Kentucky Journal of Undergraduate Scholarship

Volume 1 | Issue 1 Article 4

May 2017

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Cover Page Footnote
Special thanks to Dr. Jon Endonino for giving me the opportunity to work on this project and supporting me through it. Thanks to Dr. Jonathan Gore, Director of Undergraduate Research & Creative Endeavors. Nicole wells, Graduate Editorial Assistant for the Kentucky Journal of Undergraduate Scholarship, for the help in editing and presenting my work. I would also like to thank Biologist Barry Billets from the Gulf Archaeology Research Institute for his help with species identification.

Bivalve Stories and Snail Tales: Reconstructing the Late Archaic Environment at the Tomoka Complex, Northeast Florida

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Abstract: *Mollusks inhabit specific ecological niches and can be used as proxies for past environmental conditions. Changes in the composition of molluscan assemblages register changing ecological conditions and offer an opportunity to examine human responses to environmental change. This paper presents the preliminary analysis molluscan species from the Late Archaic Tomoka Complex in Northeast Florida. Changes in the species composition and frequency of mollusks coupled with the available radiometric assays are used to reconstruct the environmental conditions during the occupation of the Tomoka Complex and, importantly, the environmental conditions attending Late Archaic mortuary mound construction.*

Keywords: mollusk, Tomoka, mound, environmental reconstruction, Late Archaic

Mollusks can be used to determine and reconstruct the paleoenvironment of a given area (Claassen, 1998). Because of the specific ecologies of mollusks, they can potentially tell us about environmental changes through time by examining changes in mollusk species composition. This paper presents an analysis of mollusks from two non-mortuary mounds (Figure 1) at the Tomoka Mound and Midden Complex (8VO81) in Tomoka State Park, Volusia County, in northeast Florida (Figure 2). The purpose of this research is to examine the relationship between ecological conditions hinted at by the presence of both freshwater and marine mollusks at the site and the construction of Late Archaic mortuary mounds. By examining changes in mollusk species composition and the timing of those changes, and comparing this to the chronology for mortuary mound construction, it is hoped that we can move research related to the ecological context for mortuary mound construction forward. What was the nature of the environmental change; when did it occur; and did it occur before, during or after mound construction? If the data shows a change in subsistence patterns or collection preferences associated with environmental change, it would be the first step in establishing correlation between mound construction and the environment. The analysis presented here can help answer these questions. The relationship between the environmental change and people's adaptations is at the forefront of this research.

Background

The Tomoka Complex lies on the west side of a peninsula between the Tomoka and Halifax rivers less than two kilometers from the Atlantic Ocean. The mollusk assemblage spans the entire site occupation and has revealed details of the environment associated with the origins and the end of mortuary mound construction at this site during the Thornhill Lake phase of the Mount Taylor period, from 4960-4447 cal. B.P. Tomoka was first investigated and documented in 1882 by A.E Douglass.Douglass (1882) focused his efforts on Mounds 2, 5, and 6 - the three largest mounds at the site - and Mound 6 in particular. In Mound 6 he found eight bannerstones in two separate caches and these bannerstones were the only thing of note that he found. Douglass (1882) claimed there were no burials although later researchers have found burials in six of the ten mounds (Endonino, 2014; Griffin and Hale, 1946; Piatek, 1994). Bruce Piatek worked at Tomoka in the early 1990s and established that Mound 6 is a Late Archaic mound dating between 4813 and 4447 cal. B.P. Piatek also verified the presence of human remains and both freshwater and marine mollusk species (Piatek, 1992, 1995,).

Work at Tomoka continues. The Tomoka Archaeology Project (TAP), led by Jon Endonino at Eastern Kentucky University, began in 2013. The TAPs goal is to determine the social and environmental conditions attending the emergence and cessation of Late Archaic mortuary mound construction. Stage I determined the number and age of the mounds at the site. Stages II and III are aimed at paleoenviromental reconstruction, determining subsistence practices, investigating non-mound deposits, and spatial pattern related to on-site activities and community patterning (Endonino, 2014).

Method

Data for this analysis comes from two 1-x-1m test units placed in Mounds 1 and 4, respectively. Excavation proceeded in ten centimeter levels within natural and/or cultural stratigraphic zones. All sediments from general levels were passed through a ¼” hardware cloth. In order to recover small artifact classes, a 50-x-50 cm sample was taken from the northeast corner of all levels in each test unit and screened through 1/8” hardware cloth with all contents retained in the screens bagged and returned to Eastern Kentucky University’s archaeology lab for processing and analysis.

In the lab samples were separated by class and when possible to type. Mollusks considered in this analysis were further sorted to the highest possible taxon. Identification of the most common species was accomplished using Mikkelsend and Bieler’s (2008) *Seashells of Southern Florida* and Abbotts (1995) *American Seashells*. Biologist Barry Billets from the Gulf Archaeology Research Institute (GARI) was consulted in identifying the more difficult specimens and verifying the common spices identifications.

Following identification, the total number of specimens (NISP) was counted and weighed. Minimum number of individuals (MNI) was also determined for each mollusk species. The counting and weighing of *Donax variabilis* was done differently than the other species because of the sheer quantity of shell. *Donax variabilis shell* from each stratum was weighed, 100 shells were randomly selected and weighed. These 100 shells were used as an estimate of the weight of 50 individuals. The weight for all *Donax variabilis* in the level was divide by the estimated weight obtained for the 50 individuals. This provided an approximant MNI. An approximate NISP was obtained by simply dividing the weight for the *Donax variabilis* from each stratum by the weight for 100 specimen sample from that stratum.

Once data on the mollusk species present were collected and organized according to stratum and level within Test Units 1 and 5, the vertical distribution of "indicator" species for freshwater, marine, and brackish environments were graphically displayed as histograms the histograms allow for an assessment of their relative frequency and, thereby, a means for identifying changes in the local environment through changes in certain mollusk species. Accelerated mass spectrometry (AMS) dates from the top and bottom of Mount Taylor shell deposits for both Mounds 1 and 4 allow us to estimate the timing of these changes in relation to the construction of mortuary mounds at the Tomoka Complex.

