222 72950 96627 78530108372125627 87535124947104742 70631108292
108664 63957102465107082113320 92129144399112935 93343 97944 96782 80945 84424
115163 93616 77191 94228103454 98783 93521 85630105457108504 97154 77930 99744
96642100015 79592 96396 85807 81572 96767 89369 95878116245 95977102593 75886
116634111686 82256 88297 90262118693 83631109642 89589116620 67396 97256143041
91054 84740 87906 98079 80584 98205 70828 98606 89501108787 74120107906110582
96210 85659 78283127032 94808 67770110730 64820 97745 97090116159 94500131486
102322 98067102659 74432114682 94579106029 65300111444 94316 87436 98252 96104
79666100279 93994 97508 91755 83168133601 85810 79293 95097 93927106742 66786
105669100672 71847114666 97243105445 84514 74091 90597 99141125858 77900 92167
77040 77494105350 81312105744 89536 79164 70209102793 88780124680115807 51336
94063121106 99826116433 70247133242136047149509 92866 82657 87488 90514105421
95991114702 95802 85057 66324101648 74028106574114586 64278 93533106710130583
125313 68955103826 85864 89430103817104617 90833 83708 97027 73651107970123661
80034 68810 78684 69553 87389 58728 85007 99290102226 78177 95413 92920160673
92650 94397 68784134997121427150331 60768104958 99650 98233 78211103241 91702
84492 82964 70692106078100588 66690111595108581 82445106788 84370 89288 99332
87808 89826109324 82487 87643 94909 82056 93390 78243 92158 97912 72676103725
104989 96934 98126 98576 78119127174 87628 73881103846 96783111673108579 83275

```
153208 98373 70985103877 96107111498 86987 88832 96538 93070 90788 68262 87919
 84771100172 88920 93748 87937122307105738 90656 75838 99931120270 90248 85533
109685114717 92925 79864117210110014 85486 81961 89840 93740 55060102523110242
 95126112864 80761111230107645 91484 77120 86842 64974 92952 85839117026113509
 65609 64750 93712104099 93472116305 93017134418120356 90288100314104260 94303
107126151013 79658 54545102703 94188122055 76561 62661110595113665121113109399
 92289127302119641 77796128828 76273 97164106313105736 96121109434 64735 90747
 78415 86886110992119762108637 85427100056 63762107412100847118959 92957 91958
 80337 88323 76511102211103398119769120494121729 49191 79148 96455 91013 97108
 57978 88317 91306 97698103459124622 79358110792 98211 84860 99439103201107423
113818105102 89134117796134760103284111378104517 97856 80751102716 97837 85817
114209136711 85935 86811 82464100768 90893119098 81990 88192 69652 87544113214
 99892 72911 91519122701100849 91425112222 86397 92794 76045119453 87524 76182
105402107911 90666104847159699 95727130948 82654 94275 80208 89951 77917101120
108104 96085 98671109483103478115621109367106924121982152009 73461142129102590
 97558 88806 37643109481 98659105494 96947103596 73026113153 86797 86518 82021
 87039 82229 72511 61421 90674 89752106441111808120864 67814106946 90574113560
101332 91306108831 99657120200125485 66801 89245 48389 95287 86758 86496133145
103214106824107228123374 75562 90290138150156858107386 81936 92342 92308101827
 77655106853110697 97641 93166 85552 99504124564 87415 83384 73691 96290 81536
 76377101428 92637 72155 80927 92574 80458 92381 99123114703115451108178125235
 79117 67282 78074 67300103648131151136767100112 71865103284107648 94425 85143
 90577108631 91321 86532129686 91457 71653107684126993 80018116480102930 89718
102694113632101836100468 86688101999 81792 76472 89022101422104816 99208107509
 98936 86723 82834103963113015103159100686 76716 97542140304132198112602105302
101228 78560 99810103039 87080 93200 97703 85249102998 65903 83486 68272110811
102166 94741 92877 93602 90841113191 90803105537112868 99808 84680 94775106268
 73557110352109598 88944113032 98299107952 88387 96125 70219 97775101168116236
 86462123428 89220102601100478112277 92824 98222 99334 88831 74986106104104196
 98035 97158112071 97987 81494 89182108502125053 88783 64733124747 99144 94112
 95429103498 89402 56016122854102890 94176 96651 81757100905 88318 91949107834
101964110634 79524110342 98425 99829 87534 98273102157 79293 92299 96718 85444
104516101612109968111637 80580133323101447 75533105758101116102915 65340 99769
 75416 97051 71603 91455 89864 86860109626112489116786111297 94314100602100155
 97823117392101608129969103997106724 91951113635100605105551107627 99404 85459
 68789105917 92123107383108123 92482 90393114667 85678 79481110794114033 88668
114252 99431 85476 92493 89350 99092105416 65418 97755 92969 82131 71690104559
103869121507 72697104065 87391 79795103755 94858 68864115416101677 88836 78926
102052 80440113008 95447129579102207101697117161110466123704 86194 93161122770
112268 90842 99882118092 94908 96890 55543 90670101591 92500 90050111065 82247
109614 89618 68547105333109650 92067 86777101662100863101335 89128121348113628
 96666102576123209 61401118482112451 88774 94410 84940108308126601122142104378
 73240 75097 74350 95573108419132407108741 96656 79851110069 87044 63439114811
 97000104610112988 92636 83475 79867110896104519 91768 74336112297 83346 88616
111340107446116834 87115 95386 86507 92410 89104101861117770112245130267 83185
104766101329 99166 84559109682 84985 77735105294 92909 98694100713 80673102149
 85687 96140102609 73032110503133959141566118228 58095109132103347 87413119880
115697 98105 87099 74261126127 88301102544 77665 91538 67107 99057 93559 65561
102224 85708 96593114289 91845 95319 80411118976 76387101468109736137302 86900
 93663 88754 60917101988 83016 89925 74400 97265101973109660 89624123172 83890
105102 95992 89536134331 92987129205105760109467 88178116446 78588 86147103444
 93069 88289107179 81723100322 91335 83810109861 85849 95321 83007115993102349
148539103410 55133114493 97603 87021 62900 97234108342 96167 86970101585 84450
115008 99085125487117126 82183 97057108281 73832 87327 85924115063 81443101307
 92139 89628106090 84950 94267 80728106740 87941 96549114781100121109304108926
 97023124264 92525 97284118118137349101402 90377 74261106030 85052103545 97503
 79634 94153104085 99897131100 81279110452 86208122395 94531111550109926 88651
 84053 80018105415 94055110563 85085 87285 81288 89089 93027107885 90321 86222
 95112101027 90473 99805124409 96252 64179107303152647 85952103250 75976 97135
105733 88399 96872 79219101585104471 99376 86122 83300 81925100688110612 85008
108205 87034108805 77101126350 93919109902 84523110431 90986113581 74196 98368
108181 84069 90801106744121500 85930122849124862 68080105064102499 93823117441
 98319 88017101508104283 95506 92849102357 77692 90243 91469 95595107836 96562
 79157 97669102967101285 89521 84410116285 95524 94722 89549102015103361 90755
 92832 84207 83035104183 89739 94327 90284 99558103887 75436103766110292 96616
125031118909131144100573 90020 92924 75182 95604102468 76123104946108867 97630
112878 97056 82309 96212112961100744 85351 83675123776 91963 71790117176 99702
 82406 84349121328112605 83597107017105673 94936 77384 99277 94653 77059 83424
 97361 98526 97577 97140104102 91438104869105625 91019 86430125275 74219 95573
101831 98216102745108745101336 91935 78786 77769 94692113763120667111916100440
103257102790 72327105140106783114809 90038108945115508108358 79434102288 87868
 61489 96162 91811 80865103015115738 94124 94884 86160 91163 83437105740105759
 82591 92581102660 93303105231126987 81080107907 90561 62204104242 93872103850
 65286 93428 84582 98640122635 69042 89581 85260 98676 76384126340 98379 80906
106848116005110516107816102899103747113791 96683103766 72793 62210123858 80488
 85881108456 70566106411 89810153255 96776100595 90686 81174112179 79223105645
108752100535 71137123391112869 92048 75008 98853101409105016116729 94114 94506
100792116674 98504105829157314 85509110709 78379 98927 81827100834 97498 78235
 97544 70482 94313 97576102844 83158122255 88814 83195105821 98216 92791 95418
 79983110602117699110854132802 97199 87473128397 97892 91682 72697 88884129411
 92368 84734 91966 91077 92136 82064 61110 90036124653 92624 75921 91117 91521
```

127346 72822 84746 58968100939128500 80582115570139264 95163 77270100134 97471
51687 81104140013111659123262 97525 87998 89452155066 69769121222 68769 88928
55192122048115002111738137406 82619152705 92706 81009 69646114675 97260129204
88163115830 84848 75729103203105498 83710 62715106484 93293 83837 69145127244
92019130461113318 98129 91121 89629 89743 74114 99155104606 73107119895 93993
112022105093 72464 63746 88895109381 86368 89626 90432121866 47048127206 81198
127493 83728152530 67455104580 88279 95163106362 71370 80093 77129110965 79436
95961107944102885 57063 88319 91611112174109195 87745100961 81232111788100415
100151 71082129699 83761111934133321 75387 95568121759112370 74842106441107668
120787 83669154294 93739 52807103623 68187121812118822106859 51115 86536170314
104773 62622 89375124586132357103684 75999105006 88667 82433100062 61958109066
90918 78662 86802117585 77054 88917 64166 84119103454 99185152851138159 60909
136510 99855 94114 72490104432117348 97555 99863 89195 96994134825119802 56711
68504 85434 92418132773 85588 85770104026 73175115350 72597 78977114257 92063
80884113986100540164798123612 80201 48448100266 78157 77664 93603112231 64789
99387103154 86106111479 62748 96685105843112768115424 77996136737134299 71852
64414 96586 92114 97959 91840100091107824 68890 96456 92128106485107287 85472
81409105084 72973113954 72350102896 92931129466 95312115807 92983113587 37402
106837 84666117698 76433 95258 92815100205116854135650 50022102624101450112151
108063 51669134110117654 91366106795 96904 86319 98819 74493124899128417 73401
191215124325 92824 86396 91056 92215 87642 70936 96395100401120146 91757 81360
102566 60487101498 85730112968 77370 77385133157 89121148258 75812 46320161040
107561 89903108422 66737100900107320119770 80297 60789105895 79753101909 98719
85815 82888103810112046 92353 93254 98303 86766 98848106255 89776 93528102382
72003 94760 93735132206 97587 86598117300130147 88936136156 96573 38916114572
107646 91028102974 91170 81378118314120127 81934 95909 67585 66193114444101575
105049129252 75251 88351107020 83603100602 96931114762111688 51064110133 83599
88196 82015 96491128234 80210103212117279131474111367 63872 41224122691102907
89325 79110 86096 90193 81686 90471 85938114911 74919135585 89937117432 99066
112684105666 97619119891 80242121905111487 85088 81714 87953100762 85483110837
96465 73538 86597126049 90805127266 91555101695 94337 75457102225103383 73564
105083104094114879112356128198 62178 80068122301120338115451 87202 94707128403
84565 79727 89475 91137103461101206 66063109248105297116851 82998 97006 88060
107557127313 97120 87560 54640104698101982 52491 85133114069 94685 83642 96677
73764 96828 77918 87395100575 68649 98141 94621142106130325 84366 96660 71036
125653 84546106190 76445105807108476 98270 90345 76722 92559 99432 83059 83378
66626 98492 99376122699 88426 85116128778109013 93281 54038111220111491 91132
111907122084 86387102054114628115134110823128319 90813 91060104078 78541104888
107633104895 94287138537 67306118467 66321 39752104688 96957 83260119881 77703
106472119300 84616 68522 90676 48009 96008110306 95658134013 55842 81879139048
74508112546 80345151955 77949124833115535 76133101570 90537125706107428 70782
130442 81779113563108883 78397 72682107488 91056127932101950113525 93080 63518
121620 92465 96739125129 89601 95797126865107398 74329101211 85363101879108021
68576 87784 93516 89061 65241115874 73605 89260102455 68021111089 79419125137
89968 73884110518 78131 89580 51275111759 66166137794164174 81929 49017113637
73061 95326 56470130779 78546146888 66758 96317107003 88273 81525120922167366
125048 55669 90756 89595126743 93575152825169930140549 37293 95723 75164115481
162478103113150860 88444 58448 56992 47174 85813110947 64429169166150877101401
107092108862 32307150843 23711122677 61956114605 72227 87522 82102 62773 70033
58127 80076 60999 97130126495141948 39715 54512 66459 69806112942 98065173071
79575 22142 65103 68242 63474 79626 62033105022196044 73121105781104835 78130
187199115428 72218 96782 68166107678112092108895 55186159592142189132913 59357
77937 65655113424 67904 92110 89253 85119 58350158209188642 71971171034160847
168117132113 76394 71576129884104637 66200 93757 84827 94240 93016 79964101412
119847 71860 74657 91677 97459 74716 82052 95747117401107639 44859 60410105810
89869 81306 97880 95062 88163133753168334147712110095 81409156411121193120294
125643 32165125475 70833 51069 65815 67356243013140287100735 46104 92088146924
149271 70561 98872 64999110128131657123587 60658 97483 46146108243 94359 81161
106518 79400 89591115610 95066100876 75756107563 53259 47447102145101376 96465
117558 80518 85985 59621132412140831133257 54903 91853 88932 92603 96380 95144
113622 30309106906114556209862116961124171 96321135863113828119162108854 51876
122069135762 80447 75513129532206701 96729103240129601144967 54826158041 62401
114507 70140 73900 24775 34690 81078 33891128198131275271357 31088150187 25766
256096157657 10998110953 90560 37644 85015 50865 32438 70512 25475 75982 38589
31710 58072 28123 76841104866 43857150032114303252897254719110401112704118684
34963 24384112236 51272125369138075282070 73034106689 78083151937 99573 91765
35491 88159 76041 89311 95184120056167344 99040 93569 72357101664 68874 64698
96512 59064 83689128631 76185 90011 35997 72554161017132935171958 96257 92250
141688170016 84904 48796 95677 63756 77465 87688 86023101625100787 65083151368
49971 69657 90521101790103287 88599107106 68407 91129 47725 64873 90261112893
57502 22499 95477 65264107415 53252104536 92757 73683105440131722 50500 89925
59430108534116002 69792 81104 62188112147149986155171122861 78288187081135884
137107 52687 84089 83821 86819120531108139 83336 57522 77835111428129590 45923
31075 80606 46774 35795 86309 95385118030 37157164159143966 88731108084123909
40640 42566229527210414 94525 62420 92320105908 35326141569 78413122597164536
189151160366137283 97010 63563 94554133462184703 91501109590 55825 28957 58786
77586 55189 66278106641 96461 78384 62453 39402 38784 63988 45803 96774109365
109597135399 94757 81291 85223 89980142596135657103476 79337164792164306 71209
161579111618 81542 73778157922134277 77802113702131366 98119 84144 33539 64997
65049240271 28568 82023 47928 73919132802 43042 66916 56502 58265 89351 93826
105130 53923 49861 76609 48321123379111109 34979 67338 90574105578210164 59242

```
143761 84720110642200576103687142987193364 70162 91306 61217 58554 58881144098
 52073 69235 63781 33342110530 83057 58389 71283 88169107413 35795124137 56107
 45576117722 92682 84638 70865297528145436 29995132722 84483125222 74843 84199
 70587112895153751 62950108944 34280105410 94485109404 76140 89905118129 97067
 83765 85538 93631107623 79240 62761 84307121761 91678 97518 91901110625107167
109985 69352 93190116996 68276 84351253507 39268109641 88205 79054 90175 74738
 92385 47274 42877123278129341 81300 69925 88705 70173 89032 93086102875 94544
 67815113695 42909180858 98037180409 88823 55611 97075 95993 59427 86474216637
141820 73401109269 87773 54013 72424 99572 47035108830103505 95725122429110808
 73861 56558106202 91275 46472 68344111555118285109868129929 65877 75557
    5175=N   -3158=I ALT1Ars                                        -5(13F6.0)~
119418108542 82006 58553 72221 93299 81929 98649100584130183106762122621100545
130757179531114762135307118465121222 98956109993 72215 81047100483 99657124416
 79828 81695 94279 95212104561 97815 71644 70911157219130585 93716 69963 64814
110250 67315 65886 79993109742 89467 99470102147 93031141857124776 97330 88498
103281 88686 92442 84546129542 91436 77758119566110781117466 79442107581 78228
 87870 73789 75391 84377 96804107490110852123050 57131 97964 89616 75016124504
 84602 99174107847131107103680132201121456 89686104888 79354 94233111600115215
128566136156156182 85565 76092101936114536 94604 77478 48259105988 87431 89290
 96449 75535 81616 95098141801105966100476150295 94164 84113 70494 90584103402
118463 98919 84711 83597 96849 97660 96563 96431113380111220104838 95077103066
 91466126864 91586 72982 68718 97173104515 88689107438104566133278 70263106144
113243 94565 83729 96368 84597 71902 73351 73115 41988 73742105063129523121901
 90890 92556122448 75517110719116883 98754109714111015 85620131220123135120910
 99903 97206 83155111508 94661 97086106976 59516 94737 98054102069139204141730
101575123751 96770 56597 90253 82776 95577 84866 78786 78618100307 69999 95776
 98461141207120724 88945 93126 73544 94002 95756120533 42374149292125482 76037
 92900 48105 83710 68043 94959126467 95330 86686116596 91147 93583 83826117340
117121 63348 79075 59437 91302 83756103135106459104173 86429 92515102398124792
122134 99599 81169 62989 78172 86624 93998117346 92254 99479 98691 92981 61892
 85566100235 96991100872100297 78543 73311 59183 83367 75499111977152112 96286
126021 90328 70433 92334 73033103886 81529108831127851122433 76039 71986 92257
105009131270153132136084110133100874 76158 78224 86473 94508 93661 84960 82332
104500 83749121696117113 96982 65433 82806103954 81890 90009121795 97615 80787
124422105279 83908122779 90587131607101394 89326 90506 66069 60547 80226 95817
108224109545 81430 96360 95071 98297114610 84252 92244 83376148472 97940107188
133683113269108338 82220 48461 82143107908 90492 74291 98157101113105950 99712
109751108946 86920 81336114750119876115868112341 94765129779 85308 80372 97104
 72075 88776 96882 99305 69695104928 81889 73685 88976 95240 78552116199 72645
 88379 85460 80635102800 88019118860 92210129692 81546 83861 90885114195122116
 94307 96451 95077 95195104049 91897121200106110113453145602109161 64248104327
114766109618 83941 96005102842 89884 65705 91904 99986 95103 92105 75117 92652
120644111231 82133116704115299114967 86986112503 90986 98690 88721 95184102654
102197 76669 86995 93215108743 89218 88221 79312102626 99018 86999 85573 71315
 69348 71152 79420 71921 75632 89617 86749 72385114875101807120742 84758 91062
109970 90226102824 90965101687 89706128160105483103617108449127819101976124234
 94085 85853 81100 79079 98045 99436 81250100989102616 97917 98682109082121779
115586108595120196111859119640116607 86667 90854112444107758 94461 86949117646
 91815 93387 86378 74193 66633 91627 67230 89576 62961106294 82921110483101904
 92368 80372 74183109716108910 94125 85963116295 94952 79756 98864 97990 85585
 89167 92206 89992105667108406100120106998118030 98941136578 96109 95848 71774
 71675125479102126 98649 95779 87839 85006100489 94818 83307 80540 94857101535
 83832100383101094 86986119572107028123590101737 90486104948140686100817 97868
116531 68162118121102397101541 84136 91287 94269 89356112410118798101337 90251
104309 98927123363106598 96823100933 73123 92326 92604116594106836 93754104015
 77419 85188 72992111629 77965 92931 89714105930 94000 93289 70639 88292 74624
 89576 91138 73013 70002 99946 78194 97820102382 76500 91964 88332108055 91695
119555116413105474 95425 61835134561110581119183 74712119743108645 99924100161
109065105086112280112672140553106815135947145729 89208102284122837 74345103598
 68914108542 84224 83419101709 90990 56402 97169 89089103413 63676 77400102243
 85052 63537 62947 64793 70745 97128 86165108761110756 78245 80677 95338125502
120835102313 94880 70472100114113230 81131 91812 95086 90321146063113939 61798
 93782 96764 78410 86927 82264 45694 78794 61436 94019124412 77106 73600105643
 87008117538 91886118521122257 94499126638 94693105435 90603 92089110598120936
111945101086 82252 77203 91505 93028 85639105002150740 91604123435110922 92197
112216130868107506111835 94274 98886109057 70963100144 78824 95879 90090 97120
100026 79572 98736 83206 88523 79686 80495 77658 84800 98513 86034 80602 93755
 69085102035 93141 92146 91778 89403107734117459125585 81863101139122724109476
 99775 70986102304 99617104511 80252106619 97261110807 98002114360104307116507
124917 97452 92873131482105686113548101217117928 90785 66903 75567 90146 84608
110596100666111314 82587 87322 66332 88501109741116303 97947106949 88405 52114
 90904 83997 91759 70144 76991 81937 88864 72507 60153 79888 85353 74897 81329
102416 82612134215 98365 73858128384103421 99083 68094 63406106664142773141510
 67774110141163106 78891 89252 63909 72894 90831 64042 86824 71743 91190 83977
 93606 91958101466 75911 92149 74427105336104149 94228106589106711104611134033
 77745112603131523128044101203123529117499 98347133607 91635 75503106773109331
101064 86237 92376 82057 64087 71104 71899 60760 72301102827 92901 35847106348
223475 91781 46121 95211 90351 74539 72295 31454 92374 47032110776124319136027
 69645 53312 85489 82561 61784 77076 70698 85408132973139164 87976 61609118492
 60570 91619 82259 81737 80539 60319 67756 58356 86947 84992 76913 70261 99725
112068107552146403154460115416 73508 16219164592 88753113780151764 74929 91892
```

69851 74869113408 66148 83466 75497 89412 77090 96820 57510 71335104292 66591
87779 52360139306151580109495106742 37467 69977 99397117115107508106602 46305
119492 94697 61497130454100468 62679 93132 53620100517 71693142646100103110676
57224104270163051 81386122966 51148116400109390173241113178122654 31247106880
63632 44112 65960 65133 83400118459 49137 80533 75521107327 98662165874122264
159807214682 81573214043 94171142246 43388 72243 94071 51781 49734 59731 97627
152884 89430136096145529176820141745109255 60011 58825 77961 35636108813 85697
118878108086123179100001 98867 93502122116141234 58754139067121721151022101166
159408123843139863116517105174 70714110055 58707 58865 56785 84757 87172 66983
73199188122 36396171954 89342149346 89378 72178123550 70989 62850 91017 94273
78155 78707123565 50940 75072 75332 65820 86305 78960 39777145937137150164274
187583 40165 61599114862 74315110086 37364 71199 66985151160 75692 71092 80839
67981 84528 58208 98205 88722 75916 81363 88086105859106287 86966 85285 92910
104523153172122158 67104 228341054551253251733398 79576 37033128386 87274106448
116580 87493 78989 18527 80911 89738 89332124142145462 55154112268120531161596
60089109605103481 63697 51532 75865 33641 50738104821 81511 57334120389128564
104221107420126411172167119989124723117992120986 56732100174 51436 98646 81907
77233 81200 73357 62925 81528 86878 63746 75141119307198570142158 62386 63022
116217 78425115565112890 87817 91036 68685 70416 81551123972 85268100396 94807
102124 87406 90511121185166261 75494 91088132365105755110258119567153149121655
86410 70627166413120071 91408 63026 41881112096 74863 65392 86857112226 86133
80824 79238 67283 38483 74102 75415 87107 95367 80080 79038 50328114527 65655
93543 68498 70645 85967 96132 84307 99412130070125895141144112370129729 64707
142412 90524 97365 66736 91437 98873 98800101786115354 89223108868 78668 94928
78808 64441108468 47687123954100226117603117446104788104737 80881125687 95155
103292 79982101488 75114108328 85903 86360 73066 54514 45995 94957112151109330
141708100140123555 56005117311110267122948116541143373 84606 99806102024103822
72694107481 81863139893146495 53653141078132552 81991123621130549 93875119535
75259 46141 70039 60457 58249 87393 40858 86153 74459 92480133246 69518106266
93810 95058105739 98577 79340108650117653 85642 87729119018 40601110673 65390
87241 87408102736 98083110633 59391 93065 97688110137 80403 44243 85281 95734
87910116493 81422 73203123166120284120763135581105193 82310 97794108864106166
131956141318 91117 89213 75218 88689121830119056 73916105901 98790117409 94686
128913106308 85553 89386 88042105876128642119088 99966138061105909 95912111590
93481 79614 76358 85133 66445 58270 99741 93299 30376106835105151124573110192
102828 89987 79865 91269101159 63334 70970102301 97855121576 99916120521103272
104482108387 86886104515 95009 73241 86579107473 89207102836103210 82429 90938
118698 92770 95357 93700 65402110390109372 71113 93274106998 90132 77202 63526
93460 97972 81578122759 88630102182104621 72407 73352 98487118972105951 97241
113400 98327 95259101161 91056 96658112000125434 97631 96034105903 95694111472
95952105109119006 84573 98892 83427109233105618101813 82484 91600 87042 95254
107678116790 68680 82081 85110 54611102597 97201 89104 75459 98427107064146787
107932140678 99796101033 90534 80997 98952 94130 91147 89448 93160113918 99141
95347 84190 85163 90889102641103030 99981 90511 81685 80632136296 83558109660
90719121915 79112100213 63731 92920 89775 94090 69784 95881 78611 55599 61650
83570106940 83313 49906 71045 93004 81132 90800 74130 87122109262104129111666
91329 98816104158116363 81960124717134483140798140931125027103404 73946100159
95583116790111605 92024102330104014 70245115415 95495129834 99436 92038101771
70252100339 78351 84317 70250 69824 82526 82759111870 86301 62572 82558 85908
91895105494122835116069104389103368 74108112009113604 95022115676102553 80449
63565 65939 83046 89351 74349 85806 89505103302108265 92873 87064122411105717
113620 86107111846 97756 98912 68355122644 87963108313 83761 90253 71643 90807
76972 68763102643 68572105533 83773102095 94656 93560 79394 68249 80532102012
86907 95567101641 86828110827108517 82830101792 81135 96502101003111392124014
86167 68509114212112496 76116 78311 71720 65265 97152 37523 73495109590 82458
119439125143 85266114951 76035107435100938 85895113057 59548 96693 78507111807
115976101873 86650 81113154921 89092118408129387111242130292 88658105627 87099
112819109621 92373102425 98986 96683100561 95613101166 88637 64567 89729 79976
68944 99309119781101563116233121816 96777 91355104503 96435123861131100142618
67438 94034122645 91921 60737 50080 79589 71874101510 98410 87260 68164 91900
52155 46415 53624104575 92423 71634 83783 90000 98186107852 88752108778 91827
75997 94675131913131997106318100532131509106617 96492 88294101647 95428 87470
100628158837121791145275 70710 92900 80125 89860 95273104831 72948135616101857
91931 80589101110 72430 71586 97066109515 87133 67486108390 99400 83988 72766
84372 86607 79819110194 98290 95052 95021 92977110092113702121145 88754 94130
57224 75494 63880103938111852 89159 80601126648 91910 40929 92643124798 91171
108371 88691122920103060101634 74878102939137089115466 84252 76722 75509 62009
78258 88034112790102172106768 92533 97503 71010 89474116945113215144630 85890
85039 90377107266119472 99903 86910 68594114787102113 97675113142 95647 84259
82024 87573 70197 70770 86248 71516 80691 93624 85023 86169 97841 86085 92830
119295 83255106069 59814106858134579113600108973110717 83462 59178 68950129304
107365 86106114677 92910 59307 78346 73529110573 88633 82269 94927 92646115207
87942 87016 67322 87801 73441 73319 77666 93661 86797106916123347 93429114133
101033 67887101927 65859 87876 75775104292 69216 86230 97649 89489100714 81376
101340 67920 82667 57445141017 99852 59247 84322136672 70051 62440124325127459
125590102888118510104590 57929 98755 79586103066 80880 88804 98304105671103445
136517 98880 79747 70025 99422 95469128165 75384 61549121382 71620101881 72412
102579 67408114149 93550100781 88875 98433 83205116952 89554100016 86642 89128
93167 82803102215104988113077111207123840 93869 95741 68388 98296 77530108490
125392104567 75119 89843 97355 90467105416 90905 84845112950103053 94238 98659
137390 89546 97351 95067103338 82717114626 89547 45008111831 76152135775121806

127990 85609 69527 71679119288 92417127194104640 75020 73267 82690 82025 84034
69591 77391 62298 78677 74247 86123113962134412144660109927 90328 82436108726
67569125976 45311114506135398155772 85636124003 52683 72665 99200 95099 79747
127392109043129779 74790121296 92283 91962136796 82421105116 75455141124 94438
86418 82318103454113402113854 81266 84409 81506 89658102876 58148 99100 78402
121364 91730 85374110304 61058 61638 75690 93876 82246 83514 85042 88035101820
56277117080110547 94447107685125514100428 97338100604107365124636 95964 39069
65272 89719 68706 51036105276 62477 95121 64712113259105357123644 66038 69654
82645 75111 85148127562 62406104400139682177909160941129877108039 65980143339
96148 63581 55271 66463 81527102026108060 64539104652105282 93344139991 76159
103689 80794 76049 15671 82652 91032 57535114137105754 95138119351 67866109451
106043105203 79263 86920 95679 44228102649 83161 60582 69027 41720112843 69353
99411 93269 80891106950102474110878100357127240138149 85838 99172 63751153913
123494 89288103283132276 40258127246 98864104730 75215200511137045112232 96732
122797142941 88951137289 90867130718103301 64278100500119096 70753 95946 80012
89516 80447102561 92559 85571 16361 84366 31584 84909119267114552 88034152682
121898 91800 62350 85520 95145106003 86372 48592111181 78017126962106063 96230
103264 83428 78898 95695 93175 94982 98441 74955117291136949 87570 81857 52351
113879126718 88929101752 92926104330 69421125085 69167 91688112437102918116097
98737129534102501140721123613 97058133179 74465 50810 96470 91542148578100454
143692 99914 64114 38629 75978 74185 68084 76657 86805 86080 90031 50197 90258
100759 69841150564125358 96119104111114455 98754119498 86250 94922101903 88541
84337 95514100400105699101569 92345105303 73039 63112 69032 98222 90421 84594
90017 89103 62083100054106924 86870103361 98390 98829138524 75156108275110662
111757 86035 73365122742114720117836143772133330122681110909122449110217 88497
64076 68412 98007103571114554 75226 99414114428101236 89432112416 85567 91646
73092 74874102854 72058118866 98348 81133 59093 99756 63583 83464106641 95063
105952119569109281 59074141505154050 84795 73694119963124140 88156101325 97185
54367 89607 63944 97388 62430 47400 53077 65351106025 73965130493143964113733
73943 84089 94299145993 96579 79696 76197119326119115133326 87969112755 79669
83131 99471 83338134915127160132403 75222 61096111122136479 93501 63715127820
124031120358 86916138536149118 92948 70837103491 38653 65062 75812 80479109953
94358 93252113269139878 91623106190 66489 79688 47814 90727127155 49055 73129
77617 63837 59702 77009107336 64740 77783100479102446109605 96225105564156904
93913 92609118399 92192108888 86815113621 91209 87178 46739 72439 79302118201
98815 65919126578119622111805118860 63889 80089 59464 73457 70268117946 82886
85871101220 96091100319111685 55918101447 95199 86771 94938 69057117984 95749
77618120716 68043 75504115641193943190216148126 91538116475 65429 86916 89472
94992106693 94529 71557 89786 86972 65782110257 84028139271 86834119372 73910
69279150489115478 95439 96409 96459107594 94258 78116 80310 81392 62214 26571
95423 66220 92543 80784139143100666 83272109172127542105119128254105559 93164
103217 87094 79616115637118925120256101284114275107185111430107200101318 85219
114888117361 93599 81328102658107930109170 89529 75154108207 94683 79870 83166
67844 50545 77036 63940 85079 76667 67856107672 73957125398 80539 95409 88072
82509105993114932120914103220108376 98803 75489 87465 89043 60604116216 64659
85155 96288 86730 93447 86419105318104088 86118109597 95395106187 68096 85513
69856 88750 99134104380 88214100629109081 97704 72823 92698 76332 75061110758
109024108712 83444 94705 78878103191103936161616 98306 38876131956118945109339
112924 93750109490102346 94808 98212 78290 86930107980 79878 87568 82693 84653
101054 94578111749 98861 95096132150115035123420153592 98630 98888 84130 79494
92013119859 82464 93028100624 63732 85752 96738 98094 75441 65311 89805103032
63268 87133 65013101491 84701 92494 72974 81689103359103152104166102252146955
134511190133109163110309 80357 69688 91279 56937 89748 82771112227 79797 87113
109696112516 76338 92870 74723115847119801118847118215113343101171 69084104287
96139 65444 58638108804 91943 82240 88115112936103269 99620110153 96056 93189
87739 81325 99884 90030100811 94476 98576 97154108632101106102374110160109519
97523 90144 86227 63334 81731 63919 85701 70519 99526121752 92655125974109991
76326103928106578 66025 95213101606113092 95452144987123070104579101979 97837
80683 79547107826 92869 76492 87719 97529 96627 92402 83390100531106511 98773
78469 94459 92574 97539 78058 90856 80829 75839 88566 83563 90503111885 97596
103537 76421111470111409 86437 86522 85321113477 84968107781 89524115118 69660
91959137253 98901 89232 85201 93180 77071 91874 65967 89463 82648103310 72694
101824107532 98237 86200 74772119262 96176 69317102934 61603 88974 89564112267
96090132120109473104422104921 76169109634 93833105789 65892104059 90930 85794
93711 92794 77147 93917 89629 94261 89065 79831127402 89763 80352 89110 88826
102691 66001 97915 95837 70589107130 95188105209 85140 71217 81845 91144121432
81874 90585 72485 69739 94631 76171 99383 86348 75834 62711 90828 81836119183
118058 58085 86384112514101069118285 74738129558139863162776112905 93742 87645
86773100694 94469113473 98305 86372 62862 91063 67160 97612109827 66314 86764
99259128717132059 80256103215 84110 86056 98468102473 91227 81934 91604 69346
99597119653 84663 67665 69025 58049 73444 47049 69006 85151 94734 75027 88793
87064156162104376102606 69963128176124305159716 78093107361 98608 98841 77757
97795 88339 81433 77054 62858 94303 94491 64651102473104659 83870103541 83154
85728 93783 84506 85343103856 81534 83737 88679 77285 86535 72137 83803 90498
68346 94973 99752 96234 97197 97428 77149121404 89809 74185 96397 92631109458
109891 86838151336108920 79660100171 93552109985 88543 87377 92070 89570 87292
63904 77700 74853 91337 83647 88748 83170116862107606 94619 75527 93415115578
93118 85882105444114212 97004 80964112293110513 89559 80816 83938 87466 50025
89020101249 94022111600 82761108605107495 94368 76735 80581 57380 80323 75714
108731112489 69698 59126 80110 94145 89539113066 94794134846127991101402104220
105444 96138106901152164 92963 59526 92165 87157117996 79208 60005 98415108183

122860115888 98991129089126440 87806129298 81695 96543103153106046 97963109721
66790 84077 70385 77800101925117387113024 90748 99514 62465 98410 95678117727
96627 93417 78339 82324 69536 92699 97772118307124569129917 59452 73308 84923
84015 91377 53884 76232 79760 89844 98457122958 84629110060 98646 85821 95889
100413106997115537109695 93426117468138081114583119711111073103009 82881 99022
95420 84601109957137118 96046 90606 79722 94739 87052115342 83992 86337 64355
77311103260 97773 72797 84756115598102618 94039111137 88289 91426 72508111811
86828 74552 97660104106 91346103310159383110294140978 93727 98010 78934 84680
71580 92396102666 95750 97999108464105239117949114310112623126814160007 91175
147685112821106697 92037 36601 93365 88988102024 96024102907 73211107144 85080
83876 76277 79331 74278 63747 49503 74020 77120 97676108335122552 74249103691
88166111212102493 93331107561100607121309130637 76817 87633 42485 80009 74656
7790912464910626611462110758127399 83460 89847133621163570126818 96436 94916
90643 98950 76210101053107912 99660 94095 84102 94964121336 91854 84166 68880
86857 74434 68611 90689 86413 67730 71507 81669 72456 83481 91674110612116916
113562130624 88141 68365 69025 55886 89188122946140853112770 80120100178105153
95675 84770 86398103447 90406 84687124815 95414 73727100841123840 85804116141
104963 92960101650113127105173103376 88153 99607 80186 71703 79754 92989100563
98447107211100455 87752 79975 97631109896105214103191 78141 92743135786139795
126648116728108612 82746 96799100075 86689 90039 93632 82461 98008 63190 74464
57492 97427 96129 93491 90833 90588 87429108996 91342104623112865103462 87147
92156102759 73214104324107210 91213111859100002109466 90642 95104 67859 89495
94564113600 89008122545 93187103856100527112895 95962 98906 98558 88348 72027
97954100139 97807 96654110995100179 82940 85141102786123820 94812 66537116115
98711 95861 94278101607 89054 53614110409 99450 95374 95478 80089 95586 84725
87747102966101107111276 82351107578 97977100314 87351 95300 99423 78556 87118
90913 81636 98983 99026109606113801 85093131533107055 81238102190 99243103014
65961 92046 69177 88695 64977 81670 81029 80003102442110519119603117308100938
103034100997 98448117149105495133466112669114012 96905114686103708108308110079
102865 87428 66160 96253 86912103787107355 94717 90074111628 87181 77912103897
112142 92058113910101731 87664 89775 85341 94295102187 65211 89748 86087 77508
64557 93247 97737120106 77197101199 84767 76320 96171 90925 66214106211 98844
89353 76242 95035 76226106712 94012129009108353107388119987116170130106 95428
95914121214116799 97550101443118123 99409 99062 55245 79890 91090 87812 86010
106178 81934106099 88765 66649 95956104431 92607 85582 97284 98377100601 89064
118820116715103048105435124893 68023114042111715 93357 94323 82740103473125226
128593114407 80320 72248 65228 83750100111130359115986104338 82924106556 86426
61043103800 92933103411112898 96143 84203 75612103071102138 92669 72863104898
81050 84727105284106756119118 92530 96046 84612 88240 84339 96631114969115380
135840 93684107836102390100735 85039106212 84555 74849 97332 89064 95749 98305
79727 97104 82410 91581 98359 71566103521131169149439133981 72497106918101485
88650117367118385104700 90564 72613118400 89189102317 76838 86317 60892 87996
85710 60625 91022 78545 90337109249 92815 94788 78252113131 76739 97603106196
138472 96854 97824 87834 57741 90371 75330 82820 67160 87251 94745106781 90569
121791 87876104996 95634 89133131186 99028132954113485116884 93920117153 81897
84024 97328 90394 85660102537 80497 96000 87894 80416103651 84219 92029 79095
109997102062150306115655 65281108221 95131 86911 59161 85836 99757 94302 85582
97424 81996110391 99262126638123377 91150 97933106659 75155 82260 78528107685
80533 97651 89095 86731101539 83623 90563 76391 99913 84908 92943111175101882
111179111829101267126076 98897100349118060141695113638 98947 75751100119 81986
99269 95031 78357 88364 98552 98067130455 88286111548 87463120883 97905113716
112925 93480 84149 75411 97535 90330107945 85744 84903 75873 81416 85521102065
88966 83857 89859 96551 88358 96592122111101084 67259 99643148384 97431108813
77747 92960101217 87790 94119 76260 95180100293 98831 85881 79788 75309 92228
105610 85353105433 86459106273 76867121641 96121111740 86824108791 91398112654
76112 94293103773 84239 87529101763120328 90996123299129263 78023103564100544
94408116178101458 90429 99414102922 96128 92300100029 76717 84701 84854 90035
103530 96131 78686 92099 98366 99888 89286 81843110594 95730 95057 87826 98485
101447 90907 90850 80868 77311 96337 85971 90518 86235 95070100956 75034 97942
106615 97929125382124690140264113314 98329 94225 73593 88577 96377 73802 98244
105106 98622113201100024 83999 92404109110101944 86977 80822117547 93694 72528
109828 98537 83311 80188114479113525 88666106043105666 97057 77406 93520 90226
73904 75961 88305 92673 94339 94856102154 91295103071105246 92660 85351120849
77315 92830 97228 96641101591108695103610 93905 77795 71702 85119106607120342
117604107229107226105433 74544 99770103480115608 94199109555117044113637 84857
100422 86036 58217 84428 82770 74774 94808111282 96149 95407 84574 86903 78349
98912102736 83104 88906 97861 91378102904126579 87781108388 90999 61131 93836
87444100073 63701 84792 76327 91061117485 72065 85159 78161 91580 71592118499
99160 83067102708114489114312113073107839107282116526101548106244 74478 56928
110342 77455 81831101252 68546 99079 85577149702106774108552 93587 80738106773
78378101360106316102213 72470117116113433 97432 76111 92835 96654103305117089
98606 96354 99746116148102318108441159620100787118505 82887 97212 78979 95471
93737 76166 91068 65313 84912 89556 98431 81451117636 90648 83218100630 96225
91972 93024 77297104305115827115174138436108290 94352128109103866 96190 72283
81797121538 95175 86334 88095 86497 87401 77339 54105 76213113130 92716 75861
84438 84734121724 76048 81813 51579 87085119245 83518114100140519106613 84016
97171 94757 50077 68544126150113873129904106418 93343 88686151522 80597123175
71813 85172 48064107786110228115168142324 94635156829105557 89585 67874105694
94517128624 94281118121 88434 75287 95841101353 83501 58958 94603 86770 79997
62692115805 91022130339119398106621 95174 89324 86584 69556 90192 98384 71471
112894 93424112102107136 75708 58871 75999 98416 82928 85358 84766116369 49002

```
117149 78774124625 86885152549 78298106117 86967 92839102993 71169 73608 67164
 99776 75192 90024102402102184 57889 78568 81132104945107965 90273 99661 79910
106960 99509100922 71238122967 85561111425134200 84991 96358118976116425 81176
104053106231122788 89892154795105500 61110 95062 62048112143116871112426 56227
 77696159416116079 74034 85242117757134703114216 83813102965 87307 79789 93628
 57861 98216 85115 74889 78921109360 76594 84536 57496 72022 91366 93558150215
149297 79059137813106189100413 73378 98143113508100535101714 89671 94752132257
126815 67214 64117 72704 81338124845 89124 86350 99387 71287108433 70942 73132
104150 89623 78942107646 99674165696139218 97926 52959 88797 69486 68966 82317
104059 63500 91211 96403 84127107239 62446 88665 98351110929117817 83634135112
140574 85997 66257 86762 84655 92614 88122 96319105432 69714 89936 85866101834
105920 87116 79096 98461 69939106597 70085 96613 88307126248100072119174 97559
115452 40771 94701 75846111269 76034 90988 87610 96104114345138570 61039 98267
 96065110992110179 55497124809117884 98791108789 98843 87165 95615 71811117625
129017 82561190764143717114819 95505 91876 89706 84154 65848 86239 92765116667
 94804 82249 97675 57668 91118 78213106645 76172 72558123580 91235149179 86407
 49358147243112351 98874109730 68910 94736102099119599 85233 59773 94429 73293
 94837 94081 83746 78261 96558108452 93926 92886 95833 84866 94711103064 89831
 91497 99060 70694 87660 87056127549102497 90709115405132631 98674140004105932
 45434102332101238 91621101136 90372 79229112138120367 88334 95730 65079 57331
 99825 96088104095129728 82854 88061101988 82553 96700 93919112893113983 56040
101447 78334 83220 75254 88456122327 84054102263115783135522121842 73607 37725
104490 96029 88953 75972 78963 82116 74742 82172 78469107508 73960130341 93841
119837103005115931109844101997121623 85647121246114715 91304 81520 82442 94221
 81866105780 95527 73210 79645117782 92443127736 97197104567 95067 74864 95609
 99129 72796 98493100264114750115903133869 72275 77786113472120712122103 95110
 96363126913 90511 80902 83715 84821 97768 98738 65477100864101098117223 87240
 96165 85518103618126326103852 91837 53187 92507 94223 50158 72524101164 91456
 81755 91241 69350 88410 71246 79068 91919 64053 88548 87306137621137666 98138
101023 71042118886 85349105110 75792100693105552 99681 90977 74532 85341 92691
 79448 77551 58656 85780 90713118673 91689 85520124269112946 99461 55562100567
105955 92623110910123741 93434103520114629119067117231134857101314 95821103250
 78781100249104984106114 96379138455 76003117659 67465 34256 84877 84965 77749
112662 77879102819117149 89060 68105 81683 39576 79278 97659 92456131917 62482
 77016128786 78431111082 80232148661 87017127951120535 84591100521 88694123080
111482 76462126301 85040113356110155 82520 69815 98068 86744124528106100118108
 98171 65393113144 91179 96316123126 94639 97472125579113168 80729 98301 82499
 97493105190 69492 81180 85140 83120 59324104031 69374 82480 94374 64445101902
 75335119505 91466 74340103317 75647 84203 44405 96502 58238127401165371100996
 57597103665 68523 88296 49666117297 76242143437 74072 95685102666 88357 79092
114457168141143123 74636 90218 84028121691 96703154808182563167208 63837 95686
 69522107672160416118482162972105801 67866 50079 31183 63052 93365 58133158347
159431123002120155116597 38832138392 25049109725 54707105059 67651 80463 73321
 53925 55654 41685 60528 44155 78791114317142652 51701 48451 48018 50846 94601
 90507170120 95065 29915 47780 46860 44153 59542 45270 86823185921 91904114818
107331 81767183792133058 90785 98806 66705 99596107747110689 58721151124149098
151131 77801 79175 57862100730 62701 83319 80520 78350 50707143706192761 99642
182787180519197860165697104530 81038125946108396 71511 88043 78343 87555 87288
 75348 93918115253 74717 70581 81443 89285 69795 73490 85578110583108319 48191
 49132 87083 80301 74966 89403 89343 84273128647173150168790135815 98718160676
135481136488138862 46077117591 68142 45726 48822 48240224153163252131645 61714
 87007138944156888 89081103531 64447102111127623130435 71432 94562 41205 93545
 85319 76841 99129 76237 83820108724 95079100817 75322101790 50537 35894 80564
 88566 91261114017 82741 83663 53527119258139488145119 70689 90629 82960 87349
 91192 91432110457 31706 91975103929209774143608148566113453145265126326131209
119646 60539115177134341 90563 77648123004209328125705123314138434157097 73330
158975 73044115613 70418 68847 13580 10130 48644 101901002541198742761 23 75573
166845 38570249995185544 50514110083 86647 35750 68008 35046 12884 41474   418
 44795 12732  3879 24041     0 42797 78194 31364130901112904259914294454177124
155889141838 52060 18305 86660 37669108821132221290870122608136432 89646154120
111142101325 37229 73377 61689 76789 84767113466168607117099106397 76062 96779
 65052 55963 81563 49053 69202114794 75778 86129 29602 54017141081136851185978
121438108328146407182132110388 61751 87892 55991 65438 73840 75382 92423 95841
 63125142054 55281 64373 76329 91605 98267 87115103816 67671 83916 39769 48474
 70303 99244 53532 11335 68429 46430 90627 44183 90046 83263 68426 95784126688
 56318 82927 49789 94396108260 71045 75262 52601 97701143390165212143931 97074
191990157421162523 74906 86091 77305 79639112785108586 87013 55524 65585 97555
124616 51474 22658 55993 26422 12654 56116 73786106186 35285149535147505106368
115663128453 49416 341492073872275871 38618 87900 94366103022 35326126550 76483
120384166390207565194458173508126572 79273 93009129152190754116837125182 63971
 23590 35988 52588 35727 44919 85320 85936 73161 54266 25083 15104 34207 19299
 69156 91720103688135221103617 86647 82504 84109136578142341118229 89082164518
178279 98087171113128312 97360 76762152050143709 94855118054135010108762 90699
 32442 47720 43976220256 50060 85475 38095 57321114736 41105 54769 38213 37777
 66646 77941 95620 50065 37408 55328 29693100932102359 35659 52314 71005 92587
204699 83233153128 95234116287203847130500163504212382105034106847 63490 50732
 42487124112 50477 60516 48056 15931 83878 68488 48826 55073 70938 94757 30838
106995 48947 34309 95561 83241 80080 63982286407185238 74085137428 90091127638
 80161 83001 64007102153149670 75055109341 33321 90720 83765104353 75105 84531
111267 97776 84674 81604 87293102249 78155 57845 71478109588 90322 96436 89817
107744107712112810 73387 88486110857 69393 78447244467 70927121153 89533 79260
```

```
 83900 68256 82769 39119 26178 97925119426 85662 68989 79489 61330 77204 82722
 95850 91351 65225104308 39498166997106273190453111168 69814 91311 90071 55953
 74715204994163600101948117849 92273 54450 60589 84372 38283 92136 93756 93234
120020114713 79920 53653 92601 83598 41621 52346 92754110478111439133991 75433
 74043
```

Table 3.3. Version 1 of the floating 529-year chronology indices in Tucson compact format. The same information as in Table 2 applies.

```
     529=N       1=I ALTF1Std                                          -5(13F6.0)~
173402168117 45724 49514156850 82721 82559 68872 97396 30601 50983106362 63499
 38784114643 89185108196143089 97706 52340 49625 31094 68378 99203135082 76505
 76253137909126489 68513 98968131192126253169107132694126173 80827 96505 71497
110697134560 88468 45175107606 36954 73375132188335717231711 86014154249 62702
 80089 74162108425 47848 43139123101126048119834137869 76318 88745159830138183
 97032 85771 98254 79962 65065 67200147797100765 59210 75424150751 97596 83601
213135 77762 86447135244 62255 87933 51505 56640 67634 46715 86417137633164504
102307101905120987130599105084100693 66290 79823 76501 97132 97999 69551 61229
 39884 70672 74648111023 89129114355105540131187123865 66799 99664128813135457
 78240 49919 77935 98307 84162140365 98294124980140371168538110315 47681 52211
 92924122451125121 92264 59149 99285120338 94416 62299119620122599103623 78625
 57122164171118549 69050145676123655183199 89130140626 70935 80632124091 74844
 91236 54999 75482 48128 39762102856 99183129615117606128216 62132 44520 82513
 82035 88841 66036 83036 68744 47309 91698 74019115396117535 46308 50968 71582
109966184721183347 91549132419 88959157998164697133552 18951143155 79275 94032
 72089 79995166091109127106247156286152604179774155817 90032 60822 99311128311
122116 82214 71293136744116873103461 74774119665 99489125923134561 85926 93520
 50838 62536103234 43440 70723 71821 98237110866 40057144979132445 45378 72875
112200 79004100513 81311 56964 82648 34686 22599 75947 83834 86868 16485132448
 43801111391134099100754168014 86387 72938 66206104338 75992101548191114124270
127429155343105688103467192054167803 73388 74805116701 67536106427142818115760
 19569171070112900107759120166 64647 46990 33422 58335 45063 75312 58220 68430
 78257135669100868 43914103005123473149971 92136 44219 85842 95291111625 93770
120899 98248118488126349134711 93496180104 42898168922192303137193107226179733
104895110607 72974150241 75752128862145191 46014 36544120721140450 87025162251
 96774122454113362120881122287118961 53507 95276 96878 99595156673136693 88604
 65308163487 84841 73919 86819 57166104213 54186 90521 67157 48021 86453119033
 49806141258 91082121112 94284156963147740 99175 46851 30333134697163170 80807
264461112525 61694 74988 63789 24338 35696 20477 50878 87447 31466 59708 63375
 57693 44211 19015 97260180590198693143198219933 99022 86846120557 68759 83879
111383 43764 70014107904199383174837217607127714 53077 24532117815 29194100898
 70301 81963 31316100309124677 47431 93447 87933 91788202675149373 80352173777
 35858168072 18219134057 37137126400109545 53007110925158970 60665110334 32916
 71025 64672 77030 79529109792214771177296 34710200790191010126626 15135 79055
153554134269 75076306865 46514 41504 78636 38718182769256509 41106182050 36222
159362128525 92916 36177171724124927201802 48330 31663112287 39294 58095 31223
 18754119085 45282 16094116142151772270134 42291 44258 22799121523 20120 13352
 15375142872 28793 84695151690180611 89959197470149319134987107802116631 88083
 59974 41461 71113118360 92711 59868 60214 69061 21516127043171110179041202614
202432 90976168917140053136737132031127150 18577 77700 46501 56992 64340 94213
 45616182991182371113580 55885 90497 77577 61079112452
     528=N       2=I ALTF1Res                                          -5(13F6.0)~
146840 25936 64202170470 66106 86826 73184105563 30734 69931119569 61106 48465
131286108224110094140043 85646 52096 61533 43810 86286106996134595 66393 81756
143602115533 61085106879130673116964161188112884116169 72644101004 71985117839
130836 78398 47535121587 34286 89456138521326429167471 49971157397 47250 89627
 78437114725 44492 56713137422119086111593131608 65321 94406162195121311 86622
 85749101355 79544 69661 75831155733 86750 57964 85607156730 83763 83674217421
 47346 91855138294 51877 97752 54315 69170 78694 54678100248140191153038 83922
100678119536124663 96190 98495 65635 88060 81253102577 98197 69368 68795 49530
 86199 81713117069 85808116396101153128716114919 59985108184128609127007 68220
 55376 90723103216 83498143604 86029124722133207156805 90612 43708 65661105091
100826111973 84587 64515111134119373 60911 63271129638125564 96108 79318 62791
167240114929 57310152785105502184248 67829143574 66345 89654129876 69231 98500
 56416 87678 54866 55230120375 96910128011106611120212 51898 54222 98188 86551
 94250 68210107269 92672 57164101414 79302137358101286 60645 58159 95779127103
199643154384 77806127788 91940161132145517109301  2318175336 67803 80399 71897
 86438166757 89619 88566149234139934160840131786 88374 64576 96762125720116200
 73507 71702140018 96570108735 73609123570 94382128639115677 65857 86077 53959
 73240108728 50101 85052 80914107356127864 35848156706136805 32197 79329120575
 74250 88358 78731 61784 80211 54199 44971101106 97687 96831  6952152769 42108
129472138191 90453175201 68043 76802 74560 89774 65548118461175706124782119342
152698 97363104002190216141776 43666 98335124929 69019113085142052104450 10140
188053108776 94571116590 53879 60550 23601 85955 50510 95826 57870 79356 95182
127994103539 38114116941131868145423 97436 44632 99846104414109270 90541121188
 94783116693119497127048 81401181103 20709177616172809105335 97856170627 83502
103449 70068158165 57957135823135823 34448 49631138980144345 71676156078 83602
115626113190114784111815113799 43366108729 96498102097156580122541 74069 65669
```

```
173929 70733 73969 89308 61227116820 55448102954 73906 53406104722127469 45970
155204 83849117158 87862158973132787 84084 41645 41821155342153671 67669261020
 70412 45815 83548 77669 34082 56975 42054 77127103979 40159 78322 77356 69509
 58410 369891239421829001713491108412060577 71471 72850126765 66403 87447118351
 44423 82422118888203614152883187050 89911 32618 29466139693 33515113663 70063
 94423 37628120024127567 47229 99408 97314 91677201431126049 58290175589 22126
174596  1890151620 37610137523102536 47030128656154271 44827117575 30040 91083
 77996 86781 90262115592219530145497   116211446168861 92257  4544 98002164206
119280 65156301775  6963 23357 98069 51181198270247844 -3016172090 27371160862
125048 78527 33475185746118902186421 23631 27888133499 46185 68753 48242 38687
145366 52581 24560141000160052257007  -297 32140 42257145138 26346 26676 44331
172360 31650 93230164686171915 65883188067130424110951 93487109946 83389 59940
 51243 88666132384 92809 58635 69369 82754 33332147443176376160388176136169969
 55242156242126915118624118655115211  8308 90553 62376 71016 80575107457 51655
194880172692 84747 41354 97544 85571 66885123480
     529=N       1=I ALTF1Ars                                          -5(13F6.0)~
173402162300 39058 51366160227 78791 82359 69469 99132 30551 55303110154 63245
 40724118801112184112660142710 94642 50968 51205 33533 72286101158134839 73731
 76223138594123662 66069 99732130616123413166120126810121816 77239 96210 71187
111771133315 85415 44463109890 36369 76054133478333480216647 74540152034 58210
 80825 74399109333 46458 45436125930124547116763135139 72722 88660159807133907
 93764 84435 98077 79139 65267 68516149101 97092 57351 76624151807 94675 82552
213746 71304 85811135305 59313 89182 52037 59068 70073 48375 89375137953161032
 96777 99999119536128777102251 98969 65418 80776 77204 97775 97728 68890 62243
 41578 73894 76215112059 88348113942104089129578121149 64439100694128755133064
 75184 50149 80223 99050 83298140086 94472123558138169164844104270 44607 53994
 95401 99857111943 87102 61799103088120023 65128 55927120355129852102396 79823
 58542158508127252 63049145003114981187404 86239140676 74913 84370126584 74830
 93199 54983 78196 50274 44756108739 98751127748112455122835 56708 45103 86626
 83734 90824 66277100166 92707 55628 92068 77632132646108162 62364 50232 85297
124007204699176436 93905126504 97522160610158283121577  6863155719 79539 76090
 66861 79458162430102768 89149146949149822171334146810 98234 64204 89223123450
121139 77960 67060133080103538109481 75606118432 98264128273121632 70413 79845
 49714 62649100861 50282 74580 75560102208128329 41815144451146167 41921 67097
113645 77124 83540 75264 56574 71064 48105 34040 87213 94994 95776  6062132983
 49055118742142138 99328175060 83852 73401 68958 83236 62017110461177910141191
128018158599109705106046191489161046 56523 89178122650 73789107564143645113643
 13013169731123463 99512116487 57352 51568 13400 67715 43710 83970 54494 69771
 88815125638108940 39997104303132775152326108457 46413 88559102005109692 92582
119626 98917116465122965131885 88117178600 37264164402186374123527102811171219
 98502103134 70728152000 68909129275141989 43292 37687125856149791 82163152321
 94622114493116243118205115649117095 46967 97559 95984101251156844134514 81339
 61739165871 84607 70727 83143 57676107906 57113 93921 72626 47640 93694126141
 51476144983 93323115752 91180157115144817 93523 40281 29243140439162189 80767
256969103473 46547 72290 71833 28150 41842 29805 62342 96047 39326 65542 70098
 63211 50661 26597108482184686189186129626212297 95123 71823120830 70791 81295
114411 47459 71355112855206322175277202905111585 35058 15788121956 38139100634
 70196 88146 35131106361128907 53317 89576 95118 90649199461146998 68189168888
 36636161250 14790133673 44702125876107986 48712117853158031 57050108529 31836
 76726 73094 81114 86284112703222206171236 15120193568188569110911  6842 78380
159653131844 71863295849 48214 12450 79629 46891187084266186 31986157764 39538
148127135185 85937 30513171110133879193556 43337 15954115797 49512 58119 39421
 25928129764 58850 15893123285164957270689 35654 18588 25109129365 32531 12466
 25894156752 43603 81351160758184713 83725184639148251121114 97934109511 85392
 56863 42157 76483127431 98587 58337 60593 74454 27951132267183172177906192545
189462 74085150783137612126546124246120318 12588 72142 56509 61855 72541101673
 52007184771190547103818 42158 85362 82488 63196115728
```