Results

Test Unit 1

An AMS date from Stratum IV, Level 1 indicates that shell began accumulating at approximately 4962-4846 cal. B.P. Mollusk data from Test Unit 1 shows a non-intensive use of the site in Strata 3 and 4 as reflected in the low shell density and represents initial site occupation (Figure 3). Both marine and freshwater species are present in these lowermost strata. A substantial increase in shell density occurs in Stratum II and represents intensive inhabitation. There is a consistent background of marine species in Strata II-IV, overwhelmingly *Donax variabilis* and *Neverita duplicata* (Figure 4). These species are indicative of the high energy beach environments along the Atlantic coast. Freshwater species are present and commonly occur in Strata III and IV but are very frequent in Stratum II. *Viviparus georgianus* is most common with lesser amounts of *Pomacea paludosa, Planorabella scalaris*, and *Unionidae* also occurring (Figure 5). Brackish species consist of *Crassostrea virginica*. While we have *Crassostrea virginica* throughout the Strata II-IV they were incidentally included during *Donax variabilis* collection and do not represent a food resource. This is evidenced by the fact that all of the *Crassostrea virginica* fragments from TU-1 are water worn from being tumbled in the surf.

The presence of Viviparus is clear evidence for a freshwater regime in the Tomoka River and perhaps the Tomoka Basin as well (Figure 6). The occurrence of this freshwater species (and the others) is noteworthy given the intolerance of Viviparous to salinity that is clearly reflected in their distribution in the St. Johns River today which is tidally influenced in the lower one-third of its course. Underscoring this is the fact that there are no prehistoric sites containing Viviparous or other freshwater mollusks in the tidally influenced parts of the St. Johns. Today the Tomoka River is tidally influenced for 10 of its 16 mile length and none of the freshwater mollusks identified archaeologically are extant in this river system (Brown & Orell, 1995). The frequency of *Viviparus georgianus* dramatically increases in Stratum II. It is followed by a dramatic and rapid drop at the top of this stratum and it is all but absent in Stratum I which is characterized by brackish estuarine species, largely *Crassostrea virginica* and Mercenaria. Stratum I represents post-Mount Taylor deposits. An AMS date from Stratum II, Level 1of 4821-4574 provides and t*erminus ante quem* for Mount Taylor deposits in this location. The frequent occurrence of Viviparous in the stratum and level indicates that changes to the local ecology leading to the development of an estuarine habitat had not yet occurred.

Stratum I is radically different in terms of its sediments, composed largely of sand and the molluscan species present. *Crassostrea virginica* and *Mercenaria* shell dominate the molluscan assemblage, marking a sharp departure from the underlying deposits. Although no temporally diagnostic artifacts were recovered from this stratum, in all probability it post-dates Mount Taylor, likely St. Johns I. This same stratum is also found overlying Mount Taylor deposits in TU-5 on Mound 1 and did produce St. Johns pottery confirming this temporal association for Stratum I as St. Johns on Mound 5.

Test Unit 5

An AMS date of 4805-4452 cal. B.P. from Stratum II, Level 7, the deepest point reached during excavation in Mound 1, is nearly contemporary with the uppermost Mount Taylor shell deposits in TU-1 in Mound 4, building upon the mollusk data from TU-1(Figures 7 and 8). Like TU-1 marine mollusks are a constant in the mollusk assemblage in TU-5. In the lowermost level excavated in this test unit we can see the last of *Vivaprus georgianus* in any significant amounts, above this level it is virtually absent. Not coincidentally, we also see other freshwater mollusks underrepresented or absent. Marine species predominate above Stratum II, Level 7, composed largely of D*onax variabilis* , *Neverita duplicata*, and *Mercenaria mercenaria* (Figure 9). This marks the transition from a freshwater environment in the Tomoka River and Basin to one that is more saline as evidenced by common occurrence of juvenile *Busycon carica* (Figure 10) and the complete absence of freshwater mollusks. Interestingly there are no estuarine species so common in later contexts such as *Crassostrea virginica* and hard clam in the upper six levels of Stratum II that represent the latest Mount Taylor occupation documented at Tomoka. An AMS date of 4425-4256 was obtained on hickory nutshell from Stratum II, Level 1, the uppermost of the

Mount Taylor shell deposit in Mound 1, and provides an end date for the timing of the transition from a freshwater to an estuarine environment in the Tomoka area.

Discussion

Mollusks were economically important to hunter-gatherer groups living at Tomoka and today they reveal aspects of the past environmental regimes (Evans, 1978). Data produced in this analysis has some interesting results related to both environmental conditions and its relationship to mound-building at Tomoka.

The data show that when people first began living at Tomoka around 4962 cal. B.P. the occupation was less intensive and molluscan remains are not very dense. Exclusively fully marine and fully freshwater species were collected. A more intensive occupation commences sometime around 4850 cal. B.P. and is registered in very dense shell deposits again consisting exclusively of marine and freshwater species with an increased diversity in the latter. The lack of estuarine species used as food and the presence of freshwater species intolerant of salinity strongly points to a lower sea level at this time and a freshwater ecological regime in the Tomoka River and basin. The frequency of freshwater mollusks throughout the Mount Taylor deposits in TU-1 confirms this to have been the case as late as 4821-4574 cal. B.P.

A transition from a freshwater to an estuarine regime is suggested by changes in the molluscan assemblage from TU-5. Viviparus shell is frequent in the lowest level reached during excavation and is virtually absent above, suggesting that as early as 4805 cal. B.P a freshwater regime prevailed in the Tomoka area and sea levels had not risen sufficiently to alter the local ecology. By approximately 4700 B.P. we see an overall drop in species frequency and it can be inferred from this that there was an increase in salinity and a shift from a freshwater to an estuarine environment indicating a rise in sea level.

After this change at or around 4700 cal. B.P. inhabitation of the site continues. Interestingly the subsequent site occupation shows very little evidence for the establishment of stable estuarine environments in the area. If they had, it is reasonable to expect to find *Crassostrea virginica* and hard clam as is the case in the later St. Johns period deposits at the site. In fact, until about 4425 cal. B.P. and perhaps as late as 4256 cal. B.P., Tomoka's inhabitants exploited marine mollusks almost exclusively. The earliest evidence for an estuarine regime in the Tomoka basin comes from and AMS assay of 2970-2860 cal. B.P. from a single *Mercenaria mercenaria* valve from Mound 9.

Alternatively, it is possible that the decrease in freshwater mollusks is the product of a change in subsistence practices unrelated to environmental change. Still, another explanation for the disappearance of Viviparous and other freshwater mollusks is sampling – we may have simply dug in the wrong place. The latter is unlikely, given the frequent occurrence of freshwater mollusks in other Mount Taylor contexts with dates similar to those from TU-1 and TU- 5 from other mounds at Tomoka.