Table 3.4. Version 2 of the 5177-year tree-ring chronology indices in Tucson compact format; the chronology has been detrended using a smoothing spline with a 50% frequency response of 100 years and by normalizing the detrended series to a mean and standard deviation of 1 to minimize the variance changes due to fluctuating sample size. The 3 versions of this chronology are 1) the standard chronology, with no autoregressive modeling, 2) the residual chronology (which removes autocorrelation with autoregressive modeling), and 3) the ARSTAN chronology (which reincorporates pooled autoregression into the residual chronology).

```
5177=N   -3160=I ALT2Std                                          -5(13F6.0)~
104934 -3488140779110676 49238-13615 20140 70301 39030 90834 92991179966114571
169426102899193265320612204741229615184963194718125859153551 33831 57219 95007
 90733163707 39221 55616 78308 79041104965 84451 12833 10151243776167302 92313
 24710  1849119468 -7473   -92 38500101676 63267 79636 96135 95188182446167634
 72595 88568 96703 76902118406102366166292 49667 37749126087119936 81943 62792
```

```
114767 33110 52953  5091  7919 60283 87692 96072175109167817-19054104875 75211
 39267172409 20244 76589 98287153071 89475163453120361 95278107222 51025 78624
120708140236165521200751257991106344 46789108124128481139211 80915-36117116675
 58534 60362 78698 39311 42026 87334206254 93162 82566207175 50158 36742  6241
 52788 82565131594101800 59834 63783107292106131 95669 96079135157140079113711
 95034103732 74979179164108119 50402 36434 90680103172 76718120771104884145902
 42009114923112528 74295 57411 83965 66288 43176 42579 25230-41906 17645 84434
148671148657 88624 92020151398 42939130602144694 97001 71610148778 75597178996
161897 85407122773 92218 65686116359 88875 99045112540-18670 93661 91505108018
152693175930116157160687132692 23183100796 76873149073 91223 76794 41292 93876
 33310 81789 86427176302137625 85980 83760 43220 82899 94827145235-29297194580
162357 76739 85814 19579 63201 28683 87099150141 84877 82566130437 95448 90686
 69990124280134162 18088 52379 28755 97799 81341113312107944108481 76122 80871
115755172499175044130355 85312 39807 56328 65964 76446141915 80922114845117018
 87472  -252 55427 80220 85412 90589 95868 52818 41525 -7201 61453 44926113843
203202 96431159302 86870 54230 97597 47197 99714 60262109445148447157164 66221
 42179 73959 94505171448223392208863154811115929 61412 74133 86733 83431 90622
 68473 62254 98115 58181151823142947104508 24478 65087 93637 47483 77992135755
106901 69897145279104210 67403142746 90269163687109210 86094 86420 36658 -4495
 58275 83593108608113095 60147 98208 95640 98032129478 72020 86161 68563196377
107663135344176464132225151282 97176 12361 63208107985 77317 43391 94978 98413
116400105225117859122470 86849 66339125349130076128823129067 90745183310 81909
 52896 77026 20623 77795 87473 94916 39491 98954 66403 47073 71273 81498 32100
124885 36613 79817 80986 41043110764 71725144421 62184158558 60684 64792 73621
112948141341 85117101129 90461 86415109900 89987144444116649139442200686133156
 50411113066137765138014 70622 91120 89017 82509 26999100279100293120348105053
 52010 80846131234121910 63070137115129318129331 79660122367 72386106797 82812
 93169102364 95033 48635 73689 63513 98843 60429 65583 41123 88524 77086 64467
 70001 37367 28098 31386 47789 27440 44897 66690 67275 42899121867 92242184075
 73589 86615115939 95092107678 87604108498 69201167512113009117383124701163410
104301153288 98067 73438 57320 40173 94706 96850 48371100201 98916 95597 95361
113746141675131843122192145864128040129904143995 88770 85567123453114335 85199
 67536134857 65680 81394 74828 38699 26666 75090 22732 74972 21459 82448 66114
117083103641 78330 60395 46598116383125398 99397 80972144227 89285 62058 86505
 86619 63523 94994 76629 75368119510101495107064108167136620116520162511109622
 98336 64407 47326163769 95577118464101372 76592 69844105864 81154 64965 62528
 87158100376 74052104161 94778 75656130467114475151418115198 94914113875179324
108389101973134853 39706158118104898118587 64345 99883100041 80405113449129030
108852 78318106742 82637147568104444 90061100686 37592 81977 83291118485112381
 95321125897 68990 67119 32570108785 44344 84592 66103106715 81571 87259 38323
 46067 25358 72860 71024 55127 44989 96141 62344 97556103395 51321 73875 87623
108446 85538127807122232110429 83421 21587168242 81634151243 22487120238 93959
 81109 98488122871112216134031133970187900121778177335205663 80694 99532144861
 61592110685 42049133993 80761 70892102876 80578 -2023 85867 70979110986 55180
 67077 96575 80799 26760 -7171 22751 38430 83061 61898110730112395 52856 54806
119084160434156550 95133 84472 30010 95252123888 69616 83169 81157 83494195147
130479 38096102813109627 71608 79637 61653 -8811 54820 17875 87563157953 61067
 49003113035 77970140604 95662134558138965 90170156642 94300116082 77908 87866
127426154163138050 91961 68115 36812 80286 87124 57525110512194598 96180150226
134715106928127602166678120012125599 95738108957122333 45062 91754 52736 85120
 84313113273 95718 59656 94450 81426 75171 58469 47082 54028 66980107026 75766
 57485 71591 33624 95802 87802 82353 73125 69407135831148546165481 94584 91705
144467106899 99267 37427 99632 98801104723 50137109657115431134502104225139037
108263152108161443102899 81157154685 93000100347123602149786101503 52387 61093
 88091 75707102196 98356117929 56957 65896 29117 81509108752143922 93426113179
 72890 13326 81263 67857 85859 38707 48522 50251 66484 42573 35442 59717 74620
 51815 79529119051 76289178198 96506 53180141906124909116912 41331 12478110960
209021252439 61191186973233804 76172 70391 28533 54474 49747 27513 56874 35408
 72719 62671 87921 88658122290 44777 85376 55998110029103648 85553118355115446
119470180823 73181117239176673164580 93610148554143510109533176416100416 59811
121615129813128526 99724 94888 38700 43245 50285 55973-13626 47199 91782 70646
-26918 91878285076 88371 13429115207 95350 32078 85256 -1586 82072 -2121111506
109438187927 57455 19458 73510 29611  3431 42666 32509133364109824123047  5233
 30855119961 40423 77428 12310 79456 72476 71119 65015 16546 73044 93931144869
 72257124865128654118611191755219170135171140359 18839266180137534148619181200
 60651108142 65871 48421112277 36321 57539 62356 70492 71198116270 39770 39179
109568 26034 75658 14885178905208993136242101400-12902 44713122255106380 96971
 85517   534106647 69435-10633137351 93376 29315 91610  7215113550 32130197751
118037111643 22082105466224265100670166179 49635151407132307227686138483150051
 -9408124483 48144-17352 33113 20133 42799133444  5020 74327 34697 90124 95826
200302162386205250224447 57532301274114698172510  1102 51517 88398 21547 17934
 77810113705174064 50841146316178450208834154027119503 24769 27758 68627-10305
119374 45071135971105795150354 84073 69488104931125025150071 18852169946107123
197433 93852197193131230160403122995109036 56098122783 29209 37825 34241 53045
 78216 41774 54331174438 44654160303 74707187183 82135 98602178510 83083 40334
 84371109679 89068 85441 86464 10065 49276 62081 34832 75353 70220  3020154459
169263215614273514  3955 15300117176 93054134004-10961 31642 43073183604 48827
 36581 64210 50923 94949 86953111110110504 82094 87928 73960106424139415 70915
 86171 34888120115150028127546 37300  1388 81068131913214297116981 20757159383
 47203101331123530 45102 58760 -5569 67272 91231 90196154741163893 32686163019
166696205122152080108174 78507 32279 16713 38916 10543 29044123495 97172 34090
```

```
154400140409 56982 945701096641933521022820 94435117811140919 59039126755 47482
101702 72645 61862 80456 70515 29659 68740 91414  6843 485471280492307881740 37
 53276 26402 96490 -5960118763113571 56635 82221 22063 55805 80198152832 80535
109598103651136049 79110 89182120851186402 70348 82463148821107955110965122787
184901141040 80748 522302343411702771047 01 70931 21259115262 56756 35185 56191
106635 71842 75998 64036 43446 -6598 50197 64322 79610 84957 57851 49566 -2786
121346 38014 84212 46632 50806 76189 99440 73289 99702184097142540174692133670
142834-13455176479 84643 82508 26603 77420 96215 93850109429138225 96456115003
 62641 89448 66993 21931120293 10856136131 898871210311209381049231082 03 67955
136846 88291101764 -4079 95740 6178316190910065 4 81788 60862 24453 -1005 94298
107712122927167414104036139798 216241313391143611528441317471733 15 79894104430
 91865102509 60850 89228 67865164098173971 23234182808172971 84102153168149798
 88585150467 76071 14020 57873 30948 50452 93493  7869 82837 62642 92087161098
 53736113319 82132 86150106501 85026 49038102622119547 74322 86717130552-27338
111727 41163 84164 84796103823 87761123328 32396 89656 92036111317 57337  3666
 64802 95084 86420135742 67712 50338143637145250159923183110114335 75545102315
114640109999159608178644 98916 81981 66556100433147895147110 57500110352 98541
132907102937144757116929 83177101103 90609111175145992129142 86652169868123346
 94992115391 91148 67086 63087 72475 41031 34028105234 90857-18609112000102615
135742115281 98409 81995 60215 95632106878 43158 71959107166106685142484111313
167035119957109323114461 72328103650 97793 52090 80325107926 78204 97073101930
 69418 81339127611 85683 96143 86173 28368109486122447 48704 92870116181 82696
 74531 31483 91002 85203 60486133523 72927104985115403 55592 51385 95350132699
111504115731144381115435109322 99651 83767 93341114774136706 91410 92508118981
 98693125391 92331116630142230 83789107775 81886120477110848105614 74536 87819
 86914 91452116276132228 85330 81984 82422  9326110162 90696 77660 52961 91063
102508196107120400159584103866105539 86998 69585 96631 89044 84388 75518 88433
129934 92614 92218 64071 74242 84061101280109109119721118495 79261117278200816
 94179132617 94130139024 64872121344 35722 88238 78760 79993 34870 91078 53851
 34329 21706 50557110776 60185  8879 49154 83186 61196 74946 44209 70916114152
111708103092 84954 95184107060133169 91124153553178054184397204302164691129475
 72113109844 89974137336120419 85215 98507108791 49131129919 90102146254 91721
 86971105212 44051 89596 65141 72527 36285 63218 65380 77054127009 82798 33942
 68984 71145 77470107489138989126561105493108094 49749111825121207 82133112888
109350 60739 36257 36852 65877 80729 54864 67479 73123 95238125988 85070 87969
149632106375139642 78678106125 75157 87467 45499137003 78688111018 65711 77777
 44763 81636 47119 34380 90591 41020113247107004106831129017 92308 74962 33978
 69637114332 92149104270115975 68876125808113881 85961122719 78368 99525113690
125695147959 71380 71626131116129641 63480 59116 56375 38871 86147-16987 62296
124782 63823133966143380 58043122307 53598108745 97376 72963125560 15357101559
 63213119334128731101664 73567 66064212532 71734140908158390123881152099 92501
127273 84791138987110870 97458124855 95558 96783113046 84944105637 82947 34808
 85201 49202 46737 73823134710113174145237143373106216101329108581 89224145193
157583173637 40932 81794135750 90337 29373 23690 78548 59067 99582103413 87998
 37141 87738  6819 -4785 16241118986 92471 54968 86927 86212104795120303 81553
114573 81718 61661 81308177864170036147250 67693161464148240 99730 97520116221
 92750 84685107736200893154076186742 20323 82586 45393 90949 98189119412 57511
156810 92878 83005 58662 87961 31918 33619 77574112459 71227 52383121704105198
 70672 39683 70598 68880 57398115958106243 97377 83613 75345120060121935152963
 99734102445 29738 55511 40258114599121079 81284 60560149152 80507-15309 94940
166614107560152645101757162937116895116903 70986130837171054134142 75290 59616
 56585 27645 71723 72692115360 97607115922 87122 95026 57458100461146746128848
183776 60381 75572 78219101895131945103360 85976 51647100735 92447 84486117850
120178118259 85929 83281 51093 63806 91409 54589 64767 83459 70207 82528 74417
 90255112105147427 73611111495  62321185501656871270451135381192 25 56834 39474
 27862173225134450 97159159222122742 58597 67856 59887118605 78346 65509 86092
 87847126432 70836 63876 31801 77426 44598 46501 61709 80748 69894121307140854
 90440149290116631 69805126057 37580 75874 62878113338 61111 75585106178 79070
110267 64535105734 38872 71472 -4546177164113838 26275 82789179954 49741 50114
179541198504169138125083153887133375 19473 87932 61856 87053 54280 83208 90332
104508103954194192138004 75893 48736122210103791156221 63380 35290141019 29297
107571 49136108851 30396136050 62566 95955 72769 98013 71111112538 76576 82052
 76257 77514 75027 57297 90586 65146134383 98641123096 87633 79232 40178104426
 62526123174148195105498 80926 99290 95664 59777130708 88758 64129130288106102
 72832103569164839 76392 95685 94487114478 79683145601 92054 15018123941 57698
159445119796147402 71741 75769 55957148522 86213160356115957 64005 59355 77565
 91028 68386 32438 56115 22122 63272 53952 73278127497145740186582111940101847
 78720116255 41403164555 -5420127191157823188983 87780129590   325 49449104904
 84316 57476151135105047140985 56042134717 84036 69497165743 51198147259 63515
175995 93236 95589 82506114090123459106248 68444 79500 59638 74959 93554 10074
 97698 46799126348 88660 73545124572 20683 65132 61963 89920 66551 50328119185
 83149125996 39325162114107135 96594121423143504 84700 93219123650115084146598
 71222 21505 35982 82075 22619 -1664154088 35597 77820 74142122999 95571144644
 55448 84245 78329 69509 77492129840  252314221419217423826920942114580710143 5
 34404179882 79839 23726 20231 37996 54015100438113386 23385105335101112 81626
168030 63686125687114283 83175-51287 77190 83512 20117124495103698 82670145575
 40598106506104254104871 53614 98745 81888-20716132046 70954 37747 43507 -6622
128320 48870102321 74086 62977100499 81118112239 88210157298182944 65660101727
 10729212197127269 91816120485218157-45713152244 94843105553 59455294594143866
121561 98335150352167670 69460151044 66423160676102403 18361119483118626 59111
103705 72322 97207121321128382 80108 73075-30683 88697-17552 78560120527131540
```

```
 72700203375122687 64903 58887100150 95417129744 84486 -5113112338 37589138004
 85676 72115 57153 48156 60927 54998 68286 88923158653 29817197589189408 96259
 75348  7974128528136511 73631 99652 96713120139 52343132640 22618110634117719
120488137316 92309154203 92722169357133782101244130773 55679  7831102777 67274
190446 71746167194109794 48381-10304 62473 43507 35493 70919 78942 76654 63924
  2457 85999103556 37416177948130679 93451106414137116 78925123099 62401111376
107572 90389 72645 89929113193114830113539 79038107180 89574 44800 58411 88753
 82080 74794 73205 71171 62780143511119280 87419111363 84227103336156014 49521
133023118735136986 90333 69507163711138437130171202663155100153268118833149549
106415 94875 34607 37328 79111 98291104356 54130 73433114497106406 51511126663
 60773 75716 68850 49690 80156 55206140612 98209 69219 31133104898 20462 71416
 91619113651112503132047120584 16049196392206183 88022 46438158711130803 96635
 91094 82638 27872 66607 53499 96231 24058 11050  8960 63345108311 54534159593
173604104694 40967 35566 70166231826119755 76544 56457158803138554155660 84359
112650 51388 75709100311 69512197868164157185503 26612 20689120936153042118953
  5912134844 79708234081112406189733210223 91075 53780 83542-19162 26527 44561
 81464 91905 41679 66761106504206963102885 92279 54901 52447-22791 76237124980
 -5699 60152 66777 54677 70399102723 64688 26185164061154687 98257132455106846
 99212177125103802 89114129963 95502115844 72975127206 81174 65756 20258 53433
 57208136830109061 45363141063119628139799143582 32941 73487 32221 50791 48256
123372 57125 78769 93908 87644 95530113318 34981 95394 82867 70159 83565 41608
122382 90597 93834109687 49190 55081143980274971264448221940107168136541 44554
 72739 79143 91097 89576 65763 52561 78705 81901 41215109519 87653137367 94721
139478 58097 36582158956121167 97787100602 81624101982 96224 61657 66589 61035
 47462-22755 83457 37743 96627 70201171633 83335 71235141935156282114019162168
128178119279 80256 70506 85165123944124818137749103630128120105785130706122217
101826 76233120338118112 91786 68066101608107045 93935 85360 58970109964 88960
 70378 72066 48869 25913 52138 26677 68487 52193 37959118881 55457149352 66140
104865 76211 62408 98170111690122399111828117275103417 61428 75384 78251 32248
115868 38583 62951 81165 88521 95376 77663120928107660 95938105760 95341115382
 41059 76800 36890 49810 94849103659 77651106756106166 98584 52899 79305 62154
 49728115118135185120617 70329 90528 61877105418104877208988115778 12820156474
140457136708128044 94601118227103983 91591102833 66987 76712105736 67674 79405
 83341 70010 97270 81610111466 73086 84565156659121868103627220229123555117824
105763 64502 73623138325 68729 85412 98327 34886 73776 82861 95370 37119 33292
 60295 88456 25915 53788 34616 92240 60203 71819 45350 60164 87982 94561115050
 97343164916169877269320147461138665 66284 64027 97603 28197 72375 61804100086
 67751 69627112175123576 75701100552 54589137157137996146329119744131324 99808
 -4091 98786 75050 32707 13849 82464 78923 72422 79307104921 99181111128136498
 96634 92195 92065 72992104305108900109541 97428 91624102424124018 98862118576
120454126573101283 89461 78794 49357 75271 35193 68345 41191 92912137967 92698
151022110402 72888 92312 91656 33725 74602 97864119112108449174055149040125339
109735 98094 68660 57130110865 88060 59920 77145 96892 68935 86371 73858100687
 95019110751 81028 92918 91311 95391 75539 85490 69449 57509 73653 72432 69859
111683 97564102470 43929 95718 97077 79879 83130 75707126181101014120264 88339
140546 50051130219171105126024113873 74382 76263 70480 87882 33440 79149 51864
101988 51366117217118608110487 82410 87083132752104798 58346101636 45098 82092
 72515123632 89520152351109913119573132317 63872113920 89453106991 46988121162
 80734 80267 89121 73800 58316 99155 91985 89088 76909 66851134261 91357 69124
 85437 81363101904 23011123669 83181 61712121597101314127576 76117 54305 85286
 61938138215 82201 93706 52862 35712 97163 84328 99601 65478 60750 50900 82369
 71674136787134570 50435 81262101684 95463129868 56123146634158379182852147304
130604102013 94752107444 89391119340115389 69967 59973 71467 42997 91764115422
 45217 88120 93553147786148459 84187108700 78818103159 95353108637 88012 95351
 98843 65192112912134913 64484 68556 50562 31767 37136   523 27558 70249 85079
 55338 73972 64674198414 72049174465 53870171122149250252258 93505150142114834
133261 77875 99454123847 87130 85184 42818102367 91665 36131122407 98009 90538
101774 61101 78623 76691 71559 67331116116 74540 83046 79740 58089 73264 43820
 70134 65256 39238 81791 96355 95762127899123016 64500148391 95913 64061107465
 91305143913129147 90360202304145757 58948108955 98088109401 88344 81004 82258
 81350 71073 40650 64720 46710 68857 73602 97245 91804142324108220106862 42550
 90262120185 96883101003 95375130455135742 85127142565127323 71603 81620 77636
 94989 -1825 85058 60168 92389118192 82023119464117694116509 61076 62517 19013
 57431 56178 97292116913 47866 28019 59506 76871 74735120327103809174901150997
123312121556133554108402123637206683109627 44782 97008 56795133268 57441 30975
 95048110035137250128213 97668152352144450 92096162339 78853101123102849106789
107427123830 43153 73907 45939 51461 96579122506126246 95412 85598 31094112085
 97292133766 82961 90059 52645 67759 45419 78605 93479117491159796193533 60268
 73133 74752 66225 80005  -213 53124 53918 81483 85454143779 52168118348 88468
 72840 81527 92642118903127694115250 91513125929151511127418140622150062130476
 86075102194102220 69231112384185417109944 99828 66296 82360 79949114214 52237
 72479 25862 30253 97955113318 47743 76971130027117425 90467126280 73822 76157
 62477107090 78651 66899 96878113093 79536 84686214264130577179359103923 95570
 64569 75804 48559 97988100052 96072 84195123945105870143431119564147461156737
225131 94397219518132082115602 89211-17784 91232 72441113693 95063112496 45680
118024 65661 65057 49176 68612 52629 39125   624 35831 53034 82849115588122356
 58205 98741 56686122491 99042 94095118893120040140899172641 60083 81050-28365
 52050 66018 67163149966118106128100123980153381 89736 76091148025217101127441
 66969104029 92562 92460 66418118765115941 96252 86680 67885110754173864 97005
 62417 42459 80590 40875 38528 77436 66324 45376 46931 61730 37964 57010 80016
125076145259134215176621 91269 35193 20811  5794 78324144551212549137020 64657
```

```
121596121376 96333 66749 78993 96346 90187 79755167023101100 61208 99495141754
 76732135667100967 80090 99307133410129122123016 89479106094 47172 24621 52200
 80493 97611 90593118199 94315 65280 64563104487124056107647 99571 55691 93241
165599187957167698145305115088 64858105302 96949 82328 85901 85333 80995103422
 35299 55338  8129 95866 94479 90653 65730 63212 76417107673 81928113366129064
112512 73625 81150125955 42890113825112960 73155133762112145126571 81578 90002
 42009 78397 84220124366 70204144136 75372109447 97315124683 92601 92243100030
 89259 42919102886107350117773101454144124121968 85268 87279117679148483 91818
 45647131401 99764 92381 84249 88378 60416 10897130024 81616 89444 89733 56920
 93996 60095 81640105037103278132342 76761122591 89093110983 87216106484107310
 55404 75444 78611 54843 92834 81753110643117121 66299160683126967 81878105630
109838109752 22868 87385 36472 75681 13044 43926 48905 47488100465111917143970
132094111142112333103416 96036136787121647181819119754132116 80110114145 86624
107066124571105442 87348 44731 99150 79652112226105193111079 77708132221 62867
 63462108819130427 97992138354120513 93847 94771 84572109758112423 43982 83825
 63019 59066 23355 76021 84894140975 49009103271 63218 48610 83881 74672-11249
107510 97131 80367 31745 93669 54950116546 81460169122128982122045151039133174
163366105777 97166153283136850 96994106578136044109419 95766  6298 50845 81095
 77257 65998100120 69560111683 73080 38884 79587 97475 90779 71718107280107083
 98881 82877143551138152112789122765166305 50537147829127697 86049 94449 61683
107105151292145488115500 44168 49179 37855 70790 92694156600129032104772 71859
111197 72262 21396102759 76411 99172127581 85942 61791 46955100630 92210 84141
 45985110845 57306 70975111027114034140526 93621100047 78926 93849 75782110738
139362131236173016 93520125684107870115995 86538122527 66498 49661 83883 81265
 90372 99897 62455 94820 62726 93143 95827 42515112945160345198160170631 53892
156008123896 85677133000141665111422 87962 47549116298 78180106125 55883 72527
 17593 62305 72246 22721 78071 41474 69420 93843 79216105924 55654134460 56457
104026116556180090 82663120408100488 27188 78156 35100 52732 31177 61828 87391
103979 73415135655 80851118422 94629 90158168876102232172699146810152954104668
154770 87691 81450 91120 61081 70291101822 53376 91850 79886 76812138971 87761
 96159 60443116937 97484176052124338 59955116924 86215 73762 -3317 72200 87942
 80755 66391 73096 57608102758 83316157016151983 89152106686118917 62264 76148
 57429117996 60246 93075 75911 76304 95354 70656 82180 56833103719 69952 80766
116979 96570124184117406111810159347114202112662150035184664136201110130 62370
110815 58142122629 90938 49846 80387 97870 98777169938 39798122228 63096123965
 88674126618115979 91517 75444 41207115475 98724127494 78570 68867 51934 63045
 64424109823 83440 62973 65162 76969 70832 85259147340103830 33738102483194098
 90493130987 67422102276113393 64470 87073 43454 86334 92915 84901 59642 58416
 47731 79706103781 75065115468 75923122900 57330142626 93794129399 73744122725
 87167129439 62740111028105157 76889 84682102959140837 93967155230177351 72795
127822116662102266131851104510 88603102747101648 96619 74967102047 54044 73694
 77377 82460 99016 97520 61761 82337 93340 99440 79324 62151106981108795104502
 78347 95145104155 80983 91214 72076 42292 86239 59336 75893 70358 79875 93293
 52746 91042111378100404158921166480206405141306122778112800 79395 97597105353
 54689 94003105811 98498121837 98497 63321 75019110024 80407 67890 60996119388
 79264 49229111499 81024 73844 58775102800126992 76780122572109616108943 77687
 86447 87036 52150 57892 71503 84383 92262 90159 98623 80276 92765101842 92854
 80248133854 72576 90855 98298 87876103516121138124683101849 64395 30500 54348
 95285139543126591108058106431127564 72208107664110018 88757 91265106669125959
137216 91087113517 76431  8390 59104 58826 49649 84964119680104902101710 78011
 78667 54696 92035 92205 50431 89400109531114038116876170018 92816121946 89515
 19801 96485 97529119397 49420 69818 49401 85276131122 45134 82804 61925 75437
 46903133917105936 74167116379140424135360134411120145122124155388119350124977
 51615 10232106135 48262 60559 91405 34015 89132 70185194447123348128070 89594
 64914110329 46848 97940 99368 96599 28622125667120045 89091 48359 82915 90868
118051135858 65010 86172 86588134979122544115694224998110370154172 67405 95456
 51318 92178 83956 55981 77336 26399 60043 69775 95498 63050132005 86094 56102
 98667 79289 57078 75150 63350111082129081138733186676132794 92844168634112659
114033 56336 69296134074 65666 80396 75057 66934 84888 47072 -4078 38141113086
 76109 47156 59456 57170127124 54196 52427 -8992 62852126710 66204121467158751
120080 84122 75036109732 -4826 38175131936126799187301149669123286100400187655
 77953135686 70995100648  7044 95333113036123433168284 92138189545114412 86511
 42733123964111239179573100145145830 84769 59566102313108497 82221 27387 74571
 70522 42783 25067112098 78148139020132782127545104273 86246 78039 44486 68344
 80927 -3770109421 87238120481105716 64802 13730 50735 85465 74762 77449 80349
119786 29108119858 44392137456 87674200000 99228136253103531103445127292 57408
 79789 36331 99275 56599 78874101887104396 29570 60816 64607 99777114495 77903
109713 67446117324102639113685 65356116803 65341101231140687 49526104484140075
132721 68280 82157 96144136027 65215168714 84220 59347 86229 31230113768132998
124719 83958 91043182120 99528 76812 39944 64599139388144883107505129472 77821
 51418 77457 31212 78875 60546 71264 39216103319 41723 36958  3889115645 65553
 57226218521213547 68631170279132624127663 74641 60876140321111830 48648 55201
 96951149943144551 61785 37700 78555 62721147750 82932 87895114071 57008 92085
 24910 39249 87898 73471 72670110796109267227734175150133583 26149 84975 73021
 66888 75742104885 34505 86964 89965 78850 86740 32694 81842 86990112818138134
 71671185351159910135100 74069102316107025118443 84277 67577110701 33315 81311
 79179130559118298 86042 56224 95182 41327115914 35582 94210 66124111305 40289
121302 94811153301 12931101489 59106139055 32915102331 62713 94961103345140143
 -19571251911136701335741253632 18741369661506101180571392221109 45 85329 99028
```

```
184492 84391  754818515113818111969512080350739 85521 84850121534 68914 31685
110935 63677105781109619 68498 58655102255116886 71688 93811 99588 83602100657
 82596 90947 84963110480 56602 68627 81232153661108343 72941160946154345107418
193873124699-28730116989 92719 93509 86184 83787 55497113730131038 80831 84390
   567 12075 94393 89005 96443154404 62069 88674101725 65026 91504 77038136289
139878 30920120501 50352 82452 57454 74043158137 68266117377135262192240150297
 59486-28788119826 62093 67140 55403 37402 55940 31415 59241 46867 89387 42898
181448104591162337119772153417125814115546158962103872154139116171 78951 58666
 65805 79947 59167101197 85882 37094 69726139291 56245161182 75031 94139 78596
 43682 90258118836 49912114742 99253145791145371180528 44439 55153104599125443
143014 81817102024160317106986 55707110979 88720110656 91825 44852 91619105635
155040 77524 94147 73954102328147007112346 97472 34868111694108977  6454 65358
 88812 75806 67172 96484 40267 82009 32223 76745 97891 48229115316 80403212353
206325 94556108920 44535146354 68843108609 58016106188125207112207100593 52231
 73453 83172 57444 43330  9011 63358 96788132658 88016 70305138131117970 96540
 16213112022126907 95483140142151879 94274126242132069132523140141163796 92907
 78869102571 64943 98562122444104935 48942121647 43704120190  7876-24860 72927
 91850 58061118643 86414102776128614 79932 23966 61164 -6245 67624 84083 73014
142890 35188 55916180282109948143755 81830208668 73184166934158800 74274 79304
 96052170300132061 44937139778 68279139186141863 52243 44466107910 84119147608
119049116090108603 38615117947 67101 84677133805 93085 87616120087105078 65699
106364 77452105820103158 34135 57714 71250 67137 21101105366 23306 67792 77369
  1736100587 65105130190 88571 57925 98731 70009 93791 24549125513 31155152180
213462114574 22979135986 27584109011  7161144974 59107190320 13149103437 84137
 93664 49709137222218736158297 50856 82678 68772128352 52065191678233459228550
 54499151985 28279154326226471111990214861116894 18439 13440-24940 58615110992
 17119216661195254144730134723160445-33673170891-56823135969 -3686153254 60941
 82834 71358 20815 46986 -4237 37244 -4004 77670136202171424 -2316 59085 22621
 32078 97852 78301203433 76138-10197 47905 14364 -4172 14564 -8754 83635260601
 50591118616 98703 67935263875118545 83154113601 26675 93847126937120371 -3302
178570165817 91691-12804  6265-18947 90543  1104 65986 53281 42377 -8931170482
271792110489272196220581273903181568108801 79014156982115581 55387 85283 69007
 74705 62842 31392 52841109451 41805 50137 66095 84215 55470 69448 86834121846
134394 19915 49967 78802 51262 45892 62198 62042 72242140712214322168280164408
123782180740149151178102154084 18635117834 15789 18283 36808  8996344968178498
233397 73088128842174354177985 62276117888 39606 58610136531155666 60924 87659
 24365 89344 97960 41000 73706 76971 48645 80430 44696 75455 57551 98781 41103
 -3045 26399 66344 61936121837 63720 63739-28102121483125388210121 51877118158
 69305 90488 75908 68067 88866-50511 82170 60109328639159264264178146002190294
158565174653 96693 76261 75314153245 39950 51461 83650242229 89280139060124578
188985 65286199525 65222142104 60264 50453 -5456 -5396 48079  3374110627136141
318248 67676164284 20703275400205684 25303 99944 83792 21082 62926 27929   175
 38046 -9190 43647  7491 -6065 20634-10067 43679 88286 27184144200123971294459
333528175498142596134099 30062 -6699 86714 32962115885146743333700122744187625
 84401193118149591147441 33020 52195 38544 68961 76455135568300192176017132967
 46182 90733 14727 -4417 64093 28503 21472169947 13933  6332-11919 -6152179007
165217339345179493 78363146058297156170271 40616 64017 41399 58275 79454 67027
 84201 87360 69622215865 50961 56340 88059101057 99989 83036109197102972 94706
 20315 10027 30493 88826 24253-51431 28951 27151 89788 28243 84364 69661 59179
 90695154864 80027 64556 14658 96701110142 62662 44352 24973 97716182017190635
154631 84693265239216009231715 61379 50718 60050 55837111971110190 81469 53039
 64792101226136252 37945-11844 30801 -1802  3263 49050 74648103543-10235198510
166847 84909129250138880  1712 -1360293810325815 85141 41757 90685109060-12304
180148 53447144777206365246944196318161605 93307 39706 94907156117241469 76618
122618 21611-15793 35226 62622 23599 46439113032 91268 63822 37784  -820   166
 42279  7875 99458113302115486160196 86998 70619 76360 83594173799155397104149
 65857214205201182 46454213121110003 70954 57361201970150125 61204128037150737
 93855 74735-12702 47316229203288397 15386 89073 29712 68746131711 36384 55120
 36625 42875 80055 84971 86102 37234 20213 97555 36091122981 72518 22049 50424
 82545102338245432 32319150223 88922 99115222248133928152143250235 50784 87386
 77695 14307 74869178838 64093 81427 64154 40414112143 75850 66642 81384137796
120365 16526100694 36357 49851114362 82127 66257 52831357044162138  5374121041
 68180126705 56307 77711 37215 93665154553 34387 91846 -4347 74120 74617 96738
 61543 84536115128108263 70962 79899 86244126632 92503 58885 74901124127 95374
109814103054124340107370119012 52071 86251121549 60243 63994289805 35682126488
103581 81203 82338 50087 89238 29364 22627141137126923 80214 54519 80126 55647
 71689 88873100112102315 37854103629 22489219128106222626396106101 57868109128
103339 56612 77082234201202501 96593150149 89409 39172 48894 89491  7737 96606
 97311 96200134240114624 73906 30723107222 85603  4507 14637101284125059116464
161952 57258 62447
    5174=N   -3157=I ALT2Res                                          -5(13F6.0)~
123463 40042 -5871 53911110851 63121110617107823184122 99612150066 84477178193
299807 81890165707123531138457 75909120900 13858 61426120711104213169782 28123
 55493100046 94609117281 91490 19606 38171286143158556 48322  9116 20192160607
 11693 22177 73907132992 70125103697109073 78464183401129801 62543 61766109998
 79577 85692 62957162232 59814 36261169863123591125215 50219130422 36169 77280
 37401 49462 78790109150129627128433155199-44990114221 82443 58463193829 54551
100262124678159009 89449152951130455 58922108277 55184 59766131383135005159738
161999209156 34489 40650123403134344 82365 52536-16463147068 84321 88421 96028
 51948 74278 96563191026 84042 93473206108 38080 52025 40958 99007119943137038
 88359 62364 71688105467104974 96001 96891135748121612103694 82726104611 78603
```

```
155074 72900 40368 45622119661116288 75793124110109429161072  6875117319132582
 85088 57536100370 74762 51016 64654 59384-17515 78987135546163856131161 61832
 84509161566 44587131702139513 87867110568119775 66764182926145333120366 86746
 86118 59727130091 88939 91310114316 -51721072231017991099911875191668843 77902
141985 71797  5154101347 84588105563 70746 67033 48623115783 44004108767102923
180990122790 58977 87850 54903102309102848145934-22439225388141491 33765 90986
  5832 90626 52099110011158517 79990 67716141902 79190 86323 73175145904128246
  9271 74950 35184111322 83678117825116068104561 70892 86649109774149696118906
 83325 56173 36034 76784 90774 97575132747 79187101020100888 86508 28390 82523
112314 99272104925100468 56999 56371 34432 92170 67701137149207845 67937142405
 64383 38128 98166 54549119997 63223124879154201135583 44015 48585101628123396
172230194005141577 93267 84664 46211 66718 88136100342 93688 74219 72884117815
 69907157858131218 85219 30877 83083124544 65219 90051152110 87714 60244156520
102986 61927153135 77196159794 88649 72705 86722 39341 40028 86865109692122996
115005 58762 95715 97014100364130590 62207 89096 74170209716 83207108545162505
108222102403 61134   891 91557134420 81289 52196112238109267114609 99144121746
114214 69910 68530138299132684118574115774 79046164318 56560 53085105646 48874
 90774106240103704 39652125111 69711 55877 93218102146 59318140991 40716 91719
 80216 66921114892 77050143826 71982159431 51385 69353 93678132926137609 73023
 91776 89587 92565111989 84340144156103810120982185608 92269 15990125248136566
113339 57415 97857108804 82795 33634 99562111059 90560 87494 55272 98980151983
116574 57944140657126586117344 63147121684 78854101552 78352 96478111382104338
 57557 88069 98810123338 77522 81041 64297117332100478 75501 79775 52920 54653
 63987 79230 57164 69577 97844 84049 57907149219104019141395 51610 81523124655
 81322107365 81013107290 80529160210102034 97973115211148751 88627142194 78498
 68391 67687 70193110215103700 62062111169106934 95484 97296118983139167122725
105556137620112896124804123235 62873 84177132155111499 81859 74056141960 77892
 87368 78761 55528 47193108652 45588 95868 37221126937 69310128793104337 81387
 66546 58401135009121065 81211 73036139507 84056 59638109968100666 73924 84531
 93007 85943115604116645 96844113189133740 89151161165 76161 86273 49273 63701
177712105187 92570 91477 80140 77947111178 93180 69746 70100102764111247 70454
109059104782 73685139999105544137331 92462 75615112908181709 78922 84302128822
 30646152730102455 97353 67152 92903 99455 84052131656130274 93192 77137109173
 96704145956 99517 85246102705 44188 97427 94193139024108237 87305111300 55944
 78669 55239133816 56326 93630 85333117979 87542 84946 44247 91899 60257 92562
 94049 52670 56062118253 62171108597109968 51725 95436 83519123309 82324139938
125224100525 83431 25213189166118302132136 37168141077114596 91194 98852116525
107269118669121868173329 94187155848177850 47198 98087151801 40712112843 45298
130172 72138 77660113671 84076 19712117048 90434116858 26330 70256121790 76963
 32673 42863 53773 59351112280 77192121254118448 49034 68044101268157210129990
 87059 85227 39198114903134667 56538 92370 94592 82954191859107818 11086103563
109771 61371 85515 71905  2787 85617 42459111643167996 43624 54959123822 74411
142426 81349139512136410 73391149881 78483109392 81266 88296127098139227114954
 89989 62816 60092100667 97466 76491119320202019 58828145555120780 76243126754
160919 97350114099 83702105318117422 37463114263 62667103690 88584103656101561
 55436110686 71102 85291 69541 64473 70162 88597109386 77943 66665 98390 43335
121141 90886 89237 91645 84394125495137458143526 19679103282148302107559 92699
 39642121302104856106458 59943123085 94144121771 90876124950 99957130040136962
 78122 77394167926 96174120701 91231132177 74007 41549 70357100070 83888127119
105195121144 61611 80880 42319 98424127608132601 89128111918 70012  9521104896
 79417 92888 46035 65558 76714 89276 54975 41128 82443 88975 59242 78799120390
 75411184068 87056 46850171111103098 94080 29714 35138142336199888170078 15171
127007226194 23835 73180 38010 71106100725 37744 95830 55011 93995 75444 94643
 91278110225 47257108058 61123120967108507 85012116863111376104923169867 44928
128226159439132997 79328140890121803 84288168870 67808 52746122175125160101411
 83566 93322 58438 49108 61281 72147 40932 70022125058 87304-17328129180299769
 31295-11681114388 97718 52059 69575 -7388126868 17869139748141037178715 29009
 16170 98352 79146 40710 79920 69165 64854159491151957 51089 29742156518 23906
 97982 75971 74038 77282 44335 60434 43289 99787 88411 70159 61915115095125814
110008186924185762 96525 39728-34388257323 72399117962182718 35671 87543 50765
 69493135848 44357 84196 70770 95364 67234105765 34044 68784122260 46762 91850
 29602183248184786 87686 96667-14014 76160124647137584109783106655  8872156667
 95171 38440169929 95765 32801105258 33257122964 60393191911 87385109149 20631
114902207096 46862138688 146381423331195562175200 90006122022-31437135581 47400
 12841 70618 64507 91231143907 15610 84973 72511124265 99062206836112280180737
264433 14577278684 47312159902-18249 67287107058 25703 38134 59396121030191967
 56325164934167936205772131996 88066 20899 46846 85468 12482150543 84233135165
108643131452 83010 89157 88752139637159130 19675174699125458171079 78181190441
116072147737107414 95066 45209126855 31642 45528 50134 98520 92390 54417 76857
222806 -5137197969 65466168557 63373 48978140058 49057 53017103699 97250 68241
 82133141750 24175 79976 81362 63330 95662 82262 23369183013147953172568202981
-29816 44176142373 66592126705 11737 76290 72725199479 58782 61747 84707 62750
 91133 47447114890 90229 70586 89397 93883115560109184 81369 81432 95911111742
166802114617 34162-10293131350140209193044 48380 17089172295 84936111339124726
 79100 75078-14853102257103143 93028141329162613 12620127158131957185297 19082
118378106864 42406 48328 88045 15501 59839135619 78715 35875153927143441 95657
106109136556209506101921123546114360122492 24623108508 -1781117501 81743 74530
 83073 70740 54996 83869 94165 53886 75675137758242859123471 14246 46112143933
 62374131454121558 72835 90620 58874 65492 86017154029 70988101814 96381102483
 80508 88435132750192100 36817 82118152675 97051107208123358170547118187 62203
 53827217468121436 69938 42703 21478148278 64061 48386 98179130638 74520 77340
```

```
 76120 58476 17493 89178 81575 94074100504 73692 74097 29341146954 48299 98164
 58251 62461 92173103691 81250108405147369127391146790 98389133651 24185182967
 70502 88505 43216 97395110780 98291104963128371 79489113279 63810 98968 65993
 49613133131 11753159066 99405125814121204100621100590 57591147993 87272101773
 64075111476 60638137843 77427 83318 64011 35435 297131222231358031119761635O7
 84849131207  2268138392115061130223113217162157 56899 98872105457103625 55362
101730 73701173063170945-12725188467148810 50336140778144959 75687134876 55038
 14904 74902 54057 41721103433 15160104886 73379101144166766 34103113912 87022
 92140112425 89101 68247123351129449 66130 84479140250-29772138852 46971 88587
 90007109426 94742123453 28598 99439101740116859 60715 12357 99468109295 88930
137223 51700 55868154536132910127727149886 87108 59703101760122887109642152988
157577 69553 74156 71894 93589140995131253 42456116340100093132059 80414140998
102573 66133 82105 88590120503150451121115 90275162908 94507 83799123029 88688
 65180 68862 85612 55231 45193124586 95825-50909140750121352141278104356 92628
 79449 70323100929105819 40587 62492121526107031140081101020133577 98220105786
111701 74240108682 87217 55204 90741120300 82767105556105700 70740 88339136629
 80340 86627 91746 37553132598121891 42083 99933112329 77410 57770 43652112769
105976 62051149001 70564103921111331 50560 58199116514140572104205 87557125346
 93477 91337102545 82933 95520122332134596 80582 91588117771 90255121466 91913
111195136943 61128 99535 74726123644107126 98095 69167 88397 85609 99985119488
120893 73394 83748 90212 34790129499 98417 81481 59778111765116351185063 93662
164264 80387 93384 82026 70208106380 94748 88585 84171 95414129655 92768 90832
 70078 81435 94811109904109919 95147 91703 56997 66112173615 58169121058 84213
141398 53243105546 34846104939 95632 94906 48671108839 68894 47069 54045 97481
129947 69198 14591 74239109070 75838 90897 59388 89472126931105352115562 77011
101055110437129455 56985148920155748154616163793121052 88325 43861107808 92899
134591117106 79545102539113339 46503142342 90569152622 82681 81670104425 44806
109927 64518 85392 57531 67242 92252 84345132683 74521 36804 86635 89947 93003
114963146634118005 91701101168 48167125997126050 82464129503 98859 60612 43208
 56312 90593100284 61944 85182 89158112521121998 81964 85297149953105217121528
 69798123976 90033 96424 42262153890 82420123077 70038 88868 57466 97779 67705
 56230123631 48056123846 68682106930 95234 86346 67123 47973 83219104972 80978
100908111350 71638129034110506 52963104581 62987101439101629120958139979 62389
 47131145048125683 46413 70767 69687 54064113802-19355 83233140561 68089144589
140825 60190128512 49851115121 98181 70773130522 19745103595 67132134476131014
 94235 71092 72137223450 59487126342152487106610158019 62888111496 73188132009
111920 88521107697 94193 92242107168103647109241 80963 39728100927 68282 50295
118286142005 89666131323134406 84387 78518110115 88388143879152850158484 16770
 99083150585 77924 28175 24377 89160 71281118814102702 79910 42903101744 21887
 31747 44288141965 98191 53705 71161 92964 99814115596 75851119545 84181 62284
103292173420152137 81652 91057151259 93574 83083 81267111008 92199 82141112423
212037120134162180  2081 88798 70748 92226106130117322 49418183376 89472 79601
 67220106667 48986 55013105321118428 73483 47600138922105687 74290 56684 87737
 82535 74319128530101588 94779 85595 83202120828116517138503 69160 89957 16285
 73823 51333133867127800 75701 66183163868 77421-20885112946157373 79109125934
 75650150742 98888 98267 58597125175168591111327 56655 60557 71993 46695 82497
 98244128870102042109210 80106 93352 48345103782144122119585176054 50812 75345
 94670113785135104 87864 71498 52100135083 96730 89283121432 88051 95187 81845
 84777 53372 69990 96536 60368 75360101758 81474 89273100475 80698 92576140977
 57734112482 22406128501168794114902106693112565 63277 31818 59214181172117117
 64199128497 96176 32833 74501 68186131696 85020 73791101455 96777132273 71125
 79034 47406 95865 63841 67745 74320101126 83374129065135137 81486122784 91002
 48443122978 41633 86752 78533129138 54750 87846 98259 84559110219 70444109402
 46278 85172 40561185903 96101 16759 88413184710 42245 49394171679163220136045
 89492135542103297 16714105453 69993123677 70102 87422104392113888118002168475
 84487 55534 57868120922 92513140647 47125 35641157997 46690121708 62657124696
 41584153678 94708102180 78656104882 72036146072 82458 99961 82985 82298 94309
 68885115282101656125398115988123376 80817 84795 47326113779 78660125680141044
100811 66734 94235101960 86309107681 72889 73473146618106139 91296105369172367
 64984 95566 99347109401 76614146906 88536  8812144006 62806168416123163137388
 58837 50774 64616143336 80052160637105345 48037 65269 83247 91407 81136 39212
 57400 45068 83141 73213 91279143083153980172242 90780 70460 73992117888 42711
156108 -60651430091665431839461 50963131792 -5624 62075123878 97824 69456161743
111512142283 37018137779 79606 83880171873 57940111582 58865177646 73886 70185
 72224111690116863121119 57998 81184 80046 91146121315 29814108242 69554150207
 78724 74439130040 31892 47307 80373105347 76842 81650 90781 87593114882 28211
150386117707 84477115741146376 87068 84491103469110469138941 81579-24384 59963
103741 56507 26557124279 43928111200 43872137064103952132275 37449 59013 88385
 66337 87503157006 26121126952178624225875176290116431 91485 36011185009 84885
 39688 35657 69082 91490118691120984 32458115374108856 80100176449 42613111469
 74803 67559-28515118387107372 36842146899112961 80620141131 40820126092107721
104533 65880 88571103964-10122128345 78453 38004 59029 12917153568 59747118654
 95700 74352120201103936115726 95098151623157521 55753 94880 34722207415123409
 64656104475159190-57144154138 95279106856 54541288511120946 88955 83019136270
161219 67129164247 72069155442 98937 22579107056133288 27770106140 71246 95460
 75330117724 90451 79552-23492115067 13381104680146149124659 73241199228118420
 62895 28077 92549108427122803 73827 12014145901 66628160628104827 85433105881
 61779 63126102661 94452 95712100854 46194149112171614 63167 66575 18031153518
156995 70361102288 85543107896 43549150145 34808 93572124667105112124107 88303
150761 87492166707123236 79814154770 40172 10217118103 98705201579 81725169523
 89829 29590  2390 88759 74549 55260 78236 93631 85195 93770  5479104454116213
```

```
 51052201773131119 79561115906130631 86309134068 67406 92257113152 80564 75341
 98159112505106496 96837 84431106704 48884 42433 62438117889 88570 83039 98026
 82717 80530118311116162 76624127081 91166102499168520 376001206991252841118940
 73527 59405165481126157115848177933139924116058106004135837106143 75070 39029
 61645117117116127124753 52470 99551121740102884 80096131116 62389 89480 62052
 67692118703 58796143060 97536 59321 29040115306 36995 86666115292 85717112749
133408109721 14311191276197093 49682 39898150873140265 70180106149 93619 27587
 99513 36817107243 35650 23918 37747 63230139243 54860167884169911 95701 39747
 76216131736205251 78191 61308 65006154483142302146679 62484119065 58656 78195
115417 75590179301138461147367 26693 40620141652163289 74303 28963156594134981
120709 62610166667177715 55056 42495119780 -3725 59724 78554 81084132118 90899
 88645128434176766 65758108591 29185 72787  92221086671668II -3095 69857 76931
 44046 45132 88875128009 51117 74109118710107947123868 86120116400188551 70723
 75459135488 85497123164 74078135203 81097 80184 20057 78426 89771145119 98425
 34778154249135229106893126883 32997 81574 47887 78885 67417137815 69042 85976
106814 97935100076114445 30359117533 97859 79235 98803 50640142407 92579 67228
136928 47247 66194152200254631197767132482 46212115106 41759 88821 94735101299
117688 91510 50051 97463 89610 52955128044 73251156185 66970128664 53091 55969
197511112468 80559 88969 88630109868 86477 67026 76340 81242 53783 -3717111832
 55340104886 76296180005 92598 66948127888150099 96703145371 97836 82528110153
 77252 74639136961128138127719 87316122734104818113181106746 93886 73480129249
125057 82571 69588113831117277118954 77653 58236120966 90322 66891 80438 56563
 44560 89642 57142 93805 76430 60251135979 60344160208 64649 99208 81403 78743
120933129266127672 96502102487 95569 55707 87095 89397 43873140058 44992 82919
105313 84631 92773 75360114292109386 75737127694 91340116168 46869 87756 59728
 96314108926107706 75490106082112177 93166 58003 96646 69312 66387133702114819
114644 63507 94815 69898120835107365204595 75614-137171878341346771077161147IO
 81311118745 99786 90582100600 65746 87947119772 66425 83478 76667 79897108160
 94137122997 92393 89011161052112721124092182005 74149 93329 78974 74799 97164
140573 64639 87154102901 40418 88215107228105222 62579 49116101851116187 40539
 89898 51096121918 78883 92275 61050 80089114385105279104718 96239170589142843
231669 79115 98409 57957 60382105260 35761 99216 82415125801 65779 86958120518
118361 61490 95465 63430138272127955117930116903110952 91204 44048118908 97207
 50796 43414136601 98049 70511 92372121734 97957 87080124148 89447 96407 85315
 74963109621 99146107298 96720101058 97725114888101678109849119830107440 92256
 80678 84139 46368 88820 54327 95208 59396110645148986 81836137485106709 54841
113790114437 39859 99576115995122321 87716173943121149 97066 96280 97215 70665
 72391124537 87412 66852 89816110423 98181 92248 75026109377113064 94215 72303
 98770 94276105893 62844 96596 76691 70237 92582 87368 87844121297 92627107202
 60123126229112855 71806 81103 82793133958 74683116034 82392132300 48147113526
178002 87265 81378 79389 82706 68619 97839 49965 97656 85972119961 57378115777
116256104253 76677 67656152494 94903 52404117144 46258 98075 93228129713 91464
151779104864102398110282 60665128001 88684114373 42673125464 86558 82156106707
 92663 64700103735 95873 96933 94438 76569151770 84443 67422 92629 95336116444
 43643115080100404 64322127202 95073123597 65858 55501 87457 98085141351 69468
 81802 65521 55211124057 74328107189 90100 70532 52889103414 82765138490125455
 20041 89944124586 97886130302 47689153358160590179041103609 77097 82307 88134
109988 91406120717 91070 71290 44449106126 60718101646119720 39774 92412110237
147505141014 58333103483 77073 93961106810110773 81368 82319 96046 64096120603
139284 71967 49830 66370 53796 79786 31812 72316101428100293 66905 90699 89898
202236 96103110145 36930158997129493194381 39712126116107143101677 72885109838
 88974 73160 71179 49240113020106065 52400119903111744 68842106696 71852 82154
 95821 83644 85471120089 72268 76799 93465 69407 87236 63977 85926 98858 50231
104759114028 97781110164109347 68533153915 79625 62918103385 97721129335112622
 71648187977 89661 47421109000 93644119214 79770 82478 94525 87493 79363 48775
 77224 70489101890 76229101494 74127156508113067 82032 55756105116133471 82921
 71104114611131774 93050 71871137264116315 74914 74773 86963 89773 19196108132
126100 95742121476 64559118467118376 94632 59927 82120 38534 90541 82123122829
128307 38812 39505 87285117025 98672128122 97956160703138113 78973102623110991
100676117610196411 62753 24066106987 95787142611 58875 300961213591240311315557
120935 93992148894135804 68211158717 58213 96651108387104882101875118661 42082
 88003 60559 80015121296134098116655 65078101433 28754114872104658139736 77716
 83695 55438 77922 56000 98519108661131777145223143989 18978 63608 83416 76937
 95668 23681 79651 81110 92574102734148544 56708121835101406 75925 98458102530
122693127180107130 85917125088161897102027118535111653104450 59089 99285109536
 72835127158169453 81448 82210 64460 88177 84093128867 65442 80147 45821 78716
128312 96996 52445 82216147202107949 88558122458 76025 83665 57746131188 77683
 48717112509106739 79809114973206621 91670155805 70792 94565 61114 82028 58409
104934112734 95808100956116515113178137276113518124876142571203877 57855186901
100141 91996 85137-22316122685101109116721 96182111151 50210131797 77859 76568
 66717 71664 68758 50172 21886 79826 76497110723124902135273 40264112800 69822
129493105374 82627109464 99928137724156039 38026 81065-13905 88005 74435 69107
169384107105114642119019143723 50052 82088166815214111108998 49562 88322 82203
101017 59098118849124293 95426 89740 73683102452149197 80450 67426 41013 93072
 59004 51495101473 84787 44105 63461 83362 63526 82088100283131082134893119026
150633 61085 35244 50534 35431106320161626184527107872 53896112795115273 92449
 71528 81411115181 83456 78737173524 88985 49208111531147880 61079131367100176
 75870106854133859111463105021 77657102442 71241 52907 81946102600108961 96584
113179 95051 77208 63937106787126161100982104737 49612 97470169677170219133106
117588106022 57175102491105649 79042 89210 95666 59085104804 30524 67257 33930
122353104151 90844 86082 88253 85077126122 84904115670127318103723 64979 67121
```

```
110977 45862125455122072 79942131296 97453119267 75519 97255 41296 96562101921
131094 72891143687 79872108110102930124239 89333 95054106685 80303 46549119515
116019101393 91321128128105585 65849 81992120464144877 80929 34872144447 98218
 90606 92451100048 75605 11862143755102464 89237 95700 59637103854 77401 86529
116055104687127798 62824119846 92831103746 75147101287102041 57284 81849 91269
 66936106024 98123119380122485 62006158699102648 51825104843101157105354 24750
 94369 44856 95748 42299 81983 80047 69727120591123118137915121252 91204102970
101267 95266136315107745161502112019113796 80048123249 99018104188114572 98888
 73106 38002110643 83948113650117168 91730 86668129825 69773 60345116945128354
 78692132666 98814 72825 85678 76214 99504112495 31896 95264 84971 68175 41927
107102107345146052 43497110464 73528 65109109367 88596 37660133816103247 79433
 56569105474 56952132445 93527166328107454104958131950122225154693 78351 89684
148014124448 81429100736135336 93612 91696 11818 76595 99010 84985 77185119282
 67980118282 79232 42067110295117554 86201 75693105861105986104345 81789147582
131523 99979105244147960 24013141811123510 78656 93287 67319114899156573147669
113298 48124 45366 47141 92363112997164123116922 92888 62362119576 72457 22397
128041 93395108528126545 84024 66246 60351121577103874 84745 51434121040 63418
 80220121925113759133593 77294 93655 77653 83068 76475105046134368122391155832
 67518111703105512 99348 69570117591 69027 55248107873 81536 97453103970 65104
105947 69587101161104370 49172122729164233182789136142 19741109968110227 79546
126760129429 98677 77086 49574126868 67884 99903 47106 90114 34100 99159 79371
 37365107298 73421 99968127910 83516 97327 65902132013 43301106762122864172882
 76913 94061 86051 27039100485 68262 80724 54235 93688104192113657 80035138035
 72982108948 91296 89453170897 83120153813111846125002 79288132470 58588 77138
105914 83342 76989113674 61864103243 80152 74361134822 73097 90077 65420127450
103475198222104449 18329125994 95412 75479 25091 91358118527 92623 75226 99697
 74484129661 97102154396137747 67141 97613114439 52034 75814 70647132650 65720
102938 86767 81306111928 72719 90731 66171115885 79392 99017129218101996120419
113343 93364146560 88622 98996138140169037101356 84472 53183115264 67320112474
 90987 63775 89648106130108152169779 41705122424 69734140890 87419123113115979
 78798 67769 60534107723 90367122478 72394 74170 63261 81637 85886115778 80373
 70905 85522 99538 85114 98754148534 92000 28957114516210344 79043108594 55792
 95576115129 76308 93113 55974102145110648 99916 68953 70338 65178 99701118805
 73240119141 74073118145 55785153634 87059121546 71335122389 82136125639 49611
 95052109944 71592 85887112369145929 74635147899167411 40402108855105687 85928
129823100913 77400106129105855 90446 85813106222 58173 90718 87353 95116117652
 95155 67521 97362109624104175 84304 67432126802 88953 86698 77284103341101863
 83931 85890 73435 69091107796 77425 92592 87203 98046106643 55792106381123194
 95897151314136912164977104281 89196 93625 60458 96165107087 57168109647117956
100114124396 95270 70492 94024123498101105 75431 72649141363 80363 52456133269
 96435 67912 72381130956124443 74954119953117000 95419 67408 97785 89559 55802
 70804 95684 99162 99754 99313105686 86883106625107681 87014 76262139056 64870
 93344104487 91518101996123572107194 86102 59231 57319 93742122865140095125792
 95459106772116813 52389100601109447128224 77957115662128336120518 64297100047
 75961 29380 87273 86789 67152107267130290 89101 89511 76816 84773 67754111499
112116 66945 89807109897 87818113860155689 66615117438 81478 30253117393 90863
102079 42476 88210 70583102479140212 47442 89502 75845 99362 64951147319100445
 68758117562139277124661117254102466109391126316 94872104429 42240 25559144348
 65100 70645111963 49465116565 85371202945100252106916 79755 60430124071 55689
109589114482 92446 44573145309125526 89107 48145 95383101931110868128715 88997
 87720106181126430104617113445205374 75024126725 56110 96560 62254104178 92913
 63280 96861 39826 86586 96093106841 72090143305 79720 72052109698 92104 94811
 96348 60808109937133751125996170022100259 66951160900 99521 88425 45793 69790
150870 87469 75005 88507 76409 81807 60094 28704 72744143840 83360 54329 85406
 84438147787 56072 74345 20431103044155681 65981133272160673100177 66634 93228
 87657 17441 59932152214115790159882 92096 84888 59255194947 51411132835 60077
 84868 14757130956121508118054160372 63887191158 81543 70500 37119141691 98408
162962 80922131250 74273 59665107157109084 84750 34962104028 90843 66485 51367
150638 88611146234127841105559 94907 80784 77229 57990 90431102825 54099120469
 87170128658107464 54558 39827 78336112712 81962 86907 81042136898 12718131567
 67557151999 41833195820 48148114261 67794 82704102463 73227 64789 56092120675
 64714 95503108269106597 27600 81549 90270124441123082 80968112672 67597115535
107285106414 54272129612 75519110438141016 43305113071140191115600 52834100062
 99700134087 61707181374100128 33696113298 57998136527137000113212 44174 86084
221916109033 38692 87447146796167689110696 78079111311 75285 75053 99833 24992
118476 79976 65401 74739135581 59976 79178 28547 67502104320 97588190481185125
 49890180237 98367 90803 48127110778127279 95488102869 78586100970156354130795
 29519 42293 96113 90380163147 81010 82747114432 56230114481 50936 65742124283
 87887 70291123107104870216946141538 77452  7110 98818 58146 63373 93460120393
 36776104768107037 76965125911 36823 99094112057112963119663 55771176196162128
 68799-12441 95855105038100304 84484 99425124130 44313 95038 85054127798114394
 77520 62679106930 51316134324 43093107216 81135144311 98533110877102578134365
-48881115289 71841149398 50045 85604 83888 96259130634170095  2254117669104316
126817120744 15647177958144359 89628122026 98376 70514 92998 59898148172138556
 69300257961147279 82197 73949 80045 77133 77774 -2170 84167 96995151245 92280
 71400106626 25049101292 70735120818 58271 41856162842 70340192699 54876-13762
207076115110 85728111746 41748 99032110224139614 66643 31261112414 65486102089
 99842 82043 78040109500126890 83346 91457 80631 72512109090106410 91376 83994
104354 54522 86912 81333161494 94664 78104131277150957 77183179024 92415-19440
131693116319 87130 93113 67996 59764131220140724 63974 84257 23388 36503132962
 99109100064160186 49209 80369113865 67196103275 86813132256123972  1038117982
```

```
 66093 81230 62930 94641168144 568831140281309381719531208655 28815-18931149112
105011 76833 55974 69465 79295 63138 84773 72740125512 47557185276 85974145274
100638133256107770 95668141859 54506144756117202 70967 64105 67768 96824 71153
122177 89773 39752 87109158563 85218162083 81103110592 81905 46082103033103798
 42923117245111047137256127263156441 28173 66191134243156337127447 73114 89228
146307 71197 73764108848 85247112500103888 36172114199102835144061 66149 97159
 68726110916149939101973 85927  9605113090115727 10669 76946113705 89481 69306
 96258 53833 92250 51662 86615 98321 45328 95260 94907217557175001 63709 92666
 43042155730 68043115353 56109113622119383 96440 80700 56812 86899 99188 65316
 66655 33563 96301 94509138077 80957 71645148518112562 85626 16103119274118188
 80894119155135942 74607111700127176124870131762147022 77910 76810113198 51586
106523120190 95477100509162752 50041135457 45535 -8621110317 92613 77298144951
 76138106969126589 66690 29772 81514-23855 89351117744 90603160909 27387 66890
186862 52527121714 62716197779 51386134575128362 56304105497 81186142528112381
 38221151440 64771144306119566 71469 58858108832 83219144018104783127915 93629
 33955133673 82451 90646144677 88842 94403155287111566 51742102434 73028113608
112420 42077 76522 88375 81013 31228129639 53219 79406105033 44667123571 65797
151292 82465 55555131325 60586 84115 13079125850 36280162393210009 79189 -3715
126681 54582 91616 14634151924 55860201859 28585 94723111986 79707 68073142272
237681147836 25317 86363 83672143218 90355193077247747191231-27185 92199 42947
123828209511107570208402 77264 30247 10777  4656 73645112492 25831242043189056
107338113881118768-40816187215-52621143473 20788122063 42795 74254 68838 28883
 44497 25868 56522 20634 98129153469176691-10533 13215 39118 41938122096 95398
226605 68121-45973 30542 36636 29577 59322 33310112260282395 49594111999107884
 60093258454127530 54955111408 40345112273119003117739  5394196676167372173620
 37484 58898 26202124097 35646 86620 74934 68681 13328209193260586 45439239752
224138191732166879 56407 43069159380108237 32273 90065 72759 88543 90573 58641
102066123580 41285 67745 85300 93367 52637 72270 89673131991114891 14766 20705
107798 76885 63668 94831 89269 75427140033231191199222124730 66771183797141292
144813148872-30570153431 39792 39465 56591 34734344006154786109601 35799 86138
154755160322 43838100073 29972120654159778147250 20988 94875 27505118991 85004
 61733112575 74778 79916130636 90264102543 70366108993 42272  9880101493 99715
 92940136139 77454 73110 150951613101776911712811 19808 85091 75512 84328 94631
 89692127083-43909113780125671327697129086156553101764148975128574146112 66394
 49504121556139528 50659 55947129910256030 76294113927146030165680 48164188484
 45482124860 61579 68518  6926 18753 73403 16985132893135867310107 19109166726
  7311291401168955 -1570114058 85391 24633 80554 37726 16747 61440  6500 68877
 22153 15393 45829  9569 69471102959 30946160396115838288270290430120221121098
123166 21688  7893111569 38139130849144688323125 70567114644 41249202289109444
117291 -3615 67705 61999 94122 89441140092238337100595 91048 42865102560 34354
 27092 92122 38769 67625155850 51262 80843-15817 43652210201142792250510101742
 89153150102240395 73253  -183 89137 26193 54254 77330 78722103812 94772 53814
206116 25529 53354 84495 99087106083 83869114970 50687 87477 18044 30082 76105
124102 23974-26535 88894 48364117580 32276105492 80172 52605105112159266  4054
 81358 42421118017130121 63291 73580 24023120128175176183724134981 58016267019
172802181637 13341 75368 64163 82307130947112820 75155 47555 75742107584139006
 28325  5105 66889 25212   170 74630 92921128675 -4226207490171741 82936116761
140173  2419  3816300731277682 98545 40631 85813108238-11555170784 60048140954
210065255855208663169757 98522 39195 89870155645246148 88467120776 23481-22317
 25502 57126 20429 40035108503 92314 63103 34758 -6040 -8296 33870  2981 91726
113186116596161499 92033 69581 73898 81599172411161543108829 66246211359210686
 54986208730119402 71876 54945198389158602 65466124839153046 98111 74261-14815
 37891 35776269670 12411 82794 10392 65606136537 30587 57995 36590 47200 85147
 91029106114 40099 39806 68965 23316131556111219 10091 58413 84813103910248748
 49482163113 82798111580236174104489151044229978 64524 88024 51485 41872 47751
155568 55700 61301 52667 27194115038 73858 44456 57690 76060106267 19284123990
 42340 31208112212 88733 81354 65425356383163350 11636133522 81967132365 62732
 78494 59874117354165500 50785117052 -4115115743 87293113643 72818 87863116352
 94355 79405 80701 90837123149 78776 50206 79643128239 88551 99747 90592113472
111657115934 63151 92240122603 60653 80711291881 25493114999 83192 73106 83153
 65032 96294 33900 27632134082127184 77136 54285 90832 58972 75405 92316103541
 95125 50730111909 19680226256102939203217 89339 48416102120 95167 47143 78743
241215166637 75474131911 82048 37447 59459100182 15937116580101714 99705138876
107553 70733 35077103861 80802  6903 34988118529122984112876150496 59083 55745
    5176=N   -3159=I ALT2Ars                                         -5(13F6.0)~
 -3488140779119481 50069     0 19908 76568 46956 94900 99596183352119389165699
102671187516320981146034205878154807165496 98738129260 20652 46417 97472 96527
168622 43990 51241 81040 83651110885 91918 19123 17861255907184787 89108 17735
     0125744  4486  2858 38167105437 63243 95671103183 78649178743145711 83829
 63963 99286 74643 79565 54743148763 65431 34485149706126754138152 62834126624
 37589 65952 21049 26177 50788 87681120189131607165388     0 93068 64232 49037
176975 66125102381120765164264107483163228146487 78342109271 54526 50173113516
131633169051182609237939 78228 53709109511130485 90875 54396     0110463 69817
 82624 87903 46772 60015 80013180984100666104339207228 64164 57677 26151 75842
104431134898 97248 66324 63312 92286 98288 94574 95374133930129073115097 90161
104267 78317150480 82042 42771 29632 95353105879 76577119315110927166225 24076
108012124449 91964 58857 89519 66828 41738 46407 38931     0 37812102355156194
144841 79930 85663155502 55896128548140473101271116222123803 74572180024161009
145461105629 93468 58918119454 88135 91060110620     0 83926 84246104117186416
187946110251156052 86488  9351 77994 67367 94889 65215 58082 34051 94551 33987
 92341 92372178163140377 78918 88173 49302 88684 93453142880     0204150151314
```

```
 59744 88194     0 64727 30181 88736146606 89589 71401133721 83432 86840 67853
136516132683 21874 60684 15501 86021 69179108644114049109047 74901 81874102143
147810130564 96918 59481 25986 53818 70001 84332125053 83076100306 98723 86244
 24948 62849 93552 92825102365100082 57331 46231 15998 65076 48285120228205819
 95786155394 77005 39981 80847 42056103680 56437115002152009149940 62773 46332
 83938112478173075213040178132126801101372 50082 55023 70836 87457 86848 69432
 63873105179 66362150540138794101131 36275 68072108523 63025 82382143030 95622
 64892147589109666 70519147399 84574162391101453 81300 82466 32697 21697 59338
 89664115160117245 64870 89637 89904 96591128444 68523 85368 66527199818102528
122345168156127391117932 69022     0 62693111779 79159 48795 97301101855114693
102884124375120394 77985 65989127296134681130434127600 89636165502 70773 54793
 91027 40762 75494 92577 98698 38360110275 64006 48673 76247 89709 53729128622
 41407 81563 68082 56890100416 71449137089 77030158871 62354 68181 81130124230
140878 85952 93839 86263 88483107433 84585141471111638129234194102118522 32839
111719130474122138 66712 92865102705 82495 29827 80553 97154 87312 84099 49812
 84938141763124518 69299136595131233129613 74322119491 80095 99393 75576 90588
105913104500 59409 79007 88449117815 80233 78694 56614104194 95739 75041 73273
 43261 37621 41644 57099 39241 49450 77784 72079 48327133234105093147001 63465
 79045114839 82082105064 79848103166 78617155542112420108272118821154322104039
150337 91007 72907 60052 57107 94728 96774 60597101368102049 96152 96652117678
142930135276119625146953126662137355135648 76293 83250125035115241 88795 73406
134151 82501 87721 73525 47606 31228 85363 33012 77996 23129105739 60511120157
103911 84982 63490 47730117746118375 87929 72594131391 87900 60910 99068 95275
 72676 77405 84019 79153108531115919101759115712137710100200166199 91936 93107
 46567 50077158770112567103331 93931 79136 72181101801 89930 67589 61058 89214
103532 69868102358101359 74320134069110254144276104351 82505109321181613 99571
 94991127574 36544141279103885103735 68554 85916 91946 80274125898133827104664
 82720105678 95770145701109830 93628102489 43937 84419 83074132937113835 94951
111928 58114 70281 42631116238 52604 84501 75379110072 86682 83109 38468 75026
 46180 76455 81331 45115 40536 96849 53558 97132103145 52094 84455 73486114946
 82374137720131867113094 90760 24746170041125014147348 51740135856116745 99919
101047116763111396123596128988183346117848171115197129 79709106102150570 53550
108479 41173117297 68475 72447102948 81134 15613 94477 77962110885 26006 54091
101084 71151 25953 21433 25290 31188 86031 64770111026116413 54397 59365 85571
148404139597102880 91148 37473 98857126128 62603 86928 86537 78023184851125098
 28277 89818 97865 59517 75602 60747     0 54310 17074 85873153670 54525 51237
106208 69440135976 85867140907144273 89332153197 89728113982 83235 86156121588
142532127927102256 67046 52551 85021 87629 71567110920200858 84266155148131820
 91105128845166605117010126953 92364107065118093 42702103023 55810 93577 81213
 98337 98682 54903 99782 65087 76956 59443 51777 53327 71117 96344 73254 59819
 85294 34523103619 83090 85692 86005 79173118689139151155312 38015 95849139119
116316101753 42216107786 99068107266 61548114898 92604121981 95127126697105664
134918146018 93687 81976162804108732131082 99780136235 82598 42200 54305 81556
 73458118366106055125013 68362 76661 32584 79299113769133140 98833116022 73670
  5376 78903 61886 81031 36483 47938 55930 71908 42464 23726 56690 68586 46042
 61808104169 71353177804101778 57561161250112058105047 32509 19748114320192684
194022 49794127494226097 57469 79735 27565 51194 79536 26423 75620 39482 76373
 61821 82436 82051103632 45748 95632 52910109186104467 87289114429113128109954
173971 63842129405161654151552 99745147645133105 98463172882 84944 58801110382
122183108061 88417 91632 54916 37276 40397 49673 21078 44591101441 80320     0
 97596283090 74535  6470 88770 82679 46453 54546     0 91053     0114578131173
188058 54081 16889 72508 61616 27943 57702 49575 47265140277154566 69397 29677
135741 23110 84416 62097 62960 63458 30744 39126 19650 72622 71274 59705 48530
 97522118419114062192705209677134875 62526     0219373 82460129573187434 60382
 89678 43072 54585117516 42519 72837 56708 81473 57102 93109 26733 50442100782
 40395 77773 164331604281881131166381122 76     0 51877 98800130935116984114786
 14635138313 92998 41840155167101199 40380 91233 23288103555 51096180746100129
119856 25372 99773197174 69950144388 212241294611161492252571219401 43803     0
113273 34940     0 38015 36422 67910127866 17996 69149 54328109320 95241206936
137091203701294008 74444298256 91099183999   557 54735 83141 15707 15851 28231
 92829180772 74593169569181127234272174667123584 36382 34829 61552     0120412
 75168131956112962138762 93946 92841 86248135418165738 39998169117133968188299
103679202991141061171123129763111551 51892116938 29311 30950 24360 71394 75583
 44826 60502206114 14885191750 76040174988 78045 53670126133 49148 44374 83741
 86027 62767 71427130030 27542 66709 63862 50330 79067 70715 13634158594150474
192324231619 13705 41049116938 62827120101 11604 57918 51026182264 71877 65934
 72884 51794 76079 35382 96354 80818 65541 78663 84251108992109241 84757 79027
 88906106329166841131355 50459     0 96743123840198285 74914 24117150925 87018
114984126574 87403 75595     0 69928 79814 84249134912168836 33612120466128048
194675 45314117886103888 45696 35923 65620     0 31229105884 71021 29759133384
142096110086114074141238221178136202148182130610136145 37269 98363     0 91005
 64997 65013 70121 59005 41293 64482 77953 43945 59424120693242417160089 47373
 41537123065 60131125019122238 81433 89143 53837 53074 68749140390 76465101555
 93639101176 79947 83820126249196205 63176 86078144494105796114470127567179019
140632 82317 54992204422140327 93339 46451  7857119277 56464 40577 78286117615
 75840 73922 66721 47110   510 58516 58551 78728 89963 68491 65274 16913122595
 42688 87517 47704 48368 72975 90434 75401101288144422138129161735118117146124
 37554174209 79900 93536 39021 82033 98443 95545103698128662 86797113928 65378
 92573 59649 39031113291  6853138663 96287130042127860111221106944 60727139568
 91492104981 64135103603 56753128030 78377 81880 56842 22771  5633 89561120841
115554169963103550141303 125641230521089841354081228281722 70 77111102982103140
```

```
104766 56911 92109 66126163961181683 15165179085156407 74212142101151566 93522
140153 63734 11585 49072 30250 18393 74796      0 77376 54560 87342157746 46167
108740 81983 89010107428 89415 66711114032128386 74739 82222132680      0113590
 33763 74625 75212100173 91505121455 32579 86236 89551112553 62320  5053 71897
 90054 82848131828 57004 49847136919135062140950164264107811 70058 95670117898
113328158526173263 94721 82587 67053 83449132701136844 55545110636 96745132691
 87761142409111044 74367 77467 79840112727150813134886105293168780111570 95646
123522 93709 66794 60131 71737 43235 27951 99940 86284      0102257101503141934
114531101630 81758 66199 90475 99084 39109 47884101076100396140317110664141445
109490113523116173 79875106032 85991 52669 77629108719 81884102399103875 71979
 82185128685 84809 86806 86598 32620114796116502 47965 89736103007 76768 52641
 29313 89691 94177 59302138549 74354102917108634 53000 48159 97967133234111842
 94769125667 98891 94467101082 82459 91490117988137750 91941 94662115436 93221
121894 96226113192139583 72289 98177 70628116415107147101966 70580 81657 77355
 92172114631123339 80881 82285 83470 28515110307 91417 80802 54076 98301109875
187187115710179529101384104229 83215 66774 96256 89464 85583 79348 88594124211
 97019 93324 68096 72962 84160102561108434 97492 92221 54815 54334156776 65638
120390 84521140411 60810101566 30036 88501 83645 89495 44010 94129 60094 36799
 33732 73359114847 69208  9229 48572 84833 65429 80667 50218 75072114418105486
118773 82203 99304107918131247 65466144836161848175258189875152385112671 53802
 98493 86432131164122726 89072102944112595 49888132086 91577154861 94619 87643
100774 43356 96553 56208 74518 45678 50949 73400 71531122393 76084 34075 67788
 73567 82455107293146049129925104909106292 50313115008123051 89933130156104702
 65718 35674 36476 66975 84027 53777 72073 76403103215119643 87062 84817144630
113827130719 78935123027 92726 97738 40762139498 83984124489 73746 85860 50630
 84164 57410 44004104678 41765110610 63506 99651 90326 83999 62037 36826 63170
 87857 73219 92931106128 72161123221112350 58972 96453 56718 90673 93687118222
143480 75142 46967129144125605 56358 63770 55297 38639 93293      0 51641111991
 64547137740145116 75913128747 53505107860 93903 70362122665 21219 87850 53824
121884130115104293 76096 67017212443 81877136898158869125494171868 83357117039
 75041128324115358 95920108757 95737 92386104793103781110774 84026 37352 83911
 56171 37740 97679133221 97263135064142386 99107 83910106169 87729141775161166
178559 43547 96040142179 87435 30763  6243 57700 48821101045 96183 79140 37436
 84102  9832  8194 10524108539 88391 52072 58224 76688 88744109835 76702115302
 84741 60677 91919166298166841106320101399152427106232 91498 80068105142 90787
 80629106597211045147425188145 29322 83638 57510 79955 95743113658 52105173787
100694 89523 64819 96912 43600 41187 83872106814 72972 42071121566103158 77893
 51842 73357 69829 63618115885100556 97012 84958 79229113898117077144403 81982
 91541 11890 51743 28203110405120782 82021 64654153082 85376      0 83095137835
 85875127576 80343149712108115106771 61281116859167482129611 72622 57959 58372
 31233 60632 79785118856103855112620 83618 91124 44067 89302134181126302186831
 74947 80866 86805108116135291 97333 75530 45926118983 94096 90388118364 91149
 95510 79606 79332 45758 54353 78505 49219 60437 85631 72825 80908 92340 76351
 85937134505 64083108499 196791105161606761307281220261218868 71392 27903 38279
156956122507 77085126021 99336 36115 59215 50036114416 81844 71378 92245 91147
129141 76887 77388 38971 78356 50623 53136 56642 84615 73981120840136655 92962
125956 96247 50982110820 37726 73367 63963117044 54040 79166 87225 78765103478
 68463102359 42669 71844 26282164643101732 25719 70971167982 54580 47577153202
168945159482112759146442116033 26670 90127 57948112367 67484 81322 95649110384
119897174581104862 66553 50553104735 87102138204 54509 29870135298 45814113484
 58700116654 40085141625 96689106897 79859101002 69612138975 87712102191 81881
 78277 86745 62859104694 97861125510121774131929 91293 86945 43069 98509 70778
118531141588113156 75363 90113 96350 84133103424 71606 67171135053110137 98343
106315173650 83341101341 97463108975 78414142957 95902 13517122889 56816161169
132005153090 75699 52013 49987125092 79409159055116672 59812 57912 67921 78210
 71710 29601 36911 20750 55946 52253 74095130607157836190048119851 87089 73545
109887 41565143513      0124153158612201084 82762141056  1864 44157 97617 89873
 66732152489119600153887 52429133587 81306 83873165565 71405113448 58284169499
 84904 75784 64467100034112173124019 65322 76110 69777 80797112751 30309 93348
 58757139515 82671 75541121930 33875 34475 56041 86224 67752 72156 79893 79128
107258 27178134021116172 92823116172149275100929 91228101505109667141440 92716
     0 30299 71208 40441  8581 94655 30568 93975 33258120390 99978134965 45765
 50734 69493 52565 72184144116 32939116831173761245648220693164403122766 49943
176111 96373 48889 23018 44009 67991103672117625 37136102749101198 80748172027
 57203110812 71716 62260      0 79796 83891 30339128196110458 86836139383 48449
119035105433108342 68583 82200 95575      0100751 63621 29448 37434      0118818
 49508109130 91196 73465112724103455118230 99892154008170355 79632 99337 31871
191119136078 85287105745158612      0128001 83106106539 53863278399157288126173
 96820138974170071 88953170884 87472161834111991 33608 92847122808 32250 93038
 60632 85173 66597107817 87894 77705      0 81097      0 76402126207127774 83313
198930139749 85433 29867 73938 92953117680 77101  8904121201 59627153826112294
 95475106430 62710 55105 87050 85435 90535 96676 44152135386172648 85129 72642
  9556128383151789 86434105908 85155105146 42810137220 36101 83291112243105816
127109 95522153281 99576173651140702 99236159971 54338  7283 90007 84068196468
102569182890109889 42902      0 55067 49330 37264 56611 75013 73513 84165      0
 78143 97554 47580188979145357102117122407136241 97894138359 76253 91679108033
 81375 71972 89028106188106518 99206 85104103056 47642 30381 38952 94160 79108
 77296 89862 77303 73790109075114855 81358124610 94556104457168860 54571118996
123796127113 83124 58976153489133458130880189704165348143466124985147528120754
 86292 38512 45204 95951107918126102 59727 93421114850105547 83380127896 66828
 85277 54163 54841101899 53277132196 99018 63344 20190 91472 24413 67556 97579
```

```
 80851107873132750118554 23055175423204863 84603 50101136966142462 85170108235
 93618 27158 81340 22746 86397 22199  3610  4528 27771109435 47554156654176455
121381 54943 68324118243205403105679 76595 60189141917147010163406 83784123591
 62124 72304103820 72836173344152318169511 50148 37951120298159914 91241 34801
139925135859134519 75564165418190048 85129 50864106124     0 34658 48627 60222
115862 89413 88224124233180974 88227116497 31553 58684     0 77116146867  5029
 53460 53301 26782 21539 60527108244 47859 62794102964103733125148 92596117963
191845 94948 86402131585 91213125250 78923133528 86286 81355 13808 55455 67777
131563101673 39349140041136735120927136719 44500 73225 34178 59686 49123120381
 67163 80859 97918 94909 98590113436 33369103457 89871 77283 92060 45748128450
 92174 69128128549 49957 58064135606257557239959186612 85323123066 45306 78859
 82474 94334114022 94097 50500 84906 79474 46076112501 69095150486 74895129366
 56757 49564179794124783 97005 91533 86219105470 85956 64409 66016 68451 41783
     0 75172 33336 85743 64090169577104403 77195123045152567112256155237112598
 92829110113 78710 70911127226130769138639100577127980111551119629112943 99561
 75086123264127298 92142 71328105971114906123289 85164 57786108962 86873 64953
 70364 44879 27528 65112 39260 74742 62389 47964118626 57894152654 71608 99415
 77510 73315111610128500135987108831109347 98960 56696 76655 78117 35580121838
 41670 71930 90922 78760 86520 69345105217106574 77991123327 93979117820 50313
 78292 47994 81071 97546104619 76265101046109287 95514 58164 86099 60474 55145
117805113124120121 70029 90346 63638110908105152207263101814   897164496136917
125027125545 90697119909103293 93998 99607 64859 79535110257 66159 76783 66669
 68898 96353 89157119935 95701 90624158253125340137823194354101597106184 80656
 71015 87711133817 71059 84740 95444 37317 72700 92445 99815 61536 39941 82476
104076 39192 75970 37338103833 71509 86004 53953 67283100512101075105041 97580
170680159338255131123868124599 66965 55776 90371 27623 80724 68259115701 65317
 80783111361118523 67399 90158 56778126688128589128260127406121209 99873 46822
106240 91660 49637 30330113367 92017 70379 84269114075 99226 88757121371 93044
 97578 83819 70793100533 95411106277 97607101318 97722114520104831112918123542
114749 98878 82362 79795 39229 71691 39557 77085 45952 94757140592 90800140663
115166 63826107189111364 43513 87640105586122016 93692175354138242116128105173
100578 71486 65684112603 85873 65157 79659100977 95724 91360 72405101670109812
 96770 72832 91880 88752102143 61867 87808 68748 61190 79217 77292 79694113464
 93145107351 60966117915111956 77019 77216 74334124839 77198113893 82683130018
 52998106313173289105535 92385 78310 76539 60170 85261 41192 81716 73847111321
 56614106952112173108068 80206 64014141315 99974 57861107116 42379 85308 82114
123515 94693153625116921113514115734 66195122039 89458114779 44795114284 82657
 79919 99636 89922 62254 93422 89317 93522 91484 73687144384 91522 71273 84674
 87892111537 44787103470 93929 63337117677 94431124609 70976 51850 72164 85096
134125 75616 80513 57661 42562104794 67874100180 85894 67200 43221 85569 71825
129879128838 30853 77306110044 97274130982 54699146677165705200844136288 99064
 86883 84890104659 90517119077 94354 72470 37153 87534 49442 87970110173 40603
 79626 97536144225151209 76364104631 75049 88638100808109463 83726 79698 89064
 58810109358136064 81784 50265 52129 35831 58190 13380 46181 77171 87746 60971
 79794 79931194790116000126485 45346149497134042209024 70150133430111149108750
 76441105390 87141 70814 62535 36468 92951 95987 50513107599107009 71515100846
 68287 74721 85614 76879 78068111814 72179 71742 83064 61642 75871 53165 71593
 85907 43122 89363103977 97321110052111384 72570148895 87631 66440 93765 91800
126560117856 79408185440107265 60447100551 88545116561 82196 80432 87516 81935
 73414 40061 59449 52917 85327 66513 91588 67698147711120146 93133 56786 93927
126313 88378 71818106370129564100925 76001131677120678 84022 73705 78594 81204
 11894 84686110807 96288122022 69308114077117667100696 62429 73274 27208 69689
 65287110563126231 46449 30234 63606 99142 93656126499103421165021154034100425
109868113395105167120611201997 89744 35112 90194 84874137716 65848 26958 99466
114246134875131116106006154437149549 87197162222 71323 98056104133105608103755
120296 47407 78174 48412 64856106114130906124816 75068 98783 25168 96908 94028
137906 85945 85363 50097 64114 40864 79705 96014128145151392159937 40032 57266
 65320 63036 82289 14580 56987 59582 77271 91983143631 66028119522101558 78876
 93638 98224121429132044117587 94338126066167350121497132554122240114046 65371
 92903103269 72675121090170858101094 91839 62663 78216 73973119795 66710 74844
 35434 60029110265 94153 52411 70121133801112040 95892123072 80971 82188 50992
117174 75288 45109 96182 98573 78965109780206167118221174177 90848102196 60427
 72904 46731 88678102997 95024100169115897116982143418126093136824154782221778
 94070201592123527111026 90871     0 92209 82988111643 96703111906 52607122096
 76849 73982 57467 58105 53167 33491     0 47210 50698 92014116483138138 51516
106309 64912121980105963 86952107149 99903138646165220 58652 79852     0 55801
 47502 50773150731112665124362126489153246 66222 81092157850225374146474 77196
 89042 76581 93996 54573107247120010101145 92658 72088 94841144279 90302 70973
 32826 73253 43758 34579 78473 71015 34363 44013 61364 46931 64354 84785122749
138293131144163106 80216 38881 33377 11500 76457144323191959135610 74527111443
114627 97441 72853 74615105552 81421 75051165131101181 58101101719142749 71477
130233103598 80724102744131963119430113870 83526100357 69148 45614 64928 87065
101246 95170112195 97314 78182 58391 94003119232104765108414 52244 87221160322
182880160800143012124294 68642 98243101085 79068 84373 89181 54445 92536 22725
 47886 11314 94363 91084 87977 82043 82392 78514118682 86508114930129086112617
 71826 62086 98232 40428111049116824 85406130049102672123876 81553 96023 37911
 81265 89254126060 77670141820 86869110516103696126508 96128 97637105611 81326
 42848103449109283104058 93513127121111180 72095 76831111262144493 93003 39090
129031 97070 93748 90576 96979 73640  5192117715 94142 90186 92590 56576 92543
 69885 78378106929103476129541 70312116689 92876104258 75218 95955 97802 56226
 71144 78616 58033 93212 90959116331125175 70155154927111769 61888 97332 95483
```

```
103926 25087 77066 29494 75942 27253 61495 61267 554211048641183801429311133896
104945108629103974 97352136211116010170099130813130396 913531252111103873108442
117093104070 76334 32910 91553 7306810612611506 4 96124 87738126395 74431 57752
103513123603 84772132164104453 78138 81065 68818 89582105893 31921 79847 71174
 58652 28279 84572 94192142630 52871104888 68459 58251 95264 81949 32739115428
 98024 81003 51788 91492 48554119080 912641667721221841190651394181341231680 23
 99046 98451147520135548 96169104525135906102752 97098 11491 55155 76638 73497
 67791108115 65652111184 77351 38158 92587107613 87032 73614 97869101990104537
 83131144168139801115288114144153346 38575134251123537 88784 93730 64344105587
153188161061134857 64491 41527 28535 67629 95846158854130374107897 68256113068
 71368 17313104584 83552105221125612 90808 67445 51391105708 98805 85215 47758
106656 58094 71130109516112206137755 87890 95766 75044 76571 67601 94240128714
128460166400 87078117409107946103540 71463111270 67935 49110 91527 72791 89860
 97960 63277 96941 64003 92193 97753 47605109967159676198304167420 48778106696
105048 81632123057132486109455 83631 46930112078 63740 92873 40616 75044 20311
 76901 63339 25589 84747 59953 88424119861 86710 96792 63382122877 43902 96441
114599175885 96897103357 86439 24257 80672 53648 67141 40289 75138 90382108081
 80686134509 78638108429 90477 88302166854 97478162053126275139458 92150135820
 66072 73803 95195 78735 71295104033 59028 94029 73314 67223123496 74353 87082
 58955115977101849200774128668 38474115148 90880 75313 18012 68588100213 88520
 72523 91643 68863121148 98016156721150979 86769101206112976 55280 66890 56857
118009 64300 96825 81291 76435103848 70519 84226 58520103931 74843 93552124358
106938125290120277101532149606100626105704139580179207125433100996 56783105115
 62822104305 87095 61274 78728 95949104375170285 59005121965 69538136548 92086
126063121133 87272 67535 51127 91804 81955117101 74076 70264 52758 66467 71661
104602 77721 66213 74538 89013 79133 92337143951101443 35112 99270201590103116
122768 61621 89455107546 76709 88569 50175 88779101390 98763 68843 62762 52199
 83405108536 73077113864 73812113748 55593144887 91866125547 76338120138 83798
124448 53285 87170100715 70066 78860103381143938 85535150267177458 65476110883
103711 88250127518105906 82444102734104184 91803 84417101430 56453 80547 76967
 87064111529 96187 68138 89278102860103437 85500 64437116424 88158 86053 72400
 94931 97007 82549 81343 66689 58699 93566 70433 84707 79656 91184101856 55068
 95937116286 99235153285149488183796130760107594 99499 61343 86902 98860 55165
 98830111749102755126605101963 74477 88212117319103666 78593 68041130929 83496
 52619119814 94884 69315 64404118430124121 83130119129119320102544 70568 91119
 83554 50715 56904 78914 88448 94217 96409104067 87375104159107002 89230 74625
131596 69031 90154 98050 89752 99300122051112347 91956 58950 46489 75583109981
139241136448109318113808121330 59289 93736102574128008 84961115787130104129767
 75359 98121 72256 22531 65175 68261 54996 92364122523 93450 90931 73792 77339
 58897 98724106378 68294 83107101685 85986110749156394 81453120482 83899 29131
 98404 81113 97374 39354 73435 56244 88557131704 53471 82625 65559 88871 57750
135796103375 742941118921387071354421308031144801169091322541047821098 32 45212
 13824116602 57655 62766 97506 43949102900 78649198249120803124856 88419 60961
113252 53680100321108434 94494 44379131349125629 99349 51379 83730 91632106726
129209 96836 90829103581126069111293119579211525104145142457 66759 94266 56495
 93069 85512 58917 85172 30866 68178 79381 97728 68823135588 84064 72966101160
 88806 92301 93036 58134 99056127991132531181462123940 83418160120111632 99141
 47127 57097133672 89807 77032 81695 69017 72016 49340 12952 45336119326 80730
 52299 71510 71353137204 61135 70018  8159 77230138121 720391316601645081197 10
 79853 91041 82862 12179 36772125560113510166476109697 95985 59582184800 66241
136017 64182 81109  55271059821104401213281668 27 82605195856102048 83662 33503
123711 95256164968 95751138829 82949 60743 95563102837 84839 31730 85782 78433
 59474 38874130737 87841147406137511120752104804 84671 74217 49830 75086 90264
 48489106927 82006125293111103 60543 31908 56919 93459 74709 80025 72946127821
 15760115205 60035144502 47136189128 62362117091 66883 77086 92633 68445 56308
 41525100986 57217 85455 99152104472 28552 65142 72530113296122614 88106112833
 69077109875105546109039 57156120614 74758107159139382 53621107244135782125071
 63529 94701 93617131868 68444178080114531 47478102724 51702125396136656125291
 55037 78731210911132607 61115 82508137493174296133329 95832114726 78237 71823
 90252 18947 97904 68760 57692 60543120599 59660 72304 16624 44005 79974 85420
184364203268 85613190469117988107045 52182100333121035100537105778 80032 96984
152996143004 46757 35313 73684 75566153854 90592 87630110245 57031105614 46590
 53778106225 83256 67131113074103634219539170458110020 18810 80828 42850 47242
 73352107077 34937 90225 96109 74747119389 38097 86931100762111416122480 62628
170278173906 95674      0 70612 84335 92692 80674 93861120114 48286 85395 74742
119858115778 83899 60934 95507 45082120664 40747 95852 72314137176103717116677
107037138244      0 87312 50463135935 52045 78947 72538 86942123897174054 23032
109149 96316127150126716 255931637881496961098851309481070 46 76283 88288 53976
135674140958 83761259514183081123054 90419 80814 71302 68410      0 52992 70807
138084 97481 75837100544 21983 82803 56329108154 54437 32094140662 71035191185
 72739      0177733119297100597114440 45262 87919100112138043 75709 30512 92671
 54554 90308 91528 78745 71863 99995123168 88857 91869 77224 66018 97994101440
 91453 82151 98977 51919 75338 69108150884102685 85471128176155739 94170185007
111868      0108193104335 89245 91127 64463 50137114659137618 74862 83250 16080
 14323101483 88133 97437158007 62670 79158103971 65385 95565 81181127192127953
 11283100572 54499 70481 49891 78816156478 67518113769129919180891144066 49995
     0112762 91519 76503 49262 54288 61711 47984 67335 58092111222 44686173600
 96170154094113001143501119838106139145943 66248142800122922 82080 62872 56566
 81581 61028110470 87111 38070 70672143397 91665165838 95664118266 85677 45089
 88075 93701 39848102102103593138389136871170288 49770 63535118927156018143276
 90817 92766143372 80559 74874100300 81996108256103472 38089 99930 94632142774
```

```
 75615 97014 64791102145145794113151 95111 10181 91075101727  9900 55739 91262
 81550 63761 85197 45520 77331 39065 69121 82917 37180 78056 81380210225198762
101779106148 44740143396 71061114206 556621049521146991005920 82784 52795 73392
 86616 58614 55039 17394 70703 76616128640 84679 71787139780118295 95239 17389
 98991107025 82432115904137403 85609113222128419133380143460161775 98354 84586
109313 51764 96279112927 98061101757162914 65241135507 49386     0 76035 71578
 67367133429 79776106578125480 73621 26866 60627     0 50150 86991 80917154648
 37865 59334168972 63559122165 63171191948 68391139213133511 69462102663 77782
137595118387 47566141396 67686142092125308 83055 58173 96641 76889138075110786
135515103505 39485119739 79146 88295139135 96605 98770154546124380 64754 97273
 67719105567109476 45067 64706 72715 69855 20449106728 44301 67045 89828 37890
107450 59357142608 87227 58150119680 59734 77138  2316 99588 23266144083210350
111271 13558107606 44962 79528  2486126018 49156193204 44035 93733103096 79615
 63633130925240230185287 64149 89111 76341136149 95826196863270239244540 29711
 94588 323661070222022391328222297291124667 50367   617     0 30635 79389 11756
218324205538148091139277134471     0161459     0114761  3825101134 30348 57834
 49597 11317 16735     0 20374     0 60889129318178495 12018  2662  4327  6307
 87155 79954220138 94052     0     0     0     0 19565     0 77784263860 85639
130249113182 67229252400159454 89250116712 428991008981116661206330 11846178432
174376201685 71509 65565 14243 99141 24102 68450 57392 54373     0178617265649
 95243260523261698251426224285105997 60929150878115176 42611 78419 60036 76181
 79622 50644 87629114110 43006 56052 67308 79778 43503 56156 71772119478115792
 21098  4022 74531 58135 50340 77481 77345 67060129201233782234911174516102337
194205164013172499174584     0138732 35356 29208 31202  90063132611934911600041
 62445 85142146254169361 66455101264 25838103177150728159738 41908 88954 17196
 97831 73540 55151 98407 68469 72204119854 91311103102 69955102255 38835     0
 68574 78438 83655129399 82287 72783  62781354141737241935503 51802 85988 65806
 74341 84005 82494120803     0 82921102928326136183272206265138055172080150754
167717 89215 55892109636135988 60495 513071131022527091143571375351568581841669
 75706193833 64593128843 63760 63710     0     0 32823     0 96954120105314487
 72795188614 24795285226203077 47444115184 82054 22371 59713 17877     0 24860
     0 29044     0     0  2444     0 25746 68162 135531356201128822960443387733
202948177162155136 45008  2101 81007 206751094661364523330491308311527944 57885
199251127488136954  8811 50897 38260 72941 74840130528242273138480119015 52476
 93768 26588  8803 60719 17365 42772131309 51144 73360     0  95311716721478881
271378148845123433162136258276119124 25295 73893 10104 29415 48651 57173 86834
 85977 48737192066 40654 51408 65087 84356 97745 81263110214 50639 77084  6066
  4705 41013 97468 15572     0 42769 15317 89866 18668 84803 65802 42460 86901
148541 13870 67286 23250 95432118886 67180 68269 12134 95029162376197906166521
 86787272672212135231146 59368 83042 54756 69301117661112962 80574 44647 60005
 90750131517 34600     0 32956     0     0 28984 58357109378     0183155177310
112323129915148919 18013     0263906302234168330 83627 90953103921     0144700
 55898136372212887287520268201234567152777 69544 89603149144256465132189149123
 39423     0     0 12906     0  1089 69727 72033 52447 19747     0     0     0
     0 41406 80041104100159835106811 79113 69829 71659161679172470134225 83970
212071235229101976227081149896100550 61673189344174789 95072133555160378116912
 86268     0  8515     0233472 30770 83972     0 39084108482 24550 41166 12617
 18632 54235 69382 92778 34332 23229 42017     0 99949 97901  9585 36626 57781
 85486239713 80802177019 985831214272410851408871794262542801117301112144 55704
 32816 25910129059 52816 53918 35465  5747 84081 57609 32266 35971 51871 86351
  9673100696 30562 14781 82757 73363 72737 55417342172215068 71032141846 88092
135066 69500 75874 50101102293159447 65231116641     0 93022 71782106007 70516
 81643108086 93851 79012 74895 82089115568 80112 47533 64532112863 86921 98337
 88467110508112632120329 69657 87709115667 62755 73922280752 65046130584 85846
 73782 75044 55628 82438 23855  719410193511537 4 81050 51809 76862 47095 59759
 75747 92451 90122 47382 98085 122672051311163492210071202889 69243 97486 90502
 44551 64296225389191747113880147344 95147 42552 45150 79537  3816 90992 86854
 95387136041115517 79190 32178 84974 68259     0  6373 82684106485112129154239
 73591 56634
```

Table 3.5. Version 2 of the floating 529-year chronology indices in Tucson compact format. The same information as in Table 4 applies.

```
AU272 Std: aug27-floatchronversion2                                  [27Aug20-1732]
     529=N        1=I ALTF2Std                                           -5(13F6.0)~
247608236858-12106 -4397213940 63150 62821 34980 93001-42869 -1409111240 24051
-26223128085 75488114619186505 93109   131 -5346-43071 33202 96355169874 49734
 49353175571152690 33652 95767161658151588238960164386151105 58762 91106 39800
119736168694 74322-14384113656-31348 433091639975806583678869 69437208929 21818
 56781 45120114811 -8562-18786145254150746138362175432 49469 74978220450176824
 91775 68814 94203 56840 26358 30595195381 99174 14340 47726202519 93205 65040
330523 52579 70345169958 21082 73567 -1139  9283 31645-10934 69724174356229740
102818101624141432160706108255 99667 28794 56687 49658 92254 93867 35705 18482
-25085 37777 45977120950 75516127587109023162030147211 30305 97754157006170858
 53756 -4575 52429 94052 65189179880 94475149441180487237742118559 -9091   115
 83499143968149398 82562 13411 96897139670 86939 216101382081441881046649 54818
  9394228832131323 34166191753140448246857 78749170775 46233 63562141227 50942
 78461  7462 50598  -188-18648100127 90920148946122657147841 19668-11358 63764
```

```
 66382 73978 34568 72837 50282 -4384 86506 58607129616129679 14876 10551 54761
115335249577247122 86271164244 821842069822017081572З1-66521175296 61138 90190
 55562 680372039071168651094661884331826242255O1187694 83878 18605 98520144286
134510 71539 543061638391326201O5339 53094130641 98802144500154149 77398 89381
 21975 31224104711 10349 45854 47816 95724120402 -8948170591150810 13408 56617
119977 60653 99341 64776 31692 63002-25225-46726 55191 74096 78884-70151150815
   586118531153420100798219720 73847 51644 37783107123 552701020502610021476б6
154092186946109869104370262681206609 57611 50483128020 32262109751167180124479
-499112160821199661118521314З3 34996 15952-20805 33855    -2 60647 13311 49787
 59318160976100977 110981035451366511784б8 82018  2989 69849 92108119704 90050
132306 94636131114142523157249 84450230759   735219886262469158144114148234691
108641117217 51010190123 58328152394175298  5028 -7512125187161672 81779203649
 98259131957116972134869132808131822 17457 94796 95020 99735193375160028 78594
 38149201395 67252 56784 80170 29768109538 24468 83592 50483 15152 77659131361
 11414163640 83736135759 86866191323171789 92028  7547-17996165181202756 70120
377192122581 38129 52906 35919-28557 -8329-34931 19348 77465-16156 33521 40742
 30529  7564-36707101083250767282270182235298797104062 79344131903 49530 73923
115454  3987 49185105321248872210606281669135904 18160-27772122220-19864108289
 49543 69601-16015102482132450 11660 82081 77807 90601270738182751 66060214658
 -9710215991-36973150956 -7646148819122877 18509123422202786 35939123827-10708
 51769 43563 60730 66501107138282387226926-11321266562253651139881-45319 62975
190827152782 56850426065 15201  7294 65892  2897230227346597  6667229093 -1041
193288144624 88429 -1112212797138946260263 18066 -8236118998  3807 33477 -8930
-28607129726 13257-32806125082181311368100  8536 11641-22224133573-26453-37132
-33941167265-12766 75454181181226822 83762253427177438154821111920125854 80802
 36442  7226 54020128582 88105 36275 36821 50783-24249142285211828224344261545
261257 85366208367162816157583150157142453-28887 64416 15180 31736 43333 90475
 13783230577229598121039 29989 84610 64222 38186119258
     528=N       2=I ALTF2Res                                           -5(13F6.0)~
195280-50657 27181243347 31055 73201 45453111316-40898 38834139805 20884 -4830
163640116728120634182346 70380  1714 21137-14957 71885114350170912 31055 62692
189262132308 20356113958162659134662224827126014132808 44175102342 42761136343
163148 55757 -7503144341-34798 78328179040563652238400 -2359217385 -7739 78284
 56024129732-13281 10971176697138540123684164714 29019 88608227318144334 72324
 70840102596 58075 37832 50324213722 72649 13925 70640216779 66758 67186341161
 -7884 83416178207  1926 95598  6572 36920 56300  7420100022181748208490 67307
101118140568150462 92067 97240 29419 75629 61417105492 96268 37371 35988 -3272
 71591 62517135388 70647133856102022159090130885 18295117148158502155591 35208
  8543 80644106238 65989188643 71609150953167775215805 80420-15042 29669110445
101371121396 68648 27819122648139407 19434 25288160289152691 92083 57930 33506
236776126679 23709208796111192273645 33693177870 30634 81511153391 42366 93790
 12842 77000 14618 12295135725 89454149419105322137209  3300 10737 96409 77050
 85264 41357116048 89818 23449102231 67337175991102298 37892 25228 93340142772
257248197188 64975149659 87280209247171831116622-85266234630 36002 69068 55651
 78598216750 81448 81955177698163021196013150162 76352 27943 94891140589125566
 58192 55343163152 93023115611 52838137196 89960151180124741 46118 71678 27342
 52178115597 20284 73287 65892113145156680-14644189490158082 -7000 67379136769
 53984 81628 61991 39690 59746 18151 -8823101976 96350 94336-66284194301  8640
147792160269 84933234390 34994 58544 54537 79198 45631129134235292150409134565
185737 95838107152261222165927 11098 97024144551 36979120649185540107953-47589
238958113849 91432126181 17579 37744-20567 77836 21898 93413 24711 67421 91390
156944105586  2337130276150292171683 94039  6168 95615109779116809 85168133470
 90062129817131731145510 65205234768-35064237329228660102926100212220072 72588
106283 46931205413 27294165184158897-13887 17072157131170994 58945193821 76334
120731118531127288116310125131  1487119756 94336104368193772137046 55616 40528
220914 45255 60478 85453 36519130980 26163104959 62285 23546108099145664  5586
189444 73478130919 76585196536148382 70064  2225  3664201118184953 49031372292
 50895 12798 67557 61036-10197 28976  2075 64589105267  -861 66233 64440 50332
 31542 -6209146832253274231911122986272872 58070 56054142332 46659 80612127329
  6533 71860124489258604179287236617 78224-10843-16717160310-10410131813 47541
 91131 -4741136807137013 14176 93951 95808 92145268254143706 30297219164-30121
229786-64934181983 -5302169858110093  7135154517193975  8366136584-17089 85708
 66094 77014 85116117356293341176989-66898286811216861 82962-60652 97346209632
127688 42297418425-46823-20951 96953 22959255081333316-62572213766-14617196048
139529 66112 -4985235317129829236382-20519-13801152866 15074 50688 18320  3241
171593 25167-19053164702194770347776-58280 -7091  8874171234-16234-15713 12148
214193 -7865 89316202082213491 46159238980148012117283 89721115696 73786 36780
 23056 82114151106 88652 34721 51660 72784 -5210174870220530195300220152210420
 29367188756142476129391129440124005-44700 85091 40625 54259 69346111767 23706
249731214717 75929  7450 96125 77229 47740137054
     529=N       1=I ALTF2Ars                                           -5(13F6.0)~
247608227529     0   354221576 57617 63941 37575 97677     0  7940119692 25187
     0137166124848126063188040 89615     0     0     0 41957101669171276 46627
 51031178564149473 31165 98919162423148300235380155591144954 53996 92292 41077
123470168276 70674     0119454     0 49806168074578525342947 50720206618 15555
 59835 47249118207     0     0152028149907134587172271 44808 76549222194171030
 87843 68184 95645 57123 28464 34695199454 94378 12697 51566206197 89960 64993
333513 43134 70992171870 17628 77602  1678 15438 37825     0 76828176685225244
 94670 99954140558159323105028 98338 29056 60129 52706 95159 95210 36325 22076
     0 45309 50568124588 76019128617108275160897144190 27950101407158809168440
 50161     0 58283 97123 65361181075 89322148620178398232933109463     0  4986
```

```
  89687 99118121204 73280 21981105602140631 28311  962614054416154910553059138
 24578220298152962 35280194656131872280608 73152172004 46366 69793146792 52589
 83432  9222 57167  5260     0112041 92085147689115741140648 12181     0 72715
 71089 78948 36758102230 90305 21331 85043 64069168140117185 41647 12479 74218
137140265362233316 94102148370 97848208777195596137508     0195944 56964 59665
 46838 66983209536105379 83131174012179191213315174919 92720 26353 78800135957
133422 65494 47804151749104329116557 56456127683 96008150308135732 53924 61612
 18955 34472101281 20564 55932 56264103590157464     0167185172761  8896 47475
125294 59510 72782 56044 30087 44472  6019     0 73715 90607 92284     0157603
 21225130581166951 99560234294 64335 50752 43778 66915 38402115676238717180716
152200197142117062110880263599201670 33311 82454140717 45875108824187468127063
     0208004137446 99613126096 23280 20982     0 47723 10477 73854 18998 49724
 80406152663117092  60711097541524231831361122O3  8834 75697104469117785 89054
131078 96852129129138095153833 76966229735     021401325357013647710818222185 9
 99211106111 48266194110 47855153791170649  1548     0134313178491 76094188598
 95690119789122854132281123363130236  8093 99676 94265103115194452157682 68218
 33585206403 68502 53596 75315 31126115933 29644 89588 60010 14809 89486143367
 15060170887 88966128508 82813192781168653 85063     0     0175248201393 71183
365996109009 14767 48935 49879     0  2508     0 38541 91839     0 43808 52163
 39880 18407     0119733257585266340159328285834 98671 55763132667 53796 70517
120888 11097 524361140982616842146122616581135 43     0     0129660     0109106
 49530 80104     0112973139847 22882 77103 90805 90136266099179995 47774207753
     0206501     0151032  5848149287120861 11693135224201670 30578121417     0
 61149 57606 67752 78070112565296086219829     0256067250958115944     0 63008
201550149875 53194408199 20512     0 66734 15691236661363174     0190810  5223
175341155989 78345     0211346154156248214 11863     0123796 20273 33270  3741
     0145858 35186     0135598202547370180   749     0     0145178     0     0
     0188366 11441 69967195521234361 75514233631177208134151 97183115080 77081
 31773  8149 62046142814 98006 34285 37303 59086     0149931231439224016247247
242591 60520180130159983142496138724132466     0 55027 30799 39140 56049102165
 24179233166243811107349  9055 76255 72042 41632124302
```


Methods

Fieldwork

Very large bald cypress trunks, roots, and knees are often recovered during ongoing Georgia Department of Natural Resources (DNR) maintenance work at the Altamaha Wildlife Management Area (WMA) on the Georgia Coast. We obtained cookies (lateral slices) of buried bald cypress trunk specimens via chainsawing. The vast majority of these specimens came from Butler Island, a large river island and former rice plantation in the Altamaha lying south of the town of Darien.

To extend the chronology to the present as well as to determine environmental conditions driving ringwidth in this specific locale, we also obtained samples from modern (known fell dates and standing dead) cypress trees on Butler Island and in a stand on northern Sapelo Island, the nearest barrier island to the Altamaha WMA and closest sampling-accessible modern trees.

Radiocarbon Anchoring

To facilitate crossdating of the recovered specimens, whose age was unknown, we radiocarbon dated trees at the Center for Applied Isotope Studies (CAIS) at the University of Georgia. For the first 26 trees, we dated both an inner and an outer ring, and once we determined that ring counts matched the timespan indicated by the radiocarbon dates, we continued dating trees at only an outer ring. A plot of the radiocarbon dates, calibrated via IntCal13 and rounded off by 5 years, were presented in Napora et al. 2019. Table 1 provides a range of information on each tree from the Altamaha WMA, including raw 14C BP dates from CAIS and calibrated date ranges using OxCal Version 4.4 (Bronk Ramsey 2009), employing the IntCal20 Northern Hemisphere curve (Reimer et al. 2020).

Measurement, Crossdating, and Chronology Development

Hand-drawn skeleton plots were used to crossdate specimens, with COFECHA (Grissino-Mayer 2001) used to verify the results. Tree rings were measured at an accuracy of 0.001 mm using a combination of a Velmex stage advancer and Measure J2X software with the Object J extension of Image J (Vischer & Nastase 2020); randomized digitally measured rings were verified for accuracy. Either two or one radii (the latter in the case where only a single line represented regular growth) was measured per tree. For the more recent samples, we used both inter-sample dating as well as Stahle's chronology from ~45 km upriver (AD 929—1985) at the Altamaha (Stahle et al. 1985) for crossdating.

ARSTAN (Cook & Holmes 1996) was employed for chronology creation. For Version 1 of the chronology, we used a 100-year smoothing spline with a 50% frequency response, which has been shown to remove the majority of age-related trends as well as retain almost all of the annual and decadal variation (Drake & Naiman 2007; see Cook 1985 and Cook & Briffa 1990) as well as a stabilization of the chronology variance with a 100-year spline to minimize changes due to fluctuating sample size (as used in Stahle et al. 2012). For Version 2 of the chronology, we used a 100-year smoothing spline with a 50% frequency response and the detrended series were normalized to a mean and standard deviation of one to better account for fluctuating sample sizes throughout the chronology.

CHAPTER 4

FIVE MILLENNIA OF ENVIRONMENTAL CHANGE ON THE SOUTHEAST COAST, USA: A TREE-RING BASED ANALYSIS[2]

---

[2]Napora, K.G. and S. Jantzi. To be submitted to *Palaeogeography, Palaeoclimatology, Palaeoecology*

Abstract

This study employs a multimillennial tree-ring chronology developed from ancient buried bald cypress (*Taxodium distichum*) trees on the Georgia Coast to reconstruct elements of the coastal environment over the past five millennia. This analysis provides a complementary set of high-resolution environmental proxies previously lacking for the coastal Southeast United States. We examine ties to precipitation, salinity level, and hurricane activity as well as tree life histories and ringwidth extremities and fluctuation, situating environmental changes within a press-pulse dynamics framework. Elemental analysis of sodium in the outer rings of ancient trees is used to reconstruct salinity intrusion events in a novel application of this methodology. These integrated analyses provide insights into regional ecological conditions in antiquity.

Keywords: Climate change, coastal environment, dendrochronology, Southeast U.S.

Introduction

High-resolution paleoenvironmental proxies bolster the understanding of the ecological events in antiquity In this article, we use multiple lines of high-resolution proxy evidence from tree rings, including novel elemental analyses, to identify and analyze environmental changes on the Georgia Coast over the last five millennia. Many of the environmental events which occurred on the southeastern coastlines can be addressed on a high-resolution scale by tree-ring analyses. These events include the timing and intensity of droughts in the past and the impact of hurricane and other storm events (Liu and Fearn 2000; Saunders 2010), and shifts in sea-level, the timing and number of which have been variously stated from different proxies (Balsillie and Donoghue 2004; Colquhoun and Brooks 1986; DePratter and Howard 1981; DePratter and Thompson 2013; Gayes et al. 1992; Thompson and Worth 2010).

Here, we examine a 5,177-year tree-ring chronology (i.e., a site-level representation of yearly tree growth (Speer 2010: 4)) that covers the years 3161 BCE to 2016 CE) from the north Georgia Coast (Napora et al. in prep) and discuss the environmental information gleaned from this chronology. This information includes characteristics of the chronology itself as well as specialized tests which provide insight into sea-level changes, droughts, and salinity intrusion events (e.g., storm surge and/or hurricane events) in the region. We use modern environmental datasets to determine the factors influencing ringwidth at this coastal location, analyze concentrations in salts in the outer rings of the earliest trees to investigate salinity intrusion events, and interpret ecological changes visible in cypress life histories.

We conceptualize environmental changes on the Georgia Coast using a press-pulse dynamics framework that distinguishes between more enduring state shifts and relatively short-term anomalies (Bender et al. 1984; Thompson et al. 2016; Yang et al. 2008). Coastal dynamics are viewed through Simiand's (1960) *histoire événementielle*, which visualizes time as punctuated by episodes of change. Tree-ring data identify ecological *événements* at timescales often invisible using other proxy data, including annual and sub-annual events.

Our analyses point to several major environmental occurrences and state shifts on the Georgia Coast over the past five millennia. Tree-ring data may indicate a multicentury period in the early 3rd millennium BCE characterized by continuously flooded conditions. Major environmental upheavals on the Georgia Coast include at least two periods of unstable environmental conditions indicated by enhanced ringwidth fluctuation. Elevated sodium levels in tree rings suggest four periods of enhanced salinity conditions leading to mass tree mortality events prior to 700 BCE, at least one of which likely indicates a period of rapid sea-level transgression. Finally, our data indicate that a shift to less stable or more frequently punctuated environment in which the lives of mature bald cypress tree were regularly cut short commences with the onset of the Vandal Minimum in the 6th century CE. This state prevails into the 21st century. These insights into the deep-time environmental history of the Georgia Coast represent high-resolution reconstructions for the region and establish long-term baseline ecological conditions operating on the coastline of the Southeast U.S.

Materials and Methods

Our tree ringwidth chronology is largely derived from a buried deposit at the state-owned Altamaha Wildlife Management Area (WMA) directly south of Darien, Georgia, at the mouth of the Altamaha River. Tree specimens, the vast majority of which are bald cypress (*Taxodium distichum*), are dredged up from the coastal sediments during maintenance work at the WMA. Most of the specimens used to develop this chronology are from Butler Island, a marsh island within the WMA. Some specimens were obtained from Champney Island, another WMA marsh island. Some modern bald cypress samples were also obtained from Sapelo Island, the closest barrier island to the WMA and closest accessible sampling location to obtain modern comparative specimens (Figure 4.1; see Napora et al. in prep for sample details). The time span covered by each Altamaha cypress tree in this study is shown in Figure 4.2.

The islands of the Altamaha WMA lie within the river's delta, at the center of the Georgia Bight, the curved coastline that extends from Cape Fear, North Carolina to Cape Canaveral, Florida. As the wide, shallow continental shelf in the area increases the tidal amplitude, these islands are subject to dramatic twice-daily tidal shifts up to 3 meters (Champney Island Tides 2021; Hayes 1994: 236–237). On the barrier islands and deltaic river islands, bald cypress trees grow in ponds and sloughs, which function as reservoirs of fresh water. The water level in these habitats fluctuates with the daily tidal cycle as well as throughout the year (Johnson et al. 1974: 50–51). Although mature cypress trees frequently grow in inundated conditions, seeds can only sprout, and saplings become established, during prolonged dry periods (Fowells 1965; Johnson et al. 1974: 51). Planters cleared thousands of acres of these Georgia Coast forests and cypress swamps in the 18th and 19th centuries to develop plantations based around the labor of enslaved individuals (Bell 2010; Johnson et al. 1974: 8; Wilms 1972).

Previous research on trees in the Southeast U.S., including bald cypress, indicates that precipitation and ringwidth are highly correlated (Stahle 2012). The dataset used for this study, however, derives from within the tidal zone, unlike other publically accessible bald cypress studies, all but one of which (Carr 2010) are much farther inland. Ecological analyses of the Altamaha River estuary report that a complex variety of global and regional climatic factors affect freshwater delivery differently throughout the year (Sheldon & Burd 2014). Due to the complex interacting environmental and climatic phenomena at this location, we hypothesized that salinity and storm impacts were also factors influencing ringwidth for this dataset. Because of the different temporal periods over which various factors influence freshwater delivery, we analyzed precipitation and salinity at different monthly time periods to determine which periods had the highest correlation with yearly tree growth.

We used a historical monthly total precipitation dataset from a station in Brunswick, Georgia, obtained from the Southeast Regional Climate Center (SERCC) (The Southeast Regional Climate Center 2020) to examine the effect of local rainfall on tree ringwidth and growth patterns in the study locale. The dataset covers the years 1895—2012, but gaps in the data meant that only the data from 1906—2011 are included in this analysis.

Salinity data are from the Georgia Coastal Ecosystems Long Term Ecological Research (LTER) Data Portal (Georgia Coastal Ecosystems LTER 2019), part of the National Science Foundation’s LTER network. This dataset, GCE3_Hydro, North

Sapelo, represented the closest geographic source of salinity information to the modern comparative sampling location – about two miles north of the cypress stand on Sapelo Island where modern recently felled and standing dead specimens were obtained. This dataset covers the years 2004 – 2016 but is missing data for 2010.

The impact of hurricanes on coastal ecosystems can be profound (e.g., Dame et al. 2000: 803), and previous studies indicate that strong storms affect the growth of tree rings in the Southeast U.S. Two master's theses on pine trees in southern Georgia and Mississippi found significantly narrowed rings in the year after a hurricane (i.e., a cyclone in the North Atlantic or east Pacific [Hyndman & Hyndman 2009]) or tropical cyclone (i.e., a pressure cell originating over warm tropical ocean water [Hyndman & Hyndman 2009]) event (Collins 2014; Tucker 2015). For the sake of brevity, we will hereafter refer to all strong storms as "hurricanes." To determine whether hurricanes produced an identifiable ringwidth pattern in coastal Georgia bald cypress, we compared known storm histories with chronology tree-ring indices (standardized units representing average ringwidth). Historical information on hurricanes impacting the Georgia Coast from 1750 to 2012 CE was obtained from Welford et al. (2017). Over this period, 24 hurricanes in 23 separate years are known to have made landfall in Georgia or impacted the Georgia coastline. These hurricanes and the relative tree-ring indices for these years in the normalized (i.e., normalization of the detrended series to a mean and standard deviation of one) tree-ring chronology are listed in Table 4.1.

Coastal forests in the past experienced periodic increases in salinity, and associated mortality, from storm surge, sea-level transgression as they do today (e.g., Doyle et al. 2010; Myers 2019; Saha et al. 2011). Based on existing research, we hypothesized that periods of increased, prolonged salinity influx to coastal forests could be identified through elemental analyses of tree rings. Bald cypress seedlings can survive only short-term salinity levels of approximately 4 parts per thousand (ppt) (Hsueh et al. 2016:1453), while at least some mature trees tolerate up to 8 ppt (Conner and Inabinette 2005). Coastal cypress forests generally transition to marsh when soil salinity continually exceeds 2 ppt, although forests can survive short, infrequent pulses of higher salinity (Hsueh et al. 2016: 1453). Bald cypress exposed to saltwater uptake sodium, chloride, and bromide in detectible levels in the outer rings; the longer the trees are exposed to borderline survivable levels of salt water before they die, the farther back into the trunk wood these elements penetrate (Yanosky et al. 1995). If, however, bald cypress trees survive saltwater intrusion and then experience declines in saline levels, the trees will eliminate these salts. Bald cypresses growing on the Altamaha WMA islands and Sapelo Island are acclimated to twice-daily tidal shifts ranging between 1.5 and 2.5 meters ("Champney Island" 2021; "Old Tower" 2021) and associated shifts in salinity. Salinity-enhancing events like sea-level transgression or lingering storm surge, however, would disrupt trees' ability to expel accumulated salts by prolonging exposure time to salt water and limiting freshwater intake. Based on the existing cypress salinity studies, we hypothesized that sampling ancient trees at standardized intervals, beginning at the outer rings (for samples containing the final year's growth or sapwood—the softer, lighter outer wood where vascular functions occur (Speer 2010: 76)) and inward toward the pith, would provide information about whether individual trees succumbed to salinity intrusion as well as relative rates of salinity increase in the coastal forests. Relative rates of salinity increase could in turn suggest relative rates of sea-level transgression. High levels of sodium, chloride, and bromide concentrated in the outer rings, with low or undetectable levels of these elements farther back into the tree, would suggest that a tree experienced mortality due to relatively rapid salinity increase. If a tree had elevated levels of these elements in the outer rings and detectable though less elevated levels in test locations nearer to the pith, this would suggest that the tree died after relatively prolonged exposure to saltwater (i.e., slower rates of salinity increase that nevertheless were extensive enough to eventually kill the tree). If these elements are not detected in the samples, or were detected in relatively low levels, this would indicate that the tree did not experience salinity-related mortality, though it may have experienced increased or fluctuating salinity levels during its lifespan, but high salt levels were not the cause of death.

For each of the 33 trees that grew prior to 1000 BCE based on our original radiocarbon dates before dendrochronological analysis was completed, we took three samples beginning at the outer extant rings (Salinity Test 1- Outer Rings), followed by a second sample taken 5 cm farther back towards the pith (Salinity Test 2) and a third sample taken 10 cm back towards the pith (Salinity Test 3). In total, 99 samples were thus obtained from these 33 trees.

Samples were prepared and analyzed at the Center for Applied Isotope Studies (CAIS) at the University of Georgia, USA. Each dry sample, method blank, and certified reference material (CRM) was transferred to a pre-weighed PFA digestion vessels (Savillex, USA) and weighed again. Each method blank consisted of 100 µL 18 MΩ deionized water. Each CRM consisted of 100 mg of NIST SRM 1572 Citrus Leaves (NIST, USA). Concentrated, trace metal grade nitric acid (Fisher Scientific, USA) was added to each vessel (3 mL / g sample). The vessels were covered and left to react overnight at room temperature. An additional volume of acid was added (2 mL / g sample) and the vessels were covered and heated at 95 °C for six hours. After cooling, Suprapur grade 30% hydrogen peroxide (Merck, USA) was added (4 mL / g sample) and the vessels were covered. Once effervescence subsided, the vessels were heated at 95°C for two hours. After cooling, vessels were weighed, and the contents were transferred to 15 mL centrifuge tubes and then diluted to 10 mL with 10 MΩ deionized water. Samples were centrifuged just prior to analysis to remove any remaining particulates.

Samples were analyzed for a range of elements (Al, B, Ba, Br, Ca, Cd, Cl, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Si, Sr, and Zn) by inductively coupled plasma optical emission spectrometry (ICP-OES) using an Optima 8300 machine (PerkinElmer, USA). Calibration and QC stock solutions for all elements except S were obtained from Inorganic Ventures (USA). Sulfur calibration stock solution was prepared from 99% pure Na_2SO_4 (Sigma-Aldrich, USA) and sulfur QC stock solution was obtained from Aldrich (USA). All calibration and QC solutions were prepared by diluting the stock solutions in 2% w/w HNO_3 into the appropriate mg/kg ranges. The blank was 2 % w/w HNO_3. After calibration, QC solutions were used to check the performance before and after each group of samples were run. All calibrations, QCs, blanks, samples, and CRMs were run in triplicate and averaged. Method blanks were subtracted from the sample results. The instrument detection limit for each element was determined as 3 times the standard deviation of 10 replicates of the blank solution. Concentrations determined by ICP-OES were multiplied by the dilution factors in order to determine the concentration of each element in the original dry sample. We discuss the results of the analysis for the targeted elements (Na, Cl, and Br) in the next section.

Results

Environmental Ringwidth Drivers at the Altamaha River Delta

<u>Precipitation</u>

As expected, precipitation is the main environmental factor associated with ringwidth on the Georgia Coast. The highest correlation of ringwidth is with January – May precipitation (Pearson correlation coefficient (r)= 0.348; this statistic is used in all further discussions of correlation in this article). This indicates that rainfall prior to the growing season (stated variably as either March – August [Stahle et al. 2012] or May – September [Jackson 1952]) impacts annual ringwidth at the mouth of the Altamaha.

<u>Salinity</u>

Correlation between annual precipitation and salinity is -.382. The highest correlation of salinity and ringwidth for the Altamaha coastal chronology is -0.167 for the time period from May – September (the growing season according to Jackson 1952) mean salinity. Meanwhile, January – May salinity has a positive correlation of 0.152 (a likely random correlation, as salinity has a negative impact on baldcypress growth (Allen et al. 1996)), apparently indicating that prior-to-growing-season salinity does not have the same impact on ringwidth as precipitation, but that salinity during the growing season negatively impacts growth. As the time depth of the salinity dataset is poor (only 12 years), however, continued monitoring of monthly salinity levels is necessary for a better understanding of the role of salinity in the annual growth of coastal bald cypress.

<u>Hurricanes</u>

Although hurricanes cannot be reliably identified solely from the ringwidth patterns of trees growing in this location, hurricane impact years and subsequent years are associated with certain ringwidth patterns. The hurricane season, which runs from June 1st– November 30th in the Atlantic basin (National Hurricane Center and Central Pacific Hurricane Center 2020), overlaps with the late portion of the growing season and thus might be expected to exert an influence over the latewood, the darker, denser part of the annual growth band laid down in late summer and early autumn. Of the 23 years directly impacted by a hurricane on the Georgia Coast between 1750 and 2012 CE (Welford et al. 2017), 7 (30%) show a decreased ring in the year of impact and 14 (61%) show a large ring in the year of impact. 14 (61%) show a decreased ring in the year after impact. In 11 (48%) of these years, the chronology shows a large ring in the year of impact followed by a smaller ring the next year. The smaller ring following the year of impact is a trait shared with pine trees (Collins 2014, Tucker 2015). The high percentage of hurricane years associated with a large ring in the year of impact followed by a smaller ring the next year may indicate a ringwidth signature unique to this species or this location. This pattern may stem from increased rainfall from hurricane/storm activity leading to a burst of latewood development followed by increased salinity from lingering storm surge that negatively affects the next year's early season growth.

Isotopic analyses would very likely help to differentiate hurricane events from precipitation-based ringwidth changes. Low $\delta^{18}O$, due to the high relative percentage of ^{16}O evaporated from ocean water during hurricanes and subsequently precipitated, is associated with hurricane events (Speer 2010: 243). Pine trees in interior Georgia (Miller et al. 2006) and in Texas (Lewis et al. 2011) record hurricane signatures to a high level of accuracy with sub-annual isotopic testing. Future research on the Altamaha coastal trees should include seasonal oxygen isotope studies of both modern trees which survived hurricanes at known intervals as well as ancient trees whose ringwidth signatures suggest they may have experienced hurricanes in the past. Such a study could help to distinguish hurricane events from precipitation and/or salinity levels that could cause similar ringwidth patterns.

Periods of Major Fluctuation in Tree-Ring Indices

The normalized tree-ring indices (Napora et al. in prep: Figures 3.3 and 3.4, Tables 3.4 and 3.5) provide insights into environmental conditions over a period of five and a half millennia while best accounting for the fluctuating sample replication.

Two periods in the tree-ring chronology are the most notable for the increased interannual variability and very small and very large annual rings they exhibit. These periods can be characterized as large-scale state shifts to multicentury environmental upheaval. The first of these periods (2355–1863 BCE) is marked by high interannual variability and numerous very small rings; these characteristics do not appear to be due solely to the decreased replication at the central part of this period: even with the series normalized, this period stands out for the environmental fluctuation it indicates, including numerous very dry years as well as a number of very large rings followed by very small rings. The series of extremely small index numbers also continues beyond the period of poor replication, further supporting the interpretation of this period as one of decreased stability and frequently impacted by environmental events. The period from 1086–678 BCE also exhibits high interannual variability as well as very large and very small rings. A third visually similar period between ca. 1451–1958 CE corresponds with the Little Ice Age's intensification in the North Atlantic (Miller et al. 2012), but low replication during much of this period makes interpretation less certain.

Sodium Concentrations

OES test results of the 33 oldest trees from the Altamaha WMA deposits found varying levels of elements in the three samples taken from each tree. Of the three elements of particular interest (Yanosky et al. 1995), only sodium was present in detectable level. Levels of chloride and bromide were too low to be detected with this methodology in every sample. At least one of three tests had elevated sodium levels in 21 of 33 trees (64%) (Table 4.2). We consider "elevated" to be sodium levels >1000 mg/kg (0.1%), the approximate value found in the stems of sapling bald cypress grown in non-saline conditions (Allen et al. 1997: 316).

Our initial concern about this analysis—which has never been reported in the literature for ancient trees—was that trees buried for centuries or millennia in brackish coastal waterlogged anoxic environments might absorb salts after being buried. Thus, salts within these trees might reflect post-depositional conditions rather than environmental conditions during the tree's lifespan. If it was the case that salts in these trees were incorporated post-burial, we would expect concentrations of salts to be the same throughout a tree and levels of salts in specimens buried in the same deposit in the same locale to be very similar. Instead, we find that sodium levels vary significantly among trees as well as between tests from the same tree. Furthermore, we find several temporal clusters of tree deaths with elevated salts in the outer rings. We interpret these results as confirmation that the detection of these elements is indeed related to saline conditions at the end of a tree's life rather than to depositional environment and that clustered deaths indicate salinity intrusion events that caused mass mortality among bald cypress trees at the mouth of the Altamaha.

Yanosky et al. 1995 indicates that sodium levels would be most concentrated in the outermost rings in a tree that died of exposure to continuously increasing salinity levels. Our study found that this was not always the case. In 13 cases (62%), the outermost ring was the most elevated in sodium, while in 5 cases (24%), the middle sample was the most elevated. In 3 cases (14%), the innermost sample had the highest concentration of sodium. What these alternative patterns might indicate is uncertain. One possible interpretation is that the tree experienced rapidly salinity influx that was then somewhat slowed or mitigated (through, perhaps, an event like high rainfall), leading to an unsuccessful attempt to expel high concentrations of accumulated salts from the sodium-saturated wood before the tree ultimately succumbed. Such a sequence of events must have occurred within a relatively short time period.

The sodium levels in two trees are extremely elevated compared to the other samples. Tree 15 (outer ring = 2578 BCE) had outer ring sodium levels of over 15000 mg/kg. The outer ring sodium level in Tree 23 (last ring= 2306 BCE) was over 46000 mg/kg. It may be notable that Tree 23 died at the very beginning of the period of increased environmental fluctuation that lasted from c. 2300 to 1850 BCE.

Our analyses found no single year or short period between 3161 BCE and 700 BCE when all or most sodium spikes cluster. There are, however, four periods of 13 years or less in which at least two trees died with elevated sodium levels in at least one of three samples; in two of these cases, another tree also dies with elevated sodium levels within 28 years. These clusters of tree deaths, including the third sodium spikes, occur within the time periods: 1) 2578 – 2542 BCE, 2) 2314 – 2281 BCE, 3) 1233 – 1223 BCE, and 4) 805 to 792 BCE (Figure 4.3). These clusters of sodium spikes in the outer rings of trees indicate salinity intrusion events, possibly sea-level transgression or periods of increased storm activity where saltwater was pushed into the coastal forests with more frequency than in other periods.

Altamaha Bald Cypress Life Histories

Since most samples from the Altamaha WMA include near-pith rings (years close to the sprouting date of the tree) as well as sapwood (years close to the final year of life of the tree), it is possible to include shifts in tree lifespans in this analysis.

The tree-ring chronology indicates several gaps in bald cypress tree sprouting, which may point to periods in which the environment did not support the flourishing of bald cypress seedlings into more resilient mature trees. Cohorts of trees that sprouted in the same year, with each cohort separated by decades or more, are common in modern cypress forests. This indicates the sensitivity of seedlings and young trees to environmental fluctuations, including flooded or saturated conditions and increased salinity, and the necessity of stable, relatively dry (though not too dry) conditions over a period of decades for bald cypress trees to flourish (Sharitz and Lee 1985).

Discussion

The specific river-mouth location of the field site, a few kilometers upstream of one of the most productive estuaries on the western Atlantic coast but subject to the impact of hurricanes, means that a wider array of environmental factors influence tree growth in this locale than has previously been found for tree-ring studies in the Southeast U.S. The seasonality of significant ringwidth drivers differs: prior-to-growing season and early growing season rainfall impacts ringwidth, while salinity throughout the growing season limits annual growth. Hurricanes, meanwhile, are sometimes (but not always) discernible via ringwidth patterns, notably appearing as a very large year-of-impact ring and a very small subsequent ring in 48% of modern cases.

This study provides high-resolution, tree ring-based environmental proxies that elucidate the temporal relationships between cultural changes evident in the archaeological record and environmental conditions. Via this multi-proxy dataset, we gain insights into some of the factors which impacted the Georgia Coast over the millennia, including punctuated episodes of stability and change, hurricane events, inundated conditions, and salinity impact on trees, including evidence for sea-level changes.

Studies in the Southeast U.S. use a variety of data sources to develop models of sea level in the ancient past. Garrison et al. (2012) use sediment cores from offshore locations on the Georgia Coast to model paleoshorelines and pollen data to detect shifts in ecological communities during the Late Pleistocene and early Holocene. Sea-level reconstructions of the Atlantic Southeast Coast focused on the later Holocene indicate a generally steadily rising sea over the past several millennia, but presence and timing of sea-level oscillations in these models vary. Engelhart and Horton (2012), employing a comprehensive database for East Coast sea-level points, find more rapidly rising sea-level prior to 2000 BCE, with a slower rate of rise from 2000 BCE to 1900 CE; data points from the Georgia Coast in this model, however, are lacking. Other sea-level reconstructions, meanwhile, find evidence for fluctuations. These include DePratter and Howard (1981), using archaeological site and buried tree locations; Colquhoun and Brooks (1986), based on marsh stratigraphic and archaeological evidence from South Carolina; and Gayes et al. (1992), using marsh foraminifera. These models are summarized by Turck and Thompson (2016b: Figure 3). Both DePratter and Howard (1981) and Gayes et al. (1992) posit a single sea-level lowstand but at different times. The Colquhoun and Brooks (1986) sea-level model suggests several sea-level fluctuations over the period in question.

Correlation between the bald cypress tree-ring data and existing Late Holocene sea-level models that find evidence for fluctuation (Figure 4.4) as well as the other major insights gained into the ancient coastal environment from this array of analyses, progressing forward temporally from the beginning of the tree-ring chronology, are described as follows:

Possible Multicentury Inundation Followed by Rapid Salinity Intrusion c. 2900 – 2500 BCE

The 355-year gap in bald cypress trees sprouting from 2928 – 2573 BCE appears from the tree-ring indices to be one of relative stability—a period characterized by press conditions. Such a gap in establishment may indicate that forests flooded frequently—an interpretation supported by a dearth of many dry years indicated by the tree-ring chronology. Such flooded conditions would not affect established trees, but would prevent successful seed germination and sapling development (Fowells 1965).

The first of the four clusters of trees with elevated levels of sodium in their outer rings occurs at the very end of this gap in new tree growth (2578 – 2542 BCE). None of the existing Atlantic sea-level models for the later Holocene find evidence of rising seas at this time. Balsillie and Donoghue's comprehensive Gulf Coast study (2004), however, does find evidence for a sea-level lowstand at c. 2800 – 2500 BCE. It is therefore possible that this was a period of rising sea-level on the Southeast Coast of similar timing to that in the Gulf that was not detected by the less high-resolution proxies on the Atlantic Coast. It is also a possibility that the trees which died at this time succumbed to a salinity intrusion event such as storm surge.

Environmental Fluctuation and Rapid Salinity Intrusion c. 2350 – 1850 BCE

Beginning c. 2350 BCE, the tree-ring chronology indicates that the growth environment becomes less stable, with more interannual variation and a number of very small and very large rings. The second cluster of trees with elevated sodium levels also dies at the beginning of this period (2314 – 2281 BCE), which corresponds exactly with the beginning of a period of rapid sea-level transgression in the Colquhoun and Brooks (1986) model. As precipitation prior to and during the early part of the growing season is the main ringwidth driver at the Altamaha WMA and Sapelo Island, the variability in the chronology very likely indicates less reliable year-to-year rainfall patterns compared to earlier centuries. In addition, a number of very large rings followed by very small rings punctuate the chronology. Extrapolating from modern data, at least some of these may be indicative of hurricanes or other storms impacting the coast. Taken together, these proxies indicate a major period of environmental upheaval on the coastline of the Southeast commencing with rapid salinity intrusion and characterized by pulse conditions including unpredictable rainfall patterns, numerous drought years, and possible hurricane events.

A Rapid Salinity Intrusion Event c. 1230 – 1220 BCE

The third cluster of trees with elevated sodium in the outer rings occurs in the period 1233 – 1223 BCE. As with the 2314 – 2281 BCE cluster, this corresponds closely with the Colquhoun and Brooks (1986) sea-level model and, paired with the extant data, supports the presence of another pulse period of rapidly increasing salinity. Meanwhile, some studies indicate enhanced catastrophic storm frequency on the northeastern coast of the Gulf of Mexico beginning around 1400 BCE and continuing until 1000 CE (Liu and Fearn 2000; see also McFadden and Jaeger 2014, Saunders 2010). Increased numbers and strength of storms also may have impacted the Southeast Atlantic coastline and may be the driver behind some of the rapid salinity intrusion events evidenced by the tree rings.

Environmental Fluctuation c. 1086 – 678 BCE

Another period of enhanced environmental fluctuation occurs c. 1086 – 678 BCE. As with the earlier period of instability, it is marked by increased interannual variability as well as a number of very small rings. It likely indicates several centuries of environmental flux.

Rapid Salinity Intrusion c. 800 – 790 BCE

The fourth and final cluster of increased sodium in the outer rings of trees occurs from 805 – 792 BCE. All existing sea-levels models propose a lowstand and subsequent transgression occurring slightly after this time. The tree-ring sodium data likely indicate that the lowstand was slightly earlier than previous models suggest, and that a pulse period of rapidly rising sea level had begun by 800 BCE.

A Shift to a More Variable or More Frequently Impacted Environment post-Vandal Minimum (after c. 500 CE.)

Climatic factors associated with the Vandal Minimum (c. 500 – 800 CE) impacted the environment in Florida, with persistent dry summers throughout the Vandal Minimum and cooling of winter temperatures throughout most of the period evident in shell and fish otolith oxygen isotopes (Wang et al. 2011, 2013). This study supports the onset of a negative environmental period shifting the expected lifespans of trees in Georgia at approximately the same time as in Southwest Florida.

Tree lifespans at the mouth of the Altamaha never again reach pre-Vandal Minimum lengths (although sample number are admittedly relatively small). Unlike the gap from 2928 – 2573 BCE, during which tree establishment was apparently unable to occur but through which mature, long-lived trees could persist, the relatively short lifespans and differing years of death after c. 530 CE may indicate ongoing environmental fluctuation, elements of which mature trees could not survive, or an environment characterized by pulse conditions—frequent impacts on coastal ecosystems of negative events capable of causing mortality to mature trees (e.g., hurricanes, storm surge, and/or prolonged or extreme drought).

Enhanced Fluctuation in the Little Ice Age (after c. 1550 CE)

The only discernible exceptions to the short lifespans in the post-c. 500 CE period are Trees 40 and 56, which include 406 and 425 rings, respectively (Tree 40 lived for somewhat longer as the near-pith is not intact). These individuals died around 1505 and 1545 CE, respectively, when the third and final period of enhanced ringwidth variability begins. Although sample replication is especially low in this part of the chronology, and thus the magnitude of enhanced fluctuation difficult to ascertain, the fact that the timing of this episode coincides with the onset of the Little Ice Age, which lasted from approximately the 16th to the 19th centuries (Mann 2002), lends support to an interpretation of increased environmental variability on the Southeast Coast. The continued relatively short lifespans of the trees growing at the mouth of the Altamaha indicate that environmental conditions at the river mouth post- c. 530 CE never returned to the type of long-term stability required for the establishment and continued growth of mature, long-lived bald cypress at this location. Geochemical sea-surface temperature proxy records indicate significant cooling at the Little Ice Age and multi-decadal to centennial climate perturbations in the Gulf of Mexico and Atlantic (Cronin et al. 2010, 2012; Richey et al. 2007, 2009), conditions which the cypress lifespan data support. Paleoenvironmental records from North America and the Caribbean indicate a shift in tropical cyclone activity occurring c. 1400 CE during the transition out of the Medieval Warm Period (c. 900–1400 CE) (Schmitt et al. 2020); the environmental instability indicated by the cypress tree rings and shortened lifespans could indicate a similar transition to a more frequently storm-impacted environment, but more research is required to assess the factors contributing to enhanced variability on the Georgia Coast.

As indicated by the interplay of environmental factors influencing ringwidth at this coastal location as compared to the much more linear connection of inland cypress trees to the single variable of precipitation, the coastal environment is a less stable growth environment for bald cypress than locales even slightly more upriver and inland. Stands of very old cypress (probably at least 1000 years old) still grow only a few miles upriver, and individuals up to 2500 years have been located in swamps further inland in the Southeast (Stahle et al. 2019). This study suggests that tree age at the mouth of the Altamaha had already declined significantly prior to the large-scale logging of cypress stands that decimated the old-growth forests upriver from Darien in the mid-19th to early 20th centuries (Sullivan 2000).

Conclusion

A multi-proxy study of Altamaha bald cypress trees indicate unstable environmental conditions during several multicentury periods as well as several salinity-enhancing pulse events between 2600 and 700 BCE, likely including at least one rapid sea-level transgression event. Our data also support existing studies that point to several major global climatic shifts impacting the environment of the Southeastern U.S.—namely, the Vandal Minimum and the Little Ice Age. Evidence for the impact of these periods has previously been found in the Gulf of Mexico; this study indicates that their influence was felt on the Georgia Coast.

Acknowledgements

This research was supported in part in association with the National Science Foundation Grants OCE-0620959 and OCE-123714 and DDRI Award #1834682 as well as the Georgia Coastal Ecosystems LTER project. We thank the Georgia Department of Natural Resources as well as the Department of Anthropology, the Graduate School, the Laboratory of Archaeology, and the Center for Applied Isotope Studies at the University of Georgia for institutional support. Special thanks to Robert J. Speakman, Alexander Cherkinsky, Robert Horan, Blaine Tyler, Craig Jacobs, Suzanne Pilaar Birch, Ervan Garrison, and Elizabeth Reitz.

References

Allen, J.A., Chambers, J.L., Pezeshki, S.R., 1997. Effects of salinity on baldcypress seedlings: physiological responses and their relation to salinity tolerance. Wetlands 17(2), 310–320.

Allen, J.A., Pezeshki, S.R., Chambers, J.L., 1996. Interaction of flooding and salinity stress on bald cypress (*Taxodium distichum*). Tree Physiology 16(1-2), 307–313.

Anderson, D.G., 1994. The Savannah River Chiefdoms: Political Change in the Late Prehistoric Southeast. The University of Alabama Press, Tuscaloosa.

Balsillie, J.H., Donoghue, J.F., 2004. Northern Gulf of Mexico sea-level history for the past 20,000 years. *In:* N.A. Buster and C.W. Holmes (eds.), Gulf of Mexico Origin, Waters and Biota: Vol. 3, Geology. College Station, Texas: Texas A&M University Press, 53–72

Bell, K.B., 2010. Rice, Resistance, and Forced Transatlantic Communities: (Re)envisioning the African Diaspora in Low Country Georgia, 1750-1800." The Journal of African American History 95(2),157–182

Bender, E.A., Case, T.J., Gilpin, M.E., 1984. Perturbation experiments in community ecology: theory and practice. Ecology 65(1),1–13.

Blanton, D.B., Thomas, D.H., 2008. Paleoclimates and human responses along the central Georgia coast: a tree-ring perspective, in Thomas, D.H. (Ed.), Native American Landscapes of St. Catherines Island, Georgia. AMNH Anthropological Papers No. 88. American Museum of Natural History, New York, 799–806

Carr, D., 2010. NOAA/WDS Paleoclimatology - Carr - Lower Withlacoochee River - TADI - ITRDB FL007. Correlation Stats. NOAA National Centers for Environmental Information. https://doi.org/10.25921/sse5-ev65. Accessed October 2nd, 2020

Cable, J.S., 2020. Megadrought in the Carolinas: The Archaeology of Mississippian Collapse. The University of Alabama Press, Tuscaloosa.

"Champney Island," 2021. South Altamaha River, GA. Tide Chart. US Harbors. https://www.usharbors.com/harbor/georgia/champney-island-south-altamaha-river-ga/tides/. Accessed January 15, 2021

Collins, S.A., 2014. Detecting tropical cyclone signals in tree rings of longleaf pine (*Pinus palustris* Mill.), Valdosta, Georgia. U.S.A. Unpublished master's thesis. University of Tennessee, Knoxville. https://trace.tennessee.edu/utk_gradthes/3142/. Accessed 2 August 2020.

Colquhoun, D.J., Brooks, M.J., 1986. New evidence from the Southeastern United States for eustatic components in the Late Holocene sea levels. Geoarchaeology 1(3), 275–291.

Conner, W.H., Inabinette, L.W., 2005. Identification of salt tolerant baldcypress (*Taxodium distichum* (L.) Rich) for planting in coastal areas. New Forests 29, 305– 312.

Cronin, T.M., Wingard, G.L., Dwyer, G.S., Swart, P.K., Willard, D.A., Albietz, J., 2012. Climate variability during the Medieval Climate Anomaly and Little Ice Age based on ostracod faunas and shell geochemistry from Biscayne Bay, Florida, in: Horne, D.J., Holmes, J.A., Rodriquez-Lazarao, J., Viehberg, F.A. (Eds.), Ostracoda as Proxies for Quaternary Climate Change, Developments in Quaternary Sciences 17, 241–262.

Cronin, T., Hayo, K., Thunell, R., Dwyer, G.S., Saenger, C., Willard, D., 2010. The Medieval Climate Anomaly and Little Ice Age in Chesapeake Bay and the North Atlantic Ocean. Palaeogeography, Palaeoclimatology, Palaeoecology 297, 299-310. 10.1016/j.palaeo.2010.08.009.

Dame, R., M. Alber, D. Allen, M. Mallin, C. Montague, A. Lewitus, A. Chalmers, R. Garden, C. Gilman, B. Kjerfve, J. Pinckeny, and N. Smith. 2000. Estuaries of the south Atlantic coast of North America: their geological signature. *Estuaries* 26: 793-819.

DePratter, C. B., Howard, J., 1981. Evidence for a sea level lowstand between 4500 and 2400 years B.P. on the southeast coast of the United States. Journal of Sedimentary Petrology 51, 1287–1295.

DePratter, C.B., Thompson, V.D., 2013. Past Shorelines of the Georgia Coast. In V.D. Thompson & D.H. Thomas (eds.) *Life Among the Tides: Recent Archaeology on the Georgia Bight*: 145 – 167. New York: Anthropological Papers Number 98 of the American Museum of Natural History.

Doyle, T.W., Krauss, K.W., Conner, W.H., From, A.S., 2010. Predicting the retreat and migration of tidal forests along the northern Gulf of Mexico under sea-level rise. Forest Ecology and Management 259(4), 770–777.

Engelhart, S.E., Horton, B.P. 2012. Holocene sea level database for the Atlantic coast of the United States. Quaternary Science Reviews 54, 12–25.

Forest Research, 2020. Emissions. https://www.forestresearch.gov.uk/tools-and-resources/biomass-energy-resources/reference-biomass/facts-figures/emissions/ (accessed 5 August 2020).

Fowells, H.A. 1965. U.S. Department of Agriculture, Forest Service. Silvics of forest trees of the United States. U.S. Department of Agriculture, Agriculture Handbook 271. Washington, DC.

Garrison, E.G., Weaver, W., Littman, S.L., Cook Hale, J., Srivastava, P. 2012. Late Quaternary paleoecology and Heinrich Events at Gray's Reef National Marine Sanctuary, South Atlantic Bight, Georgia. Southeastern Geology 48(4), 165–184.

Gayes, P. T., Scott, D. B., Collins, E. S., Nelson, D. D., 1992. A late Holocene sea-level fluctuation in South Carolina, in Fletcher III, C. H., and Wehmiller, J. F. (Eds.), Quaternary Coasts of the United States: Marine and Lacustrine Systems, SEPM Society for Sedimentary Geology, Special Publication No. 48, Tulsa, Oklahoma, pp. 155–160.

Georgia Coastal Ecosystems LTER, 2020. GCE Hydrographic Monitoring. http://gce-lter.marsci.uga.edu/portal/gce_hydro.htm (accessed 2 August 2020).

Hayes, M.O. 1994. The Georgia Bight barrier system. In R.A. Davis, Jr. (editor), Geology of Holocene barrier island systems: 233–304. Berlin: Springer-Verlag.

Hsueh, Y.H., Chambers, J.L., Krauss, K.W., Allen, S.T., Keim, R.F., 2016. Hydrologic exchanges and bald cypress water use on deltaic hummocks, Louisiana, USA. Ecohydrology 9, 1452–1463.

Hyndman, D., Hyndman, D., 2009. Natural Hazards and Disasters. Second Edition. Belmont, California: Brooks/Cole.

Jackson, L.W.R., 1952. Radial growth of forest trees in the Georgia Piedmont. Ecology 33(3), 336–341.

Johnson, A.S., Hilburn, O.H., Shanholtzer, S.F., Shanholtzer, G.F., 1974. An Ecological Survey of the Coastal Region of Georgia. U.S. National Park Service monograph series, No. 3. Washington D.C.: U.S. Government Printing Office.

King, A., 2017. Mississippian Period: Overview. New Georgia Encyclopedia. Georgia Humanities. https://www.georgiaencyclopedia.org/articles/history-archaeology/mississippian-period-overview (accessed 15 August 2020).

Krauss, K.W., Duberstein, J.A., 2010. Sapflow and water use of freshwater wetland trees exposed to saltwater incursion in a tidally influenced South Carolina watershed. Canadian Journal of Forest Research 40, 525–535.

Lewis, D.B., Finkelstein, D.B., Grissino-Mayer, H.D., Mora, C.I., Perfect, E., 2011. A multitree perspective of the tree ring tropical cyclone record from longleaf pine (*Pinus palustris* Mill.), Big Thicket National Preserve, Texas, United States. Journal of Geophysical Research: Biogeosciences 116(G2). https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2009JG001194.

Liu, K.N., Fearn, M.L., 2000. Reconstruction of prehistoric landfall frequencies of catastrophic hurricanes in northwestern Florida from lake sediment records. Quaternary Research 54, 238– 245.

McFadden, P.S., Jaeger, J.M,. 2014. Reconstructing Holocene Shoreline Transgression and Storm History in Horseshoe Cove on the Northern Gulf Coast of Florida. Poster presented at the 63rd Annual Meeting of the Southeastern Section of the Geological Society of America, Wilmington, NC.

Miller, D.L., Mora, C.I., Grissino-Mayer, H.D., Mock, C.J., Uhle, M.E., Sharp, Z., 2006. Tree-ring isotope records of tropical cyclone activity. PNAS 103(39),14294–14297.

Miller, G.H., Geirsdóttir, Á., Zhong, Y., Larsen, D.J., Otto-Bliesner, B.L., Holland, M.M., Bailey, D.A., Refsnider, K.A., Lehman, S.J., Southon, J.R., Anderson, C., Björnsson, H., Thordarson, T., 2012. Abrupt onset of the Little Ice Age triggered by volcanism and sustained by sea-ice/ocean feedbacks. Geophysical Research Letters 39(2), 1–5.

Mann, M.E. Little Ice Age. Encyclopedia of Global Environmental Change. The Earth System: Physical and Chemical Dimensions of Global Environmental Change 1. Wiley and Sons, Chichester, pp. 504–509.

Myers, J.M., 2019. Coastal Forests Face Rising Sea Levels, Increased Salinity. CompassLive. USDA Southern Research Station.

https://www.srs.fs.usda.gov/compass/2019/11/07/coastal-forests-face-rising-sea-levels-increased-salinity/ (accessed 3 August 2020).

National Hurricane Center and Central Pacific Hurricane Center, 2020. Tropical Cyclone Climatology.National Oceanic and Atmospheric Administration. https://www.nhc.noaa.gov/climo/ (accessed 21 August 2020).

"Old Tower," 2021 Sapleo Island, GA. Tide Chart. US Harbors. https://www.usharbors.com/harbor/georgia/old-tower-sapelo-island-ga/tides/. Accessed January 15, 2021.