Shortly after the Tomoka's initial occupation, and probably coinciding with an intensification of occupation around 4850 cal. B.P., mortuary mound construction begins. Based on the available AMS dates it is likely that the four Mount Taylor mortuary mounds at this site were constructed after 4950 cal. B.P. and before 4440 cal. B.P. Endonino (2014) estimates mound construction to have actually occurred between 4900-4700 cal. B.P. and indicates that these mounds were constructed simultaneously or in short succession.

Conclusions and Future Research Directions

The goals of this paper are to present the results of an analysis of mollusks from the Tomoka Complex in order to reconstruct the environmental conditions that existed during the site's occupation and, more importantly, what the environment was like when mortuary mound construction was occurring and when it ended; all with the ultimate goal of understanding what role, if any, environmental change may have had on mound construction.

Molluscan data indicate that during the site's initial inhabitation the Tomoka River basin's environment was freshwater. The inhabitants of Tomoka exploited both marine mollusks from the Atlantic beach strand as well as freshwater mollusks available in the Tomoka River and basin beginning around 4965 cal. B.P. Estuarine species are absent. This is taken as evidence that sea levels were lower when the site was first inhabited. A freshwater regime continued at least until 4700 cal. B.P. when freshwater mollusks intolerant of salinity disappeared from shell deposits. In the centuries immediately following this, salinity in the Tomoka basin was such that it was too saline for freshwater mollusks and insufficiently saline for the establishment of estuarine species such as *Crassostrea virginica* and hard clam. This is supported by the continued occupation during Mount Taylor where after 4700 cal. B.P. mollusk species exploited are exclusively marine and persisted as late as 4256 cal. B.P. If estuarine species were present, would most likely have been eaten and their shells deposited. Mound construction commences shortly after the establishment of this site when freshwater conditions prevailed. Based on the data currently available, it appears that there may be correlation between increasing salinity associated with sea level rise around 4700 cal. B.P. and the end of mound-building. This may be more apparent than real and mound construction may have occurred after 4700 cal. B.P. Nevertheless, the current data suggest that the end of sand mortuary mound construction and changes in local ecology are associated. Despite environmental change, Tomoka continued to be inhabited as late as 4256 cal. B.P.

Work at Tomoka is set to continue. Ambiguities remain regarding the relationship between mound-building and environmental factors. These ambiguities can be clarified with more and finer grained data. Stage II of the TAP will collect and analyze column samples to obtain fine grained environmental data and additional radiocarbon dates. Including vertebrate fauna into the dataset on environmental conditions may help clear up the ambiguity about the transition between freshwater and brackish conditions. Expanding analysis to include Oxygen 18 analysis for *Donax variabilis* shell could reveal details about water temperature and offer an independent measure of sea level (Andurs, 2005). The data collected at Tomoka conflicts with sea level models used by Marquardt (Marquardt, 2010). Marquardt's use of Tanner's sea level data suggests that there was a rise in kurtosis between 5000-4000 BP. Kurtosis is a probability theory and statistical technique that predicts distribution of values. The rise in kurtosis is an indicator of sea level drop, and a drop in kurtosis suggests a sea level rise. The mollusk data collected at Tomoka shows a sea level rise, which in turn should be seen in a drop in kurtosis. If we look at the 7-Pt floating Average Global Curve from Balsillie and Donoghues 2004 paper, using the same levels of kurtosis, we see a sea level beginning to lower around 5000 BP, which matches more closely our data at Tomoka (England 2015).

To explain the differences between the sea level curves we can look at McFadden's (2016) Work along in the Big Bend region of Florida. McFadden paper explains that we cannot use worldwide sea level curves to explain individual sites on the coast but should develop environmental reconstructions for each site to build an understanding of the costal environments. Sea level data from Tomoka do not match Marquardt's (2010) assertion that shell architecture (i.e. shell rings) were constructed during sea level rise. The results from Tomoka show the opposite. Tomoka shows an increases in mound building activity when the water levels are low and a cessation of the construction when sea level rises. This suggests mound construction is not associated only with sea level rise, but possibly with the subsistence choices of the people living in the area as well. A larger and finer data set will clarify these ambiguities.

As we look at environmental change and its effects on humans we should take the time and look at the human's effects on the environment. Humans are an important factor in causing changes in the environment (Wing and Reitz, 1999). Over collection of species and changes to the environment like the mound construction could be have an effect on the local species. What changes occurred because of the intense occupation of Tomoka? Future research will be done to tackle these question. The data presented here are preliminary but important and very encouraging. Tomoka holds the data necessary to clarify and illuminate environmental change along the Atlantic coast during the Late Archaic, and its relationship to the Mount Taylor period mound-building phenomenon.

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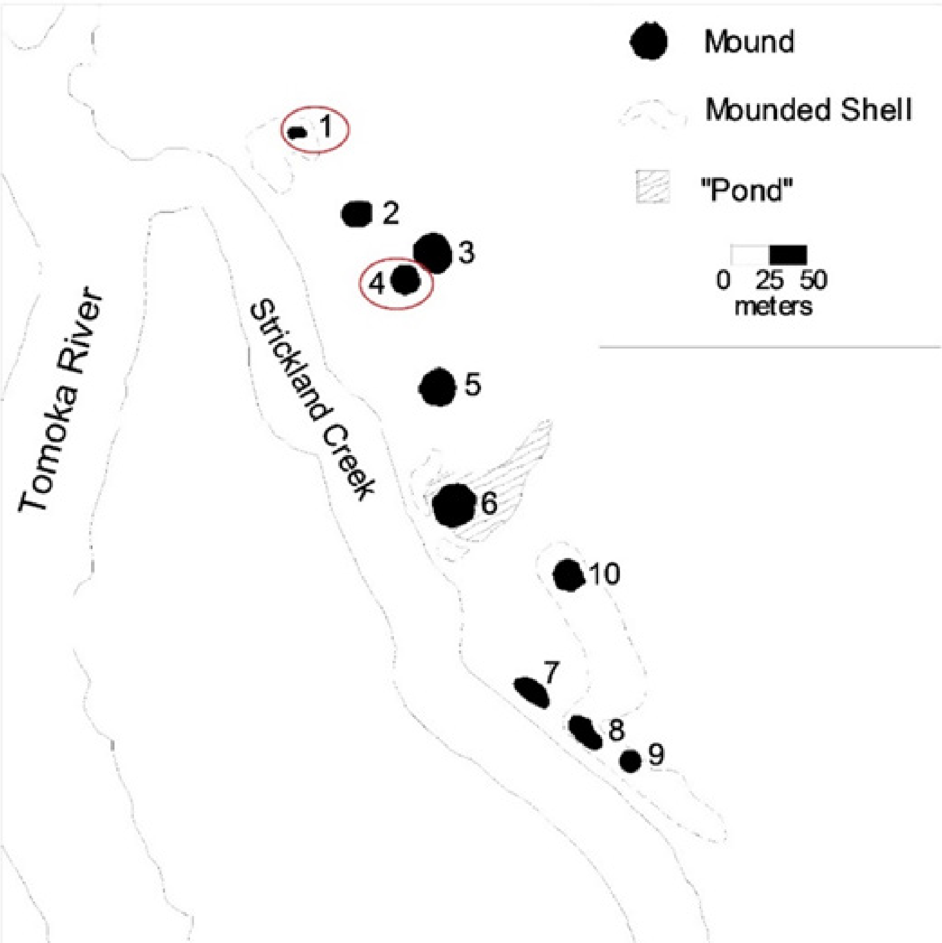
Figures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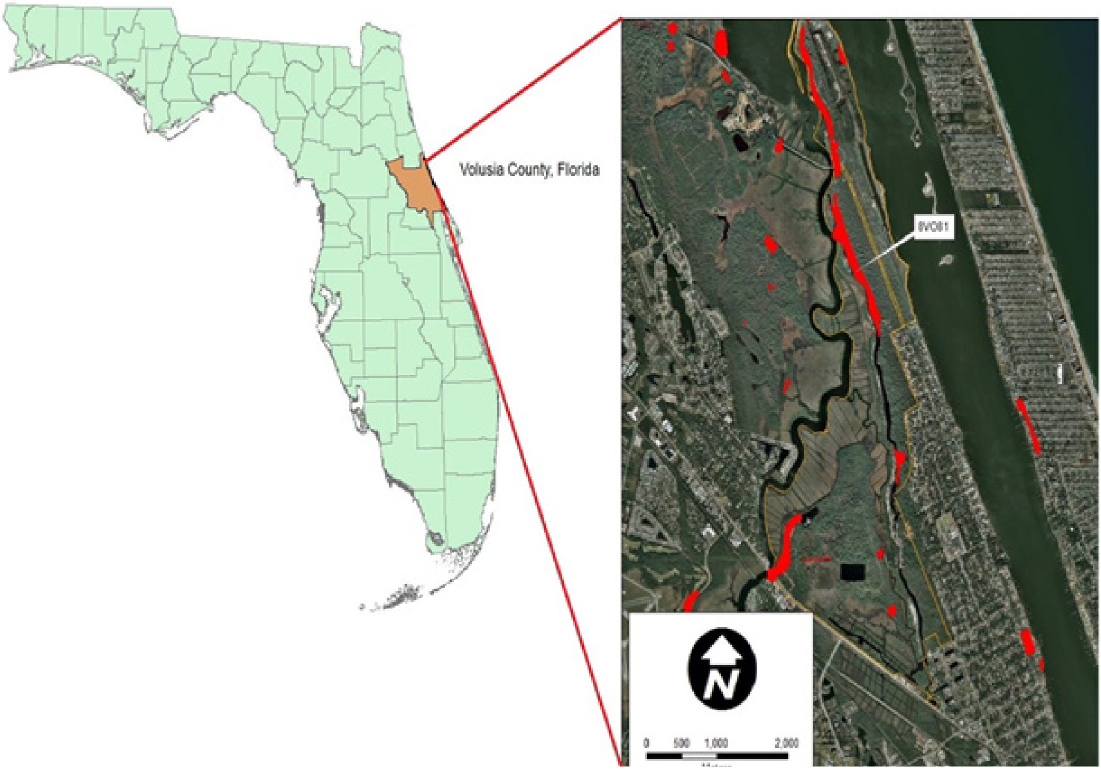
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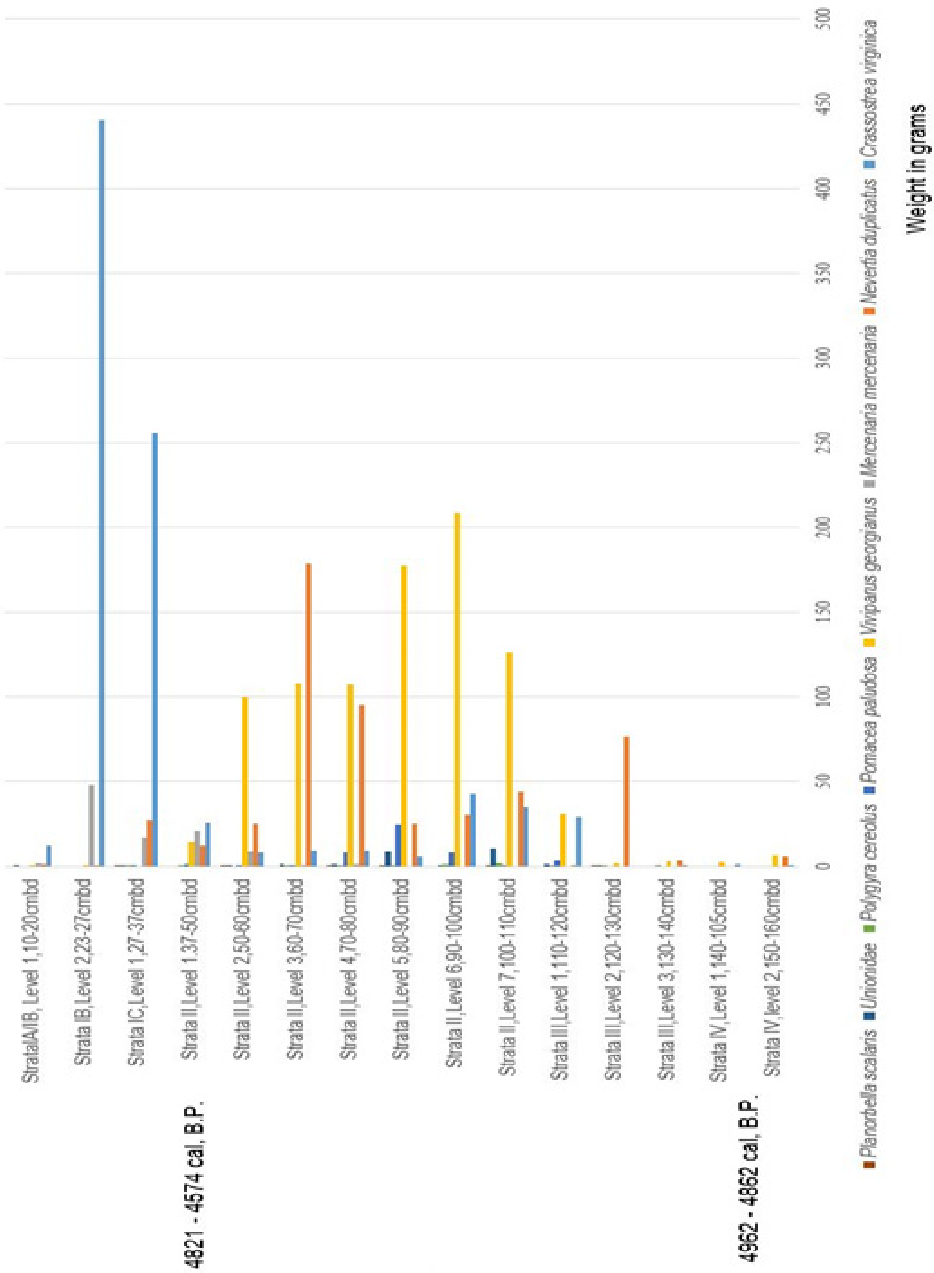