Pluckhahn, T.J., 2017. Woodland Period: Overview. New Georgia Encyclopedia. Georgia Humanities. https://www.georgiaencyclopedia.org/articles/history-archaeology/woodland-period-overview (accessed 15 August 2020).

Richey, J.N., Poore, R.Z., Flower, B.P., Quinn, T.M., 2007. 1400 yr multiproxy record of climate variability from the northern Gulf of Mexico. Geology (35), 423–426.

Richey, J.N., Poore, R.Z., Flower, B.P., Quinn, T.M., Hollander, D.J., 2009. Regionally coherent Little Ice Age cooling in the Atlantic Warm Pool. Geophysical Research Letters 36(21), 1–5.

Ritchison, B.T. 2018. Investigating 14th century immigration and settlement response on the Georgia Coast, USA. Journal of Archaeological Science: Reports 21, 606–618.

Ritchison, B.T., Thompson, V.D., Lulewicz, I., Tucker, B., Turck, J.A., 2020. Climate change, resilience, and the Native American fisher-hunter-gatherers of the late Holocene on the Georgia Coast, USA. Quaternary International, in press.

Saha, A.K., Saha, S., Sadle, J., Jiang, J., Ross, M.S., Price, R.M., Sternberg, L.S.L.O., Wendelberger, K.S., 2011. Sea level rise and South Florida coastal forests. Climatic Change 107, 81–108.

Saunders, R., 2010. The Archaic Above Choctawhatchee Bay: Hydrodynamics, Adaption, and Abandonment, in: Thomas, D.H., Sanger, M.C. (Eds.), Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?. AMNH Anthropological

Papers No. 93. American Museum of Natural History Scientific Publications, New York, pp.103–112.

Schmitt, D., Gischler, E., Anselmetti, F.S., Vogel, H., 2020. Caribbean Cyclone Activity: An Annually-Resolved Common Era Record. *Scientific Reports* 10, 11780. https://doi.org/10.1038/s41598-020-68633-8.

Sharitz, R.R., Lee, L.C., 1985. Limits on Regeneration Processes in Southeastern Riverine Wetlands, in: Roy, J.R., Ziebell, C.D., Patton, D.R., Ffolliott, P.F., Hamre, R.H. (Tech. Coords.), Riparian Ecosystems and their Management: Reconciling Conflicting Uses. First North American Riparian Conference. USDA Forest Service General Technical Report RM-120. pp. 139–143.

Sheldon, J.E., Burd, A.B., 2014. Alternative effects of climate drivers on Altamaha River discharge to coastal Georgia, USA. Estuaries and Coasts 37, 772–788.

Simiand, F., 1960 Méthode historique et science sociale. Annales: Économies, Sociétés, Civilizations 15(1), 83–119.

The Southeast Regional Climate Center, 2020. Brunswick, Georgia: Monthly Total Precipitation (inches), 2020. The University of North Carolina, Chapel Hill. https://sercc.com/cgi-bin/sercc/cliMONtpre.pl?ga1340 (accessed 20 August 20 2020).

Speer, J.H., 2010. Fundamentals of Tree-Ring Research. The University of Arizona Press, Tucson.

Stahle, D.W., Burnette, D.J., Villanueva, J., Cerano, J., Fye, F.K., Griffin, R.D., Cleaveland, M.K., Stahle, D.K., Edmondson, J.R., Wolff, K.P., 2012. Tree-ring analysis of ancient bald cypress trees and subfossil wood. Quaternary Science Reviews 34, 1–15.

Stahle, D.W., Edmondson, J.R., Howard, I.M., Robbins, C.R., Griffin, R.D., Carl, A., Hall, C.B., Stahle, D.K., Torbenson, M.C.A., 2019. Longevity, climate sensitivity, and conservation status of wetland trees at Black River, North Carolina. Environmental Research Communications 1, 041002.

Sullivan, B., 2000. Images of America: Darien and McIntosh County. Arcadia Publishing, Charleston, South Carolina.

Thomas, B.L., Doyle, T., Krauss, K., 2015. Annual growth patterns of bald cypress (*Taxodium distichum*) along salinity gradients. Wetlands 35, 831–839.
Thompson V.D., Marquardt, W.H., Cherkinsky, A., Roberts Thompson, A.D., Walker, K.J., Newsom, L.A., 2016. From shell midden to midden-mound: the geoarchaeology of Mound Key, an anthropogenic island in Southwest Florida, USA. PLoS ONE 11(4), e0154611. https://doi.org/10.1371/journal.pone.0154611.

Thompson, V.D., Turck, J.A., 2009. Adaptive cycles of coastal hunter-gatherers. American Antiquity (74), 255–278.

Thompson, V.D., Worth, J.E., 2011. Dwellers by the sea: Native American adaptations along the southern coasts of Eastern North America. Journal of Archaeological Research 19, 51–101. https://doi.org/10.1007/s10814-010-9043-9.

Tucker, C.S., 2015. Dendrotempestology: Identifying the Statistical Relationship between Hurricanes and Trees Growth in the Pine Savannas of Coastal Mississippi. Unpublished master's thesis. Louisiana State University. https://digitalcommons.lsu.edu/cgi/viewcontent.cgi?article=2428&context=gradschool_theses (accessed 2 August 2020).

Turck, J.A., Thompson, V.D., 2016a. Revisiting the resilience of Late Archaic hunter-gatherers along the Georgia Coast. Journal of Anthropological Archaeology 43, 39–55.

Turck, J.A. Thompson, V.D., 2016b. Human-Environmental Dynamics of the Georgia Coast. Paper presented at the 81st Annual Meeting of the Society for American Archaeology, Orlando, Florida.

Wang, T., Surge, D., Walker, K.J., 2011. Isotopic evidence for climate change during the Vandal Minimum from *Ariopsis felis* otoliths and *Mercenaria campechiensis* shells, Southwest Florida, USA. The Holocene 21(7), 1081–1091.

Wang, T., Surge, D., Walker, K.J., 2013. Seasonal climate change across the Roman Warm Period/Vandal Minimum transition using isotope sclerochronology in archeological shells and otoliths, Southwest Florida, USA. Quaternary International 308–309, 230–241.

Welford, M.R., Bossak, B.H., Gibney, E.J., 2017. Archival Evidence of Secular Changes in Georgia Hurricanes: 1750 – 2012, in Collins, J.M., Walsh, K. (Eds.), Hurricanes and Climate Change. Springer, New York, 35–54.

Wilms, D.C., 1972. The Development of Rice Culture in 18th Century Georgia. Southeastern Geographer 12, 45-57.

Yang, L. H., Bastow, J.L., Spence, K.O., Wright, A.N., 2008. What can we learn from resource pulses? Ecology 89, 621–634.

Yanosky, T.M., Hupp, C.R., Hackney, C.T.,1995 Chloride concentrations in growth rings of *Taxodium distichum* in a saltwater-intruded estuary. Ecological Applications 5(3), 785–792.

Figures and Tables

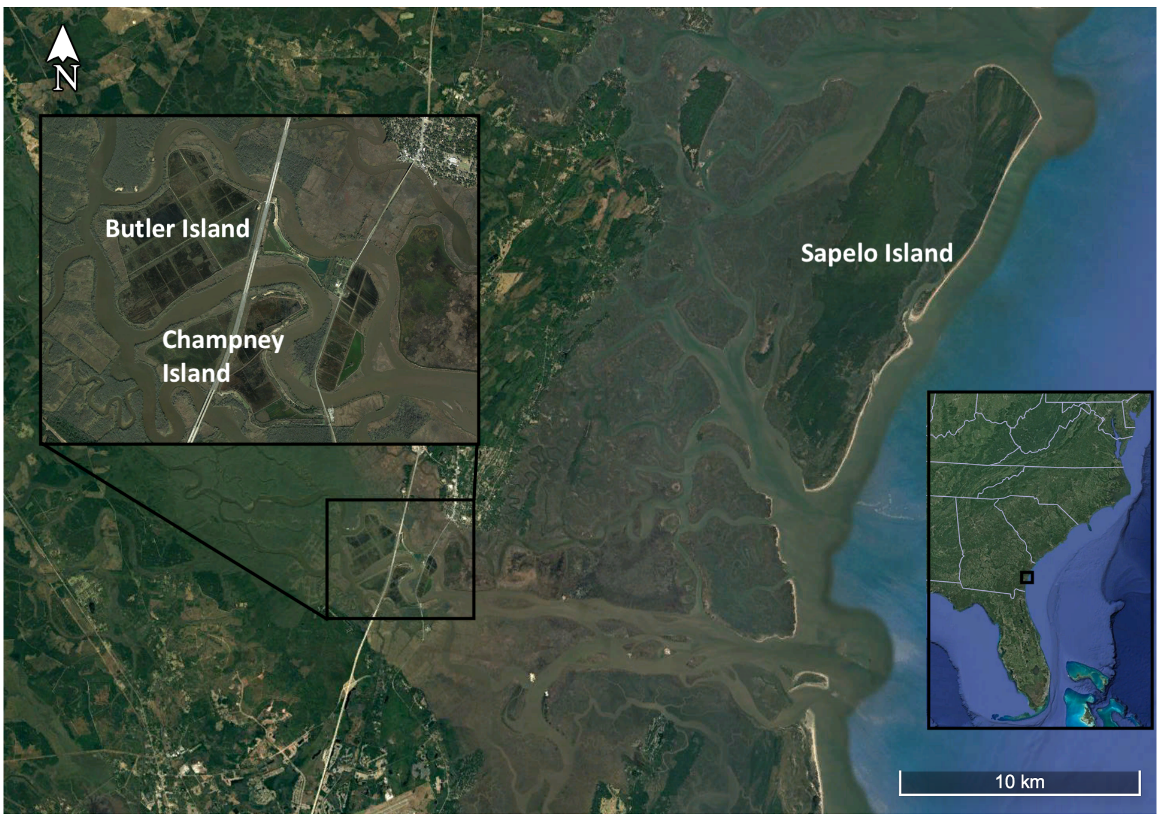

Figure 4.1. Location of Butler and Champney Islands, part of the Altamaha Wildlife Management Area (WMA), as well as Sapelo Island. All tree samples used in this study were recovered from these three locations.

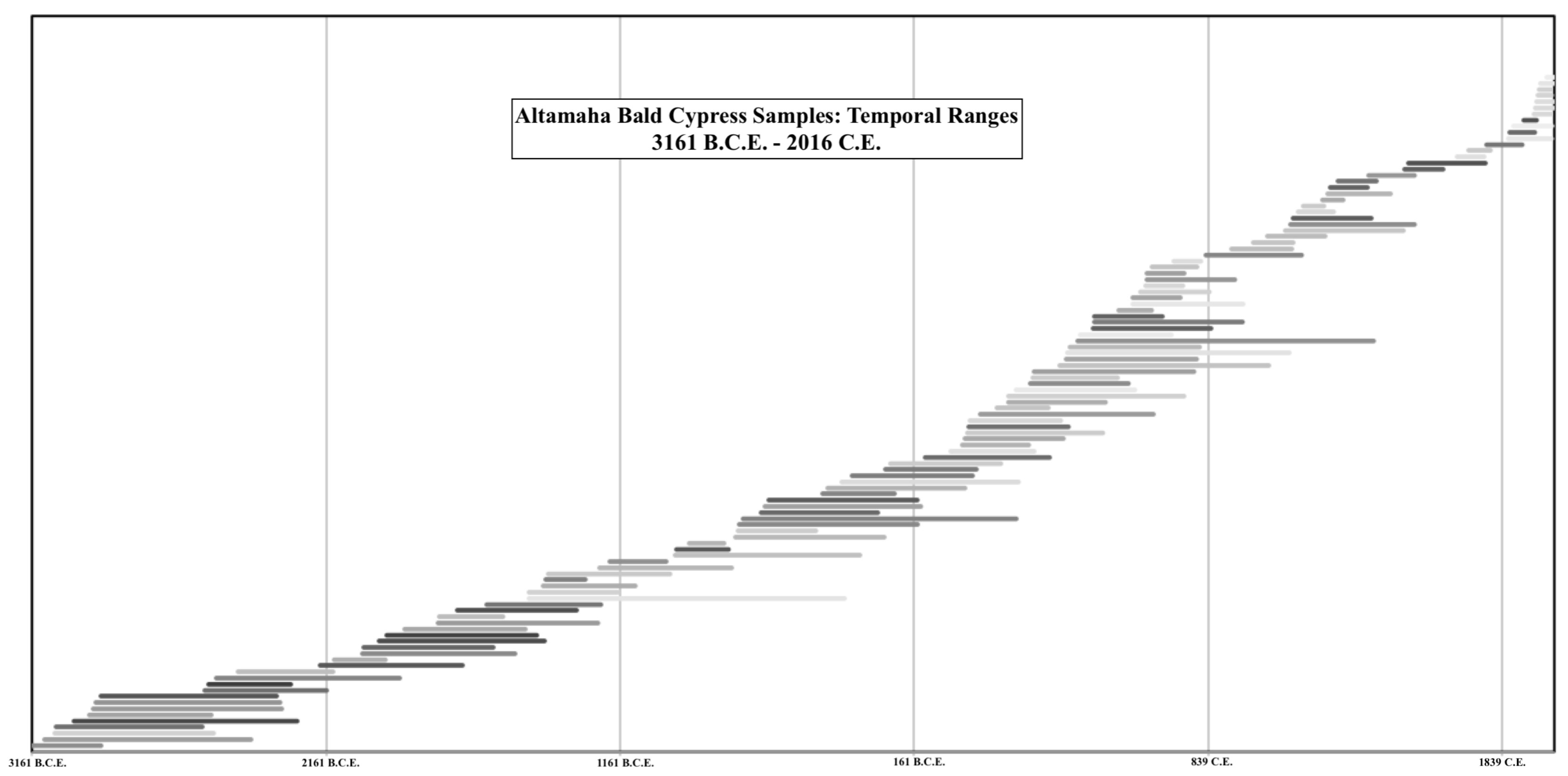

Figure 4.2. Time spans covered by the bald cypress specimens from the Altamaha WMA over the period 3161 B.C.E. to 2016 C.E.

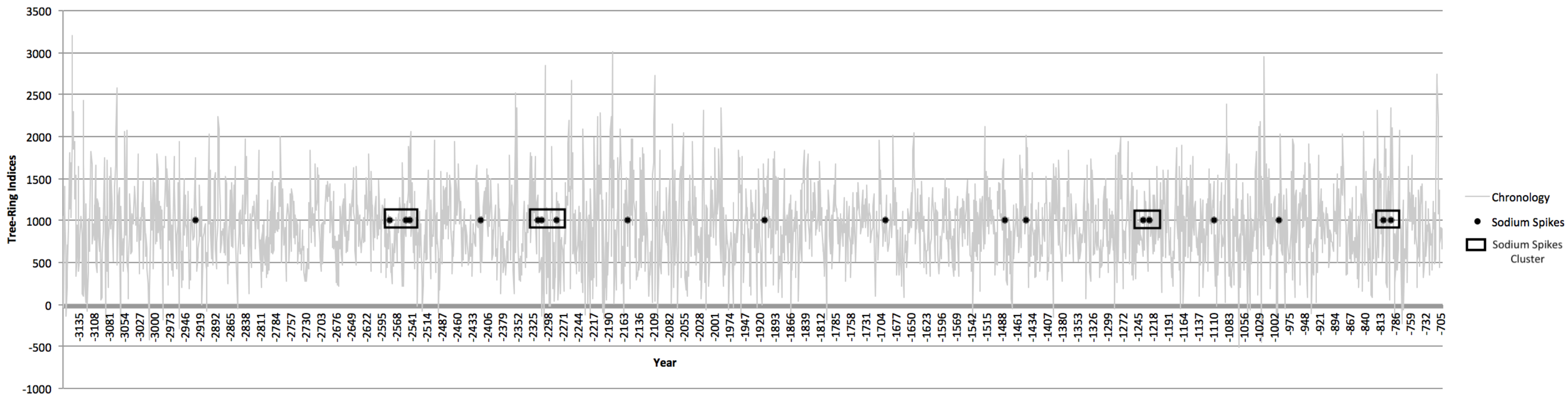

Figure 4.3. Elevated sodium levels (at least 1 of 3 samples for the tree above 1000 mg/kg in Na) in the outer rings of trees that grew from 3161 B.C.E. to 700 B.C.E superimposed against the normalized tree-ring chronology for this time period. Four clusters of sodium spikes, in which multiple trees died in a very short time period with elevated sodium levels in their outer rings, are present.

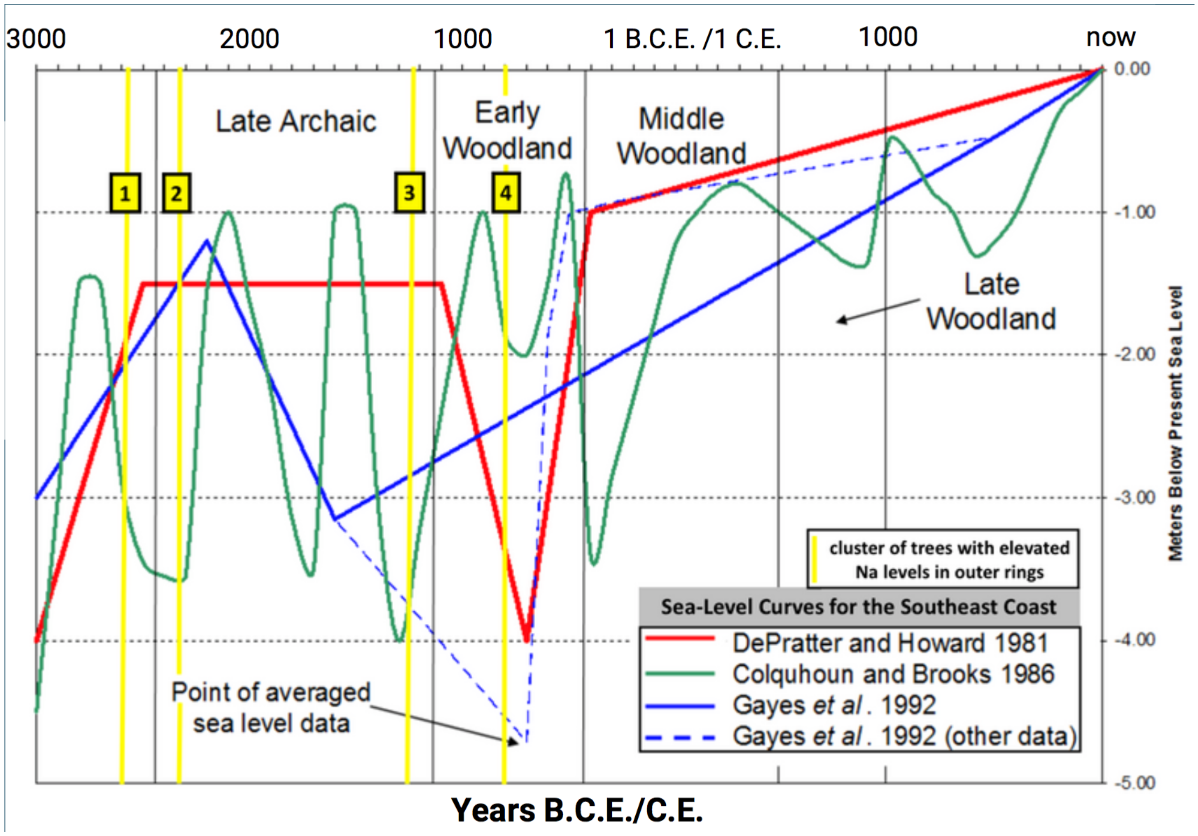

Figure 4.4. The timing of the 4 clusters of sodium spikes shown with the existing sea-level curves for the prehistoric Southeast Atlantic Coast that indicate sea-level fluctuation. The clusters indicate salinity intrusion events that killed multiple trees. Two of these clusters (2 and 3) correlate very closely with the beginning of rising sea-levels in the Colquhoun and Brooks 1986 model and support the timing of this model in these areas. Cluster 1 may indicate a previously unknown sea-level fluctuation, as evidence suggests occurred on the Gulf Coast (Balsillie and Donoghue 2004), or it may be a tree die-off from another type of salinity intrusion event (e.g., storm surge after a hurricane). The timing of Cluster 4 may indicate that sea-level rise began around a century earlier than existing models suggest and thus that the hypothesized lowstand was also approximately 100 years earlier. Figure adapted from Thompson and Turck 2016b, Figure 3.

Table 4.1. Hurricanes that impacted the Georgia Coast over the period 1750 – 2012 and corresponding normalized chronology characteristics. Hurricane information summarized from Welford et al. 2017, pg. 43, Table 2.2.

Hurricane Information			**Normalized Tree-Ring Indices**		
Year of Impact	**Dates**	**County of Impact**	**Decreased Year of Impact**	**Large Year of Impact**	**Decreased Subsequent Year**
1752	Sep. 8 – 16	Unknown			X
1804	Sep. 2 -12	McIntosh		X	X
1811	Oct. 4 – 5	St. Mary’s		X	X
1813	Sep. 16 – 17	St. Mary’s			X
1817	Aug. 1 – 9	St. Mary’s		X	X
1824	Sep. 7 – 15	McIntosh	X		
1830	Aug. 11 – 19	Chatham	X		
1837	Aug. 1 – 7	Duval		X	X
1842	Sep. 30 – Oct. 10	Glynn		X	X
1846	Oct. 5 – 13	Levy		X	X
1853	Oct. 19 – 22	offshore		X	X
1854	Sep. 7 – 12	Chatham		X	X
1878	Sep. 1 – 13	offshore		X	X
1881	Aug. 21 – 29	Liberty	X		X
1885	Aug. 21 – 27	North Georgia		X	
1893	Aug. 15 – 30	Chatham		X	
1896	Sep. 22 – 30	inland		X	X
1898 (2 hurricanes)	Aug. 30 – Sep. 1 Sep. 25 – Oct. 6	North Georgia Camden	X		
1911	Aug. 23 – 30	North Georgia	X		
1928	Sep. 6 – 9	offshore		X	
1940	Aug. 5 – 14	North Georgia	X		
1947	Oct. 9 – 16	Chatham		X	X
1979	Aug. 25 – Sep. 6	McIntosh	X		

Table 4.2. Sodium results from Optical Emission Spectroscopy at the Center from Applied Isotope Studies at UGA for the earliest 35 trees from the Altamaha. Elevated sodium levels are indicated by yellow, orange, or red emphasis corresponding to 1000+, 5000+, and 10,000+ mg/kg, respectively.

SAMPLE ID	YEAR	Sodium (mg/kg)
Tree 19 - Salinity Test 1 - Outer Rings	c. 3475-3360 B.C.E.	4250
Tree 19 - Salinity Test 2		2465
Tree 19 - Salinity Test 3		1194
Tree 20 - Salinity Test 1 - Outer Rings	c. 3240-3160 B.C.E.	5237
Tree 20 - Salinity Test 2		2169
Tree 20 - Salinity Test 3		1238
Tree 75 - Salinity Test 1 - Outer Rings	2926 B.C.E.	2748
Tree 75 - Salinity Test 2		385
Tree 75 - Salinity Test 3		748
Tree 15 - Salinity Test 1 - Outer Rings	2578 B.C.E.	15173
Tree 15 - Salinity Test 2		2683
Tree 15 - Salinity Test 3		10260
Tree 12 - Sailinity Test 1 - Outer Rings	2550 B.C.E.	4255
Tree 12 - Salinity Test 2		1903
Tree 12 - Salinity Test 3		547
Tree 107 - Salinity Test 1 - Outer Rings	2542 B.C.E.	548
Tree 107 - Salinity Test 2		920
Tree 107 - Salinity Test 3		1525
Tree 82 - Salinity Test 1 - Outer Rings	2416 B.C.E.	2521
Tree 82 - Salinity Test 2		905
Tree 82 - Salinity Test 3		355
Tree 38 - Salinity Test 1 - Outer Rings	2328 B.C.E.	100
Tree 38 - Salinity Test 2		298
Tree 38 - Salinity Test 3		368
Tree 14 - Salinity Test 1 - Outer Rings	2314 B.C.E.	1530
Tree 14 - Salinity Test 2		2049
Tree 14 - Salinity Test 3		1261
Tree 23 - Salinity Test 1 - Outer Rings	2308 B.C.E.	46110
Tree 23 - Salinity Test 2		13251
Tree 23 - Salinity Test 3		2095
Tree 4 - Salinity Test 1 - Outer Rings	2281 B.C.E.	1911
Tree 4 - Salinity Test 2		683
Tree 4 - Salinity Test 3		470
Tree 16 - Salinity Test 1 - Outer Rings	2256 B.C.E.	901
Tree 16 - Salinity Test 2		731
Tree 16 - Salinity Test 3		588
Tree 5 - Salinity Test 1 - Outer Rings	2154 B.C.E.	700
Tree 5 - Salinity Test 2		1327
Tree 5 - Salinity Test 3		809

Tree 86 - Salinity Test 1 - Outer Rings	1958 B.C.E.	682
Tree 86 - Salinity Test 2		64.6
Tree 86 - Salinity Test 3		35.9
Tree 26 - Salinity Test 1 - Outer Rings	1910 B.C.E.	4092
Tree 26 - Salinity Test 2		1805
Tree 26 - Salinity Test 3		1213
Tree 13 - Salinity Test 1 - Outer Rings	1693 B.C.E.	7862
Tree 13 - Salinity Test 2		2408
Tree 13 - Salinity Test 3		395
Tree 35 - Salinity Test 1 - Outer Rings	1592 B.C.E.	598
Tree 35 - Salinity Test 2		518
Tree 35 - Salinity Test 3		502
Tree 84 - Salinity Test 1 - Outer Rings	1559 B.C.E.	945
Tree 84 - Salinity Test 2		777
Tree 84 - Salinity Test 3		865
Tree 33 - Salinity Test 1 - Outer Rings	1516 B.C.E.	678
Tree 33 - Salinity Test 2		316
Tree 33 - Salinity Test 3		273
Tree 74 - Salinity Test 1 - Outer Rings	1480 B.C.E.	2272
Tree 74 - Salinity Test 2		1571
Tree 74 - Salinity Test 3		987
Tree 10 - Sailinity Test 1 - Outer Rings	1443 B.C.E.	7042
Tree 10 - Salinity Test 2		2292
Tree 10 - Salinity Test 3		510
Tree 1 - Salinity Test 1 - Outer Rings	1415 B.C.E.	625
Tree 1 - Salinity Test 2		191
Tree 1 - Salinity Test 3		213
Tree 25 - Salinity Test 1 - Outer Rings	1305 B.C.E.	296
Tree 25 - Salinity Test 2		478
Tree 25 - Salinity Test 3		803
Tree 37 - Salinity Test 1 - Outer Rings	1277 B.C.E.	95.3
Tree 37 - Salinity Test 2		134
Tree 37 - Salinity Test 3		138
Tree 6 - Salinity Test 1 - Outer Rings	1233 B.C.E.	436
Tree 6 - Salinity Test 2		1654
Tree 6 - Salinity Test 3		79.4
Tree 24 - Salinity Test 1 - Outer Rings	1223 B.C.E.	523
Tree 24 - Salinity Test 2		3978
Tree 24 - Salinity Test 3		260
Tree 87 - Salinity Test 1 - Outer Rings	1168 B.C.E.	198
Tree 87 - Salinity Test 2		136
Tree 87 - Salinity Test 3		413

Tree 18 - Salinity Test 1 - Outer Rings	1108 B.C.E.	3843
Tree 18 - Salinity Test 2		3686
Tree 18 - Salinity Test 3		2553
Tree 39 - Salinity Test 1 - Outer Rings	1001 B.C.E.	111
Tree 39 - Salinity Test 2		239
Tree 39 - Salinity Test 3		143
Tree 108 - Salinity Test 1 - Outer Rings	991 B.C.E.	1395
Tree 108 - Salinity Test 2		1698
Tree 108 - Salinity Test 3		300
Tree 76 - Salinity Test 1 - Outer Rings	805 B.C.E.	519
Tree 76 - Salinity Test 2		904
Tree 76 - Salinity Test 3		4316
Tree 45 - Salinity Test 1 - Outer Rings	792 B.C.E.	196
Tree 45 - Salinity Test 2		1052
Tree 45 - Salinity Test 3		1695
Tree 27 - Salinity Test 1 - Outer Rings	782 B.C.E.	255
Tree 27 - Salinity Test 2		369
Tree 27 - Salinity Test 3		768

CHAPTER 5

A HIGH-RESOLUTION ANALYSIS OF SETTLEMENT SHIFTS AND PALEOENVIRONMENTAL CHANGES AT SHELL-BEARING SITES AT THE END OF THE LATE ARCHAIC (C. 3000 – 1500 BCE) ON THE NORTHERN GEORGIA COAST, USA[3]

---

[3]Napora, K.G. and V.D. Thompson. To be submitted to *Antiquity*.

Abstract

The Late Archaic period in the Southeast U.S. saw the depopulation of the coastal shell rings inhabited by complex fisher-hunter-gatherer societies. A new tree-ring chronology from the Altamaha River delta provides the framework for interpreting modeled radiocarbon dates from shell-bearing Late Archaic sites on the northern Georgia Coast. Our analysis indicates two distinct settlement periods, with northern sites settled centuries before those farther south. People at all sites weathered a 450-year period (c. 2300 – 1850 BCE) characterized by variable environmental conditions. This study emphasizes the resilience of Native American coastal societies during environmental upheaval.

Keywords: Late Archaic, shell rings, Southeast U.S., climate change, tree rings, Bayesian modeling

Introduction

Late Archaic peoples in the coastal Southeast U.S. (c. 3000 – 1100 BCE) are characterized by complex social formations, sedentism, long-distance exchange, and reliance on estuarine resources (Thompson and Worth 2011). Large sites with arcuate to circular deposits of shellfish, vertebrates, other artifacts, and features were focal points of Late Archaic coastal life. Zooarchaeological evidence and isotopic studies of mollusks indicate that Native Americans used these sites throughout the year (Colaninno 2012; Russo 1998; Thompson and Andrus 2011; Trinkley 1980). By around 1500 BCE, they seem to have abandoned shell rings (Sanger 2010; Thompson and Turck 2009). This apparent shift towards different settlement patterns and perhaps more terrestrial-based economies may have been a response to sea-level changes (Thompson and Turck 2009).

Turck and Thompson (2016) show that the use-life and terminal habitation dates of Late Archaic shell-bearing sites on the Georgia Coast can be divided into two distinct groups based on subregional variation— those located in deltas (i.e., of the Savannah, Ogeechee, Altamaha, and Satilla rivers) and those in non-deltaic areas (for a map of these micro-habitats, see Thompson and Turck 2016: 40, Figure 1). In deltaic areas, large-scale shellfishing began earlier (c. 3000 cal. BCE) and lasted longer (until c. 1500 cal. BCE) than in non-deltaic areas, where intensive shellfishing commenced c. 2500 cal. BCE and ceased by c. 1800 cal. BCE.

In this article, we model new and existing radiocarbon dates from Late Archaic shell-bearing sites on the northern Georgia Coast and interpret them against the environmental proxy data from a multimillennial tree-ring chronology to better understand what environmental changes occurred during the terminal Late Archaic and whether coastal societies of the period endured through these shifts. We present evidence for large-scale environmental instability during the Late Archaic, including two periods of rapid salinity increase at the Altamaha river mouth. More pronounced environmental fluctuation began c. 2300 BCE and continued for 450 years, overlapping with the use-life of all shell-bearing sites. Our results generally support Turck and Thompson's (2016) conclusion that deltaic shell rings were founded earlier and persisted later than non-deltaic shell rings. Our new dates also indicate that at least some of the Georgia Coast shell-bearing sites were likely occupied for a shorter amount of time than previous studies have indicated. The resilience of both coastal Native American societies as well as the north Georgia estuary ecosystems is evidenced by the use of shell ring sites and estuarine resources for the centuries of environmental instability when numerous drought years and possible strong storms dominated the coastal environment.

Our primary paleoenvironmental proxy for this study is a coastal tree-ring chronology developed from ancient bald cypress (*Taxodium distichum*) trees buried in anoxic conditions at the Altamaha Wildlife Management Area (WMA) in the Altamaha Delta (Napora et al. 2019, in prep). Ringwidth in these trees primarily reflects prior-to-growing season and early growing season precipitation as well as growing season salinity. Hurricanes sometimes also are discernible in the tree rings. In 48% of years in which the Georgia Coast was directly impacted by a hurricane between 1750 and 2012 CE (Welford et al. 2017), the annual ring is very large, and the subsequent year's ring is very small. Sodium concentrations in the outer rings of trees indicate two rapid salinity intrusion events between 2600 and 2200 BCE, likely either periods of enhanced storm frequency or sea-level transgressions (Napora and Jantzi in prep).

Existing archaeological and paleoenvironmental evidence indicates that Late Archaic societies on the Georgia Coast practiced sustainable lifeways on the scale of centuries, and possibly millennia, illustrated by the many persisting traditions and the longstanding cycle of oral transfer of traditional knowledge. Sustainable resource harvesting and continued ecosystem productivity during the occupation of Late Archaic sites bolstered this societal resilience. Oyster shell sizes and salinity-based spatial origins at Late Archaic (and temporally later) sites indicates that Native American peoples in the area engaged in sustainable oyster harvesting over relatively large areas and across very large time frames (Thompson et al. 2020). Systems of resource management and governance based on established fishing territories, as well as the maintenance of inter-village relationships, likely contributed to the long-term sustainability of these groups as well as their estuarine resource bases (Thompson et al. 2020; Turck and Thompson 2016).

While the extant evidence supports the resilience of Native American communities and their sustainable resource usage throughout the Late Archaic, it is evident that there were shifts during the terminal Late Archaic, and onwards into the Early Woodland. People in this region continued to harvest coastal resources even in the face of environmental changes (Turck and Thompson 2016). The transition to the terminal Late Archaic is characterized by an alteration of the spatial layout of settlements between the early Late Archaic and terminal Late Archaic sites, from sites with circular layouts with dense shell deposits to more amorphous and linear forms evidencing more limited use of shellfish. This transition was one of community and societal reconfiguration, likely set within a shifting ecosystem and resource base (Ritchison et al. 2020; Turck and Thompson 2016).

Here, we establish the resilience of Georgia's coastal Late Archaic shell-bearing site-based societies and illuminate the connection between cultural and environmental changes towards the end of this time period. We model existing and new radiocarbon dates from archaeological sites from this period and compare them to lines of evidence for ecological changes— the multi-proxy tree-ring data covering the same time frame that provides information on year-by-year conditions on the North Georgia Coast. This study addresses the following questions:

1) Does tree-ring data indicate environmental stress or upheavals during the time periods which saw the depopulation of the large shell-bearing sites of the Late Archaic?

2) To what extent are shifts in settlement during the Late Archaic tied to observable environmental events?

Methods

Radiocarbon Dating

We include in this study nine Late Archaic sites from the Georgia Coast which are geographically close to the paleoenvironmental field site of the Altamaha WMA and, are either relatively well-dated, with radiocarbon dates run on appropriate materials, or they have been excavated and have well-provenienced material available and accessible for dating. North to south, these sites are: Bilbo (9CH4), a shell-bearing, non-ring midden mound at the mouth of the Savannah River, 21 km upriver from the Atlantic (Crook 2009; Waring 1977); Pagan Plum Point (9CH61), another midden mound along the eastern marsh edge of Skidaway Island (Martin 1980); Odingsell Shell Ring (9CH111), on southern Skidaway Island (DePratter 1975); St. Catherines Shell Ring (9LI231), on western St. Catherines Island (Sanger 2015; Sanger and Thomas 2010); McQueen Shell Ring (9LI648), on eastern St. Catherines Island (Sanger 2015; Sanger and Hurst Thomas 2010); A. Busch Krick Shell Ring (9MC87), on Creighton Island (Crusoe and DePratter 1976; Turck and Thompson 2014); and Sapelo Island Shell Ring Complex (9MC23), a three-ring complex on eastern Sapelo Island (Thompson 2007, 2018; Thompson and Andrus 2011) (Figure 5.1).

Four sites were either previously undated or did not have non-shell dates: these include Pagan Plum Point Midden, Odingsell Shell Ring, A. Busch Krick Shell Ring and Sapelo Shell Ring II. For these sites, we ran new radiocarbon dates from materials in the extant collections held at the University of Georgia Laboratory of Archaeology.

Bayesian Modeling

The new dates and existing selected dates from the Georgia Coast database (Turck and Thompson 2014) were modeled in OxCal Version 4.4 (Bronk Ramsey 2009), employing the IntCal20 Northern Hemisphere curve (Reimer et al. 2020) to develop a chronological framework for the development, occupation, and dates of final usage for Late Archaic shell-bearing sites in geographic proximity to the Altamaha WMA. Existing Late Archaic radiocarbon dates from shell-bearing sites on the northern Georgia Coast were obtained from the Georgia Coastal Ecosystems Long-Term Ecological Research (LTER) online project data repository, a dataset of radiocarbon dates from archaeological sites located in the coastal plain of Georgia (i.e., the portion of the state located south and east of the Fall Line, which marks the greatest advance of the ancient shoreline in the

Mesozoic Era [Johnson et al. 1974]). This dataset incorporated all published and/or publicly available dates from the region and corrected for isotopic fractionation originally uncorrected dates (Turck and Thompson 2014).

Dates on unknown materials, bulk soil samples, and shell were excluded from this analysis. Marine reservoir effects in oyster (*Crassostrea virginica*) are often highly localized and may differ on the scale of centuries (e.g., Hadden and Cherkinsky 2017a; Rick et al. 2012). This renders oyster dates problematic in high-resolution modeling of archaeological chronologies. Mobile gastropod predators like conchs (Strombidae) and whelks (Busyconidae), meanwhile, are able to move between reservoir areas and incorporate various, indeterminate, relative amounts of old carbon, thus making the reservoir effects to which they are subjected even more difficult to specify (Hadden and Cherkinsky 2017b). Even under the best of circumstances, such dates are less precise than terrestrial-based assays (Thompson and Krus 2018).

We incorporated a total of 40 radiocarbon dates in this analysis (Table 5.1). Data for each archaeological site in this analysis were input as a separate Phase into the OxCal model; both dates in sequence and those whose relationship to other dates was unknown were included in these Phases. OxCal's Sequence function was used to model series of dates obtained from materials excavated in stratigraphic order. Such sequences of dates were preferentially selected for when this project selected materials and ran new dates from undated or underdated sites. Start and End Boundaries were inserted for each site in the model to provide date ranges for when occupation at the site most likely commenced and concluded.

Results

The modeled one sigma date ranges (68.3%) (Figure 5.2) indicate that at least some of the Late Archaic shell-bearing sites on the Georgia Coast were settled later and/or depopulated earlier than previous studies have indicated. Modeled start and end dates point to two distinct periods of settlement divided by latitude (Figure 5.3), with more northerly sites settled first, followed centuries later by more southerly sites. This division also correlates to deltaic (Bilbo, Pagan Plum Point, and Odingsell) and non-deltaic (McQueen Shell Ring, A. Busch Krick, and the three at the Sapelo Island Shell Ring complex) microenvironments; St. Catherines shell ring, likely settled in the earlier period, is the sole outlier among the non-deltaic sites. The deltaic sites may have been settled several hundred years later than Turck and Thompson's (2016) analysis indicates, possibly between 2850 and 2285 cal. BCE. This is likely due to the inclusion of shell in the modeling of these dates using the Marine13 calibration curve, which tends to give ranges that are considerably earlier than the most recent Marine20 calibration (Heaton et al. 2020). Thus, our modeling also indicates that the use-lives of the non-deltaic sites may be even shorter than previously believed, with some sites likely having been depopulated by 2000 cal. BCE.

Discussion

Two Distinct Periods of Shell-Bearing Site Settlement Prior to or During Two Major Salinity-Intrusion Events

Modeled date ranges for Late Archaic shell-bearing sites on the northern Georgia Coast indicate that these sites were founded in two periods: the first possibly prior to 2600 BCE (Bilbo, Pagan Plum Point, Odingsell, and St. Catherines) and the second between 2400 and 2300 BCE (McQueen, A. Busch Krick, and the three Sapelo shell rings).

The settlement of these sites overlaps with two short time periods (2578 – 2542 BCE and 2314 – 2281 BCE) in which multiple cypress trees died of salt uptake in the Altamaha WMA . These two clusters contain the trees with the highest sodium levels in the outer rings of all trees sampled. These two short time periods indicate major salinity intrusion events—either periods of increased storm frequency, during which storm surge into coastal forests caused frequent cypress mortality, or rapid sea-level transgression (Napora and Jantzi in prep). Both possibilities are supported by extant evidence. The Gulf Coast may have experienced increased catastrophic storm activity in the Late Archaic (Liu and Fearn 2000; McFadden and Jaeger 2014; Saunders 2010); the Georgia Coast data may document similar levels of storm activity. At the same time, numerous lines of proxy data support a sea-level lowstand at c. 2800 – 2600 BCE on the Gulf Coast (Balsillie and Donoghue 2004). Meanwhile, one sea-level model for the Atlantic Coast based on marsh stratigraphy and archaeological site data (Colquhoun and Brooks 1986) finds a lowstand coinciding with the second of these events. The latter study, however, proposes more fluctuations than are supported by any other extant sea-level model. If each of these salinity-intrusion events represents a distinct episode of sea-level transgression, their temporal proximity may have made them difficult to distinguish. Colquhoun and Brooks' (1986) data and other proxy data sources used for previous research on sea-level changes in this region, including foraminifera from vibracore samples (Gayes et al. 1992) and archaeological occupational evidence (DePratter and Howard 1981; DePratter and Thompson 2013), may not have had high enough resolution to identify the first of these two possible lowstands and the following rapid rise, which would have been followed relatively quickly by a second similar event. Rapid sea-level transgression events occurring at both or either of these periods by extrapolation would indicate sea-level lowstands occurring either prior to 2578 BCE and/or between 2542 and 2314 BCE.

Our data indicate that the Late Archaic shell-bearing villages on the northern Georgia Coast were settled in two distinct, latitude-distinguished, periods, each either directly prior to or during major salinity-intrusion events, one (or, less likely, both) of which may represent rapid sea-level transgression. If these events represent sea-level rise, sites were settled during two sea-level lowstand events or directly afterwards as sea-level began to rise. If the events are instead indicators of increased storm frequency, sites were settled either during periods of relative environmental stability or at the beginnings of increased fluctuation.

Enhanced Environmental Fluctuation During the Use-Lives of Shell-Bearing Sites

The Altamaha cypress tree-ring chronology also indicates that each of the two salinity intrusion events occurred at the very beginning of a period of enhanced environmental fluctuation. These periods cover the years c. 2560 – 2490 and c. 2300 – 1850 BCE. The latter 450-year period is particularly notable for numerous drought years as well as enhanced interannual variability, indicating very wet years interspersed with very dry years. Some of these years may also be associated with hurricane or other major storm events. This multicentury period of environmental instability corresponds with the timespan in which the majority of northern Georgia Coast shell-bearing coastal sites were occupied, emphasizing the resilience of Native American coastal hunter-gatherer-fishers.

Native American practices of estuarine resource harvesting and their concomitant social relationships allowed for long-term occupations and a continued stability of cultural practices. This, however, does not mean that Native American systems were unchanging on the coast, as new climate regimes emerged at the end of this period.

Coincidence of the Depopulation of the Last Late Archaic Shell-Bearing Sites with Environmental Downturn

At the end of the use-lives of the last-occupied Late Archaic shell ring and midden-mound villages (post c. 1540 BCE), the tree-ring data show an environmental downturn compared to the period of 1800 – 1540 BCE, which was characterized by a relatively stable coastal environment with more reliable rainfall patterns. The post-1540 BCE period, while not indicating as intense a level of interannual fluctuation as the 2300 – 1850 BCE period, points to an increased number of droughts compared to the preceding centuries. Very small annual rings in the years 1539, 1526, 1483, 1479, 1469, and 1396 BCE indicate either extremely dry years or possible hurricane events in the preceding year.

Conclusions

The settlement of the shell-bearing Late Archaic villages occurred in two distinct periods either directly before or at two major salinity intrusion events. These salinity intrusion events indicate either increased numbers of strong storms, with associated storm surge, or rapid sea-level transgression. The periods before the salinity intrusion events (prior to 2600 BP and 2400 – 2300 BCE) thus represent either times of relative environmental stability or periods of lowered sea-levels. Based on existing sea-level models for the Southeast, it is likely that at least one of these salinity intrusion events is indeed a rapid sea-level transgression. More northerly archaeological sites in the study area, including the deltaic sites modeled here, were settled first, followed several centuries later by more southern sites. Whether this site settlement pattern speaks more to environmental change experienced differentially by latitude, microenvironment, or other factors is currently unclear. Each salinity intrusion event was followed by a decrease in environmental stability. Given the interconnectedness of Late Archaic villages (Ritchison et al. 2020; Thompson et al. 2020), people farther south on the Georgia Coast were certainly aware that communities living at the existing shell-ring village sites farther north had been able to continue their lifeways during the salinity intrusion event c. 2600 BCE and the following 70 years of environmental upheaval. With this knowledge, more southerly groups may have made the decision to emulate extant, and clearly resilient, communities when the environmental again destabilized following another salinity intrusion event c. 2300 BCE.

People living on the northern Georgia Coast inhabited shell-ring sites year-round and focused their economies on estuarine resources during a 450-year period of enhanced environmental instability. The persistence of these permanent, relatively large-scale societies through this long period of environmental instability speaks to the resilience of both the societies themselves as well as that of the northern Georgia Coast estuary ecosystems. The unstable environmental conditions endured from 2300 – 1850 BCE include unreliable year-to-year rainfall patterns, many dry years, and possibly multiple hurricanes or other storm events.

Given the endurance of coastal-focused societies during this long period of environmental upheaval, estuary ecosystems and the resources they provided were likely less dependent on consistent interannual rainfall patterns, and thus more resilient during this period, than at least some mainland terrestrial resources. Both decreased salinity from heightened multiyear precipitation as well as increased salinity from lasting drought conditions (leading to reduced surface flows from rivers and streams entering estuaries as well as reduced groundwater flows and aquifer recharge) can have major negative impacts on estuary species like oysters, including increased mortality and decreased recruitment (Levinton et al. 2011; Murry et al. 2020). The continued use of the same estuarine resources over this multicentury period of environmental upheaval thus implies a buffering effect of estuaries against year-to-year rainfall variation. The fluctuation in tree-ring indices indicates that, even with frequent droughts occurring, years with high or very high levels of precipitation punctuated the environment regularly; this influx of water was likely enough to replenish groundwater within the extensive aquifer systems that extend along the Southeast Atlantic coastline ("Georgia's Aquifers" 2002), in turn partially stabilizing estuaries against the impacts of changing salinity levels. As the tree-ring chronology is largely indicative of January to May rainfall (Napora and Jantzi in prep), there may also have been large influxes of water in some years during the summer or fall that are undetectable via the chronology. Such influxes would have served to replenish depleted reservoirs. Studies also indicate that oyster reefs in the region are exceptionally resilient to fluctuations in sea level (Ridge et al. 2017), which suggests that Georgia Coast oyster beds could have persisted through the two possible sea-level shifts of this period.

Subannual oxygen isotopic analyses would help to distinguish between trees killed by sea-level rise and storms. Years in which hurricanes occur show low $\delta^{18}O$

values in tree rings due to the high relative percentage of ^{16}O evaporated from ocean water during such events and the heavier ^{18}O preferentially precipitated during high-rainfall events (Speer 2010: 243). In an seasonal analysis, low $\delta^{18}O$ values in the outer rings of a tree with elevated sodium levels would therefore indicate that the tree likely died of hurricane-associated storm surge, while normal $\delta^{18}O$ would indicate another source of salinity increase, likely rapid sea-level transgression. An oxygen isotope study could help to clarify the timing and number of sea-level lowstands that occurred during this period.

Decreased environmental stability post-1540 BCE combined with a series of annual events that impacted the coast, perhaps hurricanes or other major storms, may have meant that continued habitation of the shell ring and midden mound villages, which seem to have been ideal places to reside during long-term environmental upheaval, was no longer necessary or desirable. It is also likely, given the ability of Native American coastal communities to weather extreme environmental fluctuation, that cultural choices rather than ecological drivers played the major role in societies' decisions to transition aspects of their everyday lives in the terminal Late Archaic.

This study shows that relatively large-scale hunter-gatherer-fisher societies flourished on the northern Georgia Coast during a period of environmental instability lasting from c. 2300 – 1850 BCE that included numerous drought years and unreliable rainfall patterns as well as possible spates of strong storms. Occupation of some of the coastal shell-bearing sites of this period may be shorter than previously indicated. The depopulation of the last occupied shell rings of the region likely occurred during a period punctuated with a series of major ecological events, some of which may have been hurricanes. Previous research by Thompson and colleagues emphasizes large-scale environmental shifts and the abandonment of shell ring and midden mound villages; however, this picture was based largely on low-resolution environmental data. The new tree ring chronology demonstrates that the relationship of coastal communities to shifting climate and estuarine resources was more complicated than previously thought. This new high-resolution temporal perspective demonstrates the flexibility that such communities possessed in the face of large-scale environmental changes.

Acknowledgements

This research was supported in part in association with the National Science Foundation Grants OCE-0620959 and OCE-123714 and DDRI Award #1834682 as well as the Georgia Coastal Ecosystems LTER project. We thank the Georgia Department of Natural Resources as well as the Department of Anthropology, the Graduate School, the Laboratory of Archaeology, and the Center for Applied Isotope Studies at the University of Georgia for institutional support. Special thanks to Robert J. Speakman, Alexander Cherkinsky, Robert Horan, Blaine Tyler, Craig Jacobs, Carey Garland, Suzanne Pilaar Birch, Ervan Garrison, and Elizabeth Reitz.

References

J.H. BALSILLIE & J.F. DONOGHUE. 2004. Northern Gulf of Mexico sea-level history for the past 20,000 years. *In:* N.A. Buster and C.W. Holmes (eds.), *Gulf of Mexico Origin, Waters and Biota: Vol. 3, Geology*. College Station, Texas: Texas A&M University Press, pp. 53–72.

BRONK RAMSEY, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(1): 337–360.

COLANINNO, C. E., 2012. Evidence for Year-round Occupation at Late Archaic Shell Rings of the Georgia Coast: Data from Oxygen Isotopic Profiles and Seasonally Sensitive

Vertebrate Fauna, in: E.J. Reitz, I.R. Quitmyer & D.H. Thomas (eds.), *Seasonality and Human Mobility Along the Georgia Bight*: 83 – 102. Anthropological Papers of the American Museum of Natural History, No. 97, New York.

COLQUHOUN, D.J. & M.J. BROOKS. 1986 New Evidence from the Southeastern United States for Eustatic Components in the Late Holocene Sea Levels. *Geoarchaeology* 1(3): 275-291.

CROOK, M.R. 2009. Bilbo (9CH4) and Delta (38JA23): Late Archaic and Early Woodland Shell Mounds at the Mouth of the Savannah River. *Occasional Papers in Cultural Resource Management* 17. Georgia Department of Transportation.

CRUSOE, D.L., & C.B. DEPRATTER. 1976 A New Look at the Georgia Shell Mound Archaic. *The Florida Anthropologist 29*(1): 1–23.

DEPRATTER, C.B. 1975. An Archaeological Survey of the P. H. Lewis Property on Skidaway Island, Chatham County, Georgia. Manuscript on file, University of Georgia, Laboratory of Archaeology (Research Manuscript 343).

DEPRATTER, C. B. & J. HOWARD. 1981. Evidence for a sea level lowstand between 4500 and 2400 years B.P. on the southeast coast of the United States. *Journal of Sedimentary Petrology* 51: 1287–1295.

DEPRATTER, C.B. & V.D. THOMPSON. 2013. Past Shorelines of the Georgia Coast. In V.D. Thompson & D.H. Thomas (eds.) *Life Among the Tides: Recent Archaeology on the Georgia Bight*: 145 – 167. New York: Anthropological Papers Number 98 of the American Museum of Natural History.

GAYES, P. T., D.B. SCOTT, E.S. COLLINS, & D.D. NELSON. 1992. A late Holocene sea-level fluctuation in South Carolina, in C.H. Fletcher & J.F. Wehmiller (eds.) *Quaternary Coasts of the United States: Marine and Lacustrine Systems*: 155–160. Tulsa, Oklahoma: SEPM Society for Sedimentary Geology, Special Publication 48.

"Georgia's Aquifers." 2002. Summit to the Sea. University of Georgia. http://coastgis.marsci.uga.edu/summit/aquifers.htm (accessed 4 October 2020).

HADDEN, C. & A. CHERKINSKY. 2017a. Carbon Reservoir Effects in Eastern Oyster from Apalachicola Bay, USA. *Radiocarbon* 59(5): 1497-1506.

HADDEN, C.S. & A. CHERKINSKY. 2017b. Spatiotemporal Variability in ΔR in the Northern Gulf of Mexico, USA. *Radiocarbon* 59(2): 343 – 353.

HEATON, T.J, P. KÖHLER, M. BUTZIN, E. BARD, R.W. REIMER, W.E.N. AUSTIN, C. BRONK RAMSEY, P.M. GROOTES, K.A. HUGHEN, B. KROMER, P.J. REIMER, J.F. ADKINS, A. BURKE, M.S. COOK, J. OLSEN, & L.C. SKINNER. 2020. Marine20 - the marine radiocarbon age calibration curve (0 - 55,000 cal BP), simulated data for IntCal20. PANGAEA, https://doi.org/10.1594/PANGAEA.914500

JOHNSON, A.S., H.O. HILLESTAD, S.F. SHANHOLTZER & G.F. SHANHOLTZER. 1974. An Ecological Survey of the Coastal Region of Georgia. National Park Service Monograph No. 3. https://www.nps.gov/parkhistory/online_books/science/3/index.htm (accessed 16 November 2020).

LEVINTON, J., M. DOALL, D. RALSTON, A. STARKE, & B. ALLAM. 2011. Climate Change, Precipitation, and Impacts on an Estuarine Refuge from Disease. *PLOS One* 6(4):e18849. doi:10.1371/journal.pone.0018849.

LIU, K. & M.L. FEARN. 2000. Reconstruction of Prehistoric Landfall Frequencies of Catastrophic Hurricanes in Northwestern Florida from Lake Sediment Records. *Quaternary Research* 54: 238 – 245.

MARTIN, T. 1980. Pagan Plum Point: Subsistence and Salt March Ecology at at Late Archaic Shellmound, Chatham Co., Georgia. *Early Georgia* 8(1 & 2): 75 – 94.

MCFADDEN, P.S. & J.M. JAEGER. 2014. Reconstructing Holocene Shoreline Transgression and Storm History in Horseshoe Cove on the Northern Gulf Coast of Florida. Poster presented at the 63rd Annual Meeting of the Southeastern Section of the Geological Society of America, Wilmington, NC.

MURRY, B., M. GARCIA-BERMUDEZ, S. CRAUSBAY, & K. MALPELI. 2020. Drought Impacts to Coastal Estuary Ecosystems in the U.S. Caribbean. Climate Adaptation Science Centers. USGS. https://www.usgs.gov/ecosystems/climate-adaptation-science-centers/drought-impacts-coastal-estuary-ecosystems-us (accessed 4 October 2020).

NAPORA, K.G., A. CHERKINSKY, R.J. SPEAKMAN, V.D. THOMPSON, R. HORAN, & C. JACOBS. 2019. Radiocarbon Pretreatment Comparisons of Bald Cypress (Taxodium distichum) Wood Samples from a Massive Buried Deposit on the Georgia Coast, USA. *Radiocarbon* 61(6): 1755–1763.

NAPORA, K.G., A. CHERKINSKY, R. HORAN, B. TYLER, C. JACOBS, & V.D. THOMPSON. 2021. A 5,177-Year Tree-Ring Chronology from the Southeast Coast, USA. Manuscript in preparation.

NAPORA, K.G. & S. JANTZI. 2021. Five and a Half Millennia of Environmental Change on the Georgia Coast, USA: A Tree-Ring Based Analysis. Manuscript in preparation.

REIMER, P., *et al.* 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon*, 62.

RICK, T., G.A. HENKES, D.L. LOWERY, S.M. COLMAN, & BJ. CULLETON. 2012. Marine radiocarbon reservoir corrections (ΔR) for Chesapeake Bay and the Middle Atlantic Coast of North America. *Quaternary Research* 77(1): 205-210.

RIDGE, J.T., A.B. RODRIGUEZ, & F. J FODRIE. 2017. Evidence of exceptional oyster-reef resilience to fluctuations in sea level. *Ecology and Evolution* 7(23): 10409 – 10420. doi: 10.1002/ece3.3473.

RITCHISON, B.T., V.D. THOMPSON, I. LULEWICZ, B. TUCKER, & J.A. TURCK. 2020. Climate Change, Resilience, and the Fisher-Hunter-Gatherers of Late Holocene Georgia Coast. *Quaternary International.* (in press).

RUSSO, M., 1998. Measuring Sedentism with Fauna: Archaic Cultures along the Southwest Florida Coast, in: T.R. Rocek, T. R. & O. Bar-Yosef (eds.), *Seasonality and Sedentism: Archaeological Perspectives from Old and New World Sites*: 143 – 164. Cambridge: Peabody Museum Press.

SANGER, M.C. 2010. Leaving the Rings: Shell Ring Abandonment and the End of the Late Archaic, in D.H. Thomas & M.C. Sanger (eds.) *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*: 201–216. New York: American Museum of Natural History Scientific Publications. Anthropological Papers 93.

SANGER, M.C. 2015 Life in the Round: Shell Rings of the Georgia Bight. Columbia University. Doctoral Dissertation.

SANGER, M.C. & D.H. THOMAS. 2010. The Two Rings of St. Catherines Island: Some Preliminary Results from the St. Catherines and McQueen Shell Rings, in D.H. Thomas & M.C. Sanger (eds.) *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*: 45–70. New York: American Museum of Natural History Scientific Publications. Anthropological Papers 93.

SAUNDERS, R. 2010. The Archaic Above Choctawhatchee Bay: Hydrodynamics, Adaption, and Abandonment, in: Thomas, D.H., Sanger, M.C. (Eds.), Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?. AMNH Anthropological Papers No. 93. American Museum of Natural History Scientific Publications, New York, pp.103–112.

SPEER, J.H. 2010 *Fundamentals of Tree-Ring Research*. Tucson, Arizona: The University of Arizona Press.

THOMAS, D. H. 2010. "What Happened to the Southeastern Archaic?" A Perspective from St. Catherines Island, in D.H. Thomas & M.C. Sanger (eds.) *Trend, Tradition, and Turmoil: What Happened to the Southeastern Archaic?*: 173–199. New York: American Museum of Natural History Scientific Publications. Anthropological Papers 93.

THOMPSON, V.D. 2007. Articulating Activity Areas and Formation Processes at the Sapelo Island Shell Ring Complex. *Southeastern Archaeology* 26: 91 – 107.

THOMPSON, V. D., & C.F.T. ANDRUS. 2011. Evaluating Mobility, Monumentality, and Feasting at the Sapelo Island Shell Ring Complex. *American Antiquity* 76, 315-343.

THOMPSON, V.D. & A. KRUS. 2018. Contemplating the History and Future of Radiocarbon Dating in the American Southeast. *Southeastern Archaeology* (37): 1–11.

THOMPSON, V.D. & J.A. TURCK. 2009. Adaptive cycles of coastal hunter-gatherers. *American Antiquity* (74): 255-278.

THOMPSON, V.D. & J.E. WORTH. 2011. Dwellers by the Sea: Native American Adaptations along the Southern Coasts of Eastern North America. *Journal of Archaeological Research* 19: 51 – 101.

THOMPSON V.D., T. RICK, C. J. GARLAND, K.Y. SMITH, D.H. THOMAS, M. SANGER, B. TUCKER, I. LULEWICZ, A.M. SEMON, J. SCHALLES, C. HLADIK, C. ALEXANDER, & B. T. RITCHISON. 2020. Ecosystem Stability and Native American Oyster Harvesting along the Atlantic Coast of the United States. *Science Advances* 6:eaba9652.

TRINKLEY, M. B., 1980. Investigation of the Woodland Period Along the South Carolina Coast. Unpublished Ph.D. dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.

TURCK, J.A. & V.D. THOMPSON. 2014. A Comprehensive Radiocarbon Date Database from Archaeological Contexts on the Coastal Plain of Georgia. Georgia Coastal Ecosystems Long-Term Ecological Research Project. Data Catalog. http://gce-lter.marsci.uga.edu/public/app/dataset_details.asp?Accession=ANT-GCES-1402 (accessed 8 November 2019).

TURCK, J.A. & V.D. THOMPSON. 2016. Revisiting the Resilience of Late Archaic Hunter-gatherers along the Georgia Coast. *Journal of Anthropological Archaeology* 43:39-55.

WARING, A. J. 1977. The Bilbo Site – Chatham County, Georgia. in S. Williams (ed.) *The Waring Papers: The Collected Works of Antonio J. Waring, Jr*. Second edition: 152–197. Cambridge: The Peabody Museum. Harvard University.

WELFORD, M.R., B.H. BOSSAK & E.J. GIBNEY. 2017. Archival Evidence of Secular Changes in Georgia Hurricanes: 1750 – 2012 in J.M. Collins & K. Walsh (eds.) *Hurricanes and Climate Change*: 35–54. New York: Springer.

Figures and Tables

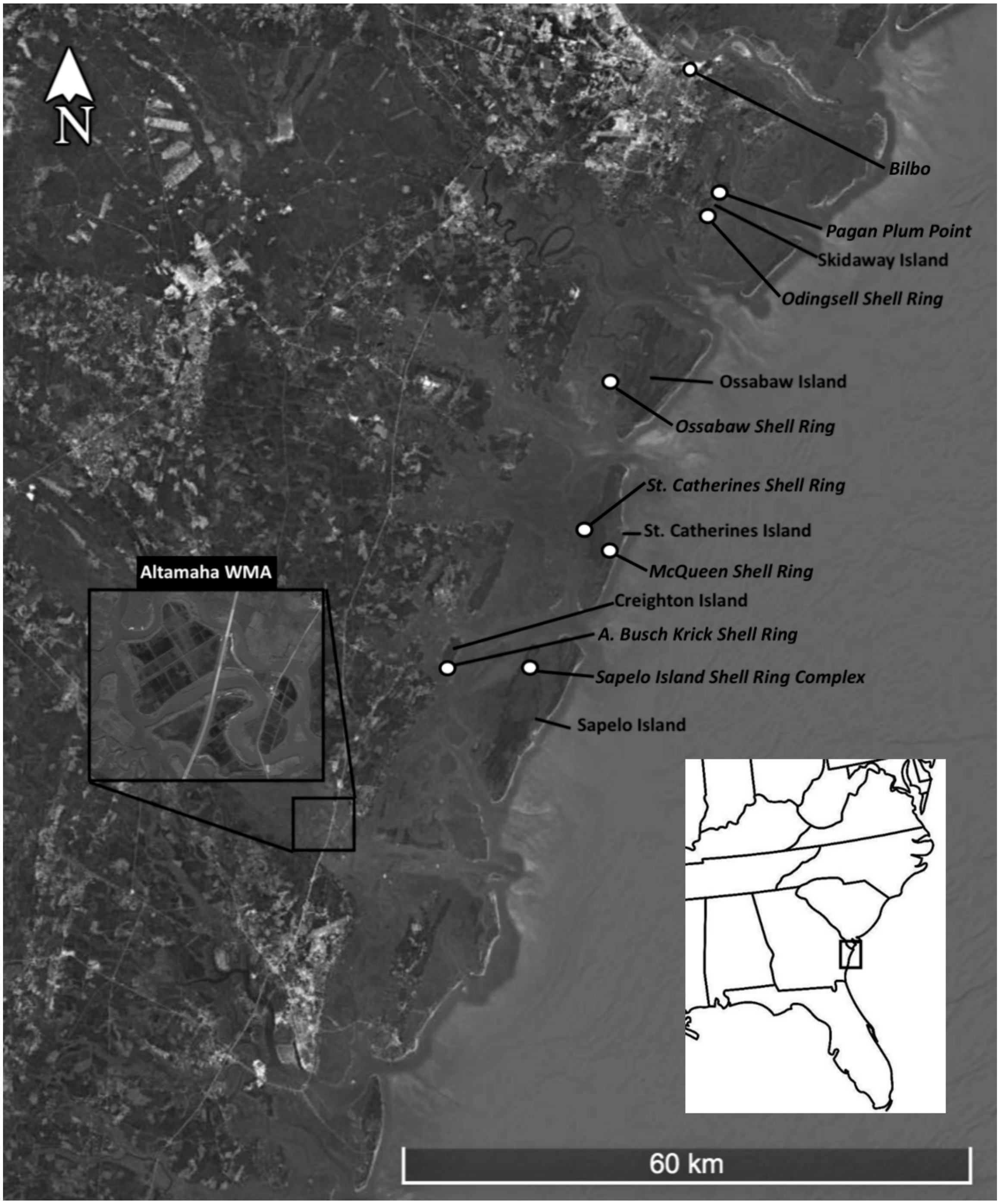

Figure 5.1. The northern Georgia Coast in the Southeast USA, indicating the locations of Late Archaic shell-bearing sites from which radiocarbon dates were run and modeled for this study. Adapted from a Google Earth basemap.

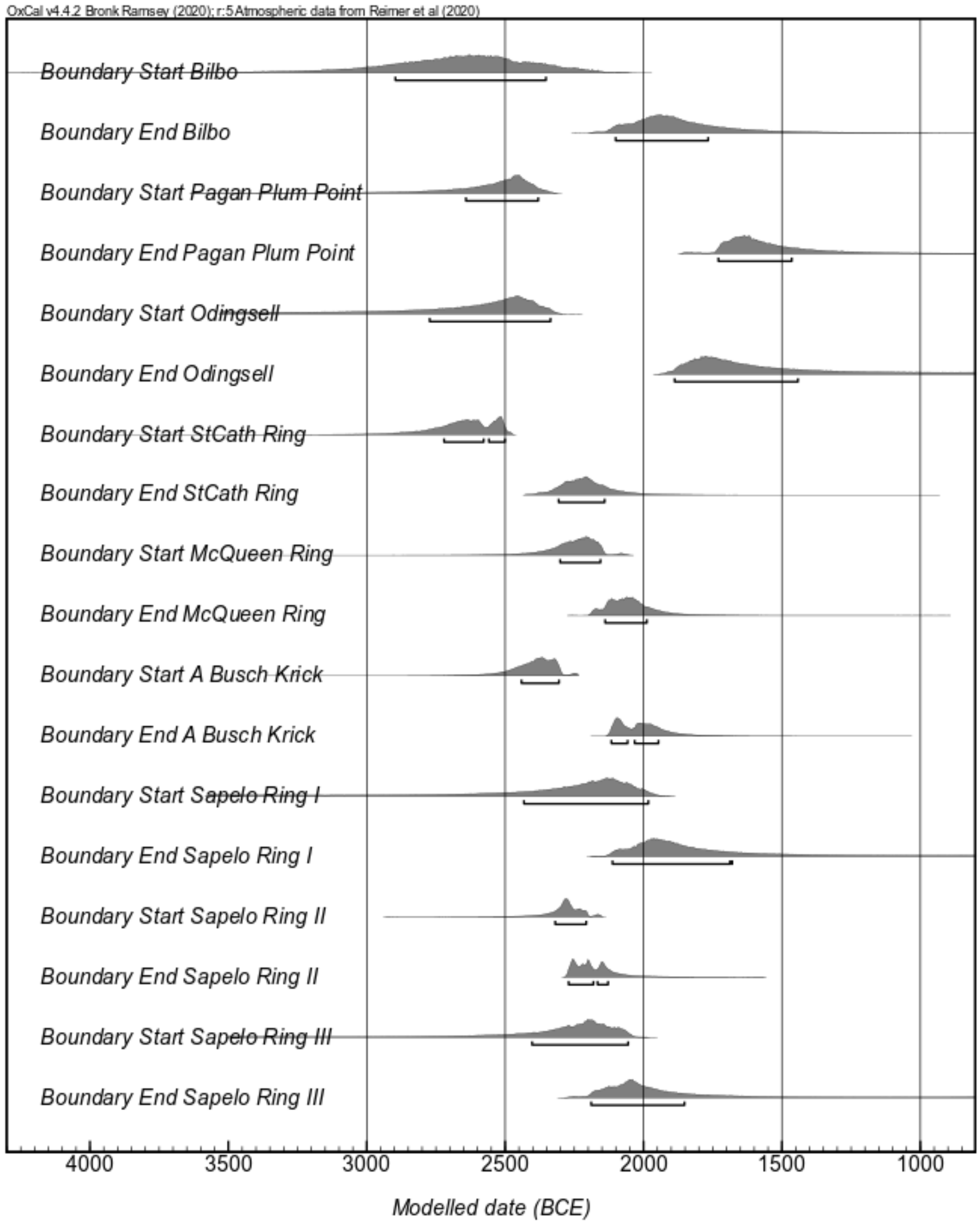

Figure 5.2. Bayesian modeled start and end dates of North Georgia Coast Late Archaic shell-bearing sites (north to south) in OxCal Version 4.4 (Bronk Ramsey 2009), employing the IntCal20 Northern Hemisphere curve (Reimer et al. 2020). Ranges indicated are the 68.3% (one sigma) probability intervals.

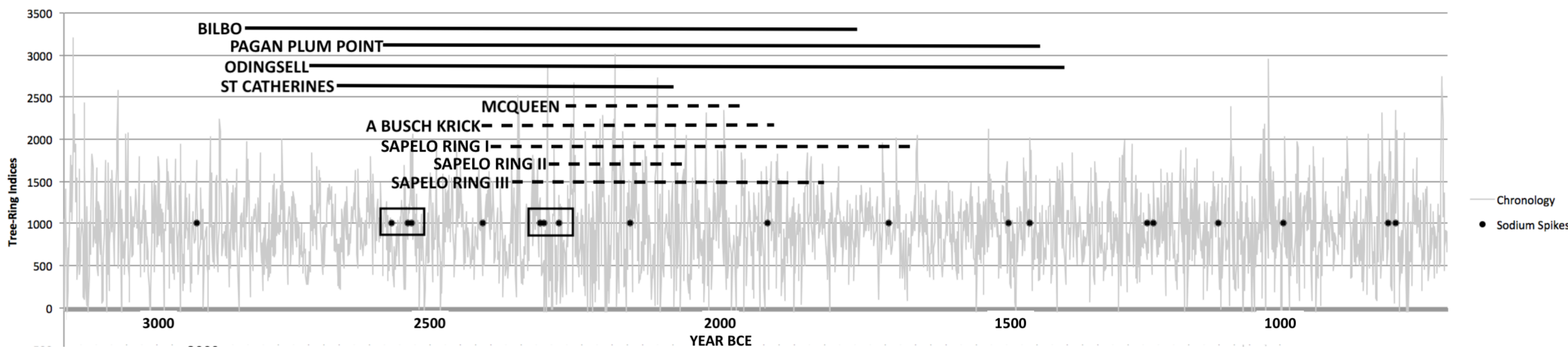

Figure 5.3. Maximum modeled one sigma use-life extents of northern Georgia Coast Late Archaic shell-bearing sites (north to south). Site use-lives are shown against the tree-ring chronology (units = standardized indices, largely indicative of winter-spring precipitation). 2300 – 1850 BCE is characterized by increased interannual variability and numerous very dry years. Also shown are the final growth years of trees that died from salinity intrusion; two clusters of such deaths are emphasized in black boxes and indicate major salinity intrusion events.

Table 5.1. Calibration and modeling of radiocarbon dates of shell-bearing Late Archaic archaeological sites on the North Georgia Coast conducted in OxCal Version 4.4 (Bronk Ramsey 2009), employing the IntCal20 Northern Hemisphere curve (Reimer et al. 2020). New dates are highlighted in black. Information on existing dates was obtained from Turck and Thompson (2014).

SITE INFORMATION	SAMPLE ID	14C AGE (years BP)	±	d13C	2 σ Unmodelled Date Ranges (BCE) from	to	2 σ Modelled Date Ranges (BCE) from	to	1 σ Modelled Date Ranges (BCE) from	to	MATERIAL	SAMPLE CONTEXT (FROM ORIGINAL EXCAVATION)
SITE: BILBO					**Boundary Start Bilbo:**		-3410	-2140	-2900	-2350		
Site Number: 9CH4	M-1109	3700	129	-25	-2470	-1750	-2470	-1875	-2290	-1980	charred wood	Bilbo: 3.0-3.5 ft. bs (Zone 3, Waring)
Location: southern bank, mouth of Savannah River	M-1111	3820	129	-25	-2625	-1890	-2570	-1950	-2440	-2060	charred wood	Bilbo: 5.5-6.0 ft. bs (Zone 1, Waring)
Site Type: shell mound, non-ring, deltaic	O-1046	5550	119	-25	(possibly prior to site use-life or old wood)						charcoal	Complex lenses of shell midden and alluvial sand 2.0 to 2.5 feet bs, Haag Zones 7-8/ Waring Zone 3 (3-3.5 feet above msl)
Number of Dates: 6 (5 included in model)	O-1047	4125	119	-25	-3015	-2340	-2880	-2145	-2710	-2205	charcoal	Nearly solid oyster midden, 5.5 to 6.0 feet bs, Haag Zone 4 (0-0.5 ft below msl)
	UGA-10676	3630	50	-25	-2190	-1830	-2195	-1890	-2135	-1940	Charcoal (AMS)	Test Pit #14- Upper limit of undisturbed shell midden, 70-80cm below datum
	UGA-10677	3730	140	-25	-2565	-1750	-2490	-1960	-2340	-2045	Charcoal (Conventional)	Test Pit #14- Base of dense shell deposit, 170-180cm below datum
					Boundary End Bilbo:		-2190	-1240	-2105	-1765		
SITE: PAGAN PLUM POINT					**Boundary Start Pagan Plum Point:**		-3175	-2320	-2645	-2380		
Site Number: 9CH61	UGAMS#39510	3400	20	-22.62	-1745	-1625	-1865	-1620	-1745	-1640	large mammal longbone fragment cf. deer	Pit 1, Level 1, .0-.5' BS, 22076
Location: eastern marsh edge, Skidaway Island	UGAMS#39511	3790	20	-26.25	-2295	-2140	-2290	-2140	-2285	-2145	carbonized wood (*Pinus* sp.)	Pit 1, Level 4, 2.1' BS
Site Type: shell mound, non-ring, deltaic	UGAMS#39512	3870	20	-22.67	-2460	-2235	-2410	-2210	-2350	-2285	deer jawbone fragment	Pit 1, Level 5, 1.5-2.0' BS, 22080
Number of Dates: 5	UGAMS#39513	3890	20	-25.97	-2465	-2295	-2440	-2300	-2410	-2310	carbonized wood (*Pinus* sp.)	Pit 1, Level 5, 2.5' BS
	UGAMS#39514	3870	20	-22.51	-2460	-2235	-2465	-2330	-2460	-2380	deer 1st phalanx	Pit 1, Level 6, 2.5-3.0' BS, 22081
					Boundary End Pagan Plum Point:		-1860	-925	-1730	-1465		
SITE: ODINGSELL					**Boundary Start Odingsell:**		-3530	-2315	-2775	-2335		
Site Number: 9CH111	UGAMS#39523	3510	30	-22.2	-1925	-1745	-1930	-1745	-1895	-1770	large mammal longbone fragment cf. deer	6'-12" BS, soil sample rough sorted, 21630
Location: southern Skidaway Island	UGAMS#39524	3890	20	-26.29	-2465	-2295	-2440	-2235	-2385	-2290	carbonized wood (*Pinus* sp.)	Ph Lewis Site 29, Level 5, 24"-30" NE, 21634
Site Type: shell ring, deltaic	UGAMS#39525	3860	20	-25.77	-2460	-2205	-2460	-2310	-2455	-2325	carbonized wood (*Pinus* sp.)	Ph Lewis Site 29, Level 1, c. 34" BS, 21637
Number of Dates: 3					**Boundary End Odingsell:**		-1920	-640	-1890	-1440		
SITE: ST CATHERINES SHELL RING					**Boundary Start St. Catherines:**		-2920	-2475	-2725	-2500		
Site Number: 9Li231	Beta-238322	3870	40	-25.7	-2465	-2205	-2470	-2210	-2455	-2295	hickory nut	Feature 60, 2.0-1.9 m
Location: western St. Catherines Island	Beta-238327	3820	40	-24.2	-2455	-2140	-2460	-2200	-2405	-2215	hickory nut	W92 S2, 2.3-2.2 m
Site Type: shell ring, non-deltaic	Beta-238328	4120	40	-24.5	-2875	-2570	-2765	-2465	-2655	-2490	burnt wood	Feature 76, 1.9-1.8 m
Number of Dates: 7	Beta-238331	3820	40	-25.4	-2455	-2140	-2460	-2200	-2405	-2215	burnt wood	Feature 88, 1.8-1.7 m
	Beta-238332	3880	40	-26.0	-2470	-2205	-2470	-2210	-2460	-2310	burnt wood	Feature 73, 1.8-1.7 m
	Beta-238337	3860	40	-26.8	-2465	-2200	-2465	-2210	-2455	-2285	burnt wood	N771 E819, 2.39-2.3
	Beta-239276	3930	40	-25.0	-2570	-2290	-2565	-2290	-2475	-2345	charred material	Feature 82, NE Quad 1.9-1.8 m
					Boundary End St. Catherines:		-2400	-1975	-2310	-2140		
SITE: MCQUEEN SHELL RING					**Boundary Start McQueen:**		-2495	-2060	-2305	-2155		
Site Number: 9Li648	Beta-244620	3800	40	-25.3	-2455	-2050	-2305	-2045	-2235	-2135	charred material	Feature 21, 4.0-3.9 m
Location: eastern St. Catherines Island	Beta-244745	6060	40	-24.4	(possibly prior to site use-life or old wood)						charred material	Feature 19N, 4.0-3.9 m
Site Type: shell ring, non-deltaic	Beta-251761	3720	40	-23.9	-2280	-1975	-2270	-2025	-2200	-2070	charred material	N243 E233, 4.5-4.4 m
Number of Dates: 6 (5 included in model)	Beta-251764	3710	40	-25.0	-2275	-1970	-2205	-2030	-2195	-2065	charred material	N272 E200, 5.3-5.2 m
	Beta-251766	3800	40	-27.5	-2455	-2050	-2305	-2055	-2235	-2140	charred material	N272 E200, 5.1-5.0 m
	Beta-251767	3680	40	-24.8	-2200	-1945	-2205	-1985	-2200	-2070	charred material	N243 E233, 4.4-4.3 m (shell)
					Boundary End McQueen:		-2200	-1840	-2140	-1985		
SITE: A. BUSCH KRICK					**Boundary Start A. Busch Krick:**		-2595	…	-2445	-2305		
Site Number: 9MC87	UGAMS#39515	3650	20	-22.57	-2135	-1945	-2135	-1955	-2130	-1985	deer scapula glenoid cavity	Pit 1, Zone 2 (Level 2), shell sample, Level 4 BS 0.9-1.2 BS
Location: Creighton Island	UGAMS#39516	3710	20	-26.02	-2200	-2030	-2190	-2030	-2150	-2050	carbonized wood (*Pinus* sp.)	Pit 1, Soil-shell area, Southern 5', Level 8, 2.1'-2.4' BS
Site Type: shell ring, non-deltaic	UGAMS#39517	3810	20	-22.65	-2340	-2145	-2240	-2135	-2170	-2145	deer longbone fragment	Pit 1, Level 12, 3.3-3.6 BS, SO 1/3, #22103
Number of Dates: 8 (7 included in model)	UGAMS#39518	3770	20	-26.03	-2290	-2060	-2275	-2145	-2190	-2150	carbonized wood (*Pinus* sp.)	Pit 1, LVL 14 at 4.1'
	UGAMS#39519	2760	35	-23.68	(possibly translocation/bioturbation)						mammal bone fragment; cf. deer	Pit 1, Level 16, 4.5-4.8 BS, Zone 3, Black midden
	UGAMS#39520	3750	20	-26.27	-2280	-2040	-2285	-2155	-2205	-2170	carbonized wood (*Pinus* sp.)	Pit 1, LVL 16 at 4.8'
	UGAMS#39521	3800	20	-25.11	-2300	-2140	-2300	-2195	-2290	-2200	carbonized pignut hickory shell	Pit 1, LVL 17 at 5.3', Zone 3
	UGAMS#39522	3900	20	-24.77	-2470	-2295	-2455	-2235	-2385	-2290	carbonized wood (*Pinus* sp.)	Pit 1, LVL 20 at 5.9
					Boundary End A. Busch Krick:		-2130	-1815	-2120	-1945		
SITE: SAPELO RING I					**Boundary Start Sapelo Ring I:**		-3580	-1945	-2435	-1980		
Site Number: 9MC23	UGA-15084	3610	50	-17.0	-2140	-1775	-2145	-1830	-2125	-1925	sooted sherd	Sapelo Ring I: Unit 1, Level 2
Location: Sapelo Island	UGA-15085	3730	60	-18.9	-2340	-1945	-2285	-1940	-2195	-1980	sooted sherd	Sapelo Ring I: Unit 1, Level 2
Site Type: shell ring, non-deltaic												
Number of Dates: 2					**Boundary End Sapelo Ring I:**		-2135	-615	-2115	-1680		
SITE: SAPELO RING II					**Boundary Start Sapelo Ring II:**		-2525	-2150	-2320	-2205		
Site Number: 9MC23	UGAMS#42750	3800	20	-25.75	-2300	-2140	-2280	-2140	-2275	-2145	carbonized wood (*Pinus* sp.)	Unit 1, 37.5 cmbd
Location: Sapelo Island	UGAMS#42751	3770	20	-26.97	-2290	-2060	-2285	-2150	-2280	-2160	carbonized wood (*Pinus* sp.)	Unit 1, 47 cmbd
Site Type: shell ring, non-deltaic	UGAMS#42752	3810	20	-26.09	-2340	-2145	-2305	-2150	-2295	-2200	carbonized wood (*Pinus* sp.)	Unit 1, 70-75 cmbd
Number of Dates: 4 (3 included in model)	UGAMS#42753	6220	25	-26.24	(likely prior to site use-life)						carbonized wood (*Pinus* sp.)	Unit 1, 80-85 cmbd
					Boundary End Sapelo Ring II:		-2285	-1930	-2275	-2125		
SITE: SAPELO RING III					**Boundary Start Sapelo Ring III:**		-3500	-2030	-2405	-2055		
Site Number: 9MC23	UGA-15082	3560	50	-27.5	-2035	-1745	-2035	-1745	-2015	-1775	charcoal	Sapelo Ring III: Unit 9, Level 4
Location: Sapelo Island	UGA-15083	3730	60	-25.5	-2340	-1945	-2290	-1975	-2200	-2040	charcoal	Sapelo Ring III: Unit 9, Level 7
Site Type: shell ring, non-deltaic	UGA-15086	3730	50	-25.6	-2295	-1970	-2285	-1980	-2200	-2040	charcoal	Sapelo Ring III: Unit 11, Level 4
Number of Dates: 3					**Boundary End Sapelo Ring III:**		-2270	-770	-2190	-1850		

Outlier Dates Removed from Analysis

CHAPTER 6

CONCLUSION

This dissertation presents a new 5,177-year tree-ring chronology, as well as an earlier 529-year floating chronology, developed from bald cypress (*Taxodium distichum*) samples buried in the anoxic coastal sediments at the Altamaha Wildlife Management Area. We use this chronology, and associated proxy data (information on environmental drivers of ringwidth, elemental analysis, and tree life histories) to interpret environmental conditions on the Georgia Coast over five millennia. Pairing the tree-ring proxy data with Bayesian modeling of dates from Late Archaic shell-bearing archaeological sites, we also interpret the terminal portion of this period in light of the environmental data.

Insights into long-term environmental history gleaned from the tree-ring data presented here include further evidence pointing to the impact of several major global climatic shifts in the Southeastern U.S. and support for the sea-level model proposed by Colquhoun and Brooks (1986), likely indicating that rather than a single episode of sea-level rise and fall during the Late Archaic, the Southeast coast was subject to several sea-level fluctuations.

Focusing in on the Late Archaic period on the Georgia Coast, we show that people living at the shell rings of the North Georgia coast were able to weather a period of apparently extreme environmental downturn lasting approximately 450 years (2300 – 1850 B.C.E.) that included numerous drought years and unreliable year-to-year rainfall patterns as well as possible hurricane events. The final occupations of these coastal shell sites came after a period of restored environmental stability but may have been influenced by several years of very negative conditions. The resilience of both the Indigenous peoples of coastal Georgia's Late Archaic as well as the estuary systems of the Southeast in the face of a multicentury environmental downturn is evident from this study.

This study indicates that coastal estuaries can be extremely resilient during episodes of major environmental fluctuation. In our own period of increasing climatic instability, studies like this one which may point to areas where certain resources could continue to be utilized should continue to be researched and, from there, operationalized to help develop more sustainable harvesting practices so that places which in the past have proved resilient can continue to be so in the future. For instance, the fact that the more northerly and deltaic-situated shell-bearing sites were used over much longer periods of time, including during a long, extremely negative environmental period, may be indicative of the greater ability of these specific areas to weather a wider variety of ecological events over a longer period. Understanding differences in locales could direct resource management organizations to preferentially select these areas for projects such as oyster bed restoration and reforestation of cypress forests with more salt-tolerant individuals.

The findings of this dissertation, however, may also speak, to the impact of even individual negative events like hurricanes or extreme drought years on the lifeways of coastal societies. While people living at the shell rings of the Georgia Coast remained there over the 450-year period of environmental turbulence, they made the decision to reconfigure their way of life during a period that appears to have been relatively stable from an environmental standpoint, but punctuated by several very negative years. Was the decision to shift to new ways of living impacted by what appears to have been only a few events? Perhaps these very negative years indicate hurricanes that would have devastated coastal communities, and direct hits by a series of such storms could have contributed to the decision of people living in the terminal Late Archaic to change their established ways of life. Today, the stability of coastal ecosystems is threatened by anthropogenically amplified climate change, leading to changes that include less predictable environmental patterns and a higher frequency of hurricanes and storms. If a few, perhaps catastrophic, environmental events contributed to the decision three and a half thousand years ago to shift from a way of life that had endured sustainably for centuries, what might a series of such events do to our own coastal societies, which are already struggling with resource depletion, environmental degradation, and the effects of rising and warming global seas? What would it take to push 21st century coastal societies over the edge?

Our continuously increasing knowledge of lifeways and environment thousands of years ago on the Georgia Coast sounds a warning across the millennia to us today. It is imperative that we do everything in our power to slow human-enhanced climate change, the major driver behind the increasingly frequency and amplitude of storms, the more rapidly rising and heating seas, and the destabilization of the global environment—those extreme events that could lead to the a necessary decision to change our own ways of life.

APPENDICES

APPENDIX A

Raw Tucson compact format ringwidth measurements of Altamaha floating chronology. As chronology is unanchored, the inner "dates" are not dates, but ring numbers.

```
     140=N       16=I ALT019A                                          -3(20F4.0)~
 394 6181067 562 225 254 243 477 7301040 505 59010671291 646 758 983 9831126 815
 815 7581073 788 9331236 814 3651123 197 618140433962499 9541488 814 505 815 815
 702 1971291 89911061416 813100017082041 959 917 916 792 647 5621250 813 562 896
2187120914593104 980106213551021122 9 729 709 709 687 604 97915841250 93817711541
10831375 625 937 70912501125 876 625 500 709 8121688 896158310211792187611251690
166720001333 647 667 854 772114613332042179417701000 751 750137311121345 752 879
131943481681 885134519681733250 9 93127972793116425 09 75030001527165611641087227 6
     293=N        1=I ALT019B                                          -3(20F4.0)~
 825 826 226 253 844 454 466 398 582 181 316 687 416 256 796 802 849 885 822 534
 473 199 556 8051094 728 6481235 808 505 97013551293200016711570 747 731 5561218
1399 922 5171017 536 86112823522278 8041710 4631152 7121438 274 677127117121378
1448 757 8311602 8561021 8311070 818 653 76216861164 596 612 918 748 2921273 564
 6471258 255 532 292 392 574 240 95815231517 739 958 667 990 905 627 605 605 715
 672 779 495 539 280 645 645 648 843 8001053 968 800 349 5391079 984 445 421 920
1173 9841777 888 92013971967139 9 381 476 85911741205 888 603 9831174 920 6031174
 934 935 768 85116191122 868188312872429226619972000139 81007 756 615 137 628 481
 217 659 461 722 369 812  90 121 628 867 545 635 9941081 3851235 153 946 960 226
 665 92014741358187 2 48710511208121 0 8661043 137 548 459 864 158 8501299 8231233
 831  89 789 621 621 442 757 9521016 132   01233 842 742 6851187 753 4811259 933
 672 351 985 817  991003 673 252 764 740 632 754 102 94711871031 677 510 714 550
 224 183 28611421020 1041086 614 61613331273100 1 535 827 947 654 636 530 591 763
 778 653 636 429 495 224 820 435 538 388 207 719 553 148 455 523 702 124 455 212
 355 2771006 786 3221045 702 762 399 115 730 7941133
     314=N      132=I ALT020A                                          -3(20F4.0)~
208017901318 7031378 938 44010272109237414 65 850 70415531699 91211431788266712 89
205210261172182 0 99817031378120 2 615 791195521682642287024321670108513 48 9101670
 8201115 792 615105511722169172911 13 733 879 4102696266720512051126122562403187 5
   019931086 8211143 93820811436108822572432243223151700 480 739 65210881522126 4
1522 8261088 784 871 9131264 871 348 522 609 567 871 480 610 609 827 913 3171958
16091158 550 840 579 767 579 246 189 205 145 507 347 536   0 781 275 710 709 478
1057 536 449 405 868 463 8841172 984 8541014 580 62211601317 130 434 695 897 781
 898 723   01013 868 507 767 376 840 190 666 260 174 203 275 463 492 680 334 623
 449 145 348 145 217 666 782 696 666 550 839 781 883 3911013 14514621838 709 927
1331 810 782 3331465 52612001010 106 263 253 600 8841084 947 506 463 842 568 831
 138 842 695 716 926 810 474 253 737 149 537 705 495 800 453 547 747 463 558 674
 106 516 474 706 368 642 389 232 137 1611042 684 5531348 653 454 170 199  99 199
  85 355 369 143 355 411 356 284 100 66813761475 979 795 638 426 397 369 383 312
 143 270 143 114 128 242 114 114  85 170 100 553 234 281 111 391 142 173 109 234
 422 564 453 235 266  80 547  95 234  80 501 517 109 470 563 250 501 173 234 281
 219 266  80 328 422  80 485 548 236   0 188 447 254 190
     357=N      173=I ALT020B                                          -3(20F4.0)~
 886 735 791 998 807 808 520 507 194 80212482271113510501042102723331927158 8 206
214812741096 835 92719401626122618041752205517671006131710931404132 2 875 7481380
14521357 5751187 97018481278 798 856 451 406 901 365 261 423 8021295   011341019
 336 538 599 222 510 669 392 757 508   0 662 554 570  99 863 234 786 861 6421239
 832 437 208 348 293 6401494 421 800 987 714 77013491074 465 9281267   0 686 927
 752 1191143 742 711 798 124 309   0 391 185 515 433 474 150 989 721 310 702 907
1113 948 4741030 640 763 5991072 865 846105210731011166 9 496 968 9071362 6181320
 721 846 763 681 577 6391113 580 24715681465 3091220 37112361133 8091113 762 577
 391 556 5561071 907 618 5361236 846 323 298 153 375 145 432   0  54 340 537 357
 832 400 457 483 764 859 577 238  93 203 635 152 804 271  76 330 237  68  68  51
  51 226  68  85  68  68  42  25  68  51  68  85 503  68 127 280  76 128 279  93
 127 357 754 644 753 457 144  42 381  51  51 135 152  51 152 440  76 330 212  85
 482 325 179 595  97 341   0 447 106 180  81 163 130 293  74  97   0 146  65 196
 163 528 870 561 106 636 512 479  81 252 406 512 227 934 138 123 238 115 562 792
 123 562 108 492 396 285 108 531 385 625 146  94 346 118 177  93  54 370 138  46
 364 479 860 131 138  69 392  61  39  46 474  92 283 515 619 308 688 523 476 382
 417 316 215 148 260 440 346 223 226 262  78 494 672 708 807 811 363 683 568 557
 540 522  71 319 189 234 266 394 188 777 777 483 235 386 331 260 486
```