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Strata IV,Level 1,140-105cmbd
Strata IV,level 2,150-160cmbd
4821 - 4574 cal, B.P.
4962 - 4862 cal, B.P.
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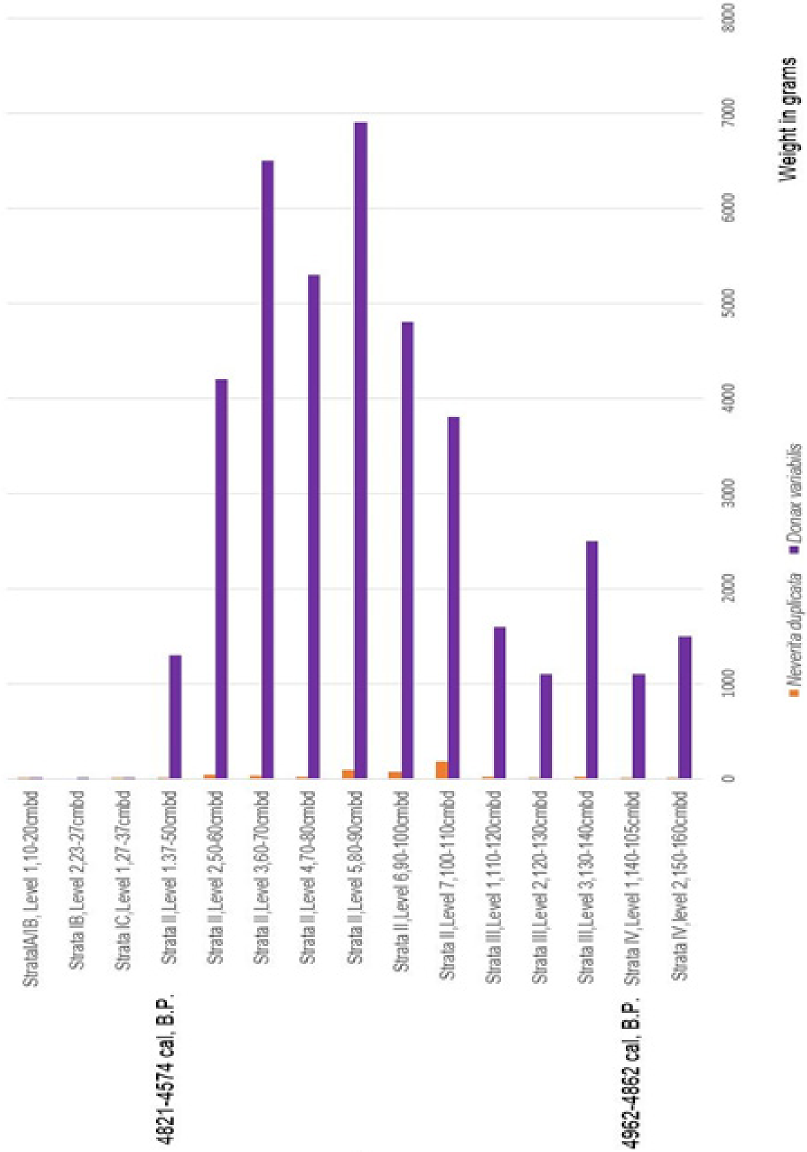
Planorbella scalaris
Unionidae
Polygyra cereolus
Pomacea paludosa
Viviparus georgianus