APPENDIX B

Raw Tucson compact format ringwidth measurements of Altamaha main coastal chronology (3161 B.C.E. – 2016 C.E.); decadal format inserts a “Year 0.” Measurements are in microns. “N=#” indicates the number of rings in the measured radius. “#=I” indicates the year of the inner ring of the measured radius. “ALT#” indicates the field site (Altamaha) followed by the sample ID and, in cases where more than 1 radius was measured, the radius (A or B). On the top right of the each informational line, information is provided to the computer program for correct file reading.

```
      26=N    1991=I ALT112A                                          -3(20F4.0)~
22132667266740281120 50730272533100024531013 815442747072708305452404440256O2667
47405941701281737100395 7
      26=N    1991=I ALT112B                                          -3(16F5.0)~
 2397 1843 1704 2640 4592 1680 3784 3609 1023 2011 1501 5123 4075 4705 4682 5138
 3914 4052 2561 4232 4147 63171008812555 2110 6604
      42=N    1965=I ALT119A                                          -3(20F4.0)~
 7501587 309  8925182874 2611576 2863257 540 696 261 143 7461808 622393315894154
113912981014101 8 55510292412124 7 798 304 226 131 267 174 195 102 264 487 276 802
 146 246
      42=N    1965=I ALT119B                                          -3(20F4.0)~
 560 796 283 11024173401108921 36 266 411 38810601875 8502623385211951740 7771688
 231 360 571 522 3171165136421411431 286 325  77 251 115 144 201 391 420 248 621
 143 135
      49=N    1962=I ALT113A                                          -3(20F4.0)~
 542 536 298 360 565 442 456 657 343 453 190 499 349 319 340 396 277 244 293 253
 765 989 724 643 521 637 500 367 439 418 459 493 484 374 452 111 389   0 492 492
 492 611 302 468 636 484 359 144 129
      49=N    1962=I ALT113B                                          -3(20F4.0)~
 676 526 360 430 579 465 474 588 445 433 300 611 367 389 591 530 521 294 314 259
 880 968 626 481 493 514 560 500 363 381 443 470 484 304 416 292 370  79 425 468
 536 573 287 489 542 277 274  84  86
      51=N    1958=I ALT120A                                          -3(20F4.0)~
 8723111 1302398211411861184 918 714 469 8783021410220001266212 4 225355130622612
2980 425 212 6731948 54943043739 63915821480 53112794298286 0 103518823931290 477
1234 5423065212118861839 138 126 780 959 603
      56=N    1958=I ALT120B                                          -3(20F4.0)~
 8101698 10626842116 3533822118811291970 5352832430723871397161 4  7927033564272 8
3179 505 37110111964 56350964412 932 674 922 595128040992718 15154403485 882 361
1403 180 640 636 689 737 9311513 472  52  78 660 1941816 649 590
      62=N    1954=I ALT122A                                          -3(20F4.0)~
 408 828 881 23310253605 753 726 299 19810491347218 3 3744220217 3 736 896 7271105
1446157012381402 84313011900  87466133041114 240 758 286 843 272 51817565100145 8
16761518 457 1981543 617 778 922 32320562733 702 60618671472 192102512741727142 2
1566 820
      62=N    1954=I ALT122B                                          -3(20F4.0)~
 5121156 811 215 6563800 567 449 312 267114512572456 71144812768 579 745 6111180
18251322 6101172 74913472030 132485338081468 312 961 5381294 186 54817495143 907
19831383 841128420981821274 4 981 308 642 7831279 557261629401279203721412005165 2
17001109
      47=N    1911=I ALT032A                                          -3(16F5.0)~
 6600 9760117601252 0 556017960220002068025280263 90 4762    0 9863 9292 3382 4906
 4905 9764 5480 2810 9764 1233 4047 1023 4256 8628 6421 1188 1792 1279 1536  746
 4029 6698 1071 1303 1954    0 1629 1033 1329  918 1229  295  180  659  672
      47=N    1911=I ALT032B                                          -3(16F5.0)~
 6646 939210489 7183 715911871 842211853180391788 8 2240 747411534 6684 7641 2311
 2998 5528 3798 2675 6913  961 4985 1561 2489 3524 3434 1007 9365 7300 4009 2417
 3044 4279  837  352 1013    0 2887 2868 3157 4493 5150 4625 1005  696  532
      87=N    1865=I ALT041A                                          -3(16F5.0)~
```

```
  561  666  323  499  405  588  394  244  277  400  366  472  728 1200 1180 1304
 1397 1345  997  407  318  405  334  318  281  281 1058 9925 18991274612O4411849
 851312531 6192 7045 9889 6018 5024 630610314 7471 6884 6075 6246 1922  889 5708
  611 2862 2667 1306 1779  806 1500 4058  564 2000  743  161  435  677  871  839
  129  258  774  177  452  180 2241  584  564  581  436  518  693  564  838  679
  193  661 1019  376  194  308  146
     50=N    1902=I ALT041B                                          -3(16F5.0)~
 5271 4090 5835 7473 5826 5903 4816 8227 5210 425111708 1261 3913 3195 1745 1299
  529  873 2014  635 1749  397  689  159  476  610  503  370  344 1007  476 1775
    0 2246 1086 1167  691  852 1141 1321 1325 1086 1111  582 1376 1545  951  883
 1507  767
    131=N    1878=I ALT121A                                          -3(20F4.0)~
3366113444844236162816962860174170372725250814452237258110431024 367105910621215
115114282516175 4 9291033 440 604 645 591 956 647 317 40614851195 7081665 240 812
 5524169189310524023161219 37 9292228 46610491550 957 882 328 8221012 811 310 444
1151 834 513 59511732297 855 89212171669 1146 868 955 531 988 860 410 505 506  97
 4732137 5441541 914 488 226 248 492  87  75  38 121 124  54  27 108  75  75 307
 315 360 524 102 833 230 506 103 138 782 908 149 5401581 874 615 676 460 172  69
 448 149 116 564 332 690 696 195   0 934 656
    131=N    1878=I ALT121B                                          -3(20F4.0)~
35971093435751831419152016751552245 8 598 2533120 55544652262209010871114116510 60
12291325245110641378 491 7921282 8961463 648 767 247 4051737 870 2722031 7921821
14394232205914261574106126 80 8351931 44013662226 993 725   0 471 6381286 240 981
1843 577 751 54111471800 337 547 87216271488 1198 688  70 500 500 407 6281000 302
 80321751396 860 824 429 396 330  88 165  99  77  99  55  33 297 143 363 583 184
   0 1541044 300 606 222 825 582 179275326711152   01414 741 405 467 577 248 270
 585 464 833 323   0 833 839 487  6710351228
    148=N    1862=I ALT123A                                          -3(20F4.0)~
18463127 163 779 218 5211658 481 344 161 650 97810311597 700  89 414 110 785 803
 122 542 75723673142 5473183 91028482751205149083202 9591850 227 116 3661714 615
1356 968 379 2671404 337155310003921 6111195 296 20329851761 463 21197532230 357
2675 24126491562123611771608 4795 3092231 18646222907 701 76312382641 1855 7221361
 4141218 495 330 207 790 767 312 4142087 5981546 86610112250 1779 8492357 5781303
 86819621603 680 547 415 321 32115281735126411 70 793 585 39713772115 340 567 487
 415 5092211 774 5861074 586 858 7571958 958 614 571 471 429 829 414 40110151514
1272 886 600 443 157 286 154 173
    148=N    1862=I ALT123B                                          -3(20F4.0)~
18371977 244 533 489 5551668 400 417 337 412 899 7681203 430   0 455 323 675 665
  97 447 58920053166 67731311079255427761832448024 46 6531778 567 235 2891888 412
 9731032 367 415 429 33613881252 3345 5151296 333 30825571665 982 23280342113 296
2671 44722551275 1398 97916324705 567 853 17850382118 1592 81511042164 1776 729 693
 749 999 413 326   0 689 642 658 2211878 5331275 74711392497 1422 8632551 6871438
 85318891423 754 549 412 402 306146516891002 1176 908 890 842 7003017 325 655 332
 433 4002044 813 422 889 897 724 6022009 813 422 526 538 421 817 567 416 8331286
1003 866 515 477 202 230 236 225
    123=N    1787=I ALT011                                           -3(20F4.0)~
1462183426902215 30938562974 99824092474 332 306271431111495105814971640 5172213
1071183223152606214818321266 833122916532233102913 26 617 357 682 844 584 7141104
 956 780 618 390 390 617 422 910 974 9761201 812 722 747 78012341137 876 6821428
1363 5851428 910 715 64913961137 68210391169 876 782 312 649 6181006 7151266 454
1136 357 2201007 782 374 9421594 276 5851496168812531686 1241 43612512341136 43341
 97827052115100149111364136463631206 2272004 24317733546 52310971778 3192159 846
 593 4785651
     77=N    1724=I ALT073                                           -3(16F5.0)~
 1080 2080 2005 2079 2559 3640  486 5528 2274 2149 1820 2990 6376 4638 8554 3557
 2758 2124 2478 2002 3793 2039 488810250 5031 5589 1144 2865 3142 2287 3281 3535
  244 1636 1268 4321 2719  931 1343  559 2089 4191 3959 4697 4689 4838 3995 1574
 1382 1717 1857 1762 2670 2714 2148 2239 2908 1907 2762 1527  381  621  571  103
 1000  619 2097 1153 2667 2857 3096 2398 2552 1464 1404 6872 7192
     77=N    1696=I ALT071A                                          -3(20F4.0)~
19432000390843742982220415461614 1183 97518671520246826 62 171 986 808 84624323545
36972675272819811526108510 02 87622131232129211061375104216872105 958164615411000
14171002118811891250 417 167 5421041 583   0 771 229 70812931021 1250 897 9621625
11041708 646 68910621150200110042063206529 18 949 3452584224815561211
     91=N    1688=I ALT071B                                          -3(20F4.0)~
61262167609653066228263716371822284926393185571735312891245424401649209710 98 635
 97013491070 921 121 437  66 63315631395135723262904 1929 9761119 691 3581167 1143
14531976152421461502 97915591270103712291351126616 35 930 313 7161132 635   0 439
 77113631023 1098 87813111304340781704149319982556251420 82 891 73814801131208 91744
216123302746416617942475193823792036223218 50
    265=N    1522=I ALT007                                           -3(16F5.0)~
  387 2097 1448  462  648  722  537  702  465  560  476  124  453  247  408  732
  257  408  184  970  470  412  803  608  525  150  125  535 1096  455  206  475
 2391 1629  341 1405 1307  773 1552  569 1173 1389  845 1794  259  319  475   89
 2216 1681 1199  527 1586 1672 1707 1500 2034  518  631 1879 2853  698  940  382
 2871 1001  517 1103  811  906 1681 1216  629  630  957  491  138  295 1227  495
 1334  851  484 1965 1052  603  310  312  294  225  397  724  225  345 1224  121
  864 1174 1086 1103  794 1484 1052  879 2096  133 1309 1709 1369  945 1612 2521
 1781 1151 1345 1684  242 1575  509 1067  388  570  121  122  558  195 1079 1297
 2824  740 1563  351 2545 1963  401 1066  933  376  764  449  194  558  109  630
  279  146  424  109  685 1182  527 1854 1655 3672 4199 2364 2000 1927  640  177
```

```
 1401  709 1837 2286 4912 2014 2068 2326 2068 1388  354  231 1769 1126  938   99
  553 2509 3902 4109 1057 1886  227  128 1472  859  741 3388 2054 4474  780 1659
 4109 3388 7743 3654 1245 2845 5946 7613 1788 5383 1771 3723 1991 1844  166  221
  240  627  426  682  719 2581  184  848 1531  224  204  16611097 4590 1714 1365
  221  645  793 1327  350 2157  700  117  130  297 1198  332  442  295 1807  700
 1069 2820 1716 2360 2667 4309  641 4206 3257 4721  662  364  221  785 1622 1097
 1695  369  177 1424 1529  454  219  805  273
     134=N    1509=I ALT029A                                        -3(20F4.0)~
 946 808 969 6701915 577 4381523 877136124923508 9874408316248005284325424462631
19851524184618691916110813381523244614311246140615441269244416143712290522591452
189014311776175317981568193734823112265119612213207622821270 34614991063 1381430
 830321318342335120515572436 9291055 3011030 97911301105 6781079 3021055 678 857
 929 527 778 929 3011155 8041356 954 653 854 803 8791055 580 779 352115513561531
 7531029 804 904 578 804 904 251 879 7782059175819331506150614811757 2261282 527
1052 144 536 4351464 39213201052150711751712101114641052
     113=N    1509=I ALT029B                                        -3(20F4.0)~
1962 7771060 5851692 818 60015821981 38230044495344043633186551044862913 8204381
235217851905159717761089 9481305191810761198162215772359185021142502223111001383
165012111273145714441015214127912152229519142894241824142460 9331741 8871670 552
 7993511258931891397119210172001 9831437 7521336148715841338 4171102 1211242 762
 794 966 483 810 742 897 535 604 103 362 606 655 776 931 777 983  69105310701483
 7081276 8451345129314141310 2081174 709219212421761
     157=N    1386=I ALT072A                                        -3(20F4.0)~
115320331860138525771841303218041577142718441633 66219891201198020251752 2571427
228317361460130215531462 842155318451875347520971105314412561861 873163410932577
 75018151645 6611191180428081991166418751144290425404000366536641355209914362077
 2629210731631694 8801017 252 9811017 72122232042167015771004 4171520 1251525 190
 822 3801012 485 470 925 219 791 925127412371299 5761501 22122971299163024772023
 404 718 462 521 577 154 9261062 866 866 848 65611351120 770 250 501 8521116 983
102114281195 501  19 577 494 811 7021021 310 810 154 8601219 19216781334 8871311
 773 76911931444 7701365 732 7691173 86513271000 8461231 9432655 866
     130=N    1387=I ALT072B                                        -3(20F4.0)~
20001796131519581634270824221796152921602317122834601713197226042281134119152769
2263194012001600148814142003108521632425200811062182 5721860 5722225147428111067
239927831726134820653185220713181552122323241279335726372638 8402238 95917092007
15522335270812851126 645 769 494 24030361015221215151485 4391318  911030 106 803
 288 658 773  30 684 380 576 348 929 9622151 161 742 668 549 789 664 666 333 152
 778 455 587 741 879 8391261 464 221 616 5911027 519 800 982 336 428 510 446 296
 417 725 721 500 760 645 806 5881376 512
     132=N    1282=I ALT060                                         -3(20F4.0)~
1627156617941869166914461187 864222117971092 894 8231457 982118710461367 9091048
 751 6861227102424601592 776 802 705 568 136 798 706   010461008109510481092 728
1393 914 826 325 844105414431645116011751159101910621408 72410631111130414981352
10621369 966 9661356 3381693 87112551353 966111235741982164513072127136014041642
12081111159413531404 871135611110151596 53116961307101910191653 389 971 7441961
1707 7312042221518692797362918661279117219331137 48312762244 931 866 102 758 655
 862 65512061208 655 527 7591103 897144812211898
     212=N    1249=I ALT095A                                        -3(20F4.0)~
40334281303221274250271921122752106323263727478938292246129926423470 314 400 613
 555  42 441 457 206 840 413 597 6611282 802 274 275 4961220 99856264569 482 344
 303 648 138 372 179 444 401 419 924 771 496 880 216 411 334 400 808 915 703 869
110111281032 3721088 924104710971335 76019161515138317072159 67010911707 2481043
 650 821 287 937 596 760 257 213 339 691 164 650 128 557 681 606 399 447 375 469
 532 6701053 106 766 341 287 585 4821246 44710871038 632 128 362 513 663 203 699
  35 725 610 451 384 429 203 746 266 575 500 309 575 532 2051025 713 628 596 504
 139 787 384 128 841 447 543 522 160  15 425 106 319 277 160 479 553 791 351 181
1118 9031106 224 437 3191856354320371330 643 7081736 678326314411646  5227582611
36935966628437003314172118281769 11911431166 16414432208223211253650487734844079
47522785 476 216277529891051277834922951 6234069
     172=N    1245=I ALT095B                                        -3(20F4.0)~
3494264510651781304741201970137529912572 849178312171938279156171869   0 8441925
3131 854 615 819 540 367 545 638 340 9771325 726 819 785 615 241 861 461 732 515
17381161 398 781 288 627 601 584 444 688 793 526 638 431 498 566 829 555 263 426
 767 897 476 503 806 584 336 2741075 879100812581144 862 901 9421024 68313321032
 63428191064 124 862 812 146 856 471 717 124 118 219 308 285 526 299 577 692 657
 176 471  46 431 569 767 881  65 219 213  73 621 336 543 168 549 494 197 577 227
1055 650 379 986 629 673 694 533 209 395 5561041 533 9031204 700 416 256 814 552
 226 550 623 705 478 650 529 281 556 173 623 5291155 433 836 8341121 502 2971050
 62311311037 584 762 552 924 2471467 74414761123
     121=N    1146=I ALT059A                                        -3(20F4.0)~
223121622693311538464693430844244980293543285770 4886734388538903651342528741945
284347075440 45650594348229817212186195321122509265522641668205223571062 962 815
103115371577280324642561 703581844772026 3312556135214401090 4701410123615001571
1617 6171763186129121590198111462092201013951686195213621387 9561101 24212331405
11141284199421192144164410871234 91012041145111614681322184018802323277320562858
14111074 913 722 831 478 929 706 6161272 741 776 568 785 610 749 93410861257 722
 626
      96=N    1146=I ALT059B                                        -3(20F4.0)~
343422642994285932622334224818742425160727832227 7312449173329502214144010661011
 83214571228   01050 826 790 3951583 6471432 82611491616112513631665 68511061096
11051132 6841277 3261315 778121214681616 40710601009 758 875 8431150111713491433
```

```
 719 2351679160118051417155 6 45315121047161414211359167522951245138610481216 794
 707 793172619521702111 1 6261065 844 9511014 4711596182221101679
     266=N    1129=I ALT022A                                            -3(20F4.0)~
1042 653 445 738 875 667 417 139 445 403 528 252 153 320 250 320 542 500 342 792
 653 737 473 334 361 306 278 292 140 153 153 334 361 278 209 222 224 472 334 196
 138 195 834 695 6111028 877 528 613 250 320 583 639 542 667132114721167 723 682
1154 66710421250 903 653 603 474125014581015 625 653 486 641 764 583 95910421737
1315 751 834112512511167 1250 875 9581087 792 792   0 8331328166613671010 7731091
 892132710521347 1415 991190118631782180323002140218122571281137513511931 1194 931
 1532241316061038 1117149714981617 857173810621255 9051255115810141967204125101124
1617254711821508 1727150510141521 1197 797 9411665112213061692222322422508 18961489
132623661489185615701713181517341448132514482060 857 530 514 67313051462 9581409
16991223 796 69312851101 89712231428 99910401346 11831387 7541040 897136611621529
2243362541164292 66616271529 3341450   0 89913021047137720 38 569 514 716 294 680
1046 16510101211 8261486 77110281322163410642184 1909 9171175 95411591450 7701303
116612111211 315 8981046 861 879 490 602 778 398 168 592 723 703 888 796 861 342
 242 500 558 620 926 907
     196=N    1132=I ALT022B                                            -3(20F4.0)~
 775 732 499   0 890 724 408 765 464 327 609 508 274 163 451 386 347 154 481 204
 371 691 571 540 723 705 576 618 409 668 573 387 358 428 594 173 142 127  92 276
 593 276 284 246 194 472 450 408 480 723 703 368 398 477 664 571 5891150 3651127
12411193 790 630 596 435 8391048 646 661 340 548 276 598 746 96817281118 14581118
15641390 7741226 946 742 860 468 452   0   0 629 904 662 324 568 962 7321166 848
 978109711291246 800 822 8031040 896 6341053 9461040 753175315661289136715671458
 89911671320212622501441302718492430143217631523153823672534296712332371 2877 872
183519171835133415081137 905 9711508 971 968 5701168176715011475 1443 98420981180
15741344170518041230 689 771 8201213 623 902 716 984 1801640185313941479 18691410
1207195123791963183515321437159618201836196317881452108511 89 901
     425=N    1121=I ALT056                                             -3(20F4.0)~
1625221217531230 1724 6171593110513651007 520 6171105 2271529126718211430 1723 813
1918 3571137 455 487 812 390 747 9771722 650 28324071202156024051202 32519511658
 650150618221008195117551170 21471143 434 3501367150110 90 280 247 436 611 206 363
 8141018 3081367 232 398 395 685 370 367 566161814222047 370   02812 5642820 968
 232 653 486 622 366 514 169 597 144 709 597 648 597 70917291163 2156 479 936 542
22471469 99214641265192022431199 28319551061 1387 178 315 5942625 769 685 608 996
34182113 482 625 98633592142 546 514 992 510 566 706 459 538 566 563 594 709 769
 765 709 825 514 486 741 479 370 737 423 311 422 845 563 709 592 426 366 459 141
 650 366 310 394 536 452 395 789 538 566 564 536 451 48015491113 573 405 577 540
 810 675 573 708 742 810 473 506 880 911 634 331 5062733 573 880 844 911 911 745
 776 776 742 812 712 405 477 607 540 477 239 541 304 947 339 1691046 641 405 913
2260 573 777 709 3332732 371 472 812 607 438 236 472 608 506 13510121114 742 947
 6081012 8441316212515191620168811491755 979 743   01048 868120414981165 822 477
1343 13916231212 608 239 655 450 779 6491060 589 993 511 270 405 675 742 945 371
 7091688 337 439 236 607 641 9453109 811 498 320 385 377 676 811 337 6411013 574
148511481384 6731429 897 729 616 982 729 873 452 505 308  84 561 813 645 784 589
1205 47613491124 8971401 4911076 397 303 281 304 443 631 41914681192 699 679 356
 188 887 104 627 42010311304 928 465 400 292 240 160 112 304 304 288 256 144 258
 288 368 496 658 320 245 405 368 161 225 368 5291712 56010241425 73718101392 801
 288 560 865 8961040 192158415362255 921 226 311 540 4811007 129 497216524973008
2820280031721864 80311241382218512531092 643215326992474237826992217144725381831
170613821253 6751767
     406=N    1100=I ALT040                                             -3(20F4.0)~
 995 846 640 853 570 996 853 711 818 305 499 499 640 464 9961284 9611640 640 464
 499 391 640 641 570 604 747 890 503 249 818 427 854 747 533 605 427 604 428 498
 249 640 249 462 569 356 498 333 356 853 427 605 569 570117412091389 1138 5331173
1565 609 107 391 302 640 160  80 480 240 189 373 267 667 832 678 604 759 462 814
 713 738 569 613 492 387 407 256 443 437 316 407 497 363 507 270 206 297 363 327
 285 472 442 262 331 436 531 331 448 206 236 331 231 673 387 412 358 651 585 382
 710 543 847 312 486 530  81 654 720 439 508 367 493 429 350 619 604 493 287 461
 349 525 581 334 160 637 182 910 692 764 854 654 910 992 800 936 509 509 618 400
 618 400 509 400 473 518 836 364 545 618 692 218 474 547 254 182 509 182 764 257
 514 764 364 582 182 364 436 473 655 400 691 436 839 691 691 474 691 582 800 764
 545 582 583 419 764 509 664 509 436 873 692 655 255 327 583 254 454 300 191 164
 300 245 245 521 273 383 400 123 314 178 327 382 482 395 450 205 141 177 477 586
 600 573 559 636 409 368 300 273 505 641 382 668 627 95410641751 975 32615741075
 925 77521491500 801 825 451 225 113 102 363 163 275 162 251 187 150 438 451 150
  75 363 238 362 200 101 187 375 177 127 164 112 263 162 287 313  87 212 138 575
 200 350 187 1501400 363 812 638 31310001350 526 388 687 275 862 975 189 103 212
 200 312 263 600 438 562 500 538 101 400 388 91318251762 16310881100 662 3621112
1962 776 225 488 113 438 913 521 350 483 300 133 101 6511066 63412001317 12511624
1576  943341 64716001741155311 06 7781129 894 541 495 688 400 400 9181153 240 423
 447 259 636 4711506 823 267 318 282 166 283 120 2831083 400 776 541 4471294 166
 3531459 448 729 906 871
     198=N    1044=I ALT088A                                            -3(20F4.0)~
15041390 944 56712231509 89115161781229414611406152513521145253313382898 24404110
3443 959 5581352 33516351730253017262012 1516 67612972695 47626272856269528681591
270337483051323640023865225619643014359335454326411140672822277623802275 11571606
1711225015081956210321782217257626341948   03292249328263139 5584016288529191760
1182 813151913511316 67613881461 811 373 880 88816291492 1016 8101905117513811111
20331112 93714141016 651 873 826 905 9071278120713 19 476 387 508 673 366 4451066
10221781197811121049 1136 8391503 85611671090110513761388 6701090221111723 1418 804
```

```
1181 473 969 357 75512981369 590 9221346 425 401 113 874 661 566 732 685 855 618
 757 4521620 856 993 477 662 761 574 602 167 644 310 899 699 912 6941218 889 764
 501 878 925 7911148 5041238121212591025 691 648 842 151 951 6211028 384
     131=N    1042=I ALT088B                                         -3(20F4.0)~
15991793 965 906 640 68418491168184916944029358632912702290220141769188018672358
246025051869196524572456 4172948226032911334 8902211165425493198 555344826983005
1750 652277040082650234824492049284834982898300236695909584664004100374824642697
1001 965253835003497359632962432173926672730234218671516 83517691535 64944953299
196724341099 8351267233125671568244425841941168518371980202927262192169052413360
3951464344953508311225221926158117292567261626171760 95515241614 777 78421211915
23612952229628943372269019971821166922372175
     137=N     995=I ALT090                                          -3(20F4.0)~
 84213201264 842 739 581116212631158 474 686131718971684168513691052 424 737 316
 686 372 526 9491579231526313105 33627361526132017371527 73717371950242125261159
1526178923161350139715431022 578 199 723 86715911253 3861158 57812051061 6761254
 675 723 964 530 314 242 169 434 676 662 689 583 689 651 627 867 964 867 9161425
14952554276520751337106414741245 280161313371567 968161311461013 339 799 737 461
 587 431 526 523 646 369 430 584 799 584 707 706 374 399 248 676 461 921 615 676
 646 461 676 678 553 8601014 55414431171184715981634 830 6441536 960
     207=N     920=I ALT061                                          -3(20F4.0)~
186210271120 2141395 948 744 1861407 465 566158425112982261915841962390630701023
 9351302130513982141148815842884334923271488 28713021305362723252325242013052606
26972884260635945127420524634511225636924618207417552785 52313492614542928153118
2697268320911755133713724792 766676987094649707059013899316442214033611854324339
349849903485 641 6793772297261732009 9211333 31614131315141330253204231836482137
595146502744141324731315141311171019 707 921 412   01315 900 9051303170229051711
4117221947813790577329825011521937413914256440671806 7253283 167 537 239 452 858
 573 214 17515011048266621183239 5762886 862 547 26617771317244522552835 464 864
17932200218111703023 957 653 932 388 467 243 591 392 902 5183170101014621221 795
1031 925  881521 2261342 65310251120 478 884 462 267 276 3241249  97 575 2671393
1499175218231678 96414971131
     328=N     832=I ALT066                                          -3(20F4.0)~
 258  91  93 449 106 115  77 359 194  90 4252932180711431189 128 564 14425922515
44412999346810483783 500 307 242 387 242 968136624322472 67821321768 644 9082121
1142 198 193 180 242  68  86 336  66  49 413 128 277  92 282  63 136  70 112 138
 214 325  70  98 258 162 310 237  63 181 110  68 140 307 164  37 118 268  37 245
 129 271  59 343 162 286 148 401 125  48 140 107 202  88 160 328 289 238 367 100
 198  70 355 258 260 519 286 395   0 681 45327763641  42371739663160252029753044
2547 729265439001443 807 237 831 304 917 285 4511467 650  69 327 575 96615321071
 327 279 353 833  69 632 4221249  6921322904311225381032172415682049 357 173  44
 103  60 330 148 125  87 195 349156118022078 296 324 334  74 158 111 139  93  74
 334  46  77 333 195  83 259 325 722 723 251 241 399  74  99 159 510 358 198 326
  85 354  93 148 354 741123430564701539732561074 75835542388 155 522 214 222 105
 176 226 152 164 224 692 314 526  71 676114625524012428946884028 340 405 131 149
 216 315 333 428 349 483 301 278 260  82 267  56 606 272 380 547 467 7921428 339
18821990 682224724391608 432 793 990 328 958 863119127551472 652 537 412 649 375
 803 321 876 912148430661546 2441340 815 609 589 174 127 381  87 196  76 229 218
 437 207 211 174 275 162 506 230 648 141 169 968 170 911 755 112 939116534862713
204823462831 107533440451166 105
      96=N     721=I ALT065A                                        -4(16F5.0)~
15025 884315723 411812677 6771 134011504147171235210294 9416132351353212944 7647
10588 529411764 9416 90401882314411144382060615599217641326414999142691430110464
 9525123672901824774 95602148824332262292401438600281272674227787121761396216727
1338213150 6973 9921161921379411652 5786 70251373713750 790511828125651289612273
1663410457118781051411799 4651 6822 80621426414267136441364713337 96121612712774
 9308120931054312403 9077110111034912157 969212235 8998130271429415197 930815504
      86=N     723=I ALT065B                                         -4(16F5.0)~
10629 5625 9062 5625    0 657010937 844313128 9380156281531513441 937514687 8443
12187    0140621969710937122031938515013238011660923539244721972710355 6875 6250
 8131 7812 40621375020025313602730428185209061911921346 863921814100311181418639
1181413622241043272128166 7732 6811113611952512714 2270 998914083150112621031618
2685110793295142413419211128801520315749163011828714020 91571927016625 574010317
 4578 5456 514810061 666710582
     158=N     647=I ALT094                                          -3(20F4.0)~
 654 8501176 8254175407633252775362635762727227531011925 851 955 485 251 5402425
2641328024802400248534412561 96012802241 408 13121603040304149614161297728982321
 800 133 6411120 907298748684000107037586173561867755583434018913845441312022122
 378 444111038252857343739701491 718 6721517 617 4474599601628464444364927562453
10842846 71714251070195614251244 893 45310811070 717160212441248 9781514 8931336
10701333 711115617801621 9141114 877 777 540 776 7421249 608 642 135 607 844 676
 743 676 878 776 645 611 95012151654128414532432158617902227   03074148828171893
1853140411611016 919 607 489 411 436 314 436 582 314 388 219 557 414 508
     128=N     633=I ALT058A                                         -3(20F4.0)~
31013086253913071419134413071384 599 560 635 8221158 971160619041344128217991579
 713 665127514372813235738554088283132523317186212581655206918623105341430004760
43884243237918621246103412461655113810341138 937 621 517 128 883 388 466 8531251
1631 7031086   012411474155213971009 474139915541319147611661086 6211009 8531474
 931 703 233 698 776100912411319   01940201716521820 771 646363327541762 8271266
 716242739652147208325321404 661 248 248 249 661 8261817 83623434926498640183991
38532863184522571822170715961461
     122=N     633=I ALT058B                                         -3(20F4.0)~
```

```
3375322431991784174218531779237111113 9631223126011851000155621852148148317041444
 409 2601037163014441668174127802315224729811677105З 7551630 558 395 781 9851527
17282043190614911074114317311975145518361663138б 866 693   0 8311421 93611771247
239215941143   012391109 590 797 796 658 8661041 658 598 381 254 208 590 740 917
 558 314 192 214 209 474 555 812   0 474137518152482 321 335398936302782 370 446
  74 5564820671042962858100б 259 705 474 6223815351925551704244529642815259З2445
23012237
     301=N     630=I ALT046A                                         -3(20F4.0)~
 517 759 421 342 291 757   0 590 7331369122515671465194127373004 428   025932351
209921501325 951 6621174 541 928 856 905 369 735 684 622 366 342 806 732 669 610
 879 521 293 951 947 922 999 665 321 5121100 812 4821766210024312013251021493483
3430212714851666 460112612831350 8731077 5631407115212281025 744 591 896 673 897
10251970181715911177186819201923137317482298167З 7742573 77614481448 34813491173
2272 674 574 726 574 924 649 599 899 599   0 575 700 624 7741273 849220112491251
12491173 6991050   0 925147511981248 401 500   02797 692 526 63112111179 842 789
 896216220632788310325251525   0   02473289323672054 7361737105311731844 500 289
 237 500 552 791 863 158 579 500 552 394 552 579 711 422 526 763 947 60510261002
1237 895 776 586   021312656149910 26 816139618431946 789 448 395 434 552 489 796
2130 599 276 226 325 375 251 475 275 3991576 7761264133 5 883 558 8911068   0 558
1611153314871248111510781029 558 624 412 790 627108211881622255510811601182812З3
1083129923722474212128201144114315781768139 0 9851220135614271780186514251703109 4
 643 307 446 504 183 518 601 412 346 50416951969 9521542150015761201 847 668 958
 14014081315185310571798 966 933 483 920 897 778 595 371 426 415 569 622 656 138
 587
     228=N     667=I ALT046B                                         -3(20F4.0)~
1317144419291574173713502126177217751411137 8 985 865 915 920   01707190023932417
3352272231183474133411091182118712 56 8131040 591 924 926140410511779 963 5911072
 703 6941810147928162034181614051295166615921224173814781516 7021774 702 8871334
107212211034218 4 945 665 706 443 8131000 872 850 449   0 480 413 332 674 702 853
1146 88711181218 777 369 816 445 776126111081034 790 739 3711035 740 784 739 820
 877 7761330 910 715 597 728 932 936 7551600168311262322248212112030161914911555
 888 984 539 666 540 484 667 619 190 159 573 476 190 603 190 414 222 349 477 603
 604 635 572 667 644 762 888 921127120311999136512501683209421891523 817 721 678
 395 256 372 675 767 419 163 163 282 266 604 395 558 256 535 558120911861279 977
1302   0153510471449159312181360104 2 955 636 795 376 550 536 89710191332159 11187
22111418 897 5161045 78119381970292423432173199618 52 302 466 642 579 231 3121478
1163139015071307104З 752 697 897
     165=N     585=I ALT064A                                         -3(20F4.0)~
1429 9221420 875 691 673 369 441 529 212 141 221 188 121 192 192 407 38318741884
17591700233017672259212837003577427332432455275 82667 140 171  78 186 155 140 372
 465 481 527 403 620 558 124 341 109 296  93 140  93 341 186 109 109 202 124 326
 295 341   0 605 434 127122417741091 946177414491691 6361690 465 248 202 326 372
 279 202 202 109 155 326 310 434 463 651 481 977 233 745 543 171 527 295 173 372
 248 124   0 279 419 264 731 451165110891336 372 5311558134516291670139213551227
1648 219 162  88 208  89 236 121 254 221 218 281 225 385 491 508 604 462 413 205
 549 675 511339026592647164 4 823 62215111044 689 447 4231622 5561491153712111446
1444173624232647 2977
     111=N     585=I ALT064B                                         -3(20F4.0)~
579156516558628249532023 209 2791140 256  70  70  93 257 163 326  23 512 421 628
 3952814395334893372381433264096228119582023205716 04 605 186 256 558 511 559 558
 511 209 209 256 140 280 116  70 209 142 163 302 606 493 398 676 678 395 280 424
 512 424   0 560 770 211 329 562 119  95 489 424 233  70 303 237 186 467 490 582
 234 489 442 326 163 257  93 260 279 187 349 651 373 815 629 7703562349723021744
 233 164 103 192 209 398 447 396 442 326 326
     376=N     583=I ALT091                                          -3(20F4.0)~
16581264140512301131133511951897175 4 4001410145411254053285016671915179813 97 845
112511281027130 0 845 915 947 915148011601968226 6 800 720 667 746101311201153138 6
 747 986 906 4561226 933 881 800 666 933 560 4331200 544 67612701594 29813781027
11891216118910271216102710 81 59512431108108 1 83911351054 8381028 892 838 9201054
 919 784 730 919 622 460 761 703 811 8111189 946 595 811 595 568 245 514 352 189
 325 432 676 411 460129743135578 955 334   0 387177729184861112 0 249 47237422972
 816 264 289 212 369 227157921841237 870 447 948 447 816 553 316 238 447 500 237
 237 474 869 816 447 789 317 447 396   0 632 816 947 816 658 1861026 81711051921
15261791179017941301 959 657 751 527 438 551 306 549 446 635 667 576 523 551 742
 578 551 935 74815911151 658 548 986 740 877 575 520 549 549 620   0 384 685 822
 9041644 850 903288926291527107212021090 658 659 291 329 401 536 147 236 237 165
 254 237 325 782 420 145 801110916721037158112001127118 1 764 400 302 310 872 327
 528 437 836 127 476 422 819107214911000129110181109 638 849 691 664 851 796 770
 798 664 504 504 664   0 613 560 398 265 320 505 6911089 9541284 5071009   01115
 800 809 872 690 757 637 584 268 346 585 594 479 398 584 458 479 346 319 345 611
 454 557 426 346 320 613 664 133 267 479 770 850 929 719 611 690 452 532 239 522
 219  80 188 168 53212813530 649 432 138 191 243 473 122 244 247 405 448 392 207
 243 325 285 393 581 663 355 279 164 167 286 351 323 269 600 443 562 6951045 906
 9821010 416 912 9101246 499102913631498 884 921 685 188 620 108
     239=N     608=I ALT053                                          -3(20F4.0)~
2754275221551607180616001651160318532101230219511750165116011050185126002001280 2
30003300225 9 900 450 287 850270720012001370029002500320213331556177815562000278 0
3222114237843143153914031370280030351866253424051599170020681566176615011466166 7
13001701206711002200356616671434221121662401210023702301203317341542140 0 8001500
2000207611861507134117382153260823 10 9471816 793126210261344142014 99 33720511657
1816118314221659134117382293 8681499 631 789126211831107205133173554165722111422
```

```
1079 368 736 263 526 631 372252512142788 4241106 89628933261289521571262 7912215
 9541192159712322590 397 59616301112 6371439 242 99315502151190922651153 120 756
 238 199 597 834 4771431 399 3581113 755 917202816311281155010731673 67511953378
19551749 421 516 755 99311521237 477 242 518 596 915 71619471391 6751996 5963061
4253 8791732119917662398203210661321 86915991201103317001466 400150242373639 433
 533 766 634 533 961 800 699313114661366 63311333032136626351401 634 333 533
     508=N     451=I ALT069A                                         -3(20F4.0)~
1000 825 706 706 677 500 76911191029 977 649 8551007 624 825 740 4421513 624   0
 744100016511621 5661306 948 9921098 647 562 503 744 445 9281098 507 865 571 736
 799 832100710311147 588 765 647 500 529 706 855 620 647 501 206 5591915 735 441
 530 562 9111682 97415291441282219992117 7301004 966 196 771 662 745 662 618 354
 467 587 538 96611181347 928 577 4241194 271 226 8451042 8471077 960119415001898
 776 771111310361496 614 460 422 580 729 575 883 271 385 230 230 691 268 537 115
 542 347 695 97111941230 82013091406 74512111136 391 858 316 978 820 549 172 587
 429 549 138 549 493 121  98 293 414  79 275  43 730 196 693 340 8611144 861 614
10931110 370 772 759 400 898 770 655 4431062 449 6551934 704 7701560 94024631806
1878 654 368 302 433   0 8101628 74411691078193913021272 744 942 3191026 137 149
 649 7201524104220911848 740 534 956 679 186 554 624 613 648 372 895 750 780 960
 714 750 802 416  92 966 282 205 740 408 639 942 193 900 558 431 216100911521135
 475 498 193 438 252 551 698 571 8161062 762 667 495 525  76 419 514 438 476 400
 476 668 381  57 667 305 666 419 628 248 438 419 572 419 457 725 457   012761544
 781 971 707 971 669   0 20910481161 42120181009 674163815611923 571 838 612 654
  95 647 190 362 533 305 171 457 248 457 305 819 114 248  76 362 421 133 248 514
 229 105 688 476 324 457 343 352 286 501 362 343 574 942 527 7361177 8481049 152
 598 176 859 88317731298 520 693 664 675 664 808 526 635 434 394 347 289 135 481
 635 924 827 597 712 424 463 232 177  58 442 500 481 596 539 692 289 254 580 539
 751 599 718 8331281 544 313 1031050 854 62020372199 140 355 634 411 275 471 690
 159 623 560 481 655 676 430 868 513 751 671 6761052 7661089 7971545 634 906 104
 920 6901135 2381091 386 291 544 348 637 212 544 714 506 401 577 597 95012911404
1393 810 404 270 923 444 2121002 747 755 344 212 196 243 145 428 448 119 593 163
 519 237 325 250 115 418 286 439 176 560 181 575 334 580 480 410 470 248 585 336
 361 743 586 378 612 613 535 511 644 138 497 376 149 779 214 658 612 513 385 389
 585 628 361 685 379 189 834 209
     328=N     452=I ALT069B                                         -3(20F4.0)~
 776 794 556 860 5881055117610881012 95810231062 894 979 773 8631067 762   0 954
118515021437 98510801103 964 998 654 550 344 517 209 757 929 550 447 447 516 482
 654 552 689 654 550 138 619 620 516 791 791 931 696 829 895 623 894 757 555 654
 735 8941893134213421412179211371273 758 832 654 413 657 757 931 689 696 275 447
 312 351 4821000120810031037 6281810 643   013671364 95712451052104816111147 401
 467 516 677 749 519 209 186 611100010031396 9541069 954 813 303 860 395 674 395
 372 534 303 279 302 302 234 279 279 349 418 139 534 465 465   0 349 534 512 697
 163 488 488 186 349 116 419 465   0 488 4651326 452 489 169 508 583 414 169 603
 301 245 169 471  96 357 188 810  75 621 847 602 734 735 509   015432108 8841441
1070 8841256 884   0 582160412091418 9301372 9771047 395 373 837 558 442 367   0
 8141070 65116271165 253 887 570 459 190 475 222  95 174 681 269 792 617 966 650
  95 475 364 142 904 334 5231218 586 823 158 745  961108 872 806 665114715891000
 826 588 677 676 9411171120612941206 179 294 824 736 235 162 280 118 132 309 309
 118 250  59 250 147 235 118 471 309 530 472 544 663 590 691 515   0   0 871  44
 839  74 751 941 221 1551133 338 927 912 135  94 250   0 281 200 271  73 156  84
 605 125 345 261 302 125 500 115 427 167 542 626 677 219 698 749 240 324 688 741
 208 685 648 375 368 304 324 410
     402=N     449=I ALT057A                                         -3(20F4.0)~
13222251169118361246 828 590 528 732 752 100 800 954 6701259  74 395 753 611 742
 732 9831790139713051807 86211631941 812 995 6971697135721611766 960 755 8931327
108515891689 6751189 578 743 511 444 712 709102116991901156114611222 981 898 917
 788 9661017 7831026 649 716 716 6781093 9171570143211551293 7121427 98412891323
 945 8161017 743 745 712 816 749 9141047 947 880 877 339 5151080 945 979 912 981
1185 676 709 618 84611161152 8161085 71212261323 956118510971046 968123110041165
 753 819 8681001 776 778 828 891 88811601160 88711151159 750 978 882 615 9561114
 5231527 5211661191016861024102711601165 89410681024 9101187 934 914 336 805 698
 562 730 561 835 727 743 776 926 606 546 47112161054 952 96013391291128911061303
1288 97013031061 9091274130312131121 273 86510611107 785   0 970 759 561 351 852
 521 478 685 743 562 609 487 501 546 788 244 179 690 609 712 111 626 541 556 312
 579 378 515 245 356 358 312 449 535 815 604 312 235 982 962 869 626 618 849 736
 401 427 358 457 557 467 475 556 556 493 581 849 714 356 692 648 400 290 535 915
 801 648 513 959 312 690 467 847100212031113127112921078 632 421 655 257 421 257
 140  74 443 116 421 373 493   0 543 140 792 722 846 791 8621093153613771375 979
10821027 937 707 470 116 734 401 853 707  96 643 817 803 822 876 746 8911033 516
 586 661 326 284 497 499 356 243 379 525 767 849 566 671 935 361 750 5251286 762
1132 835 853 795 547 397 610 294 199 368 626124710401365 994 8241010 790 849 684
 707 593 570 543 8181044 272 886 7511196 620 686 857 556 855107313081005 832 491
 385 298 196 214 320 108 263 371 310 171 472 406 388 584 385 668 7761377 713 951
 301 351
     371=N     450=I ALT057B                                         -3(20F4.0)~
2259160818241173 740 480 480 653 766   0 913 964 6961176   0 393 744 665 872 876
 9461783143612601695104313531566 9131043161020401754193717101099 904118718051568
14761587 7621002 860 998 667 525 737 808104914261568175713301093 999 8451049 667
 856 855 8081045 576 545 667 8481121106115151334 9401212 75816361727160614251152
10611000 849 849 758 698 636 820 93910321095 910 424 3511182 94411821214 944 974
 703 673 687 8201004 911 820 941 75810021316 974124810671087 9781478 7611065 675
 8261000 739 739 787 852 957 9571022 913 87011091174 8261065 796 848 8481044 348
```

```
1196 52217831826176110001131126110221044 936 913 805 829 805 719 283 761 978 524
 609 392 653 566 609 609 807 610 826 4781130 978 9781065121711311218106513481544
135513101044 9771221108810661011 511 710 999 911 523   0 823 555 468 555 644 266
 289 577 555 400 489 267 579 444 800 267 200 533 522 555 113 533 422 466 223 445
 334 311 333 467 579 311 555 666 866 533 312 666 755 777 666 178 277 603 756 622
 444 356 422 446 113 733 444 312 135 445 312 422 689 569 364 116 454 370 159 502
 523 500 364 615 434 251 523 572 706 640 751 97812531114 913 891 546 527 303 114
 187 432 412 183 183 214   0 662 525 685 800 876 685 803 92312371151125710491 987
1138 961 897 550 277 741 263 625 574 106 559 841 834 834 722 559 644 532 158 242
 540 289 314 214 297 279  86 428 251 671 732 502 615 827 5591149 2891346 567 814
 513 625 383 479 131 388 309 131 408 640 690 736 851 717   01014 473 731 408 635
 314 348 444 705 840 273 550 408 611 322 415
     310=N      408=I ALT103A                                          -3(20F4.0)~
130721811580 1635 8191696202233883381446743665290322414801534119914261145141 7   0
1198 9821254 656 980   0 81914721751299821893326327230662867111115412115244712 67
12421222 98015112034257719181954303833174456260221192119244913701852111216311371
 8551001 7441298 96315202447222320742186100115201111151917042000222531513832155 6
1705 8551710 70517501855220024604143237434852466156 5 94114061832148 5   01036 834
1243 89914831938193527232175 34116902036103612431344172429662068265419651866135 1
 519 884 733 459 519 648 728 67811361350 54910341466113111 01 607 820 7901394 974
1091 972 6671152 516 733 395 758 823 760 85314901401118214881243 758 1211000 394
1061 6071155 8791091 8181367 788 8811091 939148513361425290922141879224318201576
136520631699194 01153 741 618 659 864 864 782 94910721031 8631113 740 908 411 822
 946 658 700 53414801113 1031 913 192 742 303 303 303 494 546 113 586 667 7142391
189519481210115211 39 145 436 150 164 195 294 215 274 520 533 689 459 291 404 331
 520 602 144 81410721371125615561551 14915851072 91812051372122713201464133812 18
 918 692 655 87725184602138420274028132218602116173516 16 970 971 411 471 2541001
 971 999 91312341382135212421042101410 43 619 84611831211118410 42 705 318 986 676
 678 681 821 648 563 819 650 594 648 597
     272=N      406=I ALT103B                                          -3(20F4.0)~
17381364173815361337106514411644342935444512548240963339219 0 38121481525128613 82
1429   0114410521000 439 910   0 86213371578276824296007444946793075 97613831536
1927 76812321544146211522382238321522076331127705378361119212770245813831536 1111
15101599 7991067 80011991199168717321466164319 54 89211681377 97811991734173724 46
329323601823 9812324 84422662094244823993205200226262044131 9 72514051661119 8   0
 511 767 813 767 76611061405140518 76 22215761617136413612214225831132089264616 60
25131491 81313671490106713 22 852 597 555 8941022 85210641235123411 91 6811192 852
2086 5821257 851 495 722 272 861 457 718 86111341346162217 30 9001134 900 729 317
 861 495 633 413 994 9001244 81712611034 861112710781439175514782061156712101568
179114351119197020602776183615701031125412541657129813 43 894 766 638 596 511 723
 170 7711362 8091237 2591415 68211101156 596 982 470 428 364 476 644 351 777 813
 74320042299264113251237 2000 536 384 193 340 234 192 299 362 385 724 8721064 917
 917 681 855 619  87 468 873 93611281000 894 23310641724148914261968156617401026
101910221287 844   0 96713191423120011403377 211
    1008=N      397=I ALT062                                           -3(20F4.0)~
 358 345 294 305 258 247 224 282 132 141 227 237 446 4301059 953 990 469 412 250
 698 356 197 144 160 277 303 730 251 538 557 402 237 319 184 171 108 119 381 144
 409 381 447 591 814 342 177 486 368 447 604 370 356 290 342 422 342 473 762 945
124814311631 629 389 301 481 317 558 463 482 370 278 283 204 149 356 499 260 610
 629   0 704 444 538 298 225 167 149 353 277 486 223 518 471 438 595 438 606 707
 561 684 438 508 213 311 203 180 236 281 213 483 449 337 405 426 662 853 229 998
 842 696 628 247 426 124 293 213 583 639 662 664 651 404 507 485 707 389 298 261
 260 130 248 221 104  85 195 623 389 415 338 389 169 247 117 234 104 221 208 182
 246 298 182 324 117 350 259 312 169 260 169 325  66 532 105 363 156 311 221 112
 272 675 687 558 9471569 779 908 869 506 830 636 519 623 844 639 882 467 701 363
 85613231621 1090 480 817 687 703 558 713 869 778 714 519 530 487 341 325 295 353
 326 265 266 341 474 430 283 428 869 94112491205122013221469124913081030 663 501
 314 459 176 310 133 162 225 228 294 341 539 674 450 346 450 221  89 107 341 268
 496 725 576 844 707 798 617 441 231 765 576 713 416 655 470 290 162 103 179 103
  77  94 188 104  86 223 111 308 121  86 119 157 147 412 554 670 582 589 377 385
 230  67 154  94 302  79 216 147 208 122 243 193 337 305 218 276 276 197  69 129
 250 112 128 139 206 244 421 352 554 453 461 419 505 539 273 435 325 196 384 206
 180 249 154 147 283 188 111 197 582 402 370 625  94 242 230 153 162 127  85  85
 364 408 331 407 141 619 450 339 254 119 246 161 424 339 417 348 509 373 399 247
 466 322 127 144 213 229 221 221 256 256 322 111 162 163 180 161 299  93 112 153
  94  93  93 111 155 314 221 263 198 145 205 178 203 110 343 179 263 123 112 163
 171 215 197 246 297 161 288 297 212 264 315  77 298 424 229 178 365 433 593 432
 307 127 297 280 314 458 424 603 552 864 625 169 1211050 821 9581016 568  97 956
 567 552 492 403 167 240 150 181 181 254 319 302 389 257 361 150 299 270 319 228
 464 527 618 626 359 508 552 165 283 477 487 495 358 492 522 657 522 299 537 343
  84 373 149 328 358 149 224 269 315 448 420 403 403 239 552 224 626 5821077 546
 638 429 416 299 288 250 325 377 351 377 352 481 247 208 351 156 143 156 247  92
 234 286 208 299 403 182 260 234 299 143 299 235 352 338 247 416 325 333 326 468
 468 585 715 792 442 312 247 481 312 403 391 455 533 403 377 378 403 321 429 208
 286 234 195 234 235 156 208  91 158 208 234 312 468 247 598 390 389 250 194 444
 167 222 194 307 362 333 361 278 250 305 334 251 194 417 139 307 142 278 251 222
 222 250 139 472 347 333 153 208 140 139  98 181  56 347 333 334 167  44 265 167
 208 320 236 223 486 362 474 361 404 223 295 222 362 183 196 153 434 267 406 265
 514 279 644 229 498 264 142 212  71 169 212 238 158 368 580 591 488 255 199 277
 321 223 500 390 459 486 472 389 404 264 583 347 224 293 347 625 446 126 517 196
 120 315 121 243 157 196 199 182 170 157 121 182  57 205 158 387 220 169  73  60
```

```
 314 156 135 266 169 109 121  43 133 193 301 206 220 220 158 242 317 279 688 524
 222 562 222 293 243 418 279 272 347 467 208 402 193 453 387   0 772 694 467 317
 158 149 210 161 175 210 103 187 274 267 217 137 199  62 196 220 371 482 161 309
 269 260 248 245 202 260 126 267 225 135 283 309 257 295 161 220 330 161 187 161
  76 137 175 184 161 170 130 170  88 307 213 368 324 537 575 654 739 712 661 432
 478 406 243 216 136 108 235 279 172  92 157 181 190 207 270 297 216 235 264 320
 284 474 333 384 486 343 252 202 364 364 515 508 284 394 384 445 373 283 344 427
 192 284 358 385 324 354 334 355 356 438 470  39 486 398 382 384 432 407 520 561
 657 732 884 931 884 390 530 468 9621218 727 661 451 441 358 582 202 666 534 597
 447  71 143 172 178 243 111 258 210 140 235 108 477 404 830 607 454 461 689 536
 869 388 562 481 713 512 675 451 575 562 451 440 339 163 452 450 163 400 254 126
 412 488 341 387 300 452 400 380 251 276 301 226 230 251 515 250 214 631 431 476
 226 200 188 163 350 225 287 164 250 175 301 262 264 401 400 425 263 750 638 713
 588 556 492 396 573 426 181 363 296 393 627 671 640 492 295 360 199 100 151 167
 147 262 229 148  83 215 183 481
     758=N      360=I ALT077                                         -3(20F4.0)~
 764 627 955 954 627 709 218 682 654 437 573 409 327 327 655 628 273 464 382 764
 628 736 464 709 709 382 818 873 32714201069 273 628 382 575 601 630213013951422
 602 131   0 876 874 825117811781555180312561364131O 764 687 900 573 793 491 655
 301 437 521 494 519 328 687 440 660 386 849 602 637102610521079 553 898 737 896
 684 605 237 632 581 711 607 953 6581108143З 8461916 7151215 428168910031087110б
 737 636 684 501 243 763 606 424 584 744 819 846100812241403113б 722 744 558 882
 6071035 844 741 555 741 718 317 852 636 904 434 774 692 532 584 666 9451094 934
 676128513981203 831  8914881600149712701589121910б8 6511012 600 383 582 658 575
 708 807 724 358 517 658 492 588 741 294 625 320 460 511 283 320 243 492 454 753
 7991092 70810901130 920 819 731 781 861 674 563 269  93 485 565 462 604 429 645
 652 807 973 590123512292272163415881405106l 9471239 697 857 884 670 563 672 815
 618 728 542 134 573 709  59 701 563 670 432 515 754  92 456  27 376 379 617 542
 917 728 757 595 914 88510981050 542 565 563 565 137 420  89 196 412 340 411 518
 304 357 250 214 232 412 196 341 268 196 268 268 312 270 403 217 574 375 446 304
 681 607 121 734 564 821 526 421 790 526 606 605 158 316 158 501 526 421 447 395
 474 237 291 289 184 527 342 217 662 422 372 450 237 291 476 450 527 607 684 684
 421 501 316 552 210 342 263 289 263 395 317 210 447 552 316 342 474 474 342 500
 422 579 610 343 134 372 316 500 500 686 658 607 553 579 503  79 448 474 342 526
 584 476 791 790 658 579 658 237 584 658 421 526 607 210 765 395 532 192 562 686
 819 722 819 816 711 790 711 242 199 242 290 177 161  43  41 371 145  97 113 210
 145 129 177 210 242 194 145 323 226 371 146 228 194 162 355 275 372 372 242 194
 291 324 278 278 324 180 355 194 297 364 368 342 301 326 324  97 310 210 380 196
 340 294 297 422 326 390 528 620 528 275 326 493 493 604 199 194 292 301 247 348
 282 294 263 278 294 204 263 282 329 133 490 475 356 453 392 292 376 310 244 308
 439 228 228  66 282 114 196 244 297 282 345 215 247 235 164 196 326  66 422 313
 313 102 358 345 292 244 308 392 258 292 504 446 438 440 244 228 380 215 313 247
 259 247 199 260 164 164 196 247 403 374 361 292  81 247 260 113 294 242 278 506
 602 536 647 361 504 502 520 567 552 780 538 682 652 618 9561250 9151068 788 612
 640 560 534 407 458 254 559 788 741 280 587 610 585 686 890 865 407 915 915 890
 610 966 738 483 585 508 432 585 534 280 534 460 559 483 587 280 483 458 6361297
14491247 941 8151500 9411017 127 738 814 712 789 738 407 508 254 458 229 483 254
 381 539 356 562 330 562 432 229 435 560 534 281 229 331 230 385 280 334 334 357
 435 460 640 433 469 612 259 508 511 615 564 539 601 416 533 519 467 434 418 603
 701 467 569 434 517 400 483 551 567 434 317 350 267 383 284 400 418 434 334 234
 385 366 217  67 433 200 484 516 383 450 183 250 183 500 333 516 333 516 383 533
 533 401 267 366 283 600 400 600 533 550 234 633 234 534 283 550 383 400 283 351
 283 250 334 184 383 433 500 550 267 283 335 217 300 550 483 567 650 483 368 334
 283 351 183 133 483 433 516 366 500 167 366 183 234 217  50 567 233 550
     448=N      355=I ALT078                                         -3(20F4.0)~
 685 893 8341490 299 448 397 447 388 2991133 8631489 983 569 329 333 299 788 714
 240 507 362 774 477 451 1491132 744 935 93014931732 4551875 775 8041111 536 895
 44710421132 566 5371400 994 582 317 515 134 136 317  88 718 517 611 471 784 247
 136 180 694 339 471 539 358 628 158 314  94 541 291 560 3131008 450 761 807 515
 649174615011343 560 717 739 179 224 538 582 672 6721075 873130023503605208423O6
2667240029693384259б 557 538 112 225 114 339  67 337 158 291 180 471 203 404 201
 179 337 404 203 381 270 560 270 582 313 247 291 403 225  67 225 247 272 381 369
 564 98717701948 560 270 51515001582114B 526237225201998 276 527 643 67427713419
 150 599 6011823 4251824 103 350 357 125 304 250 201  50 175 112 176 200 299 275
 328 436 724 549249713261449 226 400 656 251 477 255 206 226 275 200 200 452 374
 402 525 276 350 150 276 125 251  79 350 100 206 176 226 255 255  25 529 325 103
 300 152 255 427 382 279 474 9851108 309 182 309 348 261 201 127  56 230  79 309
 246 103 213 285 255 348 100 182 112 255 313 2131468 535 464 464 759 457 457 366
 114 187 205  94 251  51 161 254  72 144  72 232 183 348 144 392 281 643 342 656
1116 136 441 364 187 410 253  62 243 306 262 187 259 198 244 288 354 288 273 202
 320 228 167  62 212 199 107 182 187 244 319 107 167 182 184 319 349 504 380 429
 412 455 366 638 2591144117017881350100Ž 137  68 7581152215316221789222814496 250
10412217100431871973393932401963302218433004305932402476269935412642217B 360 442
239624032257 167 140 988 22620891740 856 224 161 122 264 161 138 173 222 247 372
 284 199 186 160 274 136 223 204 210 210 222 38410141049 6422383202823621668198Z
1938 6311247 102 201 351 395179011061367173B 325 482 889156921231550 272 8901012
 228 175 276 228178024941049 146 2451050 808119916861489197719792411290826933339
17844094    02580238526772444392B
     441=N      370=I ALT092                                         -3(20F4.0)~
121816531176 690 567 501 542 999 352 917 625 343 459 328 4441027 775 727 856 752
 582  82 96017961023 158  831522 65026461668101O 8921110 770 2561612 608 522 782
```

```
 8231176 3161032 325 451 355 394  5113602216 337 418 291 764 110 544 6631089 489
 421 140 483 179  57 209  69 739 421 188 352 293 213 725 3071163 108 872 334 117
1041 367 599 595 314 281 982 2523121 159  98 403 323 776 144 66412571432 8921374
 431 486 611349416151851 702 134  51 190 195 248 4651113 371 491 207 226 786 425
 338 165 5341279 345 547 5861276 848 56210661628186814441 933 8131066 270 173 595
  6911511368 1682315  97 649 4501193 493 2541384 9441114 487 705 233 774 924 783
 764  52 218 861 655 737 836 494 5511090 803 332 586 7202709 646 869 186 500 120
 566 199  99 926 585  78 529 1391050 892 573 107 186 427 496 427 9431151 757 577
 688 246 673  94 483 6811295 642 689 789 451 181  67 675 451 550 446 48911751120
 1251075 846 6511583 187 343 471 347 6951550 686 914 816 610 160 663 969 9161646
 482 581 185 812 566 159  29  37 243 63413612584374217O9 28229281418 242 527 478
 459 115 288 269 341 373 495 153 408 412 679 663 559 444 739 488 458 575 396 940
 170  75 4881352 884 5061520 7091110 785 739 129 245 402 488 563 468 218 523 406
 743 471 707 554 5081049 9621683 939 66110311682349818121042101O1042 846  77 481
 512 523 172  89 139 455 370 452  76 648 137 221 303 471 142  88 625 292 252 219
 459 430 659 542 689 479 303  94 182 190 115  84 233 189 159 306  62  54 324 221
 146 106 556 7131116 927 802 305 204 155 145 419 244 367 176  93  83 103 174 326
 323  71 125 353  83 467  91 304 297  61 147 122 172  81 186 182 316 253 465 415
 364 466 434 145  96 113 233 282 297 270 335 174 351 194 475  61 163 505  81 323
 111 425 253 131 131 222 253 192 253 505 121  71 243 222 173 415 475 172 364  86
 500
     713=N     336=I ALT067                                          -3(20F4.0)~
16992027295913701866257521942056268521922959295912071919208215901864 98618121151
169914261096 931109712601370 8771260109612611316109713701152175712601370137O1210
13711096137115931041164520831535186321371334100O 901 8361367 9121333 81113001100
   0   01635 467 500 200 433 333 467 767 600 73410341133 9001034 8671234 767 734
 83410001133113411OO 567 501 600 733 233 83411001500113520341667140014671501l467
141314001433 967 7331200 6001134 96717001067110O 633 600 500 435 533  67 209 137
 571 367 567 534 534 501 667 269 767 667 634 902 6001000 667 63310671334l268 967
 867 637 641 641 872 773 839 501 534 9101038 411 572 253 601 442 632 601 506 572
 506 537 537 600 47411691358 885 161 189 53812001011l042 853 695 790 505 442 286
 443 158 379 349 189 412 412 568 505 569 475 632 506 316 568 601 600 632 568 316
 253 411 569 569 478 353 415 412 447 509 729 506 607 572 632 384 411 443 537 379
 475 223 349 284 189 885 284 505 948 6011012 349 379 7591011 884 916 884 8211074
 537 538 316 759 664 918  95 253 9791074 632 884 790 695 509 568 506 291 253 161
 545 126 158 538 349 161 411 349 601 380 317 538 223 412 316 412 192 347 284 189
 284 537 538 795 415 443 537 379 663 411 537 885 663 726 789 727 379 317 284 284
 380 569 568 505 632 380 215 306 196 380 253 286 221 379 100 443 443 223 126 380
 474 664 412 442 506 316 569 538 537 442 506 568 822 789 885 853 855135812001012
 853 685 391 166 261 623 555 425 493 305 163 461 578 328 558 563 653 595 3721036
12541356 506 595 652 619 198   0 393 261 293 332 130 293 295 336 198 228 412 750
 913 782 623 424 685 880 720 750 555 458 523 196 263 461 326 231 261 198 198 163
 163 130 134 196 391 196 263 130 198 295 717 359 685 5551207 848 980 456   0 753
 653 522 424 424 78310111275101l1045 848 880 913 458 785 391 391 228 295 326 425
 558 588 720 563 688 490 397 393 332 397 546 522 558 688 397 627 163 5221045 913
 913 587 718 456 761 825 934 895 685 435 198 196 206 32815451440121O1045 761 720
 788 753 587 166 196 295 263 424 293 360 263 332 228 231 332 295 458 295 425 688
 231 393 198 456 697 555 6971148 959 720 601 590 493   0   0 523 918 831 793 633
 95010513076 842 861 389 570 515 438 838 488 759 531 515 287 521 4961157 881 768
 507 235 375 666 788 305 451 279 488  90 901 477134211931148 920 768 552 526   0
 596 657 666 566 469 634 399 185 261 529 229 209 380 369 197 171 165 603 179 458
 242 526 618 451 628 261 674 496 679 381 563 467 345 254 419 259 436 565 181 480
 383 262 231 509 405 189 139 358 207 279 200 207 185 101 104 145 232 189 483 392
 149 255 181 269 292 282  58 242 255 254 165  31 215 294 133  74 333 242 210 247
 150 255 233 251 209 309 323 190 142 339 203 381 514 538 227 454 397 428 713 709
 756 606 731 506 259 382 217 176 181 163 217 364 256 373 457 440 518 327 159 367
 388 552 788 531 466 478 168 223 293 520 385 374 540 360 405 388 374 441 423 394
 430 442 461 332 529 521 356 167 217 294 254 264 312
     547=N     246=I ALT068A                                         -3(20F4.0)~
14271334112310O2 915 757 849 736 606 635 817 727 819 548 636 545 759 8781091 608
 87810931213151414851427190910001213 5781000 12211231091157312711543142215441638
13431542164417351146117411501101l049 683 683 707 857 756 584 584 6821071 8231049
10001317165719221634170714871463l047 661 9971295 97411681095 927 779 827 7301119
12171096 780 900 707 926 803 92510961071109610 46 949   0 830 900 657 976 876 949
 8271266 973 997 2931144 608 705 682 634 731 657 853 632 659 535 463 536 731 681
 536 610 632 634 511 537 560 465 536 513 712 782 8571003 531 829 922 11511301198
19331128  36172611751036 531 856 811 830 674 788 696 371 208 323 348 325 392 277
 440 161 609 583 973 690 534 879 738 805 921 899 828 667 828 507 437 600 415 598
 600 485 368 346 531 485 508 488 877 921 69410361246l035 990 6281192 975 736 585
 650 823 650 801 628 564 390 628 585 195 520 526 737 607 282 326 542 412 173 412
 130 433 390 347 498 412 152 758 303 368 433 606 499 522 239 455 217 303 659 630
 828 694 959 739 781 718 895 957 957 737 651 784 908 885 975 930 887 687 776 554
 488 399 398 244 266 509 266 179 443 377 465 177 421 133 465 423 443 355 267 376
 465 421 533 421 376 465 398 421 532 398 531 329 317 152 406 190 253 443 494 241
 190 139 167 343 215 608 203 418 380 609 241 431 304 355 639 535 823 950 861 748
 823 861 952 9771128 933 650 684 738 794 696 684 671 753 139 851 780 655 557 228
 409 420 409 307 632 382 437 420 753 771 687 409 644 736 808 251 755 632 949 743
 671 644 565 557 464 698 520 698 710 474 220 552 741 825 920 736 979 895 9791138
 8361085 860 712 777 135 578 795 77111681293128312871257 830 548 605 881 825 851
 942 791 791 454 582 548 458 518 611 515 641 424 968 9691179 912 671 666 605 668
 791100011521179 968 93814211062130012091875145111491120130013001391 879 855 756
```

```
 542 608 8211005157519651588l357 853 828 501 383 794 67913281677 9411177 620 530
 501 8251179126617351382 9701177150021173148361732952148167615291412l647   01355
 972 532 979 882 9111118 882 824 529103112991887 705 228 1821682 432 704 432 841
 409 88612741933161319551796127410OO 727 454 706 96114771227109215681559l298 662
 254 5051285218127002753 161336131333288 3373461264122861070 9071388156216851610
15232128208524831527l084 853
     399=N      269=I ALT068B                                           -3(20F4.0)~
 942 900126616001033 767 233 666   0 567 90213991500153411671268140114341000l268
1200 6031002 8341137 769 438 367 468 703 603 600 800 8671400 892 900 9661100 933
 9991133 900 834 966 600 600 833113314001168 567 800 866 600 7751033 900 867 667
 167 666 601 267 600 833 867 933 700 833 142 586 654 654 482 516 447 482 517 447
 516 206 447 275 619 722 413 760 655 654 688 654 413 726 6881101 690 585 826 688
 619 413 757 516 620 654 655 8291032 791 722 275 757 757   0 929103216171376 141
1376 894 688 794 86011011101 586 897 964 589 586 894 654 826 619 722 792 691 689
 654 517 344 483 757 378 346 826 662 655 628 931 691 629 919 739 732 342 864 547
 577 600 704 577 521 735 996 637 495 893 629 678 339 156 652 133 287 416 808 469
 546 313 546 598 521 469 312 624 286 468 468 286 286 600 182 598 468 494 728 469
 391 702 364 338 624 650 521 156  78 598 390 390 650 234 626 832 391 442 676 182
 598 469 546 494 728 754 598 260 806 754 572 650 520 260 234 286 572 234 624 624
 626 312 291 577 398 234 234 702 391  82 572 156 287 313 495 471 471 471 600 368
 291 652 600 316 835 710 265 210 393 655 208 637 423 240 548 842 480 413 553 516
 626 516 826 864 687 621 516 447 240 447 446 141 240 274 206 686 175 549 720 206
 686 550 480 378 103 995 379 240 137 720 694 481 621 755 172 755 618 618 480 446
 446 446 516 652 309 343 446 345 689 584 687 481 724 621 412 824 172 721 240 485
 413 206 583 617 550103810341242124220281475 683 735 768 631 835 997 735 761 574
 574 709 444 967 966 757 991 678104712031181l099 811 863 7381200 9971073 969 816
 91413851104 761 575 919 764 971121410781433127012 66 640 671 645 671 837 835
     293=N      242=I ALT047A                                           -3(20F4.0)~
266815731789 4631435126610591060l777 923 4441437 65332803042 78721883759 410 342
1743208626991299290528701743119624 60 657198626342633283624341711183412202155l469
3110194320701961 800 944109111101398 9461145 8911325 845 873 8731529 81715801818
18551379 218108913121102 6091155 5551102 87818492346207413892212134716541206l164
 780199714931490149713421056l055 913142612551883185522271687 943 827 4881030 486
1055117110271112 827 456 628 456 344 742 485 599 571 742 714 429 656 342 399 742
 571 657 8281198 65710561084142716571369 885 31824021501146516l0 642157817202824
30061659155918021802169714521592244619772369220619291454105213 23 9031679 9301604
10391315 916132917071148100712l0 787 938 5391070 804139810522001 8201745 934 376
 898 433 616 815 678 697 697 79223641209 931 213 603146610931339105111 85 2421019
 694 469 615 500 600 678 224 712 451 5801133 95512861104 566 798 762 928 6451120
 842 660 582 648 588 530 6171030 909 989 250 445 386 118 111 216 215 237 417 553
 323 417 236 245 402 150 246 208 192 321 386 423 428 721 829 5201223 786 689 837
 809 565 484 448 530 453 216 380 495 463 458 604 938 642 919 769 867 58117531136
 923 351 352 480 433 616 354 655 388 407333331802591
     157=N      248=I ALT047B                                           -3(20F4.0)~
 944111220211391 9251693214823903292 77923124253 563 515 67012053611135730742330
 691 768 692 2052177430235603842158 51049 972   014581330153513292276307113081023
1764 895 84414571790 9211818 946 946 921 870 486 641 179 5381048  77 616 946 767
 741 871 844 901204627373556 4459 604 803 803 839 6441011 723112113581169l204 599
 126 441 979 87213231724168515301057116920 29 8001864 96612041096128312541240l005
1639 882 31913721125108316241260l335 749 920 630 92015081732156019922878264816 99
31622670188620301633 224106110011151 671 315 7271462190315081255 999 924 708 795
14041390150811923527215610 03 792 1281048 849169812501560 917 808 719
     301=N      262=I ALT008A                                           -3(20F4.0)~
 6471028233911331013 592124012111154 5071393 564 824 648 197 253 957166123101154
1268188610981636 91514081145177513811105149915 78 828 394 434 552118315392761 908
 749 316 473 593102610261145 7501184 828 672 98614211147 711 681 240 7901263 868
1225 24117362723 4731618 986 552 355 871 475185611791257102715131180l026 8971257
148721021795 89911541027161511 54 923 692 94911791308158918211436100012 05 820 949
 744 6411128 9231308 616 950 436 359 487 6181018 8731018 655 764 7281019 582 473
 473 582 547 764 691 583 873 618 547 545 545 473 177 547 654 474 473 291 509 492
  56 364 365   0 255 218 618 76415821546l091 836 691 801 891 891 473 528 619 492
 309 255 164 291 346 782 237 709 855 782 782 618 473 691 420 456 345 509 437 437
 291 255 419 436 400 455 200 473 473 491 291 419 346 309 400 436 507 491 144 455
 491 564   0 691 783 691 618 509 328 674 547 527 420 455 710 548 605 663 478 515
 315 233 303 270 454 454 256 478 690 466 396 233 431 396 501 652 595 757 769 872
 756 372 699 698 884 628 709 872 442 396 604 434 623 585 566   0 434 359 453 453
 529 226 377 417 283 340 265 283 226  94 358 321 397 227 302 265 491 773 868 868
 943 81116041323 738 547 623 641 566 7371189 907 906 491 472 586 472 585 547 453
 604
     338=N      233=I ALT008B                                           -3(20F4.0)~
 8431583168527642424373927071618191514881413272416191756222637272133139116421349
 814 7203828428418442578 2598 894  68 709 7691155 908 786 586 738 800 893 3401124
 354 508 447 971113915231540158515551508178612651524148316 46 89217851571 8462185
1394 515 72713642182 9701394 577 636 545 394  91 4551212 788 698100012421515 698
166716431282 7931161 500 7731350 9861290   011413561292941793432250011791608 607
1857 7151108 964 750 500 395 680 573 893 751 750 643 357 9641036 597 368 621 737
 759105715861678 622 989 8971152 873 761149512461450 7441058 791 616 593 721 605
 396 430 349 489 384 489 337 384 198 559 430 837 74510471000 384 674 535 686 640
 651 143 815 291 500 198 431 446 413  89 377 319  77 281 256 280 583 455 477 375
 477 307 375 648 477 262 432 250 250 239 216 159 330 261 286 432 602 455 534 500
 398 193 489 375 511 296 580 250 295 159 114 250 318 239 273 330 307 182 205 193
```

```
 193 364 182 410 7051318 797 332 853 557 443  58 773 708 331 135 129  92 221 233
 368 208 337 331 294 313 202 123 380 129 251 147 165 233 245 190 325 331 190 178
 202 276 448 466 596 350 809 712 735 864 527 711 668 508 324 313 407 132 137 325
  83 335 220 165   0 474 281 479 511 450 137 364 536 287 677 412 336 429 577 772
 957 657 596 371 350 402 413 485 351 278 433 702 443 670 278 484 609 330 330 639
 593 381 216 186 113 155 299 185 124 268 237 302 569 592 495 794 762 912
     407=N      185=I ALT097A                                         -3(20F4.0)~
 9801038 683 541 731 506 648 694 918 906 92911651047 812136511531203 7301012 780
 2211143 9891435  781109 874 428 306 741 671106111541464125414661776 9061776 940
 893  4218811254132512891125 255 754 661 325 206  81 151 222 475 557 441 348 661
 441 162 686 661 623 824 749 643 664 632 685 763 737 390 421 243 201 401 116 338
 116 465 169 369 223 509 116   0 5801033 9931130 26313221043 5911022 516 632 495
 368 201  84 600 151 647 344 247 376 280 129 108  75 140 398 323 140 387 129 323
 462 301 333  86 710 462 258 194 183 248 200 302 228 151 462 667 935 559 280 183
 581 785 463 186 290 288 352 410 851 817 204 256 153 137 496 120 357 136 868 340
 357 103 565 102 817 290 688 170 160 169 466 464 589 160 102 915 113 768 974 877
 402 277  98 456  54 152 600  98 340 259 277 303 188  54 420 277 210  71  23 643
 777 866 536  71 233 330 375 366 375 357 268 384 375 223 116 197 100 491  45 393
  46 232  80  63  63 116 572  62 152 152 314   0 750 384 384 331  81 341 108 314
   0 117 492 500 241 592 116 514 840 179 509 680 563 733 840 893 930 768 9571056
 786 422 723 7041013 411 351  61 242  61 314 412 346 784 775 5181037 422 892 807
 470 892 724 640 892 893 869 640 797 543 567 314 579 458 193 446 557 207 109 386
 350 520 479 301 458 423 145 543 587 639 954 775 383 672 122 159 128 541 294 285
 205 523 317 261 243 402 523 364 485 597 308 317 121 467 533  77  56 271 143 281
 412 580 665 374 339 109  66 121 589 309 326  95 467 163 374 527 563 159 366 609
 132 114   0 121  48 169 374 235  85 154 151  56 140  47 178 280 112 168 121 215
  56 205  65 299  77 137 168 168  48 132 211 114 316 175 167 149 351 211  46 115
 176 175 353 122 200 205 260
     381=N      192=I ALT097B                                         -3(20F4.0)~
 754 773 461 496 713 959 526119611341362 6911206 713   01144 784 959   0 767 767
 593 470 668 223 69311131138 90713111583133514 59 965 860   01512 7671039 918 816
 694 742 865 238   0 160 347 505 436 644 564 416 457 555 376 139 406 416  99  50
 673 150 397 368 387 535 486 417 230 218 348 387 218 436 170 113 447 140 218  89
   0 406 337 574 585 576 585 366 726 842 1301000 289 634 852 654 982 707 773 388
 763 268 759 538 148 558 717 359 256 116 391 422 201 485 548 390 337 484 496  74
 389 464 369   0 127 116 105 611 495  74 211 148 558 781 663 781 487  42  57  69
 654 568 475 179 537 517 158 781 434 718 302 622 505  63  53 296 433 581  74 453
 158 718 653 591 130  53  54 264 371 289 327 380 369 674 285 676 928 366 430 315
 164 101  64 179  75 269  77  56 164 161  48  21 207 433 348 301 370 340 188  76
 413 480 396 341  48  76  68 387  38 169  39  38 423 428 529 461 576  59 178  59
  85 471 153 415 188 622 228 178  96 123 422  85 178 209 191 199 369 481 650 435
 378 267 774 380 127 734 418 469 216  89 405 101 316 190 177 266 193 367 418 266
 430 709 456 465 253  65 418 266 190 430 165 253 139 278 291 596 658 772 519 850
  89 456 331  89 278 280  38 342  76 544 456 392 506 190 266 343 304 389 151 458
 329 391 215 329  89  63 354 114 355 316 363 266 418 291 506 418 419 468 177 127
 304 443 456 291 519  88 329 278  63 240  63 253  65 157  76 331 225 288 241 252
 366 325 235 192 370 308 118 252 447 442 326 289 280  63  73  33  90 468 126 342
 169  72 225 101 272 311  45 108 379 343 191 227 228 172 244 228 172 107 147 180
 154
     597=N      162=I ALT102                                          -3(20F4.0)~
 969 519 623 935 727 659 588 761 797 9001039 762 900  27 935 866 727 831 761 485
 520 4511108 9371142 935121212121074 935 588 903 478 277 216 308 294 185 155 248
  62 277 974 88512521463 701 908 494 467 545 468 234 234 572 415 64910641221 884
10901013124814571039158314021480127215322012163513242051142810381194130010931039
 649 623 675 311  39 623 442 337 494 139 121 122  76 401 310 173 379 640 459 645
 708 9271007 812 925 887 752 767 985 9851225 9171191 821 678 408 204  83 460 273
 470 440 394 556 368 240 144 526 301 151 376 346 466 158 504 526 556 361 511 721
 827 768 767 979 934 6631128 932 770 854 730 729 729 708 791 834 916 938 792 729
 500 521 479 479 271 146 333 104 208 187 167 292 312 354 458 458 375 333 271 229
 291  62 291 375 291 604 687 666 646 500 646 624 646 791 687 708 624 520 333 781
 674 754 848 862 742 597 622 783 505 742  79  84 411 613 664 539 294 320 494 481
 213 265 532 771 904 926 641 555 615 530 342 367 162 206  77 260  77 350 154 248
  52 231 222 205 299 325 111 171 171  77 205 137  85  94 205 111 188 145 179 222
 419 470 436  76 496 453 384 154 223 325 453 444 291 555 436 504 411 547 291 624
 308 275 275 110 121 165 121  78  35  99 121 121 110  77 154 143 319 287  67 374
 265 220  66 209 253  44  39 297  77 165 209 450 374 659 682 747 472 198 209 209
 220 176 209  89 154 418 374 242 484 473 517 572 550 473 606 500 751123812921174
1319 990 645 410 263 323 119 121 119 158 121 186 278 224 359 344 501 529 884 949
 622  791727 919 504 270  54 198 117 379 325 261 171 198  72 180 117  64  54  63
 180 207 288 189 117 135  91 162 216 270 180 234 189 271 270 234 234  82 136 100
 297 103  94 145 205 265 273 162 146  94 411  94  60 171 146  43  60 128 181 111
 146 146 183  60 223 216 197  60 163 265  77 231 376 385 462 231 325 171 111 162
 162 274 239 222 188 128  85 103 145 171 300 248 111 215  85 239 333 162 376 205
 420 145 154 248 299 436 530 607 299 205 154  94 103 239 120 386 445 378 470 419
 513 367 470 626 714 122 693 395 447 270 198 137 164 164 166  77 104 111 506 176
  79 237 237 202 245 412 387 517 500 210 298  53 105  96  79  70 106 228 254 140
 247 193 114 106  81  53 239 538 425 389 614 442 179 244 236  72 219 261 228 300
 302 170 186  64 277 329 290 247 404 307 167  62 464 108 114 214 168 193  73 122
  79 108 249 268 295 187 220 265 361 258 370 396 378 496 294 567 342 664 420 530
 471 222 343 137 308 258 171 206 325 351 403 155  66 377 171 317 334
     332=N      160=I ALT042                                          -3(20F4.0)~
```

```
 4991838194211111723 83213041110 36111381276 9431609 804116513891831214218592109
18881138205322472968230516921138 888 688 5271110 722 888 3331276 999 21319451415
2191199723302941125611731203 747 398 897 946 300 697 249 548 704 750 697 996 951
 996 274 224 274 110 522 199 498 647 697  571294 8211220 9201443 199   011952490
254328961671 8271568 89712281151 88024465302287826401253165216131476 754 677 863
 168 509 899 617 586 504 363 277 282 699 477 558 500 582 250 388 195 720 9211453
1305133216711497 97012201117 942 867 926 96810581040 691 887 106 640 277 586 668
 754 921 808 555 3631534 621 923 426 1211105 485 333 439 380 788 7121000 212 485
 273 440 121 227 273 546 560 167 197 530 106 212 398 413 288 456 121 608 473  91
 841 394 694 566  84 336 105 199 294 157  63 273 283 389  53 115  63 105 389 168
 252 147 147 483 829 661 367 914 179 840 830 766 944 818 976 692 944 804 682 645
 196 168 692 551 178 403 327 673 112 804 120 307 327 240 349  76 129 477 242 160
 284 185 230 392  64  58  54 100  89 236 312  64  75 268 293 173 486 269 412 129
 247  86 497 304 377 401 185 216 766 832 292 107 755 811 372103311381250 445 511
 430 334 605 256 561 228 536 480 738 655 300 2311633 2301128 413 722 447 731 727
 286 914 671 223 496 486 912 567 769 753 328 505 587 355 493 288 533 915 411 520
 303 684  7713391003 813 769 487 795 1311094 487
     176=N     122=I ALT098A                                            -3(20F4.0)~
 520 438 328 711 777123016181210 605 697 881153723863610297941553665341824331426
1017 904 5201344 738 929 9301039 76510951376164216971088 844 830 874 697 437 658
 653 826 9171305191313041304 91310871131 914 609 609 7821000 913 9131174 565 913
12611130 9561348139112611440147910431044134712611001 652 697 388 687 775 478 179
 418 596 477 507 567 537 687 389 903 369 784 629 599 149105413471696169622781000
 583 438 604 668 417 709 605 668 125 711 813 583 751 667 542 814 919 753 796 981
10261385159012981777172120391439205717771542154212501168125214181626140111711148
140112431762141811671245124510661066 9331155146612451112133417332712   041772044
1380164417331733 6671423 8441022 979 8891245 8901023 93411121336
      99=N     183=I ALT098B                                            -3(20F4.0)~
130412761130 9861449 9851304 986 87013341276 927 812 609 551 841 551 6111131 986
 696 898 8411073 7831218 377 985 609 869 667 841 2031275136215941754127612461131
1159 8411044 667142014201189 7561163106212121030 818 485 21215461002103011821424
17281333 939 90910601273112116061303 940 939 636   0 728 849 940 637 637 6371000
11211212   0109111251000 793 703 519 700 827   0 917143215041975150018811988
     595=N      64=I ALT052                                             -3(20F4.0)~
 748 602 656 509 747 855 582 799 855 768 711 388 556 230 375 305 353 242 328 344
 115  81 575 291  76 473 703  73  97 218 365 121  36 446 462 121 339  84 315 630
 654 675 667 303 740 520 613 587 694 747 440 560 440 493 287 734 467 333 387 589
 477 442 334 440 413 333 546 347 401 112 693 417 200 680 547 586 520 653 480 573
 427 537 347 667 349 626 521 601 348 627 769 702 327 491 693 673 539 683 780   0
 808 548 644 482 645 577 596 366 519 558 356  96 902 110 656 722 465 568 743 750
 471 693 721 548 692 567 712 221 600 747 774 628 869 881100013881346160012001440
12861134 6811061 913 160 605   0 742 566 627 536  49 523 495 526 527 450 557 821
 566 755 670 552 702 605 411 516 508 564 656 669 540 523 617 434 380 373 497 443
 367 354 141 259 604 480 684 686 433 590 678 661 537 359 216 444 459 483 426 479
 599  32 580 556 286 511 445 485 353 307 106 368 225 235 182 116 357  97 258 332
 328 435 432 308 434 413 263 180 386 202 368 216 147 296  91 229 283 194 273 305
 469 102 432 408 126 113 483 379 542 567 637 659 521 778  79 562 586 466 630 386
 580 205 397 527 238 238 423 530 655 427 326 216 203 373 170  32 540 225 360 667
 518 473 326 247 399 339 517 403 208  69 250 403 516 585 348 306 599 335 445 441
  97 434 417  97 264 581 563 347 357 193 145 283  88 414 550 330 185 556 203 142
 212 610 910 735 428 199 660 416 381 760 811 434 479 602 382 124  56 484  49 390
 269 393 544  57 702 491 469 383 528 652  57 690 921 87311691236 998 811 759 542
 647 681 598 547 479 139 515  88 417 445 403 542 194 445 278 446 333 919 626 625
 611 222 556 448 306 347 464 395 528 153 474 477 472 512 601 502 209 444 474 403
   0 445 456 210  43  91 794 891 918 921 918 307 488 334 404 278 459 419 570 490
 194 528 348 472 350 347 348 331  69 502 464 529 601 214 264 103 100 175 263 514
 551 363 626 388 697 663 663 588 663 800 885 951 813 625 525 322 525 663 425 575
 503 452 488 650 463 613 133 664 500 513 438 692 677 476 777 688 551 801 174 939
 900 9391200 779 798 673 541 636   0 844 847 881 560 667 560 730 398 730 643 592
 655 160 884 219 766 149 71910781187 797 922 570 625 766 314 719 453 578 767 328
 570 656   0 704 516 437 328 234 406 391 391 234 481 439 109 563 594 328 563 469
 313 345 313 409 235 561 502 407 393 330 424 456 345 501 564 424 470 471 521 362
 204 488 432 552 344 781 641 716 638 619 652 539 430 539 168 451 308 300 331 376
 198 468 291 641 530 453 376 551 243 311 289 203 476 410 658
     313=N      28=I ALT093A                                            -3(20F4.0)~
3529164717641544 192 310 564 552 911 308 449 179 410 487 372 551 500 398 461 782
 539 424 83311791885159016671206 861 718 603 615 487 938 974 9493078191126792946
177331581927137729002252 8731087217513791232 870 632 460 436 294 411 387 830 507
 501 460 60515471281 726 726 701 677 243 291 873 822 435162541093144203718861475
 96710191500120912541293 725 941 824 588 225143117652354 492 5881001122010591509
26671980109721551979117625282010256717441196196016461020 392 612 196 686 9412077
 784119514901744 431 54910001156105810201313149020571725 882 197 511113919811264
 402142413711309 9681195 740 74211381081 740 342 854 797 683 9271310 96814801138
1538 629 854 91110261367 228 799 342 740 911114015411254119713091083 51511401083
1309 692 91111951314119510811138 685 9121025 6851083 742 830 793 528 547 359 623
 397 415 624 888 642 698 736 321 981  871151 5091114 566 547 360 415 472 528 661
 830 7741038 660 529 623 566 302 377  49 358 208 245 265 434 321 491 491 642 434
 170 717 660 1071057 963 830 245 245 151 246 283 189 170 208 170 208 342 208 264
 661 517 463 435 762 517 598  37 626 422 394 396 435 259 449 272 136 327 326 272
 177 150  85 313  95 177 245 367 598 829 571 544 545 395 408 517 545 598 340 598
 231 476 272 354 463 449 558 367 140 654 241 179 639
```

```
     128=N       87=I ALT093B                                         -3(20F4.0)~
 507 632137413641765127912671134102210 67 956108916221600 9333222366733111889 1800
18671356 8891089 733 6261201 96611871185 963102120002079 2370   0 963170517781261
13331705214815562594222118520001852237020741483192713 09 979 286 548 167 572 667
2070 500 761116618081047 5241918112511331435152917261724 1312 959 458 86212251178
1115 6772426112214421054 1184 912 96513081284 735 652 693 951 6321269135313501663
1957144211481347148315631221 358 504 158 7461112 9421003 870 688 528 323 193 409
 789 552 547 595 813140316131488
     264=N       24=I ALT054A                                         -3(20F4.0)~
 702 534 387 460 774 8502592307525191597201120572371 8711502 798 460 411 8471113
1016 99213311379121023712274217725162201242022751477 1790 1552493193531211584 189
19532604186214911674 1581 935121321391862158418691767172220461584 750111611201584
17692513158114071302102713 02 842 7501027 935 837 837112031631284 683109414191592
2044132020891499154414991091131717711229145613 69 6361139   01136109014141 2271454
1453168617731143127212 72 908 9091023   0 7321181136513181635104512 27 867 227 552
 9081061 502 411 999 999 7801311168720332090156411231343 8431030106512181060 878
 874106013131005 12216271061156216221564 531   0155921271591137410931217 780 967
 843 843 844 562 438 686 655 376 499 405 720 687 718 687 468 780 843 749 8111841
1656 141312012871344 1016 917 656 622 558 623 590 427 819 658 982 524 9501147 688
1212 950 985 982 950 754 787 851 720 623 819 688 655 558 460 623 427 819 8211477
141217381148 656 819 558 985 851 688 623 525 524 655 232 558 229 626 196 524 460
 393 398 491 360  87 460 393 167 688 366 327   0 720 721 851 688 917 656 558 656
 950 658 492 264
     331=N       36=I ALT054B                                         -3(20F4.0)~
235612201396 980 926 956116114371400153914431478108218521687224518391391151 21265
 7441091 2131264123921321364   01933168613141587151213881537136324291858208 21909
16111593148714371041193318092478230518511587176514331589158912 37 88115891234 881
1325149917631237   014101870 70515891499211615011146150113221367114611471015 1103
   01147 749 971 617 859 8891334136513021207107913971334 954 9841048 857 603 794
 635 953159210791429 1048 831   01113 446 831136512381397 8891589165110481906 985
14921587206419051365155611121080117618742063136 5 3131302114316511684212814291150
12451529 825124211541432 81110421207 77013771606183813071334157221041340 972 867
 6371071 70110021035 537 701 906 668 4061035 600 740 670 844 745 752 4061174 773
 736 773 600 976 8341069 834 902 939 600 981 740 77311051080 773 939 969 981 568
 872 740 568 534 571 740 543 745 7851067   0 4472302 5161030 72916961364 820 758
 609 486 129 545 516 667 545 637 516 666 545 425   0 546 488 575 758 425 454  93
 515 304 637 763 637 516 184 606 758 758 947 1251183 788 939106414261000 818  79
 6061338 702 428 7571062 853 639 639 636 612 486 576 760 6671060 91110321151 515
 606 849 242 849 999 763 7881211 629 747 627 152 449 269 239 330 300 597 477 179
 123 418 239 419 568 241 123 239 152 328   0 627 389 388 4781104 747 152 808 896
 689 448 955 955 478 568 656 627 448 689 481
     462=N       21=I ALT100A                                         -3(20F4.0)~
12351326138317351677120613531294 1059 735 6181237147017351472 736 823 765 823 823
1029 942170717391295 857151011861060 97217392029197411821094 1124 529 41610021069
11561150 799 711 945 566 620 711 653 591 566 566 799 741 624 890 975 916 855 741
 9531007 978 9451033 679 595 629 445 591 508109412441859 793 913 648103413751251
 887 767 335 553 394 369 523 398 488 767 729 869 455 553 579 729 820 607 823 497
 790 579 545 576 697 820 911 576 637 545 212 518 364 151 333  91 335 339 424 425
 488 609 643 576 699 760 669 767 576 853 733 339 579 335 576 242 458 488 579 576
 395 408 395 518 488 335 360 161 273 342 299 321 251 318 182   0 276 591 432  68
 432 318 136 387 457 411  72 348 446 296 274 254 299 251 800 688 389 845 7331173
 986 3561826 7301341 62018231274 2705 911 616 256 170 235 235 212 301 4471507 817
 765 475 619 595 637 633 619 801 694 599   0 786185813081848 879 710 537 322 682
 554 614 444 572 679 530 619 512 215 444 768 5511536 893 997 554 471 488 405 644
 447 388 360 423 384 384 281 360 405 447 343 423 405 481 298 661 402 381 488 488
 572 703120112111339 384 637 738 591 381 569 611 274 191 111 402 253 211 147 527
 379 632 298 360 409 405 256 562 959 233 220 353 456 301 4261173 668 207 431 302
 143 319 258 240 270 810 365 290 191 255 270 652 730 652 619 4491051 514 418 262
 582 736 303 146  81 290 526 467 305 420 355 274 467 436 2431315 510 599 804 658
 528 654 717 4801181 384 483 447 679 112 548 747 551 710 611 804 418 324 371 439
 405 355 408 382 412 477 479 414 446 303 60712171357 869 81613451906 20742005 989
123610661384 802 167 151 121 212 121 227 229 182 318 169 287 197 273 106 182 321
 217 338 249 316 298 760 834 819 74210911067136210451018 1293 411 3061400 122 318
1460 59916651502 422 360 389 389 551 552 521 651 604 678 627 899 1691249 3481394
1818 120 150 133 255 279 266 123 316 342 228 727 543 83610971035189313051049 1594
16671351
     364=N       51=I ALT100B                                         -3(20F4.0)~
10941508168811251098 1032 875 626 937 96911561313 782 8751000 750 844 906 782 501
 625 719 626 595 594 844 875 9691000 844 9371031 937 8751031 625 719 470 594 531
 407 78111891687178111871004109515941344 10321406 8751189 1033 656 813 721 6571002
 812 984 500 469 501 406 469 344 719 394 594 469 437 501 439 750 751 454 546 524
 250 364 364 409 546 478 637 750 570 409 660 682 796 750 911 750 730 841 685 615
 502 116 500 546 615 182 411 387 502 432 457 597 595 591 591 432 387 203 229 409
 288 369 364 318 167 167 122 530 303 136 364 364 228 335 470 427 152 455 410 364
 288 258 365 320 591 442 335 686 547 868 808 65124401182 1168 486 515 364 561 515
 379 318 121 303 379 273 636 592 760 808 850 894 972 898 879 819 924 804 757 760
 971 9711275 970 790 760 609 549 849 697 697 121 485 667 763 697 848 862 669 947
1182 809 880 714 762 500 524 571 524 619 381 333 333 333 286 333 262 309 357 453
 333 357 381 500 333 738 476 547 524 667 690 572 667 571 761 690 976 953 619 524
 714 619 595 500 357 621 747 524 431 644 739 761 524 524 524 452 286 334 381 358
 405 290 714 619 714 858 642 524 714 572 357 500 192 262 381 595 547 952 524 428
```

```
 548 833 786 524 571 405 547 405 405 357 431 505 549 190 143 476 572 547 428 738
 690 524 619 690 477 595 642 595 642 545 515 546 758 428 637 549 636 618 518 309
 493 523 398 579 395 583 545 333 303 545 485 518 515 387 321 182 209 276 296 232
 206 182 216 209 216 281 321 640 553 366 389 215 432 871 457 527 546 409 889 570
 659 59215301636
     337=N      13=I ALT036A                                        -3(20F4.0)~
39752251299028762367188715931368130332886 83914911120 68712772027233012271046142
1921102312291529 824106916321314193912631410150111481041129617261410226419401251
16661935 915 239 648 145 6892594359314571413 8521091 936 852 614 9911476 5451442
 339 7332163198816722164201313161373 787 500 988 563 443 682 624 116120518302382
 928 88010061006 9001036 8491243106124553667212126671152 970 459 763 515 152 577
 515 6671243 1211152151520921638145519401061 8491424 7271485 9092637239524862364
181813341273 970 667 214 85111823243 305178821522796 8492032269725841166 403 432
 771 1831456 297212313801278 6411930 2191314 179 268 156 756 201 803 97816475437
52002998 617  88 647 264 150 176 999 473 352 264 295  93  72 705 117100026451440
1380 971 7351324 6171057 147 176 558  88 793 97117621117 323 441 3831029 559 676
 264 536 206 235 103 148 147  88 117 926 5441059107312631603 800 833 834 367 667
 200 834 300 501 367 367 401 834 1001367 6681033 30211021101 700 900 633 633 668
 500 269 200 400 133 401 433 533 700 9011001 901 800 600 967 5671267 533 833 701
 700 533 283 197 197 479 348 522 544 457 413 826 762 522 500  69 696 217 783 261
 848 725 348 551 319 507 623 928 276 754 522 203 478 507 668 567 493 290 652 319
 319 232 305 493 696 378 551 436 507 435 507 566 421 565 493 261 652 420 377 203
 146 508 652 334 106 348 349 609 246 725 536 855 522 565 319 348 378
     274=N      12=I ALT036B                                        -3(20F4.0)~
20412154255924903938366336941592 376 7312655221020273271186424322593232743471442
204219841187146615141543 6691466234014561196184623402392 155 270 794 60016211861
2778231122101171 329 420  9012471017282823831711 855 828 556 449 3061245 612 816
1404 939 6901988304424812435204510881517143118751427113112031013 867 73310221395
 867 556 603 741151415071192110911781315184022131747196613441338 6881240 588 425
 591 88010431373 3601566 97816631631 880 946 686 294 914 6861500 84811411011 751
 523 652 326 8811109215216691182 992 504  47 473 72511341323 772 773 740 441 756
  94 614 394 505 268 536 315 567 190 520 315 709 347 835 630 5831009 946 663 375
 453 359 531 281 579 266 313 406 266 533 156 485 547 391 391 188 313 562  95 626
  62 391  80 281 532 516 438 297 375 250  49 812 485 549 227 454 354 285 106 180
 172 109 252 465 396 664 518 641 836 527 634 113 348 579 709 732 138 227 190 194
 337 455 581 357 411 609 434 308 580 433 572 464 464  80 168 247 218 362 471 416
 455 400 324 346 515 288 544 201 764 200 602 370 635 420 411 333 280 252 220 158
 360 247 209 322 470 426 496 270 575 316 479 246 465 543
     227=N       4=I ALT081A                                        -3(20F4.0)~
39303772339345292139115116122419276026372363284026634050355328272233316333792945
1054 832156711571377133611201404 96915551339139620162810346520072066 95910351401
1182 622 9591548   0 96114011843132725852950191711061771132719182550236013271303
238818491702 737 88519231189177618452066 52112561991 449184312701588140220602701
266123331863 339112010861634188119621449 7041120107913061875 3751402 981 514 560
11671824136219731541176814422250167715412291233014081120 74610281500163115881639
186129141489228314101172 7451174109410141190149113791856 809 777 794133223132297
30731500174214851542148920492386216015341556114012001806178117713265326426032117
128726501907 9072205 9891731 9591192 9411376 29916701488140113011432 41111711657
 64212472361202421281226173914782619208518871709152610741208 809 6531321 838 996
2228218339082605298211852177 8161547 859 392152011081254127910361312 96713121085
 691206920251357140326461174
     155=N      20=I ALT081B                                        -3(20F4.0)~
1934183314391635 990 82829232488294219961676189512381886145614563351167642132059
21301387 9711337130011313741410   01268218321932010279826671778 966 959 559 862
 87613111007 950123218032124 898152417751334199828342717 88614972438 38815551500
2051210630482717338024382554 999 99912752274277135461607 9991003 90913311500 392
14411224 499 557 7781666127513861275116512202051122011652328288620161068 741 878
1343108514292187160119801946167120151464118812051377 6201068151511541792 655 689
 7231294224016371431 809 691 831 261 5521259167717271556212810551164227814521668
44503207384026812141243629281683 7091582 7901156122714931455
     290=N     -37=I ALT106                                         -3(20F4.0)~
29192514194815433812 892 730 734 7341300219110543252137814601867 557138118651219
 8961057 89216301784113510541057 9731219 8151054 654113817861300 7341219 5681462
20291227243814622923334911381057 493 815 734 9761388 976114712191219 907 3341400
195313001057 973 487 973 59010541624138115431227194835472599 981 921 749 511 645
 8501386 880 821 5781060 7551232 868114614652664 855 411 511 9671066126013901659
1047139011861186162310151132 974 9271260 722 821136110491223 847 575 85010931522
 8881051 749 755 683   0 1011470 955109211641458 94811571302138611081108 948 347
158415371118 915 825 857 844 707 740 647 575 510 778 844 707 504 504 6741069 504
 778 785 806 543 981 9551020 8061655151813811237 543 647 707 575 883 608 713 778
 850 550 641 647 608 641 510 910 5821255 811 915 889 817 910 987119010451050 798
 9311082 89215181487 85414491260105010951273128510641378 979 572 816 736 8371095
 994 9941025 931 7911095 9001777 9871299 9551565 829 900 798 658 994 696 690 532
 563 456 626 658 595 829 728 861 7981088 82910951260 736 924 643 9391299 625 994
1006 64813644303366132831698 8442065 4482065281927203500288838724125450441353095
4228365716881144309440493193328738453582
     426=N    -123=I ALT048A                                        -3(20F4.0)~
 72510461272 949 99715022719 772 731 501 1811001 7251046 725 725 816 499 8161406
 9081270 589 861 8171360 591 641 589 680 507 589 771 58919061478 741 73811561252
 546 642 610 706 32313511219 899 51426001091 866 417 385 418 674 707 774 661 867
10272439 674 771 578 776 546 649 645 386 417 773 546 997 546 714 506 738 707 514
```

```
1091 963 675 835 611 101 327 450 323 546 802 643 709 417115618321768 3851127 707
 6111123 354 546 610 3231092102710031027109З 931 610 599 225 931 674 450 8991047
 762 7961079 920 572 477 476 539 666 254 5311618 324 730 412 508 193 317 627 335
 76111111016 736 638 843 895 771 531 602 388 794 746 963 626 770 482 794 986 530
11091686 9171157 514 420 585 434 228 242 555 340 144 630 627 415 585 392 507 439
 338 439 460 858 843 630 482 673 144 914 483 606 651 893 9651035 797 842 842 843
 412 898 8471185 97334781413 919 563 951 849 623 786 3601244 4251283 688 591 393
 753 429 718 238 231 359 360101616691081 849 166 588 916 523 4941012 653 425 263
 269 295 457 526 425 523 458 491 753 559 523 692 458 559 425 686 491 818 751 461
 751 328 591 591 789 228 688 5951176 656 621 556 688 784 8511114 686 458 523 328
 491 360 491 365 556 360 328 198 491 591 588 429 686 523 425 425 397 458 135 491
 591 491 849 653 656 559 392 719 4611209 540 904 5441061 353 508 307 338 462 384
 154 262 291 276 444 436 414 353 153 340 353 538 343 511 584 599 814 858 783 694
 599 982 804 523 662 353 338 322 715 567 660 262 431 371 476 448 171 230 562 491
 124 156 386 430 537 354 184 418 355 371 399 547 445 323 399 361 316 388 186 322
 247 184 260 439 139 260 327 478 159 317 143 222 286 175 240 367 303 143 191 333
 100 191 175 350 222 333 415 162 238 238 367 445 334 159 444 143 604 227 442 191
 366 303 334 462 271 336
     244=N       35=I ALT048B                                          -3(20F4.0)~
 818 942 523 694 446 397 446 421 373 347 257 942 646 546 793 323 669 793 424 595
 449 473 377 400 496 597 570 620 521 421 546 719 323 595 422 595 694 818 447 669
 421 372 198 570 523 818 6692603 899 929 5691139 929 751 929 3011049 720 809 749
 692 391 811 7501079 449 180 483 509 690 869 569 750 539 809 629 509 839 869 182
 660 449 360 300 570 510 449 539 419 570 509 569 899 989   01079 809 839 629 959
 899 479 600 240 929 780 689 210 929 6001139 6901320 689 750 779 689 869 690 480
 419 360 391 479 599 450 630 540 361 360 599 570 599 629 659 539 419 360 391 421
 153 569 483 419 602 959 489 432 289 504 438 720 336 432 385 504 337 360 312 339
 480 432 217 289 337 600 817 696 652 673 312 432 432 168 217 168 168 518 192 168
 554 146 480 432 480 432 336 530 649 745 839 793 697 649 745 506 578 198 304 256
 657 309 309 375 170 291 357 402 112 460 264 148 643 415 336 246 246 228 175 282
 415 357 242 420 242 357 260 326 375 448 250 412 148 242 497 222  74 112 379 277
 152  74 557 390
     376=N     -241=I ALT105                                           -3(20F4.0)~
143116351469 541 604 487 561 597 539 490 923 597 347 481 308 925134710771289 923
1077 366 597 740  58 5781292104012311019 923 770 683 672 724 93313112290 8461563
1575189015211259131618821556 821 943 812 947 728 5511263 833 85710981289 886  67
1466 701 7321192 942 82812711425 4211093 246 675 575 4921052 70612371354 9251005
15651642164417261261175613751554206514321085105613701286151313751256171314581998
1430 942 9991058 372162910011172 657 828 602 914 714 977 779 979 325 235 569 361
 807 23511831183 606 929 489 516 298 569 623 89614891370167517251175 725 778 576
 41312311500 785108519051126135З 946 407 1901110 6371060 756 443 618 76010641184
134419312449 594 941 917129419121534 87915051826201625301755143І 562 7111095 850
1017 782164310161049 921 8251047 636 923 254 25610811111 337124417461746184З1238
1081 920155515571335 731 127 920 828 8591308 957 859 673 541115011471339159517б4
105915271397 89110791400 381 921 986 858 69913371052 477   0 705117612731335 858
 319 890 127 878 262 222 953 4761016 858 222 889 186 541 858 6991271133410801238
2190 923 859181230511711147715172163 886 174 85513831226 850 624 374 973 774 759
 436 926 750 685 246 538 636 509 237 357 593 190 841 950 4111180 254 426 459 655
 4821107 964 944 545 213 702 685 490 576 774 714 339 593 720 442 593 616 884 607
 641 269 411 403 686 639 449 486 385 162 608 385 266 5261014 648 729 447 163 345
 832 852 548 467 653 628 610 532 446 417 405 547 123 346 345 143 449 224 183  81
 244 409 103 304 306 224 364 163 334 699 467 250 152 794 192 596
     312=N     -258=I ALT031A                                          -3(20F4.0)~
2114199226561274276118291132111217351062101217З9 940134218251943199216781385116І
1580186718072126251416751127177120932032193117741580132019982353241524162028154
1580228810951031 54715301032 741 9981191 998 807 613 547 9391127 901   014221159
11911067 676212621131695175023631806113926681419141716721361150014751975250018
14441001128116691558140Z 945164020311167122З1361 973 834144418131639171713341861
20031306 500 4952086305639452446289123623030541834182167264023332134139515277б5
100010531133102911 844 895102718161632150423701895223924483185247616581079 974126
 8441016 722 945 668 89010331187129013681342150Ι 92412901026 606 774   0 632 818
247625552579160515821658110514 48 791147413421185142З 7631133 86910271421107911
 8221429 857 8211321 214 787 821 714 429 321 7891038 214 573 787 500 822 8961536
125511461204127012511054 8591036 8421418158413071214184015331552116113931324121
10791271 9311072 966 768 929 788 9861072 894 850142516751201 506 225 226 4751225
142516011400 765 800 550 476 601 585 925 825 1771875 351 475 602 775   0 200 300
 9001026 876160219252000215121253601 300157519011950237521 81 676 725272714001625
155012011375 676 897   014811148 176 966151714481311307230692277 420 41227592898
36902691244816562380227719311037134520031691165 7
     280=N     -259=I ALT031B                                          -3(20F4.0)~
18262216225524092529201914231264 436154413431660146118161619173720552062115 1 909
 75110271029106611851739162327633659337443124158 973411023682136189726503759481З
423945392820168812601019180020381026120112601668133413242124220427281775   02561
152715991205 681216228262508180421171726 866141310221335153 0 549164810311609185 7
2047149114161308133318231804145 8 671145826011767239315551187111111871555155152 9
177917791703140918532518200121491185 963155718521926103 7 744 889 963 744140714 07
 818 9631409155513331111133318521927192714812444183 3 833192616301334 853100 0 922
1003 798 838 315 984 761 9451111 741 66710011445115012 22 982 501 391 597   0 575
 500 503 593 834 611 631 704 334 705 297 816 887 83711321408167711981563116 8 992
 542 854141111351631176211841612128412 47 515 197 707 854 478 607 837 984 853 869
147513171123113 8 845107 0 684 737 773 527 758100 1 721 796 845 79111281445 950 949
```

```
 756 669 634 668 707 581 337 3551268 410 672149419921399235120631201 906 752 857
10671270 533 749 669137011421423120311721329  80 243 620 102 255 265 741 649 182
 308 245 657 559 702 96910611171 5211303 220187310581166178712941014122122431287
     414=N    -372=I ALT017A                                              -3(20F4.0)~
5700 552300249003550 600435035003950425017502151580064015200 6001901330045013104
3450 5503150 850415022502202345038506102485045003800425135514105350337012653500
30503302225727442488264118981898241022573103182821381862137920353657382841052828
2724224417591414189726561759 966151820362104134710711899217327944690344820691726
13101242 865 379 690231122092621324432421783200011771218 34813912044173923921565
1218191419141957 339260917832654135121741524208721312435256617831437 783 8711435
1087165714351391134811741397143516091131265316981307160918311087 913 565 522 827
 7831130135118702306178324821479 2382462 500 962 6152038173825402463196315791231
1078 84610451154 924 385 577 7691000 578 577 654 5781078 692 5001115 615 732 615
 885 9231003111615771308 578 846 923 923 385 808 8081192153911151502157917691694
192310391539162012311577 846 540 9231155 962126911161808184613792173231024142726
2483 96611041517120718281070   013451448 897 89712762517241525522759179322771452
13451656165714831000 8971070103515181276 8631174 41415211621244813111243 227 931
 5521759 691110416211436 692 7181053 846102610001054 923136012051641 30820001615
2180138514871487 94912051077 385 949 462 929 641 693 618 974 897 231 901 7951436
1078 205 154 949 770 795 539 897 61510261718 4641359 92312571363143710261026 667
1231 4621256 976 667 898 462 490 7711154 6671154 5901257 490138611801282 9741334
13331795182115642028189819493257 88714791196  991193 5711603100112851081 9391081
 9391205 8601091 948 652 8871025 501 898136910651385 8771058 738 998 8121131 671
 680 363 665 224 308 783 328 787 738 841 533 430 974 690 84413431046165112641089
 411 67111441107 631 497 134 938 938 817 660 125 430 435
     275=N    -263=I ALT017B                                              -3(20F4.0)~
16682285261826181955329118471924154919041353 575 752 542 738 6471085 69311141354
10081537138713621087165514191487 816   0168615241305109412761486153319751393 317
 9411193 144 149 334 857   0 349 30310201237 8771154 9201085 587 7731196 628 885
 300 346 595 387 861 171 6041087 479 3111134 811   0 491 65612181571   02639 833
1110 823 912 464 931   0 4881126 995 920 676 788 8401352 682179211251549   01179
1225 865102413601279 902 490 7141029 710 8551106 809 665 563 581 960 543 1141083
10121047158711762310136015071259 5231132 563 923 680 959 651 500 479125212742113
1246 852 787 1641016 4921049 820 590 109 459 557 754 754104910161016 328 623 885
10861278141110491180101614091212134418352164216416391933147819081875140915111640
1180 46310811095 80012211076 190 990 94910121137 422 126 780 929 126 507 527 969
1117 884 443 653 614114010131542 9931203 5701161 846 656 465 105 450  841116 274
 896 475 656  87 235 810 879 917 735 9461066 9041021 822 623 880 637 611 381   0
 527 381  79 508 244 887 773 714 468 653 188 541 109 556 117 176 943 332 508 157
 381 768 322 830 576 703 864 462 509 933 232 8181204 632 463
     605=N    -406=I ALT099                                               -3(20F4.0)~
 665 745 466 126 248 127 127  70 133 112 347 224 36523844009573324533087 5894385
 711 9914008 148 386 306 125 137 225 633 335 643 2931241429728634252295437441968
1770  75 333 109 383 192  59 283 370 308  93 558 125 466 142 375 741  50 649 358
 541 184 775 310510923881889  834435 5161406 132 963 23229982718 866 609 707 171
 146 489 379327915603376 4391342 41524022767407310491901 123 354  981000 2811572
1163 285 451  67 225 244 110 537 92824832483 9391069 68038572528127716703597 978
 133  782882  41  65 144 105 209 248 951  82 560 196 665 313237213423780 156 716
  67 147 130234418621138 130 763 387  56 202 168 230 159 150 169 386  65 709 340
 184 405 276 230 342  74 544 114 406 573 297 452 643 129 478  73  85  94 168  92
 121 196  56 236  76 443 530 6361681 9201500 5982206 322 689 2301838112122922888
1362181726252427410433163022 7751466 977  79 316 334 725  98 216 147 372 147 197
  69  98  40  79  98 147 255 393 569 129 735 535 147 696  89 128 186 539 785 501
 255  81 55217091757 556 532 931 5601058 122 586 244 5991195 339 299 923 136 449
 273 326  95 313 394 123  681255 543 380 380 112 259 219 467 112 589  83 170  68
  68 199 376 319 394 149 150 116  82 226 360 713 388  89 155 313  77 394  891681
  96 416 424 347 321 151 211  70 452 428 494  66 413  82 118 165 208 107 201 313
  88 474 482 507 504 124 834 296 727  69 372 485 415  69  96  95 400 104 549 307
 297 168  78  90  82  80  71 149  53 172 305 128   0 657 578 372 283  89 550 384
 172 581 411 292 284  43 165 134  88  63 200 206 397 479 265 315 3611174 8701809
 2771915 8121269 425 219 147  70  56  71 116  49 109 108  59  85 855 132  85 102
  93 147 109 102 341  70 218 325 282  55 148  70 148 395 186  79 116  62 289  77
 195  85 117 334 148 422 117 365 512 782 705  62  42 118 149  55 118 109 412  88
 101  85 394 116 255 348 178 201 193 332  79 928 279 263  70 441  47 147  55 203
 441  70 271  78  93 263 217 331 186  77 3321261 475 403 438 853 134 2181942 361
 342 9431559 63017781561 162 623 242 265 264 256 904 175 556  46 115 167 5051634
1439271415982116206230802932266311853185347322303880420825031875  51  88  75 400
 159  26 134  65  78  59  55 140  57 483  20 341 268  32 356 110  99  33 112 118
  51 130  38 262 330 371 108  86  84 312 326 494 364 895 438 470 395 678 450 918
 29928191489282130501095 379332430001224 962 2431150 539  91 774 202 164  71 528
 390  84 627  52 334 183 102 163 162 103 143 174 132  54 417 234  81 133 163 289
 203 258 540 480 670
     474=N    -456=I ALT049A                                              -3(20F4.0)~
13571085 950 915 928 679 9181254 983 8471153 8841224 949 8821191 94912901188 882
13221492 949115211531188 8811187 983 610 780 780 576 7121017135622391473 701 947
 912 597 8421052122915081826205817541465129715571543 667140420371627 456 9471200
12451019 947112316851871 75221191375140913441287385023821067 908 539 694 730 730
1392182612331552 956 3131252 751112510743062207417681222109614092314149114931356
115214911118 440 949 8131052 508 779 847 9821457125711871050 8471088145624751392
 440 237  68 441 169 440 471 440  68 543 340240429791999   01828 948159417992912
142223420652945213614561050 813 610  681117 406 746 508 102 643 475 813 7451018
```

```
1727139212141358103510141536167824632427228528202543250920681729 916 678 237 508
 8481153 9151627346433984171369533284305484731711902175719 51 537 146 636 780 683
 4881374211220971325166520021912 9761343 463 367 122 488 342 512 709 784 488 442
 172  73 366  73 464 545  73 122 342 342 268 293 244 268 442 6361003 7801073 878
 220 561 659 610 708 709 756 780 707 171 537   0   0 857 732 537   0 881 831 440
 317 659 709 513 24412981098 537 5371000107411221105 1164 492 647 595 7571114 1034
127318181065 207 208 389 466 310 674 782 750 880 600 569 782 651 414 95924301474
181211901243   031771411   0   0 791 902 600 233 677 80811521394 757 238 468 208
14501237111015471450 553 654 327 157 289 314 68011481904177018471193147510 16   0
13761580193823 84 78610502732269223932201  73 80517561512 341 390 366 390 317 341
 488 341 317 708 512 659 951 5371048 780 8531024 951 90315122073165811 24 512   0
  98 537 636 464 733 75613171097 878 146 294 245 148 341 122 221 342 317 245 171
 124 294 488  98 318 683 4151073 879 8371881211715461772 78612691246 1220 9411219
17581024 759 146 317 124 756 536 732 536 683 245 249 146 341 219 317 219 3171634
16341320 902 445 367 122 364 302 513 367 440 580 709 4901012 1251101 87613131563
153319731443 969 2521125 407 375 75110631909304226342507
     407=N    -407=I ALT049B                                          -3(20F4.0)~
1778266721331467 2267 889 801 801 133 800 62212011022 711 624 711 844 755 912 845
13401292111121332004 16001556 674 861 651 512 744 977 605 860 814 4881070 395 651
 488 954 8381186 698 586 5581419 97712821558155120471070 791 745 7211046 8401768
170010931140 1349 794 583 372 442 768 791 744 605 419 372 860 907 93011841000 721
11631768337329541132   0 437 138 529 621 782 71312181380 1311 8281058 98915861932
10802782 714 483 920 50614941035 1333 874 483 782 713 6891012 690 644 75910351012
10571632328730352993177010 81 345 414 115 391 5521012 759 66711961013359123081550
17043941350520001508 1379 295 295 920 623 557 492 757 95318391279219918031213 525
1083 689 625 131 459 598 623 623 590 459 492 361 328 399 361 460 328 431 328 297
 590 328 362 428 591 82210831122 9191362 888 492 888 525 724 820 923 788 820 656
 626 623 492 428 754 656 626 8221016 920 459 79011821119 920 59015441419 1088 808
 9231061 738 946 854 231 277 300 277 554 416 9001615 949 638 700 231 232 232 716
 232 254 485 323 392 392 485 646 923 96911081177 1062 738 485 946 692   0   0 577
 762 854 762 717 693 693 854 369 392 416  92 923 692 90017801688 15041203 254 900
 623 692 647 836180021012448219816921371139310681646175917 08 76511311961 19862308
1985 278 604 301 900 462 118 231 185 185 600 300 415 508 485 877 71611311154 1362
1403 8321114   0177223151629 514 230 487 200 771 571 60012871058114314861143 829
 400 443 340 343 429 314 286 514 600 600 514 686 171 457   0 743 515 51412011462
11631714265714141286 574 829 343 404 229 458 80510201556 10321436 9821248 782   0
 439 398 250 470 301 426 372 566 501 845 576 563 317 443 301 405 317 315 415 742
 387 727 79111951228 14991072
     250=N    -472=I ALT044                                           -3(20F4.0)~
2927146317561661195124381850 1420 804 899 925 617 743 743 88310731563 1170 2421661
1174107323592361217217693152394324582172158513 12 365197614881407139016003243 405
18911813158510261488 7161303 5011009 739 765 630 9061252 964 78915111131 946   0
2162 77115581598247215432118148625 28 8252221198425201073 1129 995 876 648 679 396
 8761104 916101813411443123110021390 782 907 708 833 855 9251595 7162894 9132473
1073 390 520 650 976 228 748 260 553 8451139 651 4881171 71514961107174320741470
149213171987 53819851059 576 967 947 618 879 520 781 5541398 52011381106 228 781
 294 944 813 814 749 749 618 327 684 423 585 585 878 878 24116271561292710361379
 6881376120417201419 1076 258 731 518 602 432 258 344 258 389 688 690 172 387 389
 559 5611205 818 516 473 473 3891033 258 989 8171075 516 172 387 40813581075 2194
 4123355 7232581167721942107228012481118 1316 75111481161 81711621637 46618492064
 818278016531345 1852 3532337145520061433 1566 8161543 948 884 886 33113891455 353
 838 617 507 441 882 639 794 662 445 657
     509=N    -655=I ALT051                                           -3(20F4.0)~
 735 717139726091501220331723190 1921 308161424431113 1235 59215171286 1800 237 569
 261 452 308 474 452 380 547 523 549 402 473 85440533928448150903460 21922548 305
1425 356 461 865 458 661 305 382 341 441 4421969 9501633 713 679 4071094 3072239
180215261189 251 229 381 153 203 230 259 280 305 305 306 790 612 636 6111529 792
 4321374 511 458 458 486 381 840 792 714 331 5341147 565 413 377 227 422 225 536
 454 594 479 423 704 761 704 677 479 508 507 451 563 507 873 367 873 7331267 451
  22 452 169   0   0  22 423 338 535 107 454 225 310 395 39417202281335218591352
 255 144 366 3941099 5631043 507 733 6481070 197 536  772197 310 338 422 394 592
 5071437 253 479 78914371804 1016 508 959 87425922394 10421944 986 95811001240 1184
12401128 7891465 536 733 9331269 5351241 817 7041267 417 358 417 328 358 179 298
 537 626 478 596 477 626 209 748 50818202329 194 373 134 119 149 180 209 164 165
 209 478 254 298 328 507 582 403 298 596 299 463 567 582 313 671 209 64112671297
1178 731 805 956 582 716 656 850 675 910 388 522 448 6871268 6411045 553 999 641
 298 241 268 432 447 581 55311331088 1031 149 582 239 417 835 612 462 5371074 507
22972311138715 51 5971397 239 6771511 91510541414 954 9551752 7361790 291 507 268
 716 388 389 358 477 537 329 627 388 328 304 209 209 268 240 447 687 985 5071402
 433 108 362 108 180 180 324 324 324 504 258 720 181 432 362 793 792 684 324 396
 792 396 396 648 468 577 144 432 396 684 432 756 6121079 864 540 396 396 433 576
 468 684 469 504 468 297 728 324 216 194 101 399 288 198 288 180 235 252 181 288
 505 414 216 396 864 306 450 288 972 576 936 234 738 432 415 504 326 126 199 126
 198 342 324 738 576 522 396 594 162 631 558 378 792 234 774 252 918 522 576 540
 559 432 542 649 360 792 648 364 16217631313 955 378 450 270 451 252 306 344 432
 235 378 594 576 417 936 7761907 9061081110229191730302728113245259418 50 4471459
24441926 3211062 938 519 617 642 420 420 224 395 222 247 222 347 370 889 667 222
 347 420 469 150 346 395 34612341556 652 556 483 937 400 786 517 700 733 683 617
 451 432 3161054 750 502 433 417 670
     531=N    -668=I ALT030                                           -3(20F4.0)~
26191500 739 429 548 405 214 334 643 667 405 501 9531238 6291167 786 824 192 738
```

```
 813 620 477 5721024 476 429102422621619 572 414 635 394 493 349 143 619 588 349
 2862413 746 698 334 540 683 63512391445136516831191 816 868 585 632 424 658 395
 474 553 291 581 606 422 527 263 500 395 737 474 316 555 658 474 816 974 606 160
 342 368 606 658 818 843 4581053 211 421 211 739 790 685 290 291 343 790 579 737
1132 553 842 579 608 263 179 527 237 6051000150217371605136926661634108020531106
 422 631 526 7651342 763 553 870 6061001 447 343 500 421 767 922 763 500 526 500
 9471265 8431001181519731372    0142112891663 8162368 581 921 526 4581184 7371343
139612891080 737307819231448165913421528149916081975    0    0 977 184 289 606 474
 658121111261320 579 289 2381159171510481000 794 668 494 746 95210191772 667 334
 175 561 965 702 105 140 509 509 92111931070 63216141456 685  88 266 333 124 421
1421 842 8421491191217721088 807 70319301843 632 334 405 229 807 684180734211948
 5091807 738 211 211 299 246 158 140 633 228 140  70 105 193 457 562177230351123
1825 9301353 474 429 704 579 860 80810882193270913761253 345 125 125 250 188 501
 594 406 314 156 190 314 283 813 469 504 252 156 140 156 281 411 156 156 344 508
 531 421 563 406 40614091438 782 281 813 531 375 2521094 469 408 413 256 313 256
 314 595 252 657 7501156 875 631 844 188 5311031131312191281300126262532 688 594
 2211094 96918751532 9071563203122191844 190 501 4061314 531 438 219 719 281 875
1439 969 719 281 625 15613752313281312931104 432 103  69 155 278 315 268 485 197
  93 580 190 474 523 230 458 279  86 208 109 3871009 665 673 414 197 436 235 164
  84 469 9212069 604 10315521741 172332816891379 517  69 190 311 345 121 380 380
1156 742 983 397 414 207 410 218 126 116 164 147 33311751897 362 328 448 8622207
 897 6031037 501 190 208 12124822172172423451372 1711086 143 543 344 543 745 514
1029 657 171 229 657 286 543 373 771 371 458 65712291373128612012202151444005001
47724800420120571788 271 234 381 353 462 389 326 660 499 652 499 389 49916492259
280035141517 371 800125723144459308642004246422939153110 46417874036550145004108
17142715 751 5003574475045733822368132504893
     397=N    -677=I ALT009A                                          -3(20F4.0)~
3214   036432957330015003002 814 177 171 602107120142615261536001652269528251131
19122045 522 91411731913134812171218113310001434 478 567200019991480182613051956
28892237308712171214226021731263334713051739156520075447480044322770258518021154
1754147715231938171012011154161614321108 923 83112011432198524922261193828611801
2725 694 462 69213391015 969 9691247189511511347 8701207185217401347 47724981880
21051852   016281712185214941003151618802750252613471432157214881010249818032021
3220378911801150358236404595486517311375 8951014181921501522158512231313 9851611
1075 924 899 895 955 955 59711632149 98512261105 477 537 836   0 268 89510751462
2089212139082863190911471293 91312651381 31225022175 999108814702822155819981445
1028132414121940182315012175102914111234226931641733 927156212651351 885 9701265
 801122312391307109911811139164618131771148112221138 9701138 9281265 97013931604
181313091141105410551139 536115420552040149317171916211114351436 987 59124221407
 762 9291042143610141070 901 564 478 9871351 817 9851435 872 874 507  84 591 395
 732 929 901 817 619 253 225 338 339 620 394 478 564 732 450 538 732 648 394 296
 232 317 718 528 570 274 570 593 802 718 676 591 69811401098 6341061 971 9721182
14781035 739 761 992 845 870 989 676 944 9671011 831 629 8541259 944 967 202 315
 584 877 562 85411691011123713271326 85410341057148412141551 899 944 854 8781214
1056 854 854107915281146 990 405 652 809 67410561102 494 360 878 315 382 809 562
 495 630 742 832 652 697 788 653 382 337 315 450 903 225 2251506 967 551 594 884
 682 927 6671043 595 725 927 682 681 840 623 797 739 580 652 653 609
     254=N    -679=I ALT009B                                          -3(20F4.0)~
2615311621171070 633 63311662066266720661540 435 856 90827782216204614131330 526
 949 93429165696322714483406390520871566220315941073 899 870 9861188 871 927 753
 985 898 78310431565139112461565 870116016811740 6671188 9576238617913792039 960
 840 78213811564235119341570150415191027 782 972 998 962 84212651629288935123014
144411461200126013321027 660 782 90215781391197115081131116015661420127711341073
 900 60911031014   01362227022151832 9581514 667 9892132134411071636143515753779
2010168812861746204019761328106012201409 604132010571284132218351406 887 577 869
 9081686303331471456 7591138 5951319 8741847123211161709 942110610591224 4421875
173238971840112116011161108110031409100111661203116321221924 6811562 601 801 724