Mercenaria mercenaria
Neverita duplicatus
Crassostrea virginica
Weight in grams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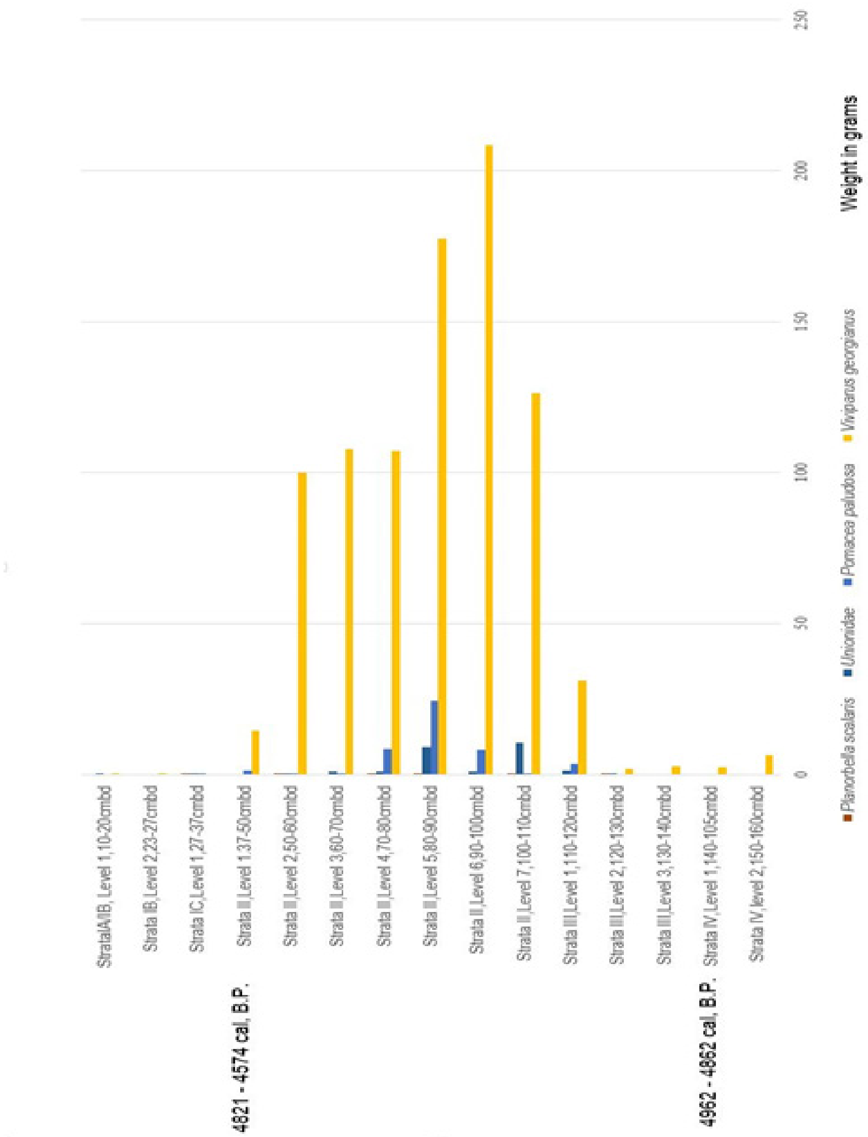
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4962 - 4862 cal, B.P.
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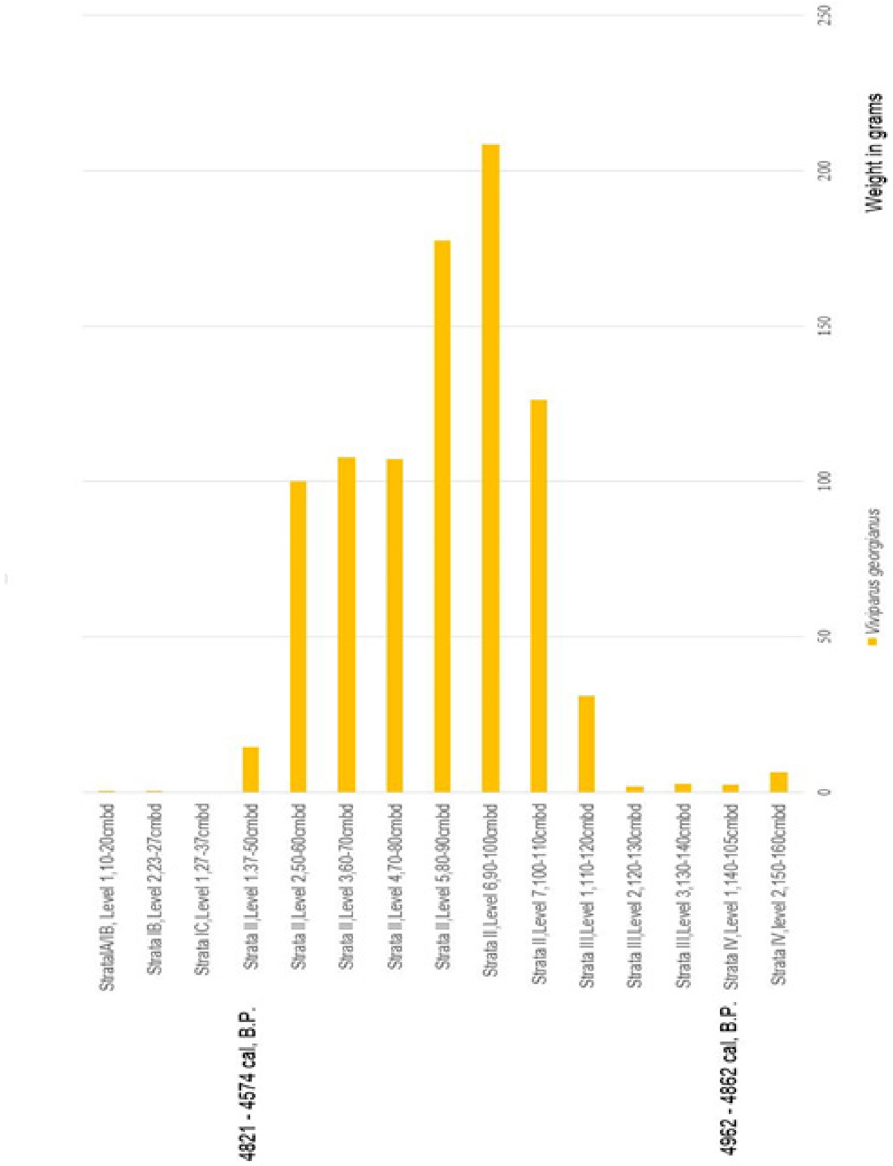