 8811007181613771613213121301870    0 90916361065103912481039 857 520 338 649 675
 8321195 883 701 74911951247124714551559163612991358 8831122 935 863 338 731 677
 583 897 783 812 390 202 215 886 709 8861165111511141140 8611166 888 886 785 812
 96510961065106611401038 582 633 253 329 329 684 583 481
     909=N    -743=I ALT002A                                          -3(20F4.0)~
23922163197717071011 875 919 9671104 758 460 230 559 6451150 875 9191012 965 783
1057 73710571196 783 787 74111961153 93011041011 919 737156317491103 9241150 645
 873 234 690 873 737 460 6901199115010371044 8301034 830 621 690151712431103 552
 899 621 552 690 693 827 552 556 798 337 276 343 398 736 85915941594183918391502
1440 583 859 644162719921433 8181092 6811161 549 954 617109213021244109013651431
1705 95710221364 591 688 547 592 411 681 502 547 638 318 636 3631227 3211000 454
 681 411 681 547 727 411 772 500 341 363 151 363 485 515 333 485 607 273 273 607
 214 697 5451151 606 902 1161185 7981272 5231727 5681295 79512201183 63715151030
 818 57510501210162813952372111712101535130210231171 32611641352 884 978 884 512
 658 372 419 163 280 698 2791070 605 186 860 744 6281281 605 674 792 163 350 560
 512 279 283 256 326 514 744 302 419 489 862 419 535 349 651 395 721 326 512 475
   0 465 434 531 7161179 900 776 469 524 777 277 823 547 862 7001154 900 600 854
 923 392 427 219 312 300 439 577   0 704 369 127 162 519 127 369 600 415 496 416
 485 635 531 658 566 542 681 451 715 520 543 739 716 577 716 579 623 762 255 209
 600 693 533 346 487 600 186 278 326 323 415 623 231 323 671 418 439 508 232 531
 278 508 508 301   0 277 150 243 419 312 669 118 752 6121224 674 557 855 843 577
 867 543 682 786 738 450 796 118 591 291 657 699 399 785 376 505 806 710 4191065
 302 8281054 387 861 484 571 387 688 205 710 323 796   01021 764 796 559 517 732
 828 806 849 215 678 290 688 4631000 6671055 602 677 796 419 677   0 775 581 538
```

```
 581 355 462 430 409 505 387 172 484 194 323 398 376 508  97 570 357 301 419 204
 560 151   0 355 205   0 247 381 224 247 213 213 247 750 246 239 358   0 470 481
 201 302 414 235 661 293 728 663 504 844 675 565 471 618 493 325 449 135 226 315
 247 325 515 225 722 483 663 594 440   0   0 471 405 485 247 247 269 179 306 314
 193   0   0 224 225 237 101 147 101   0   0 135 538 203 203  81 342 213 640 449
 493 226 405 179 213 236 134 203 124 426 169 168 427 213 426 490 236 136 499 270
 446 594 192 358 370 236 494 304 415 381 462 449 578 586 506 731 396 561 471 482
 451 302 532 553   0 900 731 568 733 642 569 419 513 152 255 123 405 196 106 239
 164 165  76 343 119 315 239 553   0   0 925 479 821 778 582 674 658 179 552 134
 523 313 493 912 508 583 537 448 194 479 134 419 298 284 454 164 479  75 315 298
 598 493 731   0 806 448 314 358 388 179 418  91 374 120 149 269 419 135 269 120
 343 657 627 687 731 925 508 373 508 149 599 388 389 224 284 179 373 165 269 179
 403 405 376 195 388 344 554 435 344 493 376 298 464 224 433 194 478 493 224 313
 394 511 232 301 462 141 301 463 532 231 416  66 108 200 185 200 293 185 231 570
 771 401 786 479 540 370 432 494 601 647 633 157 556 308 5411033 478 663 509 632
 712 987 478 432 755 832 236 540 510 324 601 324 478 324 216 216 201 432 524 324
 620  79 416 325 309  77 185 463 339 370 401 740 940 9091033 5391605   0   0 972
 493 416 142 571 387 356  77 232 140 416 262 355 402 277 339 309 216 232 308 632
 694 403 432 324 525 480 524 587 432 355 509 617 370 494 324 186 216 139 463 188
 247 279 188 339 355 32515451250 232 541 422 444 327  95 372 190 243 265 211 254
 539 139 106 116 137 127 264 211 127 338 306 465 370 328 380 477 3911088 7291077
10451669 95019331552120410451056 834 434 708 549 634 718 433 729 423 433 496 454
 4751056 8801081 851 980 433 592 462 534 332 332 115 130 187 115 360 187 277  86
 679 404 245 448 174   0 461 303 461 521 649 101 779 822 549 490 5341067 708 432
 5041225 218 807 2451153 145 563 735 245 404 764 577 360 361 447 332 375 779 259
20471096 1787 217 101 605 376 231 764 173 909 288 649 346 332 433 259 101 145 131
 261 606   0 190 389 620 610 216 375
     886=N     -695=I ALT002B                                          -3(20F4.0)~
 9611041 964 633 675 613 633 5721287 9421208 755 755 776 735 796 571 633 449 510
 816 225 225 286 42910211474145319521706162117651061   0 997 83114751518 1350 833
1583 4371583 8141066 95917932432141315181599 18071599 955 769 893 453 381 219 377
 200 751 217 8121520 749159610452007 5491355 353 472 431 927 671 961 491 569 353
   0  98 178 314 593 691 806 455 555 474 593 375 176 886 4941503 4941009 3771559
11041557 8261522 6891003 671 693 810 55212501058 901 5711112111012891054 1863 970
 82613261214100513411466135710191198 1127 7331072 611  71 591 251 808 810 3611108
 625 179 824 717 7871181 805 9311000 432 703 947 540 203 216  95 297 351 770 351
 392 675 824 500 392 351 783 729 567 581 595 541   0 689 757 527 933 9861014 851
 338 622 568 527 554 797 500 743 797 918 595 419 311 405 338   0   0 583 850 851
 117 637 267 133 384 652 184 551 634 617 501 5701150 766 733 750 583 8001016 633
1000 766 8661067 68514491310 946 716 662 663 243 812 784 500 623 622 624 420 488
 420 491 609 758 678 555 853 63910691135 4731163 8241015 811 622 421 203  68 245
 637 5691043 3171098 6481030 950 804 803 923 6051028 684 778 697 975 395 843 645
   0 225 607 529 264 567 303 663 738 756 6981189 39511321239 5011329 790 856 606
 843 105 807 4741053 422 9881001 935 883 685 619 818 744 892 221 702 550 907 599
1298 9531172 781 928 708 598 892 159 869 512 440 622 330 342 463 439 757 354 342
 610 354 476 524 561 599 183 648 683 342 648 418 725 516 147 637 368 428 441 516
 453 369 504 330 477 905 357 310 434 349 625 327  61 170 558 738 953 45812271079
 6601115 584 695 597 922 584 672 680 322 216 441 347  60 574 192 668 4671400 961
 962 923 666 800 6091009 419 381 248  95 562 448 333 362  58 219 295 219  67 371
 143 124 314 401 476  86 162 115 257 219 753 430 682 141 518 467 201  52  67  52
 163 111 393 256 172 128 438 512 207 521 371 394 104 652 467 519 437 201 481 163
 393 259 319 393 460 348 126 556 407 527 396 637 659 539 737 593  7711271088 604
 880 704 659 495 770 392 484 176  62 515 248 247  63 350 124 366  63 361 309 384
 289 526 1971127 557 796 547 505 526 577  73 588 783  72 4411081 578 983 542 721
 147 424 415 442 234 180  81 541 415 415 216 361 270 388 505 476 642 144 541 253
 216 363 191 679 281 271 501 214 679 470 162 488 524 759 566 688 732 850 469 767
 209 519 327  64 509 582 118 373  73 227 464 218 255 191 356  91 300 418 545 347
 245 174 428 164  82 409 200 664 618 437 336 109 128 491 145 291 264 255 173 564
 200 546 173 473 573 455 509 455 582 5181082 955 555 564 473 501 464 609 800 609
 6541001  45 496 113 188 128 564 324 346 321 436 624 489 609 880 933 472 647 745
 399 322 828 754 591 483 602 608 575 493 900 614 357 730 306 209  51 289 185 160
 652 449 702 621 736 508 702 556 579 334 662 599 548 185  51 623 244 502 106  81
  95 546 138 230 322 116 253 126 173 161 161 414 661 392 452 448 518 403 374 458
 210 359 366 529 331 291  58 205  80  68 355 183 343 468 284 321  92 252 585 444
 244 673 708 344 229 542 439 408 484 477 251 482 126 264 209 400 240 640 446 309
 174 195 183 343 126 241 265 489 170 160 637 198 105 442 442 88815921354 969 782
 374 210 528 344 117 776 411 505 190 341 264 557 180 452 105 276 298 566 315 480
 415 376 490 311 591 579 531 503 591 635 593 524 672 624 395 415 165  82 455 564
 205 500 361 123 436 196 494 196 560 695 361 332 292 567 542 354 580 687 178 341
  78 714 127 262 439 287 457 769 302 468 331 334 320 403 490 137 762 198  83 540
 226 291 449 137 370 284 270 213  97  86  86 290 251 216   0 407 542 321 331 698
 1581251 242 540 686 333 448 147 863  54 526 396 201 727 202 283 465 203 263 252
 405 152 101 275 265 564
     615=N     -757=I ALT050A                                          -3(20F4.0)~
 7051120 569 837 6151283 783 960 899 436 6201021 759 324 996 6981320 92110291190
 82010471047 353 507 419 421 132 705 331 81613221322 13661368 424 536 558 804 497
 696 818 684 110 783 355   023842720115714191354 824 312 265 534 247 624 288 512
 334 455 266 643 5991201 733 845 531 649 6891111 332 714 755 398 843 621 552 641
 552 313 575 574 662 531 887 731 486 464 376 442 375   0 419 643 487 294 463 509
 552 66312231744 8791350 772 7741136 900 450 900 557 729 536 879 643 921 729 643
 815 750 600 537 450 300   0 257 288 279 451 579 279 343 429 771 364 901 451 793
```

```
 279 407 664 664 3011071 536 922 5611157 858 857 814 664 622 471 429 236 214  88
 214 279 193 407 203 7071200 264 310 236 808 470 896 603 472 705 236 514 840 867
 905 500   0 676 544 294 619  89 544 470 441 530 222 867 926 369 647 353 530 691
 324 705 206 823 2941429 415 834 415 739 115 439 258 301 301 627 533 418 788 854
 740 277 577 370 623 277 623 162 531 692 923 300 508 600 808 508 531 71514781584
 692 832 372 185 231 163 300 508 395 408 200 123 216 262 446 408 61513081615 538
1015 512 102 637 205 216  57 296  92 194  68 136 193  80 136 125 205 251 137 456
 262 523 114 400 159 557 388 364 309 649 346 159 137 434 290 148 149 138 257 483
 386 365 250 312 355 217  91 174 127 161 119 345 297 210 234 276 185 281 364 334
 116 234 116 176 155 196 355 342 195  80 207 183 537 254 210  91 173 163 509 537
 340 429 298 312 673 392 421 179 310 182 302 198 501 390 370 440 358 408 543 415
 109 153 153 446 471 576 471 804 401 495 358 306 125 358 189 300 198  73 439  86
 567 497 188 391 358 483 629 568 562 197 228 166 291 302 137 341 239 489 188 442
 293 540 380 740 378 747 5452010 1305 907 188 557 555 5501529 177 152  61 184  79
 146 187 114 123 195 183  91 199 136  68 183 168 239 243 159 205 136 227 130 311
 220 344 244 314 268 356 174 351 190 320 278 207 328 281 115 167  91  72 114 137
 366 177  77 253 162  48  94  89 158  72 300  70 201 162 108 101 103 142 199 151
 161 235 243  70 221 129 272 156 522 197 252  71 229  63 220 252 292 317 7321001
 6971330 378 356 134 51213451143 440 150 213 187 241 169 151 155  63 145 258 335
 214 771 332 378 158 631 545 5831623 349 319 286 190 381 524 610 525 372 191 139
 138 234 117 195 275 203 127 404  79  75  96 212 222 243 275 878296543123909 2060
2459 2671571 280 297 903 344 161  54 172 172 581 377 462 355 280154820541205 1745
2033197719541466 9471100  90  89  67 100 156 111 500 267 256 1671100345629883853
1059227732121795277022382306 589253611182002 916236521382167
     460=N     -747=I ALT050B                                           -3(20F4.0)~
 260 288 269 127 246 123 307 387 260 427 336 535 315 283 254 208 314  89 492 298
 523 898 916 779 926 194 373 389 523 328 522 626 300   0 731 150 239 52219981711
1578 9421318 526 264 329   0 592 526 570 351 680 4831315 8112347 6361556 592 724
 726 548 329 964 307 767 548 462 570 504 394   0 461 308 351 351 461 439 592 925
 728 723 726 614 483 592 592 552 395 373 767 61410321938 1305 8501523 37211361110
 723 290 894 217 418 677 787 790 979 612 354 544 326 587 457 457 414 327 340 283
 414 479 239 283 326 696 3491130 4351152 414 739 739 609 2831305 219 457 5441805
1196210914781022 1022 4791002 979 326   0 9131044 85211321023121921521891 489 378
 156 311 423 156 535 356 333 711 223 511 789 633   0 645 578 778 600 511 535 689
 311 290 958 533 8891045 356 289 312 467 511 334 622 267 556 111 535 178 716 178
 422 200 511 511 444 555 689 336 445 578 624 622 133 689 290 244 311 489 511 402
 622 312 113 689 445 559 5191111 735 901 856 467 289  67 245 222  67 400 400 402
 157 423 600 245 245 223 780117813802089 464 948 696 253 528 211 147 381 147 443
  87 360 316  42 233 319 343 402 274 549 295 593 360 379 316 464 337 168 211 358
 189 168 422 485 211  87 126 170 215 423 384 277 298 107 381 423 174 295 235 128
 108 301 253 253 337 281 189 105 170 253 696 339 170 215 211 443 360 591 400 281
 322 506 274 423 191 347 170 256 126 533 488 388 512 194 298 388 281  84 174 322
 274 343 277 322 422 471 434 402 153 423 232 360 429 301 689 174 533 697 274 467
 256 277 447 530 423 211 170 215 298 426 170 509 212 637 256 616 212 554 507 593
 614 739 800282317261475 295 504 190 454 423 431 929 327 337 336 264 263 190   0
 211 189 223 285 184 200 189  53 158 168 149  95  53 116 169 190 158 254 211 318
 296 286 244 358  74 379 263 264 137   0 211 337 396  74 116  42 137 118 179 308
 202  74 266 213  95 171 138 244 151 358 263 166  63 235 263 169 116 181  63 220
     268=N     -760=I ALT079                                            -3(20F4.0)~
51412275 174 358 500 337 806 612 357 459 42910401061238720301602 643 612 592 919
 694  88 439 562 500 554 2971084 2561064 364 864 535 544 379 165 307 499 144 419
 117 506 636 346 498 605 5791184 380 342 399 626 304 361 171 551 455 759 418 645
 588 456 171 512 722 285 702 494100610641424 742 66515191348123413701899 1594 802
 440 780 300 780 141 561 201 720 5201460 641 11719021381 340 907 508 463 506 148
  53 504 441 358 620 495 610 421 326 568 326 506 305 494  35 494 346 420 567 252
 441 483 452 294 253 168 220 126 619 535 113 945 54710181000 767 948 457 8411107
 336 784 633 271 402  80 269 101 308 119 213 134 206  69  53 207 354 300 286 279
 465 199 670 340 279 308 449 388 662 439 412 219 366 212 300 472 434 592 539 835
 418 379 332 207 358 241 548 673 711 781 630 855 330 155 116 213 272 281 126 146
 107 194  58 175 165 184 156 262 283 320 495 437 592 495 407 369 592 214 437 292
 156 252 272 312 194 215 176 272  49 252 156 235 262 224 311 546 565 763 710 705
 720 691 845 700 624 307  46 515 158 268  99 436  89 347 307 495 318 317 337 426
 486 545 693 555 468 368 436 218
     506=N     -766=I ALT055A                                           -3(20F4.0)~
1377114318801435 1717 5002066167317391635 1851 4572074158920001917 1087 109 392 370
 283 631 304 391 479 848 696 870232634562109 1413 565 413 327 435 370 239 307 327
 304 457 5441334 435 826 848 652 500 283 850 631 567 848 304 43511961695 1653 826
 761 804 272 250 319 409 477 477 477 613 557 182 750 3861094 456 592 363  87 683
 25011361045129713071022 479 523 206 114   0 136 138 204 319 477 477 318   0 409
 569 728 81821872798263510441113 1273 800   0  68 144 228  91 479 463 347 206 303
 215 259 237 397 116 165 527 318 434 591 296 136 272 241 364 136  91 114   0 363
 299 341 386 136 182 250 227  68 409 386 182 250 341  73 795 318 56811831098 1156
 98621402000 821  45  68  80 114 193 352 173 209 469 681 556 771 590 3861134 921
 924 8871152 380 810 484 231   0 445 806 443   0 535 352 353 397 805 555 453 612
 521 591   0 656 9441525306533371593 544 523 453 275 407 682 113 295 160   03198
417532222151 74813843025220514 29 275   0   0   0 250 373 349 792 814 769 419 256
 442 302 512 67413031279258214 19 395 163 675 586 2571816 560 796 79614311094 630
 55911631048 792 581 512 931160626171981  74  93 151 501 256 395 500 349 756 594
 512 6281224 302 733 605 489 396 419 361 349 496 459 572 375  59 107 347  82 365
 410 105 107  83  92 457 6571047240631042993 2543 558 465 435  93 303 34912102675
34471140 155  83 107  96 179 381 369 214 513 572 608 321 690 452 440 631 333 405
```

```
 334 298 476 583 357 370 821 142106118691539 917 167 824 718 393 418 405 560 321
 536 6081228 227290645382893 905 287 500 33312541263 778 540 810 621 6351732 487
 643 738 580 612 424 722 408 5981257147411612134161 6 110 247  94  71  82 306 200
 142 259 236 165 224 247 447 365 576 647 183 671  59  82 165 271 118 224 271 365
 295 696 506 353 4591084 55410971146 519 152 122 1891003 616 822 446 839 459 786
 564 657 426 223 459 520 597 621 483 478 394 255 208 186 265 127 371  92 414 403
 471 216 578 462 489 613 462 417 270 216 376 192 661 478 438 699 625 640 631 725
 557 324 424 237 255 474 312 537 115 756 616 624 491 512 376 387 333 246 227 510
 417 228  87 276 387 553
     399=N    -766=I ALT055B                                           -3(20F4.0)~
1442 75514352357 396 39638464791381423081917186929011494 4181077 500 718 972 915
 964 841 696 862 820 953 790 993 848 881 826 290 174 391 351 457 62310151000 804
 920 319 863 581 345 723 547 399 635 676 643 751 306 480 318 596 365 358 777 697
 324 892 286 582 428 538 429 363 671 440  88 165 341 441 681 648 938 935   01102
 869 343 408 243 959 533 345 168 424 278   0 506 748 901 661 993 508 256 155 110
 177 353 553 9581048 928 663 749 483 608 314 334 595 673 696 681 488 237 360 101
 438 304 115 101 393 349 596 506 248 528 169 292 258 216 450 215 214 351 292 327
 101 202 449 303 270 203 226  68 137  67  56  67 170  65 221  34 247 338 396 439
 607 632 575 563 836 542 203 293  79  91 157 135 225 573 147 101  90 282 499 225
  91  90 124 101 272 172 297 273 425 525 307 197 434 833 753 401 879 593 344 494
 491 369 313 445 353 366 491 293 435 523 438 522 462 556 460 665 810 653 202 181
 483 532 904 627 856 846 519 5661065 700 725 715120314501367170 0 428 470 268 189
 175 472 804 94913011097 68310641142 490 619 624 226 508 100 206 301 577 235 223
 310 493 472 601 459 589 766 8021105 894 499 818 960 687 348 300 501 211 300 311
 237 530 437 364 295 344 348 401 360 332 316 369 327 295 248 279 316 366 101 101
 257  79 232 178  85 293 271 599262929202493228 3 249 221 170 166 453 462 415 572
11321152 559 506 497 329 564 278 147 450 497 358 462 329 294 147 446 345 313 695
 361 513 335 182 577 660 300  98 262101611572212212 01823 218  85 186 238 565 535
 489 720 900 315240226872178129 1 656 276  91 132 264 313 436 394 345 477 559 365
 457 670 687 702 3511017 677 811 882 283 550 587 618 4251478 885 538 596 165
     123=N    -926=I ALT076                                            -3(20F4.0)~
 473 145 203 279 247 146 435 478 567 464 348 145 494 130 710 305 493 391 522 508
 813 754 377 160 253 116 508 247 378 587 697 613 291 570 554 639 626 441 684 642
 176 670 264 739 247 803 634 656 451 824 543 715 231 810 232 827 231 866 655 693
 539 616 577 500 599 521 680 943 561 808 4491041 675 926 860 270 443 642 2121142
 135 789 885 370 865 154 890 869 655   01020 675 597 752 501 492 895 348 732 192
 885 192 789 712 463 867 848 7901000 680 4041102 327 769 211 830 541 288 601 656
 288 721 716
     177=N    -967=I ALT045A                                           -3(20F4.0)~
 896 6422007 706 849 64211801304 510 61719082603 3212238 40835093571233442363450
2813484645033529159122941092125718811650629939004280210 1 825 37510501275 5253226
18751650105012001350217 5 31921012850 2112198 73616991185 220 6851051 708 342 903
 415 586 733 9531367 830 610 489 195 391 854 80613181710127017091270178514421050
1074 637 763 586 488 489 2201881 879147214901373 687 269 637 489 586 564 538 928
 687 904 906 978 955207613351145 249 553 229 706 763 611 801 420 496 5911201 591
 553136516851502 8661055 27810511246 499 94014931354 975 467 442 211 504 478 795
1427 600 884 65016441242155218191125113 3 806 79253951642 206 40312991072276713 12
14721025 416 740 603 793 9872133 432 497 6031343 560 3911203 561 707
      98=N    -900=I ALT045B                                           -3(20F4.0)~
1141 760 380139015002466416331853586181153686084242728 04 860 860 657 961 727 484
 484 1421221 830112910621352 962 911 761 355 305 726 176 338 460 500 559 669 521
 399 4781084 678 383 518 481 741 641 899 616 653 989 35711461061 936 863 654 320
 690 837 123 148 4801220 569 240 721   0 253 215 330 355 215 101 190 430 405 847
13911796   0   0220138732289 647 393 437 217 462 380 791 661 331 331 316
     523=N    -975=I ALT101A                                           -3(20F4.0)~
 832 596 833 856 595 97513111950 717193024721094123 6 73812831403119218141689178 5
 99915491046 644 5951003 40713091191 570 977 8081284 977 880 595 667 6911379 785
11181738 840 690 837 481 383 690 814 7431332 74410081010 71814571187 583 694 896
10751008 717 94116801187 806 6501388 965130012761366 896 963 694 963 828 112 694
 291 337 672 605 337 965 295 80914571299159024402127152415901523167919482933250 8
21272015 8281346 776 518 242 655 7761208 621 759 794 552 569 552 552 241 242 483
 724 311 449 810 483 276 552 517 655 966 483 517 897 776 86213281621 810 483 500
 863 517 708 879 155 103 776 483 259 517 397 431 672 810 638 673 362 311 259 397
 569 741 777 91411051431 848 500 417 294 914 776169316041707117 5 354 479 646 478
  92 154 170 4931019 509 371 446 433 340 540 200 139 340 279 478 339 401 508 772
 493 925 371 355 112 354 539 201 370 263 355 262 417 540 370 386 509 493 896 447
 632 831 447 400 648 5881000 386 740 262 401 187 323 415 819 615 124 862 834 708
 908 339 446 416 415 446 416 170 263 169 354 248 277 323 493 416 325 431 185 692
 415 463 477 325 292 60111381292 985 403 379 345 379 758 657 770 771 357 854 518
 253 356 115 161 196 276 126 300 460 231 207 208 104 288 333 242 356 381 253   0
1252 265 620 460 885 851 563 6211070 667 862 384  63 421 268 421 455 679 786 545
 563 429 349 366 232 411 348 259 491 412 509 554 554 339 116 170 286 241 224  71
  80 152 143  99 188 464 475 287 448 379 368 331 188 232 331 349 349 367 366 224
 215 268 226 421 172 143 304 286 343 322 348 295 162 331 286 305 162 251 153 189
 443 295 128 239 385 439 421 148 238  73 585 439 770 151 129 274 166 350 714 585
 501 810 439 476 531 275 567 350 385 256 422 275 513 586 404 110 201 220 293 257
 275 769 934124415571208 897 915 439 422  84 303 210 336 345 176 311  84  86 134
 262 202 345 317 143 210 185 235 143 110 244 311 227 186 395 303 185 672 118 169
 185 261 193  84 102 152 160 101 160 193 277 219 168 118 101 303  96  94  96   0
  35  45 162 323  61 358 339 220 126 438 210 203 269 253  84 110 135   0 303 336
 244   0 337 101 168 253 235 219 193 202 185 143 235  76 303 109 194 276 118 361
```

```
 295 336 329
     627=N    -968=I ALT101B                                              -3(20F4.0)~
2276 9492460274820101300105712891527143217201531134 1 8151300 875 616 5431185 607
14371060 4461248 961 997 747 841 517 642 9261227 84115251395 816 633 493 455 362
 402 432 563 763 52410091109 4861125 710 293 4861258 824 747 940 679 9781271 716
10551387118610781532156310 16 719 65411561032 264 618 418 329 700 547 501 990 275
15101511115451563196820961632123115231143160120632572118617951489169810 47 733 233
 709 558 919 373 698 791 524 628 721 570 535 326 756 722 512 721 966 523 384 606
 558 5701128 674 9441209 919 90714661314 896 523 651 872 535 698 954 105 198 186
 698 396 396 745 512 721 663 895 919 524 141 523 408 582 632 868 713 884 8681164
 870 543 620 372 807 7671209 651 581 583 302 349 791 628 140 186 4891116 582 652
 861 465 280 442 209 234 605 558 744 791 5581047 977 373 514 326 375 211 488 674
 209 209 302 257 141 192 442 279 209 419 512 954 72110231256 722 571 993 782 904
 572 903 425 452 242 332 482 692 722 183 812 724 602 752 361 481 471 541 812 662
 331 444 180 541 286 271 406 677 526 301 421 226 556 406 556 451 406 316 631 887
10981067 298 218 250 266 596 645 628 637 387 508 411 162 379 201 162 145 307  97
 226 258 177 218 186  40 234 283 331 363 379 258   0 782 476 870 83813291201 862
 9911102 712 561 424 242 531 364 485 303 440 485 607 576 576 440 349 348 394 273
 409 531 348 515 6671061 285 159 114 205 250 150   0   0 194 175 206 193 421 425
 239 386 308 466 297 239 273 318 364 295 251 318 172 296 228 205 432 147 139 303
 251 312 286 416 296 243 304 269 331 280 226 131 192 496 235 148 226 434 321 234
 130 208 182 538 425 582 295 260  69 520 338 703 469   0 659 676 642 434 503 234
 225 304 399 278 434 434 347 512 356 174 304 451 286 312 382 659128310751023 542
 467 299 168 243 206 224 188 411 187 262 203 154  79 100 236 188  88 264 226 263
 150 187 162 150 226 386 374 287 336 224 294 162 150 200 299 287 199 187 199 187
 112 237 224 262 262 399 474 486 573 424 140  93 131  85  95 132 187  66 160 226
 151 114 311 206 418 469 283 122 113 121 168 262 301 104 196 338 151 291 346 300
 300 421 253 272 215 178 103 262 169 225 234 169 319 280 281 294 211 137 257 165
 366 293 147 165 220 284 284 277 322 431 202 302 229 413 202 284 110 202 247 220
 286 211  92 138 119 256 110 211 211 238 256 119  64 284 183 302 641 403 203 385
 787 337 159 231 396 243 180 347 372 501 288 644 374 276 192 216 358 253 192 360
 227 263 155 204 192 312 168 190 384 310 634 690 464 203 190 132 369 250 488 726
 715 334 238 179 238 381 357 465 310 500 203 548 667 488 7981036 6631181 802 705
 813 77913681163 789 765 392
     195=N   -1194=I ALT039                                               -3(20F4.0)~
16701333 7801056106519441917 86814721196 861 528 307 667 5831000 528161213902250
31113638155616671444244432221639225036944278l806 833 807 583 889 861144528612639
3196180724171167l342 897 854 751 2081917116713342022287039943779l7581354 854 251
 709 459 167 543175012711104 521 709 771 7101542120820631271l084 750 33930012417
18121566 72216491299 971 948 660 752  82 124 804 144 752 475 237 886 639 835 681
1061 556 217 515 381 567 196 248 484 598 804 845 670 680 649 835 423 671 330 546
 537 680 752 464 547 866 9381773 990 44414941042 618 845 372 248 835 905 495 493
 7401499 575 247 700 822 442  93 575 401 144 709 791 493 113 431 832 751 9451007
 699 28319732065 781 124 1951181 534 761 7811346 49312741027 812 7501818  93 657
 75011301263 298 648 6981254 730 627 8831007 565 503 308 618
     431=N   -1231=I ALT027A                                              -3(20F4.0)~
 272 881 322 492 628 366 119 407 526 678 881 661 729 593 782 932 661 712 5221914
1036  3213051376 847 627 373 408 5761051 814 1311186 127188118311033 678 729 851
1628101819151898 729 51116451950151710861122 6041190101710692517191428961483l172
1052106914652776 2341845198318791310l638 223 46214651258 26121731569 966 8971069
 70810002224 638146512071414 604 759 261 659 155 208 39610521140 983 879 896 950
 6741086 41415011810 41415001242 983 941 7901288 6361607 9391243 819127317941973
1093 8791758 66715761030  891061 851 910 21727581182103116671940l121 940 6971182
1212 53712491426 75015702428242726412070146414991714l499 750 8571464 64213211608
 465 857 822 6421788 2501749 9281285  9314281109 82113921181 35718921143 8571000
1356 75013941250 53519631285107l1003   015011000160610731499 678114311421178 964
1823 57115351094121911881281 5311501  87 719 65610321187293910621219131616571689
1782168712501969l532 1531283 846 3681657 9381375 937156511881345 1621313 2051002
10311316143718441907l062 9031782 96916561125 81217831094190613751439187510981781
100010631187 973 90712191595112511 31 73217631796159613 30 967 93210981364 6321397
1364 8991365 73216301100136 41630   01699 632 225182919291598 8321463 865 998  33
 899 798 734 799 96511311000  2213971098116617631199l198 7981298 8651098 932 833
 931 765 602 366 665 599 632 133 633 632 698 5031098 898 831 200 632 366 965 766
 801 766 867 6651131 218 967 765 600 399 437 967 765 565116511641600l4301697 801
 865 665 760 597 659 725 63210121101 889   01043 607 535 539 411 546 406 356 288
 356 198 417 349 509 535 509 380 766 570  83 721 719 500 687 625 406 687 690 625
 688 469 6251094 344   0   0 844 532 281 751 503 115 156 219 687 531 344 437 344
 625 687 469 345 501 437 539 570 442 820 822
     272=N   -1052=I ALT027B                                              -3(20F4.0)~
 832 897 703 940 752 280 959 682 557   0 6321407 5991814 96611732232 9871027 792
1363 9381048 855 38416001158 50113701905 214 70311791579 7942589 602109013701581
2631225926381591172115 01   0155813131168172712951795170614961188 979  881934   0
141412161570 7822798 415 723 34214141460119912141215161412301783l2451170 971 786
 989126410191125117313682045155314621092 60022801941 672 389  101113 8671049 683
 928 82218401516 409151710491548 91418771099 874 187124810162077 8621124 553 740
   01241 972 750 9811070 553 964  61 375109914272108 5021091 4851067 6691034 851
 8001091 5791067 6061128 486 853 853 5771092 184 760 790 733 797 579 333 4591406
 708 446 593 604 316 970   01105 920 735 920 3541048 774 408 708 524 786 7241153
 735 459 578 447 98510571057 8261131 655 865 115 800 223 564 501 151 696 252 867
 427 826 259 600 257 458 195 110 547 534  53  39 732 717 401 157 763 447 611 358
 121 662 507 348 587 106  38  59 414 324 153 580 953 711 351 272 755 300 562 192
```

```
 471 776 679 776 421 718 254 177 357 411 430 228 537 260 115 673 158 550 557 815
 434 308 490 771 693 620 523 228 143 629 348 419
     402=N   -1406=I ALT108A                                       -3(20F4.0)~
45213264377120182013 431283017071309  8832073370 39726603128305334442507353215 64
2202 6262273164917271208 531 598 589106210621651100417O5 418 495 647 609 8741063
1519 835 532 723 380 3421025 797 6843380284820511292129 1 570 190 684 342 5701139
 34212911064 6471102 8351557151922791329 1406 342136814811253129214431101 684 646
1178 228 266 304 494 608 4941025 797 988 456 6841025 723 342 647 570 723 646 533
 115 803 918  57 373 459 519 516 4011349 402 717 803 487 545 659 460 344 688 229
 487 264   0 143 631 315 258 172 889 260   0129110331061 516 918 745 172 860 516
1233 631 659 860 631 401 735  57 172 288 172 201 516 229  26 947 602 573 5161004
 54610901148 831 487 688 746 803 315 775 431 516 631 573 774 545 775 602 603 459
 487 201 287 258 405 776 602 231 688 229 287 402 517 574 717 574 258 394 194 173
 237 473 968 8841011 538  291226 718 897 360 539 487 464 436 718   0 333 179 256
 154 360 256 410 282 487 232 360 179 205 176 307 488 128 385 307 464  24 461 231
 231 384 718 539 745   0 307 487 436 667 769 487 820 205 462 436 436 974 309 692
 207 512 256 309 512 462 131 668 307 794 436 743 821   01461 6411256 974 3121153
 592 794 257 589 564 307 461 667 923 3591103 871 719 5121102 231 487 283 8981642
1179 385 512 410 359  22 512 256 462 181 589 384 385 309 692 256 487 154 641 102
 615 84713841153 504 311 1541051 617 360 181 256 317 769 951 232 847 338  59 275
 119 355 262 256  44  69 435 297 574 396 295 708  59 608 438 277 236 217 297 100
 336 297 258 100  59 432 554 569 474 178 314 137 510 414 453 373 295 353 235 686
 216 510 490 255  35 765 490 451 119 706 706 647 236 569 451  81 472  78 549 235
 236 490
     402=N   -1391=I ALT108B                                       -3(20F4.0)~
29123414246229042371 1779 8181261 451 6671779 556 446 370 560 234 446 5241121 481
 422 444 305 96615621865 892 5601305 853 74913381645 52418651681204928512616 1228
 266 917 339 421 627 159 451 574 5771622128414401440219610461176 159 9141204 679
 757 758 470 470 367 785 209 131 288 392 157 523 444 340 367 211 366 340 601 653
 496 236 445 496 705 810 940 39312541098 185 888 810 758 551 3391020 313 574 523
 367 679 8621020 366 761 497 157 185 420 2611176 8113426 389  521076 600 962 419
 419 359 119 330 270 211 209 5111165 717 600 747 182 179 419 241 538 298 179  31
 300 300 211 269 568 448 903 627 598 270 269 393 598 477 903 574 389 570 540 657
 719 778 7511134 751 937 211 511 985 6301144 808 182 545 748 270 778 449 630 667
 747 448 726 456 597 751 9371170 667 330 152   0 452 392 508 275 570 419 363 363
 840 659 422 217 538 270 609 363 471 163 246 142 121 136 272  93 519 270 522 431
 313 725   0 292 250 206 538 564 364 475 450 250 383 142 270 510 472 865 247 659
 431   0 744 283 308 515 747 128 489 205 467 359 385 256 438 181 515 413 156 385
 230 413 156 282 413 154 205 384 615 232 133 8961333 515 512 795 413 387 308 951
 438   0 131 211 283 257 317 186 422 156  38 413 181 257 232 413 162 181 362 236
 257 543 367 569 317 855 724 809 775 772 645 106 772 487 181 257 154 462 435 256
 102 442 487 615 362 211 564 591 307  17  47 205 102 232 257 334 337 215  81 497
 515 206 102 282  77 487 154 230 563   0 436 307 179 232 179 645 205 464 512 156
 693 312 517 102 8741106 1811055 724  221377 696 231 211 809 839 417 283 243 543
 131 598   0 144 255 268 107 482 501 178 340 197 521 503  53 290  53 321 160 294
 413 773
     139=N   -1414=I ALT037                                        -3(20F4.0)~
 38720971448 462 648 722 537 702 465 560 476 124 453 247 408 732 257 408 970 470
 412 803 812 525 150 125 5351096 455 206 47523911629 34114051307 7731552 5691173
1389 8451794 259 319 475221616811199 52715861672170715002034 518 63118792853 698
 940 38228711001 517  77 811 90616811216 629 630 957 491 138 2951227 4951334 851
 48419651052 603 310 312 225 397 724 225 3451224 121 864117410861103 79414841052
 8792096 133130917091369 945161225211781115113451684 2421575 509  631067 388 570
 121 122 558 195107912972824 7401563 3512545 1021963 401  441066 933 376 764
     318=N   -1424=I ALT018A                                       -3(20F4.0)~
 8931237 710 826 8071682 741 510 593 841 757 776 346 939 791 774 890 560 2821368
 477 363 528 791 9551367 7081400 511 412 247 4953053 922 5281185 585 544 479 839
1022 461 494 576 642 626 708 93815811615 807 82312681498 626 676 840131722391400
1333 6751070 744 8241171 7571943 790 39513831263 9881210 963 642 889 839 8391607
1114 306 608 574 779 912 709 7121689 27011142261141915201721314016 88 540 777 540
 912 743 203 169 169 5061891 814 880 97911811283 306 743 540 948 743 371 575 236
 979 7431654 609 641 444 373 405 506 405 3381755 5071789 9451013 911 743 8131047
111411501148 878 675162019582161 54031052633108011811013 1183 9121080 676 811 574
 578  68 373 540 676 845 270 304 203 5741013 81615211720   01458 620 573 163   0
 573 423 735 277 147 674 571 244 180 6101576 829 8361353 513 708 631 130 185  99
 217 134 686 237 134  83 935 533 1821263 970 295  49 252 348 115 711 638 396 180
 214 383 114 311   0 754 450 549 695 781 150 237 288 9381024 612  81 366 310 123
 894 1391017 635 512 398 3831073 883 358 553 1631106 618 718  45 451 171 902 561
 646 171 781 147 86612081110 513 451 220 317 817 732 817 646 671 759 110 146 573
 951 561 817 8051793 939 879 415 562 9881756 5371136 52527561001 352 235 139 268
 442 341 266 405 176 447  69 363 113 415 1241022 181 362 53321931246 555
     141=N   -1326=I ALT018B                                       -3(20F4.0)~
 802 240 177 175 103 109 356 219 594 687 188 1251000205210941220 146 354 104 104
 292 437 219 104 573 552 644 750 323 552 334 562 4271645 637 902 500 480 451 530
 854 598 922 353 843 706 324 206 294 324 157 520 608 226 147 275 569 442 687 654
 824 402 618 451 569 618394822111069 775158117921692 310   02034   01723 690 897
 207   0 517 6201138 758 897 406 336 492 129 776 750 956 129 388 414 3881088 994
12951266 1262 69515991133 746   0 549 165 5491018 937 387 678 460 597 5501116 387
 436 274 177  651259 549 215 774 355135517901161 312 191  70 825 936 755 684 171
 343
     293=N   -1469=I ALT087A                                       -3(20F4.0)~
```

```
19741333125512553686313826673764337222752274211718972296233927222695310222581133
1582 907 30124861735189020342789204021101130165911301507188423362269223117712269
13851461 924 769 500 461 8081578157726542500192315021077153817302384173115041269
 84913811108159611081000 811105412171054 568 919121615411135 5141030 87318382379
202820541487213618381976 8951273 486 865 842 8381000 865102812161189124410271811
2217175714601600 406149216931284116019771486131212371037118612351237 91711361333
 890 815 8411013 839 841 892 864 86610931063 964 276 751 8001121151913141066 889
 914 568 64213831533 989229917281180 669 617 643 796 694 590 590 411 385 488 541
 796 410 6711365 694 8481263 776 929 815 779 633 902 730 576 9831139 965 7221172
 961 771 852 846 337 805 207 666 725 539 573 780 801 932 932 986 835169813251207
 705 578 734 634 448 734 840 773 99610321302 532 567134710532193 922 3981009 291
 718  141415 5291278 614 805 9081090 7931022 805 677 671 480 625 346 800 1321073
 945 614 883 702 857 970 563 779 645 2681017 888 723 558 702 294 434 893 774 753
 7911283 862 9531079 948 8111107 964 822 786 785 644 572 929 715 715 679 762 619
 791 619 619 595 381 547 382 167 309 358 500 529 607
     270=N    -1436=I ALT087B                                          -3(20F4.0)~
 5581061 8941122 8621184 77113531099 959 8581035 395 501 496 8301293 98812281009
1035 874 630 99715251494 984 85318771116120911581033 8351091 971188221381495 826
13011303 667 921   0230218531254191015531400130416511600 90010511000170116501350
1800110015501050 752 600 8001451147615432001 45914751606144814151053 959 985 887
 955 793 862 894 691 739 724 689 604 598 572 501 733 858 630 297 561 689 557 264
 691 49210821442137614421082 887 262 68813111246 787180315411419 734 877 759 903
1001 931 853 816 591 541 378 591 730 773 3241001 597 956103410061132 79611481296
1041 773114811881182118814491223 8241195 978 8581041121014781415 7911120 620 824
 7622888225922151545187519801193 690 379105210381028 885108812711203 902 912 621
1126 3791126 9891126105910001126 8351341 5951193 495 557 573 786 78610921166 951
112910121077 9361265 5951088 888 641 928 84410861368 8041020 82412421232 873 894
 847 912 769 84814051052104311661242 702103110621026 790161513241075 867 581 750
 692 952 708 819 660 708 75011611080 732 830 745 770 732 622 567 641 629 736 598
 885 781 988 581 543 422 422 311 574 366
    1078=N    -1472=I ALT085A                                          -3(20F4.0)~
181220371546211315841132 9431357 943 528 605166318481773113111711018 943 9463098
15131697271523801697 679 452 7161433 981 655 557 245 458 311 229 541 27813601376
 752 688 334 213  82 197 254 311 562 477 802 360 246 180 213 230 347 638 492 605
 327 262 589 557 772 8851129 591 752 742 793 540 409 409 409 229 409 213 147 196
 508 442 405 147 213 147 245 248 66415661250 912 706 302 378 514 430 54910951611
133814921043 831 488 520 710 481   0 912233230602551 663   0 630 480 120 240 331
 360 6311110 87014401050 780 7811110 66122203241156516001597 845 340 141 140 440
 120 200 120 281 140 34013601900182124021020 701 962 9831021 703 784 341 840 880
 523 681 2611440 600 220 160 260 280 760 420 72024601580 440 520 280 520 382 681
 221 341 341 160 180 234 400 160 460108521211201 603 4601784 281 502 502 661 560
 701 824 661 142 480 500 601 563 81219691571269528882140234318941894 7821563 468
 884 519 468 420 414 968 705 654 583 578 654 994 471 862 913 603 676 840 121 138
 139 331 419 261 682 209 172 173 226 295 207 436 365 436 142 470 453 242 155 280
 190 261 368 138 226 259 346 193  86 289 173 193 402 665 399 770 624267125361362
2343 628 36912931404 853 706 555 443 703 517 554 111 592 629 295 482 665 334 369
 406 628 449 332 629 152 518 591 702 408 554 188 406 462 186 314 259 246 445 261
 667 575 594 520 502 630 425 850 706 465 204 369 204 369 279  55 351  94 333 167
 185 222 351 222 333 388 148 166 225  92 203 222 314 388 369 148 592 536 240 351
 388 481 905 742 92410161330103415891330138611451219 8691662 9601977184722531423
 676 731 444 214 501 160 196 196 249  91 213 197 149 107  81 189 178 107 202 165
 174 174 259 227 161 405 227 230 230 147   0 298 364  93 443 390 458 495 162 259
 228 243 204 230 309 241 228 254 165 187 107 161  93  81 161 227 136 437 421 408
 777 605 701 622 9161002 954 772 515 614 547 228 241 280 187 428 496 308 295 402
 415 256 442 136 334 213 147 160 110  67 161 107  93 114 165 175 173 174 228 121
 215 442 162 189 214 255 215 243 207 415 454 321   0 217 107 254 228 233 298 471
 214 612 696 842 767 493 493 523 371 327  88 365 256 169 175 251 202  83 343 111
 202 237  83 316 283 375 229 211 149 170 319  52 112 207 129  94 207 188 193 135
  76 211 152 261 207 229 170  55 149 167 167 129 259 447 225 559 592 610 729 614
 407 265 141 305 386 193 368 170 223 247 185 182 158 232 199 174 248 175 182 287
 316 184 126 153 117 266 269 141 143 389 196 278 294 442 333 335 141 331  74 290
 401 372 153 132 126 257 313   0 153 518 225 392 590 371 497 254 299 525 359 568
 193 299 254 448 123 225 126 310 208 374 294 225 419 486 301 392 529 289 178 267
 160 170 404 287 240 266 152 305 155 314  94 298 117 178 261 251 231 605 219 122
 114 186 141 274 202 323 240 379 249 193 319 479 574 608 6641051 912 690 604 884
 743 685 571 796 731 398 299 553 213 283 144 301 113 188 259 199 188 373 229 218
 215 191 246 205 414 294 307 199 267 273 113 215 157 152 144 155 100 199 185 276
 218 283 227 133 215 127 130 102 144  86 144 147  84 160 199 304 354 558 442 412
 213 185 213 472 451 232 370 236 389 276 183 213 257 255 406  58 199 246 356 315
 285 500 500 560 655 731 563 546 446 478 393 429 375 341 191 256 119 393 307 599
 550 376 427 290  51 378 409 345 345 311 174 395 460 224 224 187 120 141 154 137
 188 244  68 154 224 307 376 586 482 392 275 361 290 309 465 277 309 277 324 204
 307 194 148 136 174 137 148 171 148 206 159 159 148 250 136 432 307 137 342 170
 228 171  68 205 182 273 148 219 182 216 250 239 264 296 422 342 284 352 466 411
 341 386 204 421 194 206 125 261 250 318 239 273 193 148 204 148 204 170 170 193
 114 148 136 148 148  68 264 159 295 420 170 319 114 273 432 716 329  69 273 216
 341 341 262 284 318 275 204 216 239 148 227 318 443 466 352 409 193 216 319 455
 364 409 489 375 489 489 591 240 523 580 377 246 208 113 208  94 208 151 151 245
  94 246  94 170 170  75 189 190  57 283 170 190 211 245 340 226 189 265 170 189
 113 151  94 227  57 133 265 113  94 151 121 189 152 151 208 283 190  78 132 208
 170 226 226 472 115 453 490 698 679 812 773 679 585 585 434 415 226 490 227  94
```

```
 190  60 245 208 302 170 171 491 226 340 528 566 283 642 679 541 887 798 854 832
 699 426 189 174 113 246 208 378 137 490 174  75 417 379 491 473 623 796 775 852
 665 227 681 700 208 60410591457 6451040 710 387 498 173 198 151 172 368 323 587
 456 755 667 368 861 4991318 606 798 608 238 566 389 710 8401075 9461011
     590=N   -1431=I ALT085B                                       -3(20F4.0)~
 588 464 249 340 534 30712022173175516 59 644 338 249 251 448 391 660 536 911 712
   0 766 80513721506152711 09 509   0 634 558 363 328 324 249 307 161 199 304 450
 83813551320190913702472 1138 427 551 498 391 427 143 196 249 60417422275 1511 800
20261227 907 570 729 782 410 516 304 94221541298 764 144 854 58828192332 20812086
 724 800 880 724 721 538 320 534 498 322 534 462 356 569 854 641 213 9961103 853
14232170344916432857306736172529274125221210 986 822 576 301 301 411 356 219 412
 246 246  55 192  82 383 548 602 5481589143114521698 1095 329 520 548 219 219  82
 246 219 248 221 275 411   0   0 4931096 931 932 93123281178 1260   0290322732274
24381782   01452 602 713 602 274 330 520 602 630 192 493 438 411 164 438 849 411
 548 356 466 493 356 219 383 493 685 658 904 876 712 657 685 493 550 575 301 248
 356 383 602 932 5211123 87615062383247928172648202911842367304220281581163 41183
12961128141320 84 9581409140914 66 734 732 959 566 734 338 951 830 602 680 266 677
 527 188 565 376 338 415 376 338 303 300 225 490 300 377 225 830 9021127 908 640
 413 865 792 904   0 677 527 480 141 310 283 343 197 538 197 370 348 169 169 282
 189 169 284 150 583 452 696 676 621 640 432 510 394 414 263 264 191 169 131 245
 319 287 489 434 563 394 320 414 413 545 714 657 601 864 282 188 357 396 319 376
 414 601 207 282 490 380 133 244 244 282 244 507 188 376 131 301 582 751 354 456
 506 456 911 8611014 761 812 867 608 557 456 253 557 177 154 204 203 308 160 204
 462 442 541 509 637 684 584 431 278  38 433 354 253 179 203 425 136 135 255 355
 475 727 527 749 509 494 391 222 186 220 427 237 182  84   0   0 186 203 203 219
 169 186 205 136 220 186  51  84 186 118 322 101 440 473 796 676 574 591 425 160
 222 189 594 477 619 542 530 824 430 516 666 516 358 271 425 289 222 220  67 287
 325 341 272 458 373 401 237 219 186 170 153  34 173  89 101 114  89 115  76  51
 114 127 152 102 115 115 114  76  76  51  63 216 178 330 217 281 316 620 506 443
 646 405 342  76 240 228 418 456 266 582 315 234 208 103  78  52 259 181  52 129
  78 155 181  78 103 164 155  78 208 103  78 284  78 310 233 181 103 310 129 311
 107 234 208 310 238 336 315  78 414 543 440 440 491 595 440 465 414 672 543 388
 543  82 310 414 233 336 310 388 181 397 103 379 431 362 431 155 259 190 259 156
 138 103 224 224 431 259 103 172 276 172 155 138 207 224 414 224 241 241 500 517
 241 241 259 121 397 227 345 138 225 224
     395=N   -1616=I ALT024A                                       -3(20F4.0)~
12971137 841 841 638 500 659 841 773 751 773 705 93310451591159111821886 1046 523
17271886106811 59 500 750 523 912 933 9781114 819 864 8411387 7501205 871 868 750
 796 818 61411361114 6821068 479 751 682 591 888 4771205 70611362318127312271092
1114 6821636 9031420 90313551099122610 97 581 323 9681226 7751033 5811033 452 388
 549 710 677 839 970 774 774 645 4841065 290 839 678 582 936 710 678 387 613 484
1065 8071262 77712261452 87114521033 1581 93610011355132312901420148418711097 419
 614 614 54821291613122610652387112912261226 484 83910652290 90324522129 5841097
 235 212 294 353 382 679 265 412 382 296 208 147 237  88 177 235 294 177 206 472
 416 413 442 647 692 644 7061088 7061266 8241236 73611761622235410301266 294 589
 677 735 412 912 324 853 562 529 589 325 236  29 384 441 353 529 591   0 677  88
 413 324 382 589 529 471 912 500 5601029 767 529 588 884 529 794 9121324 884 206
11471001 265 707 765 706 914 7951149 9721589 97222382500 1736 679 549  93 158 186
 214 325 121 728 9431000 501 8831238 9671248 749 687 374 905 687 499 812 437 749
 374 562 749 749 625 312 749 6251093 842 782 780 7171031 8741154 655 689 499 469
 81210651092 1156 843 530 469 561 250 500 561 530 905 5931125 562 593 282 530   0
 81110601031 6861498 859 286 401 171 628 371 400 314 629 657 401 4612171 5142487
 37226852485145714 86 314251412852799379948004313 658 65866843714 229 428 1431831
24282220203220 63 96915011441 844 31320002126137521 26 18822192438521932512750 4469
38773597 600 125 473 566 95341875479 25831393838  992374 3451688 3142659   01751
20001281115616892250437835023937371925001940118828762000 1500
     251=N   -1552=I ALT024B                                       -3(20F4.0)~
1339 857 98213051339 1090 911 19614821126 752 626 375 875 182 113 340 911 839 946
1107 822 662 411 268 250 607 519 125 126 393 536 572 428 768 6782303 5282106 913
12281544 9471544 9851299 670 982 982 807 843 948 7371053 913 98216841965 11231825
21771193137017951018115814 39 77216491372168510581018 1123 597 772 632 421 807 491
 4581088 316 772 667 403 351 386 632 386 632 596 562 579 213 790 895 368 7021018
   0   0 7891316 703 737 456 879 421 71910191406 10011263 299 702 704 772 386 685
 1231195 649 703 421 544 509  72 421 509 140 634 632 316 860 614 649 299 527 526
 579 667 842  66 377 393 656 590 460 361 410  98 508 508 640 5251103 645 216 773
 772 561 971 5921067 706 887 65710001049 1131 885 590 230 311 508 722 885 213 771
 869 984 508 8851148 91911311033 934 197 640 674 328 803 131 5081164 164 6881344
14921410 170 442 421 737 526 821 842 758 610 506 800 674 993 548 674 379 442 464
 863 926 905 632 547 569 591 274 402 7161032 7161159 5681348   0 9091032 274 337
 842 674 400 950 599 363 512 343 603 665 720
     409=N   -1712=I ALT025                                        -3(20F4.0)~
28801857  953261 810 881 548 716 3812476 45212621071180918351287235715472714 2452
29992642368920 48 45318811500 1309 762 643 238 357 3331452 666 952 691 967  34 905
 64315041262 1237 91016721799 9751567 540 972 842 82211202248107113 57 8811095 905
1192 8091048 42811671143 714 64314531714145218812143 952 691 81010481143 8601357
15471095 952 857 762 573 524 643 453 619 763 619 667 786 881 7871262 857 238 787
 619 524 666 690 643 500 500  64 7851190 119 668 619 382  95  37 190 357 214 287
 595 738 768 838 405 667 809 833 597 405  75 190 143 192 286 286 381 239 238 262
 286 119  95 190 121  95  44 857 452 310 192 310  71 119 309 238 119 741 762 381
 573  91 182 318 410 432 455 637 568 569 6141045 864 5691091 205 251 753 888 978
1251 614 432 545 773 410 638 342 296 637 889 865 8411161 546 7281206 159 501 614
```

```
 274 773 272 409 206 479 569 296 205 228 659 341 501 659 341 136 364 409 432 273
 500 568 909 705 409 705 568 478 886 479 547 432 432 659 478  66  65 364 432 500
 614 455 114 776 182 1111023 750 547 342 276 187 546 273 568 659 417 333 256 283
 309 308 282 643 718 283 565 769 720 283 154 846 359 795 821 487 179 385 590 513
 667 615 592 308 564 795  77  77 795 949 411 131 7441082 410 179 256 671 154 771
 128 618 103 642 437 385 641 156 745 128 590 48815131282 846 8971053 950  17 850
1026 359 856 488 565 642 207 283 309 667 385 566 154 436  25 256 385 642 487 641
 258 667 462 411 308 487 694 256 256 128 564 616 256 131 436 231 282 256 462 282
 899 769 541 667 410 360 360 128 488 718 103 744 488 872 950 7441026 308 590 641
 359 411 616 359 359 1541103 5901026 899 436  41 462  58 667 720 205 641 464 976
 718 564 513 642 565 590 718 513 462
     212=N    -1774=I ALT084A                                           -3(20F4.0)~
 807 750 389 667 611 500 679 666 944 611 389 334 444 305 301 473 833 752 305 278
 250 417 333 389 473 528 528 362 362 390 250 615 611 617 501 528 501 584 528 586
 694 837 722 611 666 754 583 475 777 528 583 417 530 472 584 176 833 304 417 492
 641 379 379 379 192 264 605 267 377 302 490 641 490 512 547 472 396 434 566 359
 528 529 566 738 529 340 453 359 396 453 47312831660  231453 793 360 283 265 339
 265 340 229 302 192 283 226 189 152 283 171 246 285 358 152 189 245 189 381 340
 321 321 358 339 398 605 698 680 434 830 642 698 645 605 227 132 226 229 189 113
 246 245 226 208 174 434 302 416 285 207 226 229 155 132 170 189 133 171 132 246
 189 358 434 641 90516413002 415 265 454 398 245 208 340 227 133 302 152 491 378
 245 415 265 381 321 4921810247320211794 548 473 830 775 302 717 265 454 360 359
 264 208 302 321 321 304 396 359 360 227 606 509
     200=N    -1757=I ALT084B                                           -3(20F4.0)~
 426 656 196 161 149 499 357 494 494 587 483 323 415 575 5061024 827 690 449 230
 391 207 230 231 253 265 127 277 310 414 299 621 713 471 494 253 391 333 405 771
 404 644 839 701 644 391 460 299 402 517 368 403 242 402 495 379 530 402 381 299
 218 380 253 414 310 437 460 287 322 484 518 425 632 7011310 820   01036 765 460
 315 371 415 292 291 200 165 219 273 164 111  93  93  91 310 293 328 147 164 218
 145 273 254 273 147 201 273 218 328 545 674 291 618 658 930 8551019 691 546 509
 364 164 364 183 291 382 291 201 291 364 473 436 328 182 291 218 183 200 182 273
 201 236 254 273 310 328 364 382 601 746 654 600 382 402 527 582 309 400 221 237
 255 183 309 291 236 400 382 491 382 345 945 727 856 818 291 418 420 327 546 291
 509 346 418 364 310 254 364 327 311 527 491 491 309 310 182 219 291 273 346 492
     468=N    -1768=I ALT006A                                           -3(20F4.0)~
 877 843 913 458 562 842 8081298 563 807 528 985 983 91217551018108824911018 950
20701474 49127743053 84219661333 702 456164912643160352018251088 737164920363018
3368265827151980 681 85016981923164023192376316831112376271536773507424244123565
265827152829 7382206650742425204283018112150213537843270243217582757394631352784
2189243428922162165018921216 948108113511163173018652027173121352216194627302892
31902868246019731433 83818651650146036493649302822981434159620002198116015301210
1951202437034075207414071877 8641583 7693137195130122791333328392742140716551704
303618271903 642 815 7161063 815 864 964 568 816 890 864 769 840 889 39610381012
195313831434 7661556 795 923 847 8991053 923 822 541 539 590 590 718 898 769 949
 2071385 539 848 539 795 616 612 1541000 822 949 590 897 9741129182116161667 641
 539 256 207 616 744 795 949 872 771 667 256 616 744 949 718 488 590 7691668 983
 9831039 884 690 771 796 585 796 902 324 398 106 5111008 698 715 560 722 921 560
 560 479 4051381 6411021 997116912261469146218041412 98314122258228428791058 907
 194 123 666 625 959 526 987 947 218 654 702 944 341 535 145 463 678 484 364 606
 630 894 705 364 801 702 896 175 290 580 949 215 528 693 538 636 756 266 652 484
 338 130 700 7001066 875 846 293 293 726 582 579 194 246 549 801 987141920091063
 7482803 474 553 134 290 396 92312111895 6051372 422 291 211  79 3951842 255 354
 537 709 206 683 305 546 609 242 651 481 256 453 482  85 453 312 284 312 170 255
 372 597 709 256 679 316 339 200 424 568 594 5951131 481 400 4532379 170 425 424
 566 369 198 200 482 428 424 537 510 735 341 849 369 963 538 538 256 255 170 481
 766 425 651 509 311 405 255 566 200 226 537 284 341 425 622 228 198 283 233 144
 397 400 172 255 368 341 179 369 170 312 341 198 144 170 283 200 339 311 283 117
 200 226 510 656 255 341 311 113 316 172 766 568 397 628 424 312 453 284 510 341
 284 396 4251020 70829741473 905
     550=N    -1781=I ALT006B                                           -3(20F4.0)~
 962 485 701 185 2981257110811901492 825 413 406 702 960 886 554 517 554 702 813
 705 261 923 664 886 701 73815501328125512591034 922 9961108 51725091930 8621199
13551976401342222661289324301828121426573040281220711474370637682308168519213220
278331861804228326903728386929922957350331061532 816 7701840 7301168234874085152
66624163259321101306348839913779263847604938415642833733448136073379221421231400
 678 964 91912972309271639412571280618151699269814071414158219321229164111122747
15791286304418151820128717201524189311121462181311691344198815212338177015392001
11452224 347343521272079134123041743156411191442118919771743 816 69311061032 871
 927 693 693 584 160 670 254 616 408 795 983 9581212 857123410981019 2931019 267
 988 614 8271178 695 9631181 671 860 864 3511237 996 4601125 943 833118422772084
20801281154716011467 7471013 267 614 534 401 802 6451308 774 8841094 860 483 754
 347 701 884 7411259 716 642 8401358 940 792 716 790 494 642 889 667 494 765 593
 691 938 247 420 247 568 741 667 8891260 790 938 148 988 543 716 840 964 716 642
12101111 963  99 56812841012 8391013 568 766 519 642 741 889 889 741 716 667 198
 593 198 420 519 309  86 445 111 618  87 247 593 284 717 122 377 588 105 612 443
 155 537 544 671 386 280 582 643 627 648 394  57 188  66 423 348 423  76 502 330
 460 768 700 669 723 373 600 382 614 798 876 188 141 741 603 492 470 398 396  57
 322 546 322 201 360 236 189 423 248 136 149 248 325 149 337 400 315 426 376 240
 114 293 399  93 122 289  65 104 232 417 463 157 398 324 333 361 324 343 210 103
 134 401 146 154 247 143  42 418 4551111 166  55  51 149 240  82 248 198 468 497
 176 358 400 351 309 443 104 205  41 216 123 216 319 428 258 289 290  82 186 112
```

```
 247  72 308 370 290 194 268  72 286 215 473 798 565 215 523 389 133 236 164 369
 236 265 308 389 521 4191133 840 428 557 368 480 377 446 771 531 841 524 403 481
 291 411 498 360 471 274 471 480 866 394 352 608 128 345 378 334 309 403 608 428
 806 707 127 579 490 685 214 168 368 125 349 252 160 337 142 286 243 403  55 255
 402 242 422 349  74 241  47 121 275 248 279 124 163 449 225 511 519 318 248 350
 356 458 421 364  78 248 527 512 473 325 481 412  87 201  85 101 466 349 480 326
 364 372  77 325 504 457 298 320 154 267
     415=N   -1893=I ALT074A                                        -3(20F4.0)~
2284 641288045522242231724081838247726362100l677 962 8781679151726402430235734 53
16181863141715021250l336   025011333 50014191357 1621924 750291815831333116713 36
19331340 984140411921124105214741340l054 982140317532386301627353717215126 20 592
15951830272827381916259825691640218015441408181726341862186221351408122614 98 545
17251771218122351682 81711361000 777 954 863 776 7091293 978 223 92713661373 731
 610 927 9511024 634 927 805 8051073117112681317109 7 928 5861292 512 658 585 659
 707 90210001024 805 1461439 829 829 634   0 658 903 439 513 464 415 268 390 829
 585   0 927 415 707 781 537 219 610 7801073 9751097 707 634 683 512 610 659 536
 488 732 781 854 731 610112214701012l205 964 988 797 843 788 651 892 8701060 628
 386 554 602 361 916 796 988 982185614471663144621211566120510l2 892 892 964 796
 699 723 626 723 749 651 6621012 771156613981398l108 819 892 651 821 626 771 675
 843   0 578 723 531 337 531 337 242 434 338 410 289 265 120 241 266 241 361 217
 554 771 482 265 651 555 531 844 747 965 916 964 747 434 868 3731014 9081014 720
 373 880 453 882 827 560 827 884 669 160 374 373 454 373 347 960 747 667 544 213
 400 587 747 6411013 747 800 722 561 400 454 587 613 587 507 453 320 667 773 561
 614 400 614 773 507 722 800 775 934 720 827 561 642 408 785 404 686 623 162 481
 440 592 6801062 739 90215752298 877 515 783 436 834 674 7701125 93513561251 442
 623 467 261 594 337 467 939 156 9391028 880 417 512 307 489 845 724 719 615 256
 747 411 131 540 896 128 438 307 692 387 440 179 603 764 573 960 7471086 623 794
 972 9991045 922 925 719 772 642 798 900 693 645 464 717 798 770 7681058 795 770
 693 66816631369 8491013 387 548 438 8761430 876 850 9891131
     327=N   -1888=I ALT074B                                        -3(20F4.0)~
44641384146835792309   01117   030481384 84610791583180827311350130714731711 1307
1807 92312732356180710381125 133119111201693l507 807135612881430 4651606 651 788
 686 394 394 5751350 32115761931154017121721103510721391 89815711357225716 78 642
21041324 9642071 892 679107016801356 9991464 821 6781428 85616371636131014721205
 81810361255109610911528l418 8181091 818   01036 818 757 436 494 545 765 927 927
1145 927 98213091418 98211001200l528 491 365 182 150 145 438 364 619 335 728 663
 254 619 574 583 509   0 6911422 545 763 873 692 327 364 509 618   0 699 618 654
 728 474 148 407 6311149 741 852 555 296 555 444 74110031000 481 630 892 481 407
 370 481 778 3701003 446 481 634 667 630 370 444 481 481 370 222 481 333 259 667
 778 85212601223192615181074129611 12 63010381037111210 75 704 667 518 630 518 742
 705 518 630 592 96314072222l223 9631481 889 963 88911851000 889   0 168 463 194
 217 484 120 123 241 482 676 484 218 144 170 313 241 338 168 120 266 337 578 674
 433 674 4811252 795 7711373 9391085 7461348 529  72 939 457 867 508 193 939 409
16851059113111131 7461156 891 91517331180 529 6501300 674 217 652  96 289 410 512
 650 168 313 481 674 337 818 7461180 433 144 724 388 50520712267417127681662 1396
1516 9711001 295 1791061 974 883 1761591279240632165260716482040 386 385 929 478
 242 670 118 735 266 316 158
     513=N   -1954=I ALT010A                                        -3(20F4.0)~
 560 850 604 136 131 559 313 291 246 425 630 626 403 761 627 646 492 586 339 112
 544 272 673 630 515 184 112 336 157 694 470 380  89 716 537 604 738 8281052 561
 5511007 65017691008 7391007 582 716 7611007 60611911052 873 877 626 761 3831186
15892394 72930812270137815431624145916 24 892 626105410571219l378 568 730 486 486
 730 390 379 218 433 649 138 355 8651000 838 8381271 2421487 703 541 352 487 595
 892 541 595 676 867 649 406 432 811 919 973 678  12 62231362128166711031026l077
11281128153811 03 565 282 359 590 411 669 256 564 667 308 539 846 718 538 615 513
 564 615 513 436 462 282 385 538 385 283 258 744 283 154 590 565   0 89812051267
 769 923 74413341333 769 622 667 6671282146214361154 897 718 770 411 795 385 436
 360 309 360 205 282 565 513 718 308 513 590   0 436 333 232 539 283 462 590 333
 847 641 431 693 282 181 385 437 385 694 769 744 539 847 975 744 771 872 667 744
 590 513 923 822 619 762 429 7411023 571 785 762104712371023 590 642 572 334 404
 524 286 463 405 286 381 309 263 245 571 690 619 405 524 571 714 431  98 143 357
 476 571 476 358 309 500  95 343 190 190 667 548 524 667 6661166 452 833 595 643
 404 500 302 643 405 404 429 405 524 215 167 523 786 548 336 239 310 666 904 452
11901047111811 43 785 92811901208 881 643 738 833 667 500 692 500 500 619 857   0
 523 314 523 349 908 628 523 420 384 558 593 733 524 628 453 455 593 698 701 805
 663 803 523 666 629 733 907 908 698 311 90715701117202314 42 349 279 356 362 209
 419 419 384 558 802 384 281 279 209 212 351 524 385 490   0 338 116 141 234 187
 280 442 323 306 302 140 303 209 116 257 280 442 352 234 488 419 442 256 256 419
 329 535 163 467 233 652 58224141250 406 444 379 192 274 151 234 302 179 233 192
  97 248 288 164 644 493 781 767 479 616 233 507 261 466 343 452 151 143 534 425
 494 728 452 356 277 371 507 356 479 236 343 466 523 466 494 424 521 194 603 126
 562 261 767 164 438 453 438 493 302 534 370 493 301 274 137 151 164 220 713 397
 138 536 356 425 561 630 179 357 165 535 438 343 753 425 277 603 192 247 247 192
 316 493 505 309 110 288 342 331 342 233 358 279 425
     383=N   -1954=I ALT010B                                        -3(20F4.0)~
 434 614 412 214   0 595 235 439 224 323 486 969 639 561 592 756 552 626 287 163
 660 114 251 293 402 553 344 217 261 281 860 340 237 447 486 639 569 454 530 543
   01052 969 67410861120 6401019 780 702 679 600 599 659 739 839 719 580 980 842
15792586 818284714031044 781214421901135 917    0131011791224 930 409 718 524 467
 777 272 272 330 5821264 369 544 583 543 815 9521245 211 700 796 679 583 699 699
 466 369 427 446 369 389 2921165 83511481321 796    013791228 570 625 223 442 307
```

```
 94711981121 670 366 285 778 63615461054 8711093 518 478 962 379 553 408 248 582
 655 670 495 408 433 9461077 292 422 480 844 190 611 742 7281034   0 713 626 976
 8051257 822 540 539 338   01130 6941010 804 984 846 700 674 746 287 354 377 419
 462 305 286 305 356 640 383 412 353 176 462   0 186 207 137 168 186 147 700 592
 850 383   0 456 848 765 541 719 545 464 442 364 265 605 698 707 467 484 447 464
 612 727 651 911 526 628 744 326 464 228 487 651 908 588 573 683 184 283 514 291
 398 220 368 471 428 648 127 523 267 687 326 127 102 475 291 432 404 127 224 241
 345 447 243 451 424 408 263 412 628 342 608 546 484 714 4241067 867 9471005 862
1104 764   0 789 583 782 846 724 540 286 362 543 977 996 322 781 733 812 848 566
 844119319021549 507 881 691 806 273 676 351 297 784 825 567 444 497 594 989 969
 507 317 589 423 769 287 492 341 269 438 239 477 351 409 127 166 355 531 566 463
 457 516 4861266 752 127 135 270 440 214 389 508 288 334 233 295 258 398 448 455
 399 413 280 497 585 330 536 177 321 656 133 558 276 437 452 445 413 494 527 509
 328 527 436
     568=N   -1981=I ALT001                                            -3(20F4.0)~
 524 633 715 521 521 590 236 167 479 304 672 76278278070 187 132 258 198 136 350
 673 737 603 596 749 479 16013931906 6801262 868 894 906 706 510 614 458 8221279
 790 635 718 407 531 646 8851124 489 8941030 6911125 863 458 510 565 7941009  83
 528 397 615 482 526 438 526 482 263 451 24113391096 900 220101010081315l2061907
 725 899100918631545l584   01908157818052301263022371578151412491249 789 526 465
 723 723 855 79226631778157823671581187720742179217213841282197518842367158l2406
  882005 1071965153211641123132412441244l123 9221003 481 682 926 521 682 572 601
 60212991203114310541 962114311741323276825902948291 9   0288726231356 72214551903
1804117618041446l083 812 4511083 8121263 6381086 992 992 992 90710831086 812 792
 797 812 7221086 81210861207 6321031 345 624 407 721 312 407 937 5651001 6871343
1374 874109314061312 656 2211093 7211007 531 937  63 688 999 843 845 844 876 958
 750 75013331291 958 481 28416461687 8541436 936 892 824 728 589 909 762 952 892
10821168121111l7 740 857 824 879 312 845 754 9841077 870 691 628 691 691 546 565
 883 754 699 807 627 615 588 412 292 349 371 309 533 395 615 506 588 780 798 423
 791 545 547 855 641 785 629 665 47510421226l031 901 906 659 737 974 563 650 555
 456 7901284 9931613 857 889 626 691 725 658 461 692 692 758 996 165 379 477 331
 165 198 132 527 561 353 368 632 913 9831510 808 316 369 298 316 667 966 842 738
 598 527 246 930 632 684 448 395 342 500 65811321210l369 84211871237 8961289 791
 660 553 817 737 456 219 184 412 474 667 839 95112811070126310621 4741114 237 219
 868 149 500 317 114 149 105 158 325 623 141 163 172 329 474 289 263 225 382 421
 395 592 764 487 303 237 212 158 172 153 132 526 776 923 632 934 691 632  72 194
 175 386 263 500 237 316 369 500 289 421 474 263 289 289 562 246  39 421 175 773
 246 351 140 740 246 702 772 510 614 649 495 542 499 590 594 583 518 294 694 427
 405 484 349 737 303 446 145  78 123 145 222 712 571 48915071320l414 759 877 460
1178 936 489 156 200 467 336 222 378 556 800 533 512 133 179 73310311232 8371081
   0 292 720 462 127 236 610 247 508 480 194 415 137 101 122 167 596 482  56  89
 533 667 676 653 682 625 447 742 8491714 845 244 578 537 334 289 156 156  62 200
 533 444 479 113 245 234 512 144 167 133 569 622 523 200 445 367 181 156 323 204
 163 356 183 119 148 400 373 241
     421=N   -2032=I ALT035A                                           -3(20F4.0)~
 5111860 28814231489l9531558 9701000 850 394 606 849 455 818 636 485 1651091 485
13941121106213631303115716362787166616971636387729732183397229391977157520302152
16062047241435101631166130662510180117O7 80316851016 272 9731095 999 513 608 439
 146 731 146 78012431265 730 196 730 292 951 754 396 780 830 34113621717 9881153
125610501073l214 876 760 463 9541280 860 921 921 826 425 578 339 146 549 782   0
 640 401 616 661 83316841080172013221346120814161220l364 903 659 659 274 182 250
 636 70512041363l364 21511361230 977 5911704 977 886 889 727 705 932 545 7271038
 116 204 232   0 860 713 916 897 319 116 159 187  91 572 216 183 136 513 829 397
 777 620 415 299 114 187 296 688 311 223 617 392 530  91 250 527 678 7781038 468
 713 691 691 932   0 93212481132131915331360l553 826 96114891092 856 643 811 342
 370 643 183 660 250 410 818 614 159  91 136 82112281120 7761000 746 687 732 687
 150 359 582 716 687 687 761 702 179 746 792 422 988 719 222 731 179 343 716 552
 314 351 657 627 630 149 209  47 149 450 226 194 194 134 388 418 597 373 552 239
 507 598 507 149 552 627 583 299 599 776 716 642 522 523 374 224 388 314 134 403
  90 343 179 642 613 149 418 150 119 149 209 537 537 598 628 148 123 334 790 457
 297 805 272 716 827 457 383 284 136 136 123 173 136  74 136 432 123 506 642 704
 173  86   0 631 506 150 105 173 432 778 420 358 160 126  99 136  74 272 136 149
 185 210 494 322 346 222 123 630 531 111 222 716 482 348  87 668 126 765 273 531
 778 741 343 447 132 316 342 842 13210801210 790 237 448 868 342 158 398 186 454
 610 924 842 947 710 526 424 474 7891131 870 268 434 395 526 553 793 868 684 816
 843  59 605 186 631 132 422 450 105 134 192 316 263 166 447 395 791 763 632 660
 842
     407=N   -1997=I ALT035B                                           -3(20F4.0)~
19231942355630635432464244774446289 9 711162948332896175622211654208722181055l910
21741646 988 662 692 59311201120109111 53 857 494 858 461 7241021 6621284 924 922
 82314161844 724138312511449 8891186 96012181023 331 599 722 820 746 159 918 624
 685 575 232 723  41 123 832 722 758 661 783 343 758  98 759 97911621151351O1419
21041199122311501676194512621098 247 878   0 8511070 960 823 625  98 122 293 658
 211  85 500 781 976 123 866 232 173 9881232 268 244 110 135 195 208  50  62  61
  86  73 685 940 563 171 342 317  73 537 232 525 465  85   0  85 305 561  99 220
 427 732  74 135  50 817 7691330 366 133 989 831 398 211 140 327 842 760 421 409
 784 340 59714741328l256 949 609 796 398 153 972 936 761 678 491 924 164 936 632
 725 702 503 8901190 728 3201078 670 524 7571107 525 325 635  91 324 752 778  65
 117  92 467 557 610 544 524  39  65  41  70 487 399 325 104  79  79 160  92  66
 390  65  53  53 339 287 873 417 528  52 211 262 703 129 211 549 758 8861158 832
 624 716  47 170 533 752 558 648 712 390 104 583 117 678 349 104 216 102  92  61
```

```
 326 326 143 636 569 110 153 545 255 127 584 332 233 685 284 508 467 607 243  90
  71 365 403 490  71  63 228   0 277 745 687 6301006 120  70 316 741 553 622 283
 745 5281049 388 663 171  41 155 122 221  82  71  82  92 104 149 184  95 628 369
 102 120 397 166 415 120  84  75 120  47 344 120 113 241  93  74 120 389  73 251
  64 378  37  46 431 111 285  84  64  56  74 277 119 600 845 937 922 560 542  67
 246 633 205  87 499  67  44  95  49 162 142  53 550 116 391 382 583 287 654 209
 368 583 339  60 138  66 127 511 613 546  92 575 508 870 961 917 468 699 561 182
 577 642 170 464 516 671 505
     524=N    -2038=I ALT033                                          -3(20F4.0)~
1049 819 583117515781648 947 702143819461107 631 789 912 316 4381964 562 651 842
14381352 96514381000 316 6151789117614381841112328242560252815081929185915271087
12801916 84210531052 2681263121011051368 633 84318441631 9991739 3261052 738 999
 9991053115713991369 89413691579152918941001 736 948 894226216001367 967 8341135
2234240128672334 633180030364034246737692067 702 340103416341267140010691000 767
 534 634 538 4671034 4352200 3001334156722341133 468 700 533 433 500 501 434 700
 471 8661170 76712991100116610671433 7671632223320671167169927672666190225321899
226620002100253210331000 86911661033 80016671933 41221002299116715691600 7661170
 60010671100 867 93310671636 733129910351133 967 9681066123416661333 69110241476
1048 5961620 8341143 4761049 857 573 905 71411191215116814291239 572 6911024 833
 405 406 263 143 477 214 881 857 381 9051167111914291215   0192913101405 9653413
220818961121112111211638186218281414 948 9141121 879 794 483 293 259 500 121 103
 276 294 500 742 897 138 879 193 9661224 261 364 431 139 190 259 172 241 586 828
 655 293 398 122 173 639 156 465 415 159 494 690 155 500 638 156 828 604 583 208
 932 845 345 208 121 242 810 657 345 400 656 241 5521241120713451057 944 658 800
 515 828 143 7431000 944 800 685 6001057 343 943 715 773 772 54310281171 829 344
1171 658 486 7711171 546 543 600 230 458 773 181   0 343 686 571 658 716 143 315
 628 657 200 287 404 432 286 857 401 347 171 174 287 600 174 259 600 686 6581000
 743 686 659 202 114 657 658 657 686 743  84 631 171 771 200 800 657 146 202 315
 146 314 229 200 543 515 118  86 376 314 202 543 286 401 658 259 429 458 343 202
 143 371 287 344 118 202 114 629 628 543 773 160 234 667 568 682 406 609 507 336
 971 507 669 377 145 146 234 101  87  88 101 131  88 101 160 130  49 609 466 130
 203 246 175 392 203 103 146 322 174 131 234  87 145  58 116 261  88 205 131 247
  72 362 146 217 103  60  88  43 175 159 449 812 856 928 642 362  72 232 580 262
  74 536 101 248 160 131 435 189 304 319 494 436 232 362 450 451  46 101 101  87
 333  44 435 493 160 479 421  89 623   0 681 638 421 566   0 435 188 353 472 183
  77   0 317 320
     178=N    -2134=I ALT086A                                         -3(20F4.0)~
14282472247710494190142838012004532161934751456421871144142836151523 5701900 955
 766 855 7601239 995 6652851540854104901 233 36127882056 507   0 591 6761521 760
 6451014126738031859279018611355 507 431 92912671180  32 5071102219711862704 681
1355202831261861 591 869 9601043 956 956 960 36313161654165240866781356827832262
49562696199926961217 615 956 522 5291307 782 609 522 609104313074261660751225469
6513433916582271 442 958 566 566 738 781 3071438 869 260 3901693551051262365 456
 5211171 803 239 629 348 413 651 521 501 501 803 479 846 95511521107306110581047
201915722169216931421354 97210341423351629421396 5491172 4251521 103 425 598 474
 648 674 698 798 700 549142112241148219636413266351523702667340931843777
     126=N    -2126=I ALT086B                                         -3(20F4.0)~
229312731697161210221273135816991368 5091116 51611911191120012001234 26120372387
20121729 152 568155813221278   0 769 912 821 888 822 93715021422122214781245 916
 200 566139117821925 369 7972265304217402346   012192000304226061911 96014771566
1042 7821564 434121621722347243432151911286822594868208517371064 804 804 655 695
 41515671412 78311301065 978 8691716388814251042  851064 7462191 511 170 511 640
1893 341 7021468 766 547 979278744244020 745 129 681 256 406 428 597 320 447 319
 511 726 468 809 7241002
     419=N    -2181=I ALT013A                                         -3(20F4.0)~
 201 553 159 575  86  70  61  89 184 865 939 874 687 121 542 370 393  75  89 136
 346 127 846 453 472 724 463 562 113 411 187 407 140 243 309 243  80 603 430 495
 159  85  98 374  65  61  65  85  80 234 108 617  80 103 136 327  75  75 514 463
  94 117  75 650 337 491  85  84 354 113  99 257  61 318 113 467 668 108  99 201
 103 522  87 100  93 642 810  75 324 131 219 100 194 437 224 361 711 581 486  81
 343  64 145 143 667  69 237 206  75 667 143  63 530 156 417 660 100 748  81  67
  68 160 427 296 134 627 854 120 147 107 309 121 107 374 147 213 813 533 174 600
 573 747 680 307 161 414 482 133 267 133 200  80 600 813 894 123 774 387 974 814
 121 521 7871200 827 187 933 907141319471693 374 987 453 85310001160 93315341427
 640 827113310931614124013342067 60013341307161317612420 8202580 720 181 220 160
1260 3421240 60016422391108213461238 161 574 872 777123410471117 349 701 216 990
 565 743 981 945 722 654124910581313 757 473 225 900 492 683 9181142 909 950 763
 4541725214710361526 733 230 77811351290 8601281 897 967 967 9251236 848 477 169
 372 295 110 397 162 228 136 137 634 752 947172713621664 3161300110016001170 942
  59 314 757 677 217 733 1571409 716 351 481 759 577 735 125 403 491 126 175 127
 113 125 635 1891083 765 566 300 26614421212 824188861235114712061823 677 706 736
 118 179 176 530 706 588 9121706  421092 7381030 442 413 237 206 237 296 2351031
1237 97110001676 883 237 618 853 853 9701257 437 877 271 699 885 999 9001933 928
 789 7851357 143 2861364 571100010001287 7142143 78511431071 286 589 800 783 121
 128 393 956 6771031 7471619 828 474  98 288 566 964 632 6321099 4381204 6701483
 429 128 885114425711595 786 1921523 358 382 738 643 7141571 6661024 524 524
     392=N    -2083=I ALT013B                                         -3(20F4.0)~
 952 925 641 949 770 316 794 388 1581025 285 906 391 470 949 190 625 728 625 451
 128 712 776 855 728 855 158 6641202 991 917 789 304 309 103 498 231 673 691 467
 637 81410011104 825 656 625 594 363 250 578 884 488 401 252  96  62 120 111 100
  87 520 528  85 541 753  87 131 103 756  86 600 429 461 531  94 582  97 526 122
```

```
  87 103 139 176 230 479 637  70  86 492 436 121  87 500 100 119 151 466 111 205
 133 108 569 427 200 608 521 203 486 481 226  81 104 154 439  89 166 278  81 672
  65 301  94  46 301 166 207  79 580 960 104 158 652  70 642 422 426  86 353 129
 250 122 810 114 336  96 365 686 934 486 178 767 449 702 682 234 775 8501000 112
 486 561 178 113 832 579 421  84 113 112 308 561 495 505 112 187 112 178 215 545
 458 402 365 552 103  56   0  56  93 196  93  75  65 505 262 402  93 131 383  93
 439 290 150 280 542  94 131 206 374 617 179 785 504 385 645 848 724 121 107 272
 628 966 632 626 755 14811921045101826l4   0 655 7781785 545 110 109 477 4641662
 790 136 341 62710361512 736 7081104 858  68 5721104 804 233  83 545 749 681 586
  56 545 477  68 654 382  681049 643 682 767 686 8361064 648 4491103 528 153 382
  75 235 102 526  75 1181076 871  39 680 530 463  78  63 780 100 5851170 474 663
  39 769 8071029 818 126 883 642 585 414 691 534 982 783 199 645 112 373 757 819
 732 524 347 102 397 796 112  99 459  621227 822 569  63 253 139 140 456 115 531
 114 506 127 266 114 557 202 708 772 784 531 202 165  52 333 585 127 102 358 432
 837 876 830  771252 6361066 772 87115972059162423961231196212621570 6671161 667
22152151110710492900105113811239l227 485 762 453
     310=N   -2440=I ALT034A                                         -3(20F4.0)~
 645 468 468 392 253 544 468 417 443 392 518 670 468 418 531 417 304 494 341 177
 342 506 557 417 518 455 329 607 582 594 480 632 860 771 7331606201014161783l846
24162035166920351909 607 443 557   0 708 316 367 392 519 392 164 228 253 721 708
 527 169 371 607 674 236 691 607 438 524 320 590 270 321 220 556 472 169 421 556
 692 809 893 775 759 80911131214   01239 9101214 632 228   0 430 430 759 860 835
 759 607 329 152 582 152 431 683 735 835 65810371012 658 228 73510871214l0121038
1087 9101188 683 253 683 657 506 152 354 430 126 430 177 228 379 481 480   0 936
2798 646 285 603 479 297 109 201 249 148 363 556 799 278 240 521 463 297 402 355
 325 633 911 172 7811035 4731136 811 4091053 580 627 50313131467 911 799 9411283
13841762 9351479 881 1541337 627 8171076 586 674 563 402 704 325 456 402 503 417
 781 308   0 834 779 586 694 918 879 725 603 154 509 486 571   0 317  49 540 221
 213 648 379 225 263 124 231 240 509 308 295   0 603 748 363 586 208 586 486 771
 563 625 109 526 340 178 201 186 295 450 263 308 308 586 4711110 7641196131l 625
1126 571 402 308 340 540 349 225 197 122 842  49 794 517 710 586 871 184 341 162
  57 184 354 646 611 651 224 603 441 586 721 502 791 834 8731114 716 595 564 573
 529 394 524 284 397 297 389 394 176 437
     278=N   -2460=I ALT034B                                         -3(20F4.0)~
184121163134277116861451171221131 904 2731142 93411552076223 2 43235363494211 71283
 780 572 487 433 363 572 557 237 417 295 376 348 503 348 515 502 237 364 278  70
 278 572 376 502 423 390 237 529 585 613 463 557 765 867 93221021965143416152269
21172480113010 23 988 243 146 160 161 387 372 311 395 280 311 145  85 235 622 841
 465 265 523 503 652 311 654 683 530 630 410 637 517 485 500 645 630 341 439 477
 526 546 503 500 654 477 744 834 800 971 7651009 709 446 1251000 472 932 924 963
 780 705 508 152 712 205 530 652 894 614 583 576 697 773 167 652 69710571159138 0
15381197133410 23 721 773 795 554   0 720 579 387 576 387 599 554 576 795  43 819
2311 939 394 491 426 349 142 263 230 255 480 602 895 131 122 458 372 186 240 240
 218 612 743  55 471 689 589 840 811 5891092 633 535 317 874 6761006 580 8081365
12142008151619221233 42616801102 9831560 634 731 471 449 683 441 464 546 490 696
 590  65 365 621 559 375 251 665 528 221 414 135  79  79 419 313 185  90 362 216
  57 661 555 115 114 102 445 181 308 449 524 550 709 806 476 665 365 603 330 872
 485 515 137 524 401 449 128 248 221 538  93 149 220 396 429 905 6441218
     558=N   -2534=I ALT026A                                         -3(20F4.0)~
 8283484 897 7591034 897  64 862 897 932 724 483 657 109 172 241 69011721483 966
14831138103410 35 7941246 869 9221611 562 818 563 716 4861100 4351203 769 1291023
 639 435 614 511 206 410 435 486 521 463 128 281 308 307 461 511 614 153 512 281
 333 130  51 384 8471305 179 102 307 332 359 435 336 895 588 6391862 614 6141023
 767 187 282 281 435 179 8961381 691 973 9721177 818 460 767 537 409 512 384 293
 588 461 537 537  51 589 537 511 387 460 460 563 870 333 128 870 282 512 205 563
 333 898 619 309 785 761 904 666 500 619 832 119 429 880 143 405  95 927 642 133
 428 358 214 262 357 741 145 381 116  52 476 548 381 381 691 238 619 476 619 121
 714 524 809 666 476 381 5711689 713 715 478 618 428190436861189 833 833 880 809
13084471 50229022474 905 121 143 106 383 143 454 452 571 785 98016652783 476 333
 285 761 381 690 190 809 4781046 92814741142157 0 214 761 666 523 644 642 571 999
 928 812  71 215 333 810 717 525 190 691 881 958 19210862968 977 2151119 405 500
 167 357 904  71 857 8331406 952 428 667 76215003666292 81167 904 714 833 5001238
 157 739 405 833 714 562 563 250 719 562 622 625 688 937 314 9371344 156 437  46
1241 554 3441251 50012191095200016561625125 0 9061656 8751064 687 531 156  21 875
 40616251549180615 81 453 3871549 67710641548 452 780 904 936 839 872 5161033 452
 839 4851521 839 645 646 4841260 136 508 222 50810491174111 1 889 603 699 381  95
 508 476 666 767 159 762 190 317  95 539 349 422 453 5091143 543 764 190 412 857
 382 254 159 571 381 444 571 7941015 796 445 508 190 382 317 603 349 635 476 730
 730 730 5721079 445 254 794 476 888 540 888 666 764 730 667 412 635 349 349 699
 794 890  95 730 793 4121111 571 571 412 355 540 317 349 778 412 349 699 222 222
 444 286 349 827 286 638 444 509 667 922 585 277 492 431 692 416 400 6001015 323
 877 400 216 416 446 508 477 493 723 586 524 369 124 446 446 708 923 631 138 200
 462 647 692 847 109 677 493 7241062 585 138 277 400  92 154  92 338 323 569 308
 262 138 585 616 646 710 370 108 769 7081293 557 892 877 384 640 102 974 435 794
 973 872 435 896 871 999 640 589 97313571513 589 640 84510261025115 3 898 717 385
 948 999 949 897 487 461 333 461 461 615 589 871 747 794 384 538 692 487 461 410
 512 358 358 512 594 721 589 154 538 591 436 154 283 436 487 114 566 617
      78=N   -1986=I ALT026B                                         -3(20F4.0)~
 765 653 579 230 205 386 102  42 145 205 350 326 195 208  36 290 367 169 290 230
 193  25 350 231 169 205 157 109 291 169 181 121 278 206 253 411  97 278 145 217
 217 217 181 133 362 544 334 185 299 305 717 390 527 360 738 592 770 575 833 464
```

```
 431 572 604 869 817 919 492 821 607 563 322 191  52 366 533 469 498 378
     281=N   -2560=I ALT004                                         -3(20F4.0)~
 83110861210 961 6401062 641 604 6291152 830 660 661 888 711 922101912481490 962
1397 679 434 887 853 774 812 755 9061113 547 585 717 717 585 641 537 682 661 792
 491 359 698 585 585 509 604 812 378 397 4911038 811 925 868 513 5471265 623 717
 737 4161872136211131076160410771004 566 416 692 642 9232051 974 847 897 8481026
10541180151310771615123 1 9491001 87213851821128216701282 949141014871437159027 69
17191872171813081308159013591205143618591770112512 00   0 975125613121218 9561294
 863 7881107 825 97512571088 788 544 675 469 93711071069 919 881108715371987 1106
10711106 8441106 67511621050 844 73114621406131223991519 769 881 787 731 7691275
14441837107813 59 744 821 95012561128118114361205 924 744 641 667 949 873 9231052
 795 462 590 615 718 642 590 565 748 513 360 488 520 154 425 577 80815001115 346
 7441000 962 359    01038189921871211 86720001058 943 88510001077 521 683 157 106
 288 519 680 923    0 9491000 859 846 705 808 872 7801346 76810571284 830 252 931
 919 9311170 755 805 591 679 717 742 667 403 327 466 616 214 579 366 453 415 403
 302 138 302 391 479 415 604 102 516 429 7191069 918 692 479 503 453 428 503 617
 918
     420=N   -2572=I ALT005A                                        -3(20F4.0)~
 673 852 6711446 85312401393144511 10 774 74811101678 697 619 775 6971523 877 775
 4931033 826 5941290 723 646 905 800 69711611602113 8 903 929 826 723 464 5161084
 904 594 620 517 388 465 38710841014 929 8521290 671 439 697 646 464 490 442 413
 54310071161191017 55 778 723 80010081310 8461000 846 69213071233 84610031384 692
 846 538 538 538 53810002006 84910771386138616171384115615401231 1463 92310771000
13101771230713841461 846 769 7691231 846 84617762077261512331233161521861534 1069
13021813134810691163    01116218618601582 8371163 790 8381255 97812561069 1069 930
 5581024 74413491302116 3 930125520922464297611171070 1023 9781535 60612091213 697
 7441302 978 9761023 790 558 467 653 590 6161073 96416881018 964 754 643 589 884
 9651045134013401259 1018 670 884134015021795171510 99 509 750 85711521073 670 723
 858 696 589 831 696 510 80412591420217122 77 168 57411662036 685   0183248134275
 278 5181814 463 925 75921102517 259 760 556 648 629 723 4631147   01277 538 851
1573327927572557334419031115111534761902170512481508 9861085 180 705 68913282672
2902 919 771 623 67211801803 73813611117 738 722 31111151033234520662426 2694 822
2311 76511321688 844 5551445 932 133 444 312 44425312775 1088 777 64516651069 200
 8001177 80027313219179911322309299721761909195518812530278520603181245834003361
31451374129015181159130116 26 8321012 65511951339 90614861988 1881 4341193 9041880
303720601732 80417932476253524732288278331542720 2211551 92923503030290626593524
383524742847 659 92721642845284425972536253819791670 2102 85018001001 6501603 951
14502300205020511751195019522400 2550 3503201 20746003908325010511451 1501 8502952
2350198120971165250625633495285522731283128215 16 5851748 818 876 9321282 834 772
     262=N   -2571=I ALT005B                                        -3(20F4.0)~
 982 92216781369175918 21 37010581313113914 51 570 882 828 88013951079 9511577 778
 988 996 743 855 380 708 613 813 992 72313651214 694 52710141012 724 638 494 607
 84210431043 638 606 499 724 720 437 957 928 463 413 463 552 607 521 466 6741043
114410251050 992 698 567 523 874 8451187 8171046 96028953008164812481311 9111075
 911 743 967 96212551812 1031 688 743 96211881586170415301080107510 80 7991187 848
16391808214826001925102412451696158314701696108019641406 824 97817401496177115 26
18321251 9771312    01620177218981739 79416781507104411 37 90811371502149 9 953 682
 999 77615421408154211791816145425411950177113161002 953 953 5461146133111451145
114610991009 1145 916 8701008 87011921100 1329 824 916 8261237 963 641 871 7331012
11001511 779 870 870 91712822338183011991109 480 180 570 660 720 630 450 510 540
 630 660 719 780 450 75210801140126 2 720 454 83914121439 306  821079207217401799
17091889 510 722 540 630 719 450 692 660 689 750 91912401376   0128511941009 736
 688 644 642 9181377 9191055119610561056151713 77 8731285 873 919 919 826 827 964
1057 644
     601=N   -2927=I ALT038                                         -3(20F4.0)~
102710011158 658 764 660 555 685 581 343 311 237 289 291 291 291 448 448 527 134
 632 579 527 442 631 474 5791052 95116061290 685 689 579 974 5261082 8951000 527
 658 711 632 501 447 631 658 948 658 806 661 6781097 952 72610161210 98414841000
 855 323 453 371 421 468 581 226 380 645 3551081 36216451242116211611064 984 726
 774 712 887 6141033 597 436 517 629 855 83916131032 95214861268122 7 708 747 960
1254 854117313341027116010401267140313 47 681113317341894 907 76027471000 347 402
 429 417 600 734 493 853 398 854 5071164 533 734 600 32115071054 842 494 720 708
1493 697 637 539 577 600 37912351174 557 856 398 597 538 617 498 102  79 558 577
 141 717 717 840 895 717 87612151414179113711438 1708 854 585 921 541 741 405 383
 385 876 494 788 450 540 226 202 495 832 854 540 529 607 404 607 517 924 7191079
 405 8091101 899 788 71910583101 1485 829 489 390 271 237 422 405 135 608 591 608
 726 557 591 687 879 492 119 422 338 135  91 861 558 575 574 4391081 658 9781191
 605 729 302 409 642 587 622 889 78210131351 1246 658 942 8781244 853 587 107 818
 480 551 284 604 142 373 623 929 889 5161174 8711031 960 978 534 837 7471015 858
1031 810 612 80615022698 1194 611 361 613 861 724 612 333 833 810 895 584 696 641
 611 583 389 694 778 752 945 889 896 75212221280 917 97210011140 7361084 278 500
 612 583 528 417 666 917 472 639 837 5451107 692 907 925 62411251397 454 526 454
 782 544 491 308 599 562 290 236 454 472 145 327 145 357 308 363 127 599 582 689
 400 998 490 853 600 329 291 817 835 690 980 383 765 399 564 327 363 437 128 454
 710 653 836 564 891 7441143 853 617 599 636 139 599 236 508 345 529 128 181 200
 563 690 713 124 230 435 558 363 382 142 302 133 487 487 372 336 425 549 266 743
 655 761 637 708 212 779143420181151235414 87  221753 708 921 655 832 797 903 390
 620 496 389 301 584 213 214  59 449 437 177 448 602 496 614 7801015 768 720 189
 224 6491215 874    013001564 9751119 711 691 386 813 589 853 487 447 874 488 447
 528 132  71  86  56  71  71  71 269 340 508 401 173 341 320 173 503 503 619 457
 564 487 42713311320 8941158 940 739 937 366 366 259 647 465 480 640 526 686 792
```

```
 868 899 824 747 488 777 670 777 473 686 610 807 685 731 685 609  91 564 548 777
 777 427 457 656 889 295 274 416 150 276 142 118  55 102 236 284 181 512 284 528
 402 181 362 205 426 371 173 677 315 244  96 317 481 158 386 331 292 543 567 599
 496 173 205  96 260 268 449 457 764 402 606 646 370 370 559 480 441 654 528 622
 457
     630=N   -2942=I ALT014A                                        -3(20F4.0)~
 318 410 364 295 591 502 250 410 2091773 7061318 568 133 295 364 31517061318 614
 818 205 454 591 52513861046 887 638 500 341 729 682 932 705 705 591 727 500 865
 341143236311069216016614 932 957 914111411601159223218291166131115231200 507 597
 716 358206011051314206015221075 98510452836 221419917311194 776 855 246 406 300
1553280621792643 627 687 985 83610751403134510451045 561 323 30610171493107 5371373
216413601229 410 443 6062205 312 361149313114393 1197 264 180 607 721  47 231 934
1033 820 738 951 263 197103318361285 1736 121287014271016 771 227 918 9011066 805
 706 164 476 475157413612016318027541721 8201524 199 837 770 460 623 443 2291082
10491959 852 328 460 426 295 525 590 7891311 984 393 395111510821115141 01575 798
 705 798 705 767 521 139 154 245 199  21 567 659 291 169 276 352 567 337 782 966
138026672238130317782375 1778  411257 797 490 552 123 383 538 245 414 414 598 460
 2911226 997 965 674 521 859 398 935 690 338 122 644 783 276 7051058 613 475 369
 812 965260615641165162511651180 705 9811226 99613491503143515652521117413051261
243617391478117 51479 610 556 692 696 913 391 654 784 217 609 6971307 696 914 652
 478 391 435 394 304 437 522 174 652 696 348   0 696 95710011695 871 826 7841174
1695 739 6521739 421313827832004 1765 329 423 447 612 471 847 565 424 306 188 824
 28310821177127015531388152919061271 13652059  282652 8361471  37 635 401 635 682
 941 659 5891647134115071576 682 736 368 405 497 774 479 571 626 442 958 847 975
 736 97513801343114113 44 920 665 571 493 405 939 99412151142 681 828 498 1171178
12331362 957114111421254 148 883 424 425 460 331 350 939 3681362 681128812881417
 2431068 865 718 5711013 405 644 552 479 699 6491012 631 314 957 737 847 387 202
 921 681 865 718 810 7001288 8841546 939 447 208268322141645 477 452 667 595 667
 548 381 431 786 933 596  24 453 381 190 333 429  62 619 405 667 381 501 548 810
 690 548 571 809 667 5001144 691 643 572 762 834 786 834 667 524 262 405 500 762
 819 738 429 5481000 453 619 571 8571024 857 833 810 929 787 500 714 501 738 857
 813 737 589 540 663 638 540 271 663 515 589 638 712 515 614 687 491 565 638 540
 957117813012209 1473 957 540 6881031 982   0 810 491 712 344 564 564 564 393 515
 369 859 368 663 589 491 540 589 540 344 466 613 491 589 418 466 442 589 664 859
 344 737 417 515 712 810 638 761 540 688 736 294 393 369 564 589 614 909 3441006
 564 221 638 442 442 442 442 371 393 308 282 437 667 128 411 231 667 334 566 488
 308 641 539 564 771 617 770 617 359 592 487 590 693 590 3251000 205 385 590 538
 513 564 513 461 410 333 128 745 849 744
     316=N   -2690=I ALT014B                                        -3(20F4.0)~
12801908118217101582 2006 65719292114222813311253139 61428 919 835 620 636 557 869
 636 573 7461722229713621063 764 659 8511068 623 682 531 788 445 8261079 508   0
 425 720 614 910 487 952107918652793 1046 8011292 446184620311877 1723 692 462 710
 738 492 831 80011081169 616 924 405 618 801 739 653 435 714 562 466 277 772   0
151110481296 143153916931754166418771446 1200   0 770107412841104 850 537 820 731
 418 328113313271089 1253 2241118 716 686 582 865 641 552 671 448 463 448 613 733
 512 194 300 613  47 716   01089 8201014 92410141358 165 985 731 746 224 641 925
 8351416 2091148 4921790107420 16   0169912871286 952 969 715 7941604 87321432093
20641222  22114316031254 968134912861016 841 794 651 3651175 85717631616   0   0
169010291241 639 420 567 8401128 994 763 724 613 842 774 121 417 266 186 246 462
   0 497 206 655 433 423 629 835 206 753 268   0 516 7631093 784 733 784 144 196
 299 237 435 459 636 128 636 366 617 654 441 575 598 5291060 244 341 274 403 628
 490 451 441 244 835 173 310 445 639 791 591 142 420 292 348 537 504 370 363 231
 437 373 227 396 522 363 489 504 504 268 553 624 567 371 165 506 309 340  59 374
 870 724 404 508 562 891 818 797  63 466 441 300 473 477 411 317 192 442 568 616
 602 441 283 394 110 725 598 551 174 490 189 395 679 378 346 284
     645=N   -2951=I ALT023A                                        -3(20F4.0)~
 642 470 518 355 125 74816871543 819 758 636 758 335 364 910 365 579  96 636 697
 727 697 818 607 364 364 8191273 819 455 788 697 545 9702091 576 8481000 848 727
 516124310311032 698 214 424 405 793 66711221758 7581637 519 4511162 720 743 604
 83610461743 860 92910691255165014641139 860 813 512 954 7901050 744 581 745 651
 722 88315111324 223 954 976 814 99912101070 721 8831000 8831162 837 697 698 837
 860 279 2281119 9541142 604 512 372 581 7671024 512 883 465104510221176 1264 822
 6171263 647 763 941 735 85210281205 91214401233 734 941 8231057 53610571263 529
1028 853 675 793 705 7931176 881 70511781233 793 9991439 6981070 721 699 651 604
 837 7211047 9541186 976 9761373 7211047 628 744 442 489 651 744 535 535 604 954
 792 739 93012791256 9531325 814 722 465 496 372 583 488 511 79114881558 14431954
20461680207028602001181411 23 9521050 830100010731317 1000 658 853 829 975 878 683
 780 439 321 219 124 245 245 634  77 415 367 561 586 484 585 488 658 878 439 756
 51315121341 683114610481000 1292 8051024 683 683 829 683 539 978 757 587 829 634
 805 853 829 8541609 732 756 829 610 610 683 488 513 683 390 586 325 323 312 811
 345 662 195 488   0 853 585 536 634 536 708 975 634 536 512 464 418  91 254 364
 583 547 291 310 618 657 747 800 709 763 729 836 692 782 727 600 618 636 800 582
 673 636 509 509 855 674 627 763 618 618 855 655 690 964 818 8181436 727 673 782
1000 727 909 600 655 655 583 474 582 438 474 400 273 309 318 291 291 420 382 400
 546 527 582 709 545 345 201 185 266  92 123 170 370 339 155  46 279 231  78 293
 277 154 170  94 139  92 155  62  62 308 108 308 325 339 262  93 450 569 415 462
 492 615 616 462 400 431 323 386 326 215 187 416 247 308 616 292 431 239 385 231
 169 262 416 385 416 308 418 123 185 139 108 124 139  46 323 431 323 308 262 124
 123 215 385 416 385 262 124 323 293 155 155 215 323 400 308 302 400 678 616 600
 585 139 139 170 369 677 432 415 554 308 739 600 539 462 462 524 692 831 600 677
 569 494 693 386 539 372 508 108 262 233 339   0 662 569 585 667 700 450 684 584
```

```
 8511150 633 867 750 583 417 567 167 467 434 450 583 367 700 234 551 500 583 517
 567 250 467 318  83 333 385 683 450 650 634 417 684 500 567 617 768 967 933 951
 917 917 917 2841000 767 817 786 483 283 800 484 486 867 650 639 717 484 384 333
 367 350 800 267 467 318 302 600 8171067 901 384 884 900 576 729 491 543 458 424
 679 661 627 848 576 881 729 9501103 951 8301031 712 594 382 328 346 655 440 115
 236 236 207 237 183 225 270 345 129 314 285 239 132 203 190 362 318 296 278 265
 115 296  98 230 455 380 322 332 385 129 190 147  93 392 386 260 357 371 375 420
 481 617 517 328 460
     566=N    -2946=I ALT023B                                           -3(20F4.0)~
11451344 944 658 730 7571192 570 6491516 681 684 636 6361712115515151615 669 531
 498100026951387 909 7651034 648 521 915 842 9961145 782 65019722442 8471098 765
 707 589 430 772 56919771658 611 861 694 639 667 695 556 473 80610842308 835 278
10101390100014451250 891 8061056 667 722 750 806 750 833 750 834 69510591306   0
136115291393114017801225 8891001 946 83410841003 722 917 750 669 111 18411111057
1055 694 583 6951000 9171061 7231139 61113911139 9171084 695 6121306 778 889 806
1000 94514441418117310431043 652 826 7391000 522 7821217 7841478 956 739 826 674
 717 870 848 96011981587 93813771836 610 982 784 937 913 717 827 456 957 695 869
 979 9561282 6521479 783 805 370 435 679 958 742 766 610 870 8491065106614601413
 782 913 848 697 370 420 458 485 587 567 849117714292349221819081583126721551398
1267 993 844 929 816 9281072 98411551075 963 8491243 911 705 855 574 465 212 510
 338 359 682  99 229 326 627 698 544 805 7981084 943 9271098 97418461533 891 971
1245 9741112 7331017 691 7601005 794 651 735 932 509 965 904 8181215110014292325
 7541288 717 799 8431109 909 887 998 554 732 688 444 421 820 421 710 111 599 111
 687 555 621 624 865 754 843 444 444 534 578 310 133 422 488 757 578 266 377 643
 798 621 776 488 621 643 643 194 666 80810171131 8751056 744 846 808 520 518 600
 374 404 259 358 324 342 486 580 697 623 652 600 260 244 244   0 259 552 460 583
 783 568 483 651 522 499 348 349 348 357 196 170 237 227 401 288 480 606 551 448
 355 214 278 308 124 114 193 299 165 279  81 195 144 369  52 143 152 272  94 266
 451 122 438 165 215 185 279 114 259  82  36 559 690 737 464 145 490 308 531 372
 291 300 502 250 352   0 524 226 408 387 184 291 103 314 162 202 364 264  56 191
  56  98  40 133  81 206 187  96 221  88 162 129 258 233 352 200 514 219  48 233
 361 144 428 510 283 563 566 572 268 426 417 201 124 122 456  70 290 272 158 682
 778 404 160  69 178 516 530 721 278 748 567 282 784 394 903 421 726 232 475  68
 330 573 357 483 685 716 239 402 602 571 8181047 689 628 407 185 120  79 353 333
  69 379 404  72  97 353  67 464  67 238  86 420 360 656 566 463 648 243 783 413
 611 749 751 887 898 984   01076 883 954 344 998 491 395 531  99 751 331 330 839
 544 473 599 377 367 454 437 518 675 216 397 390 676 640 904 745 5152190 1221493
 717 950 475 689 586 496
     414=N    -2962=I ALT012A                                           -3(20F4.0)~
 941 659 722 659 472 533 816 900 2161255 910 580   0   0 141 502 769 988 628 769
1036 487   0 393 502 643 3051020 737 597 439 769 392 408 533 408 549 549 471 675
 754 471 424 690 847 816 739 759 675 347 173 347   0 487 535 707 361 189 122 141
 204 439 533 345 220 125 110 189 345 440 424 816 674 722 330 204 188 300 440 800
 926 722 424 111 220 361 392 816 519 628 659 816 832 800 690   0 486 472 338 565
 643 659 581 675 566 236 345 722 506 506 690 414 575 414 184 185 437 506 368 460
 737 965 974 690 529 506 713 368 345 253 460 391 437 299 506 414 437 322 322 299
 667 644 598 598 460 483 690 851 828 598 667 713 667 944 897 874 529 599 185 369
 283 215 169 399 175 276 569 475 537 414 5671027 6741303 521 692 628 383 569 644
1012 8431211 79811661057 767127310581333110411341150 9201349 981 905 920 736 782
 4513191058 9041502 797 9351035 966 674 8131195 981 7841536 847 941 941 9721003
 721 440 346 502 627 471 376 314 502 408 470 408 470 345 471 345 237 188 423 212
 353 635 423 541 470 588 471 377 259 447 658   0 917 705 917 8941105 96410371199
 7531011 330 588 964 353 494 259 613 517 588 6821035 353 753 3301741 9771071 477
 452 643 452 501 500 286 120 276 321 298 429 238 238 286 429 441 381 798 179 464
 250 190 145 882 702 726 655 536 702 631 298 548 381 417 631 596 66710841000 953
 595 536 5481071 678 440 583 405 480 369 608 714 619 560 322 595 643 5831393 845
 8691003 774238416511384 907 825 87210001210 372 883 221 709  81 151 163 558 686
 7681396  941407  61 849 806 243 500 197 530 213 9851318 1823241 6211985 3492393
10151984 244 757 666136311061893 2131166 802 116 362 478 2201461 2331811 2201099
1191 93210861514 948118510991746 9061359 49113711235 937
     278=N    -2964=I ALT012B                                           -3(20F4.0)~
 616 86016741720 927 77010021159 853 943   014861055 747 739 704 256 437 7501333
1041 425 896 808 514 264 528 528   0 718 469 498 396 733 308 528 572 718 791 718
 762 909 762 586 557 6891114 659 689 660 733 250 147 352 337 66011441084 924 308
  86 323 484 572 953 674 454 352 205 337 308 425 352 665 9391027 396 441 425 455
 734 95614161038 713 110 110 144 356 494 474 625 553 6621183 987 620 605 500 464
 390 486 702 661 846 941 702 340 454 680 548 586 623 473 246 207 171 151 419 698
 378 510 606 947 913 793 396 454 868 509 473 398 603 494 664 339 585 396 330 142
 283 170 662 631 671 537 497 297 725 672 471 416 875 594 968119611021102 645 175
 819 250 368 193 249 175 241 157 352 147 250 184  93 138 102 631 305 315 259  73
 389 449 433 425 524 535 543 682 499 728 801 872 785 825 705 62710921047 9581016
 958 992 1211320 992 9981347 531 8841020 902 778 752 899 928 6581114 884 8241046
13901248 868 403 359 703 585 7581062 6711170 86616681430162514511560129916051149
11981022 83013871175123912021043 914 997 932 977 872 542 912 328 716 716 630 628
 651 869 477 739 326 524 826 238 567 369 499 520 564 715 672 484 616 326
     764=N    -3018=I ALT016A                                           -3(20F4.0)~
15791475339440791842281523161291349927103195247529932212401843142019398622842341
40804080414286506247480371826070312050492048255546982695405640601799337832372928
4707389339752315240015672187 825210418971485199039722441518137794338335622602491
14551782189141101235165621881529189811841243 83127152312135818052150149817911570
1250 706 622 840 7671495 731113012751055 936119710951470 687 821 446 514 6161204
```

```
 9922704 924133712331854 719 78711361510 582 705 382 664 456 939 946157921731810
18241129 9601231102613681128147011 36 616 890 685 650 581 924 755 480 685 513 615
 517 650 725 827 691 5511141 57312871049 476 324 615 954 454 797 774 432 295 342
 660 432 637 5701297 764 591 561 468 316 376 633 773 843 610 355 209 406 356 366
 356 285 550 194 397 397 406 630 328 367 331 610 359 232 281 367  94 132 388 478
 203 194 457 722 705 439 621 660 165 114 309 122 285 519 481 353 303 331 266 503
 403 468 656 381 503 518 3161128 575 827 618 877 403 884 553 812 690 525 640 870
 988 590 232 584 116 325 316 194 144 295 367 254 303 499 209 275  32  94 152 216
 254 397 481 596 511 173 453 546 575 503 582 523 500 773 500 523 659 613 527 386
 409 410 410 408 136 319 454 523 250 250 228 159 187 296 273 364 251 182 161 182
  91 204 296 295 409 206 364 321 274 204 457 273 525 386 796 319 341 432 341 409
 479 227 386 296 387 409 410 409 227 387 387 227 454 432 159 114 432 410 457 296
 500 593 660 478 454 400 364   0 568 344 636 500 591 296 355 308 387 387 210 355
   0 554 478 424 430 419 113 390 345 149 345 241 247 146 180 196 310 228 324 212
 114 395 282 250  65 146 195  87 168 161 153 383 215 206 388 340 294 356 421 526
 377 242 228 490 307 390 469 242 468 145 342 180 178 260 162 226 355 323 178 294
 468 502 500 323 196  98 275 390 431 264 148 203 283 328 119 192 248 283 203 280
 155 338 244 270 104 382 476 169 135 239 322 386 295 457 632 679 710 807 680 788
 7101006 295150317981896 1871126138114081250112714861368158622091794201021 10 689
12001311104510 67 2251756 978 534 911 422 243 756 7341134 578 7781023 624 426 205
 378 645 667 378 7791000 689 689 734 689 845 803 711 245 356 445 356 423 512 378
 644 422 111 425 600 623 489 444 113 557 423 378 356 179 178 223 447 515 423 556
 600 183 336 268 380 380 491 422 334 556 356 422 511 400 168  95 137 327 305  63
  53  11 358 505 347 305 295 284 347  23 264 263 190 285  97 183 118  99 232 337
 137   0 268  74 421 285 358 474  85 443 347 453 317 264 253 106 127 107 316 379
 481 369 348 379 232 442 106 284 179 389 295 242 432 316 326 347 192 274  74 158
 158 265  95 233 190 379 369 432 316 463 243 274  74 295 286 328 221 182 317 147
 242 212 265 128 190  95 169  54 116 147  84 211 221 221 133 358 137 242 422 274
  84 264 137 338 391 368 307 326 295 208 327 313 406 231 391 277 154 334 223 428
 307 493 343 454  90 533 476 447 542 444 437 579 449 443 474 400 551 498 445 670
 752 553 408 702 763 557 603 504 419 287 112  97  42  63 523 122 157 236 201 331
 221 413 6081312 604  98 333 188 7261443 695 360  73 433 152 178 440 256 331 520
 669 836 158 178 119 121 1301907 251 142 216 194 127 205 186 166 404 218 238 181
 985 137 224 175
     625=N    -2971=I ALT016B                                         -3(20F4.0)~
 954314721001236135322941354202520964036291119961623 923 73811982240 590 781 881
 186 714 682 998 43410051178 6331075 851 83510421084 604 652 385 533 205 714 285
 419 639 601 476 785 711 704 599 806 649 195 662 948 6641074 884122610121611 953
10401704255325182114 92015711082 809 77312501636100113251144111615861068156415 40
16161560 8061285 514 574 416 245 489 183 416 257 295 330 357 519 392 395 175 433
 127 784 311  66  23 177 281 263 476 538 497 193 467 464 474 514 347 890 362 263
 436 126 113 218 535 660 912 779 758 355 394 665 792 682 633 880 564 502 722 532
1034 377 534 430 820 732 744 665 516 453 388 594 641 692 515 628 754 954 589 839
1065 264 425 501 413 5631026 391 464 300   0 276 465 313 376 689 276 438 400 275
 738 725 738 550 713 413 888 638 638 988 713 663 7631263 694 506 756 658 613 470
 377 362 109 445 151 361 151 486 161 380 426  63 130 308 380 517 688 728 359 543
 76910951068 824 562 503 528 303 495 521 386  94 294 319 261 286 185 146 349 437
 252 109 252  59 229  94 203 177 286 344 416 109 177 161 437 432 281 487 487 596
 505 755 495 682 345   0 327 763 433 521 535 413 601 630 419 823 783 551 599 666
 779 412 560 777 263 672 467 226 277 376 452 442 334 543 587 576 302 361 313 196
 301 485 363 513 483 455 407 406 451 437 436 362 406 392 496 391 453 376 317 316
 376 180  91 332 271 287 180 176 230 319 317 410 198  45 257 241  91 106 287 195
 346 346 407 240 195 106 106 286 302 106 256 257 391 226 240 301 466 526 556 584
 346 307 412 314 458 320 327 320 294 374 144 165 170 151 243 275 386 399  91 262
 289 360 459 197 289 178 237 251 414 243 336 270   0 422 523 396 568 533 495 441
 405 344 569 408 389 509 131 367 235 264 283 480 325 296 369  78 408 341 112 240
 485 259 336 246 472 317 448 315 400 280 224 399 166 349 397 259 688 345 955 498
  55 621 688 65622462851323811581166 1628 732 333 611 214 206 271 438 175 679 336
 377 446 277 315 448 198 128 292 353  69 226 251 212 394 424 367 310 218 379 131
 440 171 132 300 275 638 75113441454100 71359 567 760 9101073 849 669 479 248 284
 667 617 460 427 532 136 242 262 313 198 319 223 171 278 181 238 131 233 237 217
 182 212  71 248 197 197 258 156 126  66 222 328 343 268   0 297 151 389 222 277
 288 217 192 222 282 540 876 398  93 233  81 222  77 156  75 149 123 300 252 109
 258 201 850 135 319 180 295 320 229 302 282 251 260 353 461 262 123 223 364  89
 318  82 178 221  96 188 277 370 257 127 138 297 154 169 236 141 354  55 208 257
 185 139 278 322  93 635 421   0 449 192 235 393 219 323 240  84 168 327 167 130
14161864 171 114  81
     504=N    -3080=I ALT015A                                         -3(20F4.0)~
 194 435 7741041 72617671355 629 557 436 435 509 556 775 5561113 412 339   0 532
 411 266 145 242 315 364 484 218 339 605 799 774 335 943 435 315 303 387 315 460
 266  731041 654 798 703 508 339 750 678 436 438 5091380 726 435 484 919 847 847
1016 556 896 411 484 726 677 532 992 895 653 363 242 132 435118613311017 726 702
 992 726 823 799 92010402057 643179916062313122111891001138511891253 803 386 739
 835 193 8671414 9001287 964 578 771 867 964 7401157 67513191029106 51253 803 515
 804 7391028 803 867 611 38613511189 7712957 2141640 932 6431092 964 96417991479
15761478218517672001 675 54617671896215322491191 1079 984 954 7461063 810 889 524
 652 8731191106413511493122214451191 1209 317 46110631111 98612221937133410 64 714
111212701349 762 492 715 794 905 874 397 333 370 652 508 63512061651165114131413
13971016 952 984108011121365 921 635 508 731 82611751080101611 75 6361018 954 763
12382191152414611809152413 97 765 699 762 82612061048136511 76 929 993 835 882 551
 362 425 457 5681118 94513391228 929 740 772  94 126 788 725 83511191039122911 19
```

```
 5201087122911351118 850 4751071 7091041 725 789 662 583 757 661 850 583 504 363
 662 426 488 489 504 363 410 189 331 174 284 221 363 488 458 409 425 583 411 425
 473 236 520 457 583 568 725 83511821072 363124412441025 425 505 803 96310711277
1513170112301010 82111971103 9761260 8841008 879 683 585 757 488 756 805 927 854
 951 415 711 488 659 585 513 636 537 317 317 439 659 854 878 903 8291073 6101026
 9761223 546 466 562 675 418 386 482 578 562 578 546 466 594 626 675 755 434 193
 225 498 227 466 354 482 675 466 723 691 739 707 707 803 8521028 708 771 771 611
 482 353 514 482 274 548 337 106 627 788 614 546 450 514 498 627 482   0   0 755
 758 386 418 724 579 610 675 626 691 546 6911013 675 610 91615261558 1045 932 803
 579 305 451 546 450 530 595 675 498 602 676 723 578 321 594 755 675 675 514 450
 355 257 306 385 498 883 482 450 258 337 530 289 241 370 466 578 723 643 627 628
 756 626 611 868 355 643 675 482 482 451 642 578 8351060 579 610 578 642 578 772
 610 546 450 546
     454=N   -3074=I ALT015B                                          -3(20F4.0)~
 673 606 725 453 349 272 312 440 519 596 324 349 414 544 466 285 218 259 349 414
 518 286 285 556 789 543 4791152 196 236 234 275 234 662 480 207 339 602 962 831
 751 597 421 249 222 148 236 494 469 249 325 510 536 392 513 254 475 338 318 550
 338 380 528 528 718 380 296   0 380 613 6661099 720 518 401 285 444 560 486 560
   0 159 370 5921110 709 963 62811871361 1016 764 467 81610591133   01240 467 693
 522 256 404 4861000 921 860 449 637 336 599 598 938 860 573 336 424 162 174 187
 9813721358 4361470 44711711171 59913961309 773 99715591346 89810971072 623 199
 225 162 487 523 636 486 436 7731570280438402054 1362 724 702 319 404 447 4681959
10961128 394 394 724 223 500 521 683 862 660 521 596 436 235 330 42631392 1061394
 750 430 280 350 780 870 560 670 480 480 90012201070 770 420 8201000 99010901010
 720 630 300 280 710 581 731 570 53010501222 7021224 882 820 844 770 6581217 559
 882 559 249 199 186 658 869 85910181242 7951044 982 782 869 807 4971242 9312198
2175303020911556 695 57311021266110214311224 1307 735 7371000 939 653 510 184 471
 368 185 349 469 248 205 225 309 636 755 817 715 755 858 429 512 228 348 431 512
 248 144 416 144 410 705 802 926 755 564   0 748 565 700 663 626 675 761 663 810
 774 860 985 731 126 807 580 605 686 347 448 426 538 571 673 675 370 123 303  78
 101 270 560 247 381 157 191 292 415 448 483 583 518 146 350  45 146 371 336 168
 348 595 594 549 527 527 336 571 695 7731132 987 415 771 93013801315118912521125
 935 99810271190 819 866 723 613 919 726 742 726 456 113 420 144 179 434 369 433
 594 402 707 514 642 690 675 706 690 770 642 594 642 491 357 351 497 403 339 439
 222   0 246 117 444 193 322 310 398 393 211  58  58 364 246 287  94 276 317 164
 310 263 604 649 772 895 731 865 637 719 795 298 737 465 465 419 388 527 419 651
 838 451 465 465 496 527 527 685 667 682 605 527 605 709
     542=N   -3082=I ALT107A                                          -3(20F4.0)~
10791026 8691001 81611321158 14741079 92110001026123812671264123713951238 921 632
 711 842 737 789 8441000 816 842 711 526 500 580 737 526 584 526 448 447 289 447
 553 816 684 553 369 343 421 396 289 396 658 500 553 737 658 816 527 448 396 421
 711 606 606 632 737 711 606 501 421 342 291 263 160 237 264   0 128 529 975 746
 653 414 763 415 700 635 287 206 286 190 493 286 604 332 415 730 716 683 6701223
 858 861 975 866 9881183 853 902 622 390 634 378 512 366 317 366 402 317 512 464
 695 683 646 719 2311000 9271073 1421207 817 720 476 256 622 305 341 350 342 343
 456 374 309 358 520 277 293 277 195 374 553 52011221220107315121561 12681146 586
 318 463 391 634 512 537 342 414 805 732 634 658 707 440 463 244 268 197 146 317
 537 391 561 463 539 390 367 585 294 318 219 366 439 318 245 195 439 80513171561
1952125524311501 982 873 327 474 327 291 328 237 273 203 273 347 327 310 345 237
 527 400 219 582 327 655 784 437 782 309 201 273 273 219 564 618 364 382 328 273
 364 564 654 382 655 400 963 618 729 818 783 600 400  88 474 692 600   0 473 291
 474 183 291 328 182 400 350 129 273 400 164 221 382 273 604 106 655 436 183  91
 473 364 311 364 327 255 545 309 800 909 927 764 746 909   01019 382 142 400 674
 710 273 332 364 237 418 600 774 618 8591492 488 545 645 402 631 172 244 301 258
  91 236 258 104 187 230  77 316 260 231 187 236 146 130 132 144 144 158 186 230
 244 158 201 233 420 316 230 344 459 459 244 258 189 187 174 301 143 115 143 144
 143 158 215 416 473 373 502 358 717 430 273 273 244 272 230 258 517 287 173 158
 158 158 173 203 359 173 245 288 330 230 217 187 244 186 101 100 130 272 287 130
 158 116 144 129 260 173 430 258 172 143 201 157 215 158 574 229 172 373 273 659
 201 516 252 204 559 562 269 222 442 505 441 312 226 302 388 265 227 349 310 212
 242 198 235 152 181 439 363 235 242 129 121 310 281 297 265 167 396 204 220 220
 250 371 295 379 190  98 167 333 433 272 266 219 469 333 355 265 431 243 189 348
 364 273 220 129 189 273 220 303 476 522 356 341 383 262 306 217 103 193 147 420
 306 388 522 613 511 363 216 181 204 193 148 193 148 204 352 374 286 103 340 238
 411 242 348 333 257 136 121 273 423 560 303 318 212 202 212 197 273 154 182 227
 181 258
     515=N   -3083=I ALT107B                                          -3(20F4.0)~
1116 768 744 628 746 76710931395172511861093121011391419135013721377 20831536 978
   010701397 95311861071 1140 698 767 744 698 625 575 450 501 550 650 475 575 425
 551 627 725 575 502 378 225 150 251 150 325 400 475 675 925 700 875 600 551 400
 376 551 401 451 526 625 476 602 450 426 375 200 289 100 177 250 125 142 426 725
 650 501 376 575 351 625 725 526 403 226 103 200 127 351 325 502 625 526 575 754
10751050 850 796 612 674 776 531 632 857 816 899 714 980 816 471 490 473 246 327
 225 367 307 327 307 168 633 449 470 221 715 551 632 572 367 514 490 469 451 428
 530 491 390 307 44910421572 472 625 737 514 431 333 180 666 514 7501042 944 500
 625 403 348 375 194 320 208 278 223 153 195 125 125 292 238 167 195 236 264 153
 167 139 139 306 250 417 403 389 265 112 320 221 289 334 445 417 403 805   0 989
1140 916 875 916 556 570 667 458 181 236 292 347 250 250 208 281 278 347 542 444
 458 570 430 133 667 431 444 819 431 680 820 542 584 528 347 347 264 278 444 944
 458 458 167 306 195 430 366 473 361 444 253 251 333 194   0 224 278 180  78 139
 347 473 528 542 307 223 431 417 431 501 500 321 471 263 209 405  33 177 157 353
```

```
 168 471 423 189 344 167 206 451 137 549 451 774 598 618 541  79 795 217 202 314
 647 843 344 333 432 178 353 5981010 598 5391176 765 284 784 374 716 167 255 491
 559 392 402 491 315 118 284 431 235 353 274 314 295 129  81 186 139 210 118 189
 119 197 102 218 256 186  89  90 179 268 237 177 208 138 100  69 202 110 108 162
 206 469 376 210 395 187 704 582 456 488 416 574 721 511 394 355 533 355 262 210
 108  92 131 133 131 185 333 211 303  67 250 118 210 305 183 187 157 133 162 118
 236 181 162 178  78 453 137 119 217 280 203 101  92 101 281 313 112 224 269 325
 258 124 236 538 325 313 269  67 127 157 179 213 203  56 146 416 302 168 235 358
 103 168 204 235 101 560 494 313 347 246 260 281 280 101  90 180 370 460 325 381
 616 505 537 369 459 114  90 190 336  92 134 149 150 104 463 477 269 194 418 358
 343 299 224 298 313 224 224 209 224 284 209 298 329 343 388 328  76 195 209 254
 329 135 434 448 405 239 134 315 466 791 970 673 642 358 373
     702=N   -3116=I ALT082                                          -3(20F4.0)~
 9631443134216451747134319751848146911141291113914171544184811641191 860 6581063
 7851272101410891215179 7 9871038189915351157 565 594 834 7021588 404 619 9951373
 699 5391187 377 834 673 61913191049 99612661534 888 566 512 538 592 457 242 968
 942 8881211 91513791293164 1 675 9821509 69717121411190614761027 1084 814 775 945
 446 471 7271328 851 878 631 579 289 424 223 223 135 201 223  50 178 453 653 380
 870 814 942 312 603 372 314 248 292  89 135 205 323 312 340 431 540 205 179 205
 275 851 749 540 356 270 275 223 226 183 226 226 135 183  44 162 140 211 449 345
 232 361 275 179 140  92 190 267 183  87 162  79 190 323 759 636 270 275 106 275
 588 518 436 884 719 311 402 211 179  92 135 162 248 289 576 409 588 8841002 915
1102 890 489 400 155 266 778 848 355 289 289 178 245 358 333 155 178 133 244 449
 400 155 245 157 133  92 155 205 289 489 515 155 312 577 289 555 555 422 578 377
 241 445 119 778 555 402 712 579 334 266 4221001106614471124 895 534 267 190 209
 248 248 286 343 629 514 552 781 611 667 364 362 324 267 209 248 324 648 535 250
 286 229 555 591 400 876 516 172 210 171 267 286 362 876 457 495 800 514 476 438
 699 707 70511431067 914 628 229 232 191 171 171 362 305 248 267 4191028 591 476
 267 438 324 476 571 553 305 438 324 383 209 209 457 158 954 705 534 553 419 609
 667 400 286 190 152 190 496 362 438 383 133 419 457 343 209 419 326 495 419 743
 592 533 687 609 8201028 374 243 188 131 114 262 187 188 225 280 355 991 523 187
 112 206 281 280 224 225 318 168 169 168 224 168 114  77 151 150 168  57 206 131
 168 131 169 206  77 150 187  77 112 206 131 112 169 304 805 937 9561049  75  95
 444 118  77  75  75 224 363  75 318 396 505 131 374 132 168 150 188 393 243 244
 225 318 413 188 487 579 206 168 244 318 168 168 131  75 301 132  37 191 132 131
 132 436  95  77 188 114  77 151 169 191 132 168 132 187 268 355 356 336 392 449
 246 187 177  77 172  56 225 172 195 114 227 136 118  93 224 243 187  93 112 206
 150  93 132 112 224 172 150 112  93 114 225 132 150  95 131 206 206 243 112 112
 150 188 150 112 131 187 206 244 131 224 168 151  95 187 206 188 262 393 374 355
 262 227 172 169  95  59 172 142  75 150 225 114 188 136  56  75 131 243 187 206
  56  97  93 150 281 150 188 243 151 112 169 187 206 131 209  75 206 187 136 114
  84 114 151 169  42 188 169  95 132 151 300 154 114 337 318 321 224 151 224 243
  93 224 151 131 131 131  75  93  91  97 131  93 206 206 191 112 112 131  75  75
 169 206 236 243 226 243 201 344 343 219 184 201 302 503 164 234 140 237 105 175
 164 246 211 164 164 187 140 182  94 211 189 140 152 351 354 248 106 222 294 167
 273 142 239 164  70  70  94  70 122  83  44  96 227 165 273 446 269 379 262 239
 296 312 241 298 257 202 281 187 176 177 140 190 258 305 234 444 270 304 211 316
 246 305 375 409 175 304  81 351 257  93 211 222 410 468 409 234 433 398 318 333
 296 177
     236=N   -3160=I ALT075A                                         -3(20F4.0)~
17721081196917691380 98811841475127815731573206416711969157620672753177221631674
16741573187010861180147814551830 890 89012191313149914061 937 611239015941079 751
 6561172 562 704 8431125 891 938 984103214061546 849 891 564 564 515 4691079 703
 658 984 8901172 703 937 564 562 471 515 658 890 658 985 937 422 750 570 796 938
 656 849 611 833 424 796 704 666 562 193 656 517 798 93710321180 938 6581268 845
1640 864 213 969 428 323 323 409 534 323 698 586 594 962 586 564 488 751 698 692
 646 534 541 586 481 428 522 717 719 672 616 777 541 800 798 612 533 599 478 515
 66810671232 422 695 563 454 511 426 402 349 586 349 380 428 373 323 402 349 426
 642 428 668 695 432 454 534 478 9651085 454 768 588 272 204 148 182 182   0 385
 317 610 769 497 5651175 700 971 520 677 520 294 384 345 227 317 339 361 384 452
 542 542 565 565 452 634 170 520 565 497 474 406 406 368 407 361 384 385 429 431
 294 384 499 249 452 271 407 587 384 384 361 294 384 112 249 203
     191=N   -3143=I ALT075B                                         -3(20F4.0)~
30092779270227411941186512961409144713701676133314481279114011421000 79110461233
13021140 885 7691116 728 628 643 671 557 715 642 657 714 699 614 8281070 928 828
 699 514 528 400 701 728 585 671 565 462 497 396 398 429 495 561 595 694 330 826
 561 429 697 460 661 795   0 528 363 529 535 628 431 467 793 894 991 8921223 694
 826 892 6941024 595 110 661 497 429 429 494 892 49713541156 595 661 497 432 307
 396 429 528 497 628 561 727 727 793 925 991 778 744 678 412 500 501 489 411 289
 556 478 456 534 456 589   0 400 500 656 478 600 667 422 600 478 322 511 512 511
 589 523 623 878 834 778 878 833 490 645 734 756 778 511 600 356 244 368 322 322
 345 221 312 179 433 533 467 601 756 722 378 800 744 856 589 745 513 556 422 511
 378 467 445 323 456 378 300 356 389 309 389
```