Planorbella scalaris
Unionidae
Pomacea paludosa
Viviparus georgianus
Weight in grams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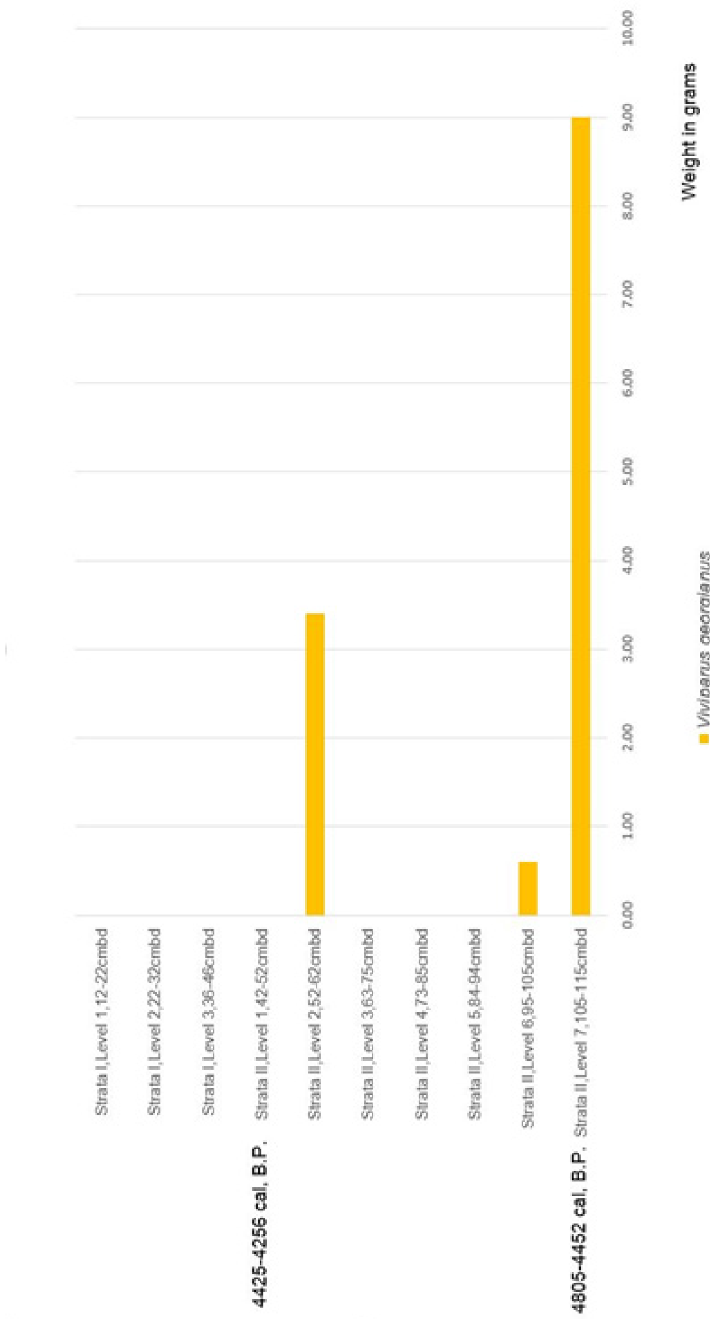
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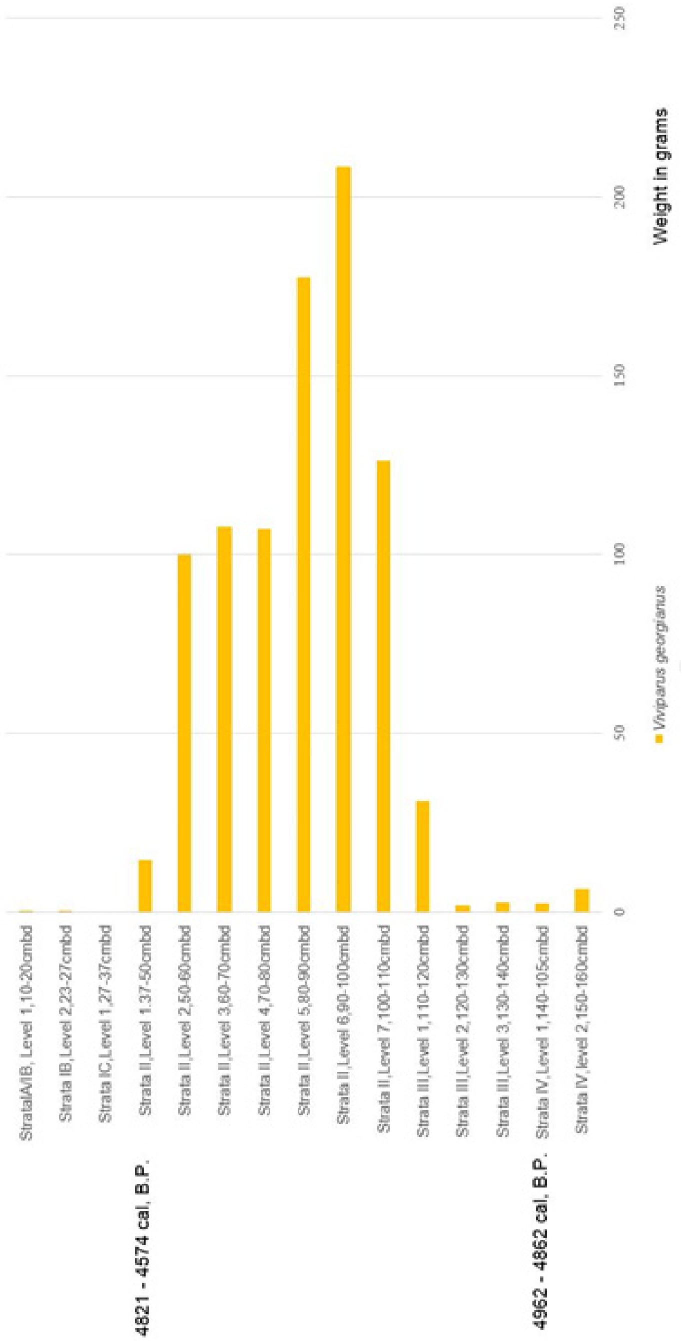