APPENDIX C

Spatial Distribution of Altamaha WMA Trees

We collected the vast majority of specimens from two locations: 1) trees lying near roadways, which could be accessed in vehicles and 2) trees buried in ponds where large numbers of samples could be obtained. The P.I. and collaborators hiked around the WMA impoundments on several occasions to locate ancient trees and mark them for subsequent sampling. Since our DNR collaborators had limited time to help with the sampling using a 4.5-foot long chainsaw, we selected the ponds in which the largest number of samples had been located for sampling. Northing and Westing for these trees and other (modern) trees recovered from Sapelo Island is provided in Table 3.1 in this dissertation.

Mapping of the trees sampled at the Altamaha WMA (Figure C.1) may indicate that older specimens are generally located in the eastern (downriver) portions of Butler Island. It is unsure at this time whether this is simply a result of sampling happenstance or whether environmental factors (e.g., sea level regression that allowed establishment farther downriver) may play a role in the spatial distribution of ancient trees at the Altamaha WMA. Future sampling of more specimens at the site when they are recovered and located, particularly in as-of-now unsampled ponds, may help to elucidate the spatial distribution of the Altamaha WMA trees.

Figure C.1. Locations of buried recovered trees sampled on Butler and Champney Islands in the Altamaha Wildlife Management Area. There is no clear relationship of spatial distribution with ages of trees, but, in general, the older trees sampled were located farther east (downriver) than the younger trees. The reason for this distribution is at this time unknown.