Weight in grams
Viviparus georgianus
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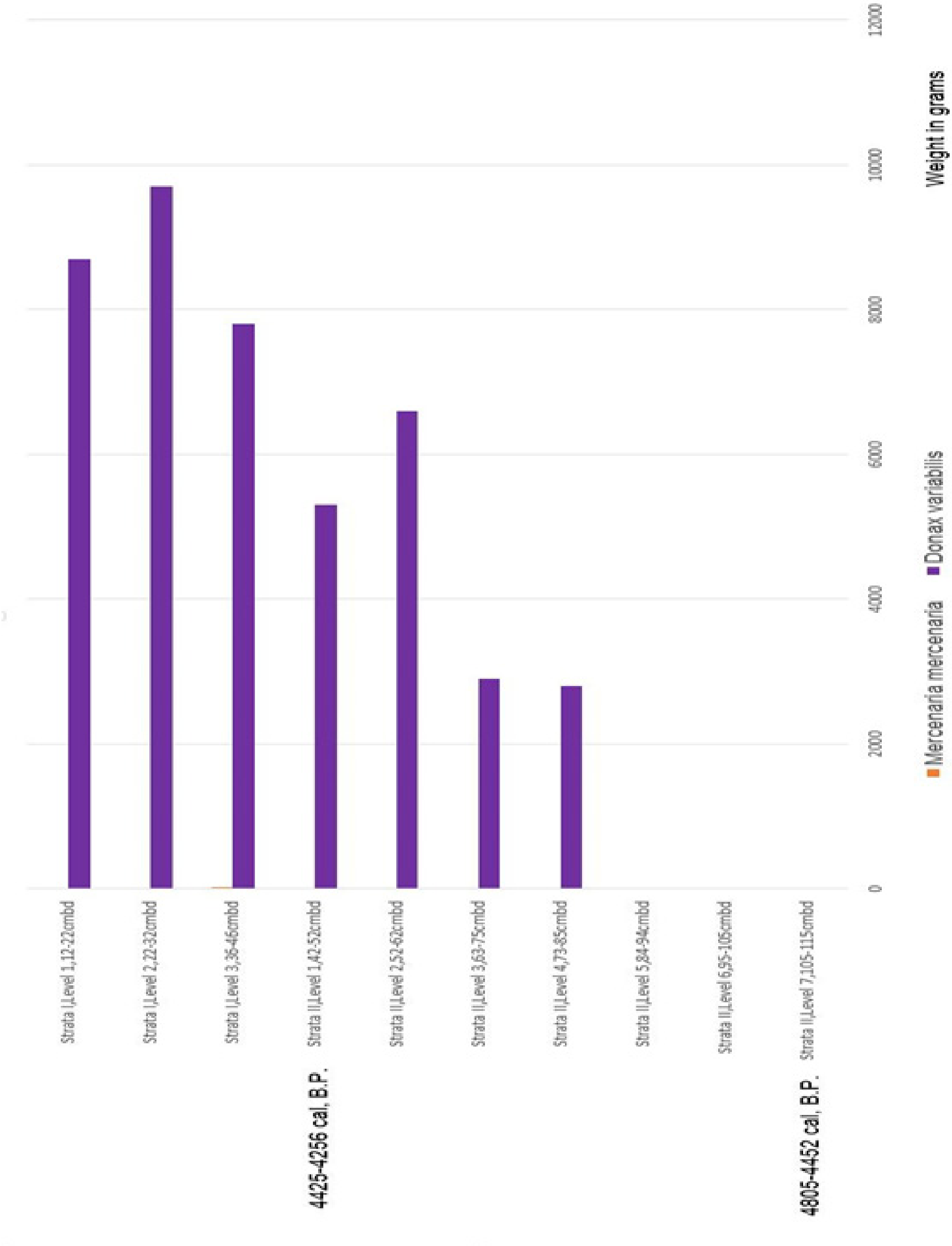
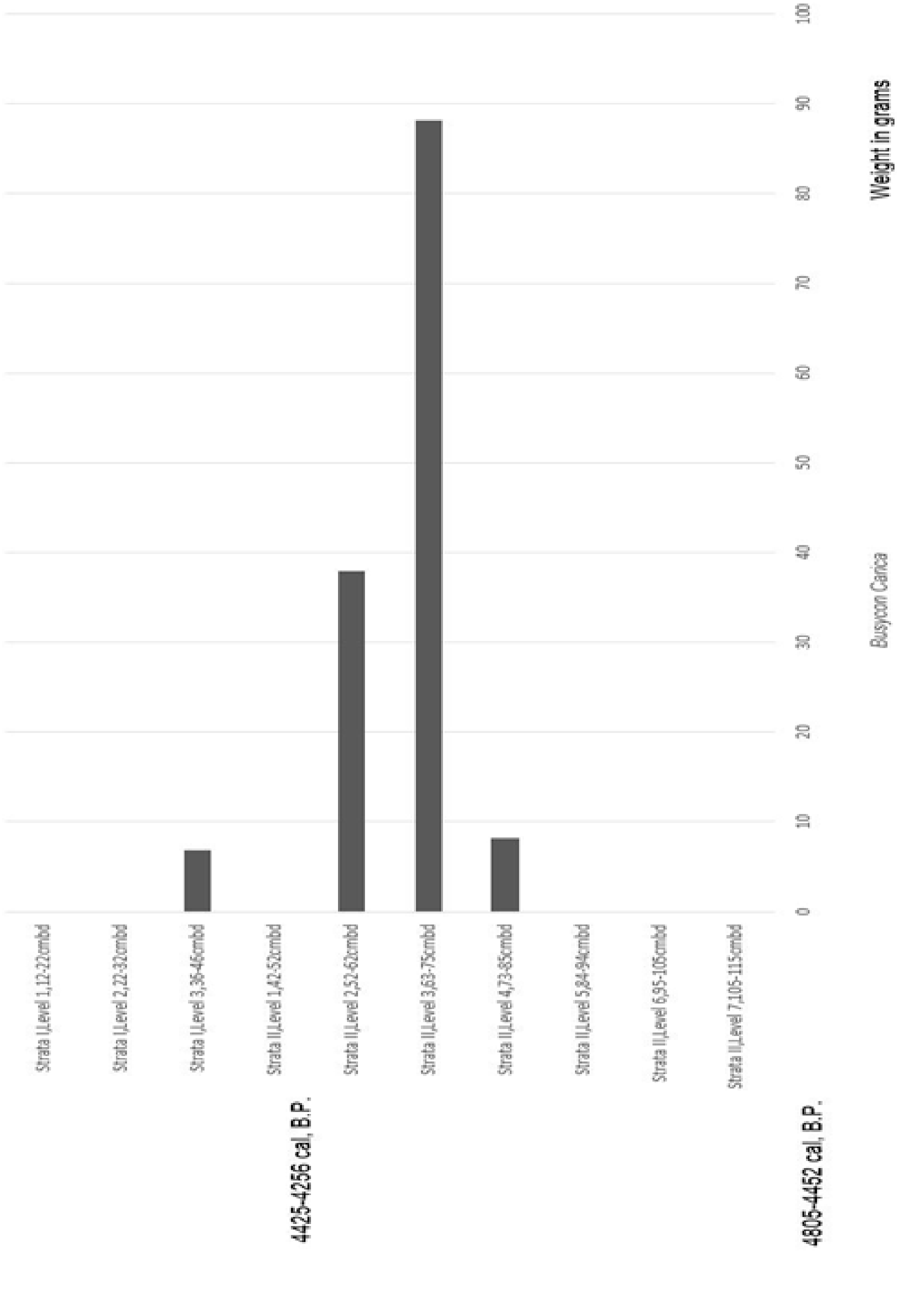
4821 - 4574 cal. B.P.
4962 - 4862 cal. B.P.



Strata I,Level 1,12-22cmbd
Strata I,Level 2,22-32cmbd
Strata I,Level 3,36-46cmbd
Strata II,Level 1,42-52cmbd
Strata II,Level 2,52-62cmbd
Strata II,Level 3,63-75cmbd
Strata II,Level 4,73-85cmbd
Strata II,Level 5,84-94cmbd
Strata II,Level 6,95-105cmbd
Strata II,Level 7,105-115cmbd
4425-4256 cal, B.P.
4805-4452 cal, B.P.
0
2000
4000
6000
8000
10000
12000
Mercenaria mercenaria
Donax variabilis
Weight in grams


Weight in grams
Busycon Carica
0
10
20
30
40
50
60
70
80
90
100
Strata I,Level 1,12-22cmbd
Strata I,Level 2,22-32cmbd
Strata I,Level 3,36-46cmbd
Strata II,Level 1,42-52cmbd
Strata II,Level 2,52-62cmbd
Strata II,Level 3,63-75cmbd
Strata II,Level 4,73-85cmbd
Strata II,Level 5,84-94cmbd
Strata II,Level 6,95-105cmbd
Strata II,Level 7,105-115cmbd
4425–4256 cal, B.P.
4805–4452 cal, B.P.