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Ecology and shell chemistry of *Loxoconcha matagordensis*

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Abstract

Studies of the seasonal ecology and shell chemistry of the ostracode *Loxoconcha matagordensis* and related species of *Loxoconcha* from regions off eastern North America reveal that shell size and trace elemental (Mg/Ca ratio) composition are useful in paleothermometry using fossil populations. Seasonal sampling of populations from Chesapeake Bay, augmented by samples from Florida Bay, indicate that shell size is inversely proportional to water temperature and that Mg/Ca ratios are positively correlated with the water temperature in which the adult carapace was secreted. Microprobe analyses of sectioned valves reveal intra-shell variability in Mg/Ca ratios but this does not strongly influence the utility of whole shell Mg/Ca analyses for paleoclimate application.
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Keywords: Ostracoda; Shell chemistry; Ecology

1. Introduction

The application of ostracode shell trace element chemistry to paleoenvironmental reconstruction requires an understanding of processes that influence the chemical composition of the calcitic shell. In the case of magnesium uptake into the shell (measured by Mg/Ca ratios), the most important factors include water temperature (Cadot and Kaesler, 1977; Chivas et al., 1986; Corrège, 1993; Dwyer et al., 1995; Corrège and De Deckker, 1997), salinity and water chemistry (Engstrom and Nelson, 1991; Wansard et al., 1998; Dwyer and Cronin, 2001; Holmes and Chivas, 2002) and ostracode metabolism (Chivas et al., 1983; De Deckker et al., 1999). Equally important for application to paleoclimate reconstruction is knowledge of a species' seasonal population ecology because this will determine under what conditions the species secretes its adult shell. If both the processes and environmental factors controlling the uptake of magnesium and the timing of adult molting are known, the ostracode can provide a powerful tool for the study of interannual and decadal-scale climate variability.

The genus *Loxoconcha* is potentially an ideal ostracode for paleoenvironmental reconstruction using ecol-

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ogy and shell chemistry in middle and low latitude coastal environments. *Loxoconcha* first appeared in the Paleogene, is common in Cenozoic fossil assemblages, and today has a cosmopolitan distribution. Kempf (1986) estimates that the genus is represented by more than 150 living species and 350 fossil species. Thus, the development of a quantitative temperature–magnesium/calcium relationship for *Loxoconcha* would be important for shallow-water Cenozoic paleoceanography.

The current paper is an integrated study of the ecology, morphology, and shell chemistry of the epiphytal species *Loxoconcha matagordensis* (Swain, 1955) from Chesapeake Bay (Fig. 1). *Loxoconcha matagordensis* is a dominant species in shallow coastal habitats along the North American Atlantic and Gulf coasts where it lives primarily on blades of the seagrass *Zostera marina* at salinities ranging from ~15 to 30 ppt. This species was first reported from Chesapeake Bay by Tressler and Smith (1948) as *Loxoconcha impressa* (Baird), and formally described by Swain (1955) from Texas bays. It has since been the subject of several ecological studies (e.g., Morales, 1966; King and Kornicker, 1970).

In the first part of this paper, we present ecological (population structure, density) and morphological (carapace length) data from monthly and bimonthly sampling during 1999–2000 from Guinea Marsh and Goodwin Island at the mouth of the York River, a tributary entering southern Chesapeake Bay, Virginia (Fig. 2). Supplementary material from Florida Bay was also used to examine the carapace length–temperature relationship in *Loxoconcha matagordensis*. In the second part, we present evidence for temperature control of magnesium/calcium ratios obtained by direct current plasma (DCP) emission spectrometry for adult *Loxoconcha matagordensis* from the York River samples. In addition to *Loxoconcha matagordensis*, measurements were also made on *Loxoconcha* sp. from the main channel of Chesapeake Bay and the continental shelf off the bay's mouth, and *Loxoconcha impressa* from the continental shelf. We also present evidence for intra-shell variability in Mg/Ca ratios obtained by electron probe microanalyzer (microprobe). In a companion paper the ecological and Mg/Ca shell calibration presented here are applied to the reconstruction of 2200 year temperature record of Chesapeake Bay (Cronin et al., 2003).

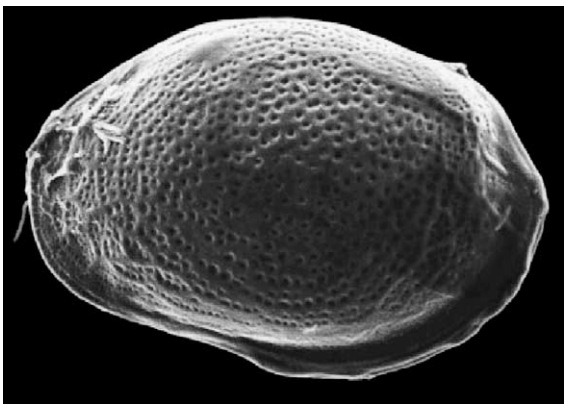

Fig. 1. Scanning electron photomicrograph of female left valve of *Loxoconcha matagordensis*. Shell is about 600 μm in length.

2. Materials and methods

Guinea Marsh and Goodwin Island are located at the mouth of the York River, a tributary to the large partially mixed temperate estuary Chesapeake Bay. The two sites are characterized by healthy beds of the seagrass *Zostera marina* which have been monitored for seagrass and water quality by scientists at the Virginia Institute of Marine Sciences (VIMS) for more than a decade (Moore and Berry-Niekirk, personal communication). Thus, they provide an ideal natural laboratory to examine seasonal variability in ecology, morphology, and shell chemistry of *Loxoconcha matagordensis*.

Sampling of *Zostera* beds living in ~1 m water depth at Guinea Marsh and Goodwin Island (Fig. 2) was carried out from February 1999 to December 2000 by the U.S. Geological Survey (USGS) in cooperation with VIMS. *Zostera* samples were taken monthly during fall and winter and bimonthly during spring and summer. During 1999, *Zostera* was collected either by hand or from material brought up on the ship's anchor. Because some samples did not yield abundant ostracode specimens, a different method was used during 2000, whereby *Zostera* was collected using a post-hole device lowered into the water to scoop up sediment and growing seagrass. After collection, *Zostera* blades were quickly separated from bottom sediment so that epiphytal species could be separated from those living on the bottom. Separate *Zostera* and sediment samples were then shipped overnight in plastic sample bags sealed in cooled containers to the USGS ostracode lab in Reston, VA. Water salinity and temperature were taken at the time of sampling. It is noteworthy that the 2-year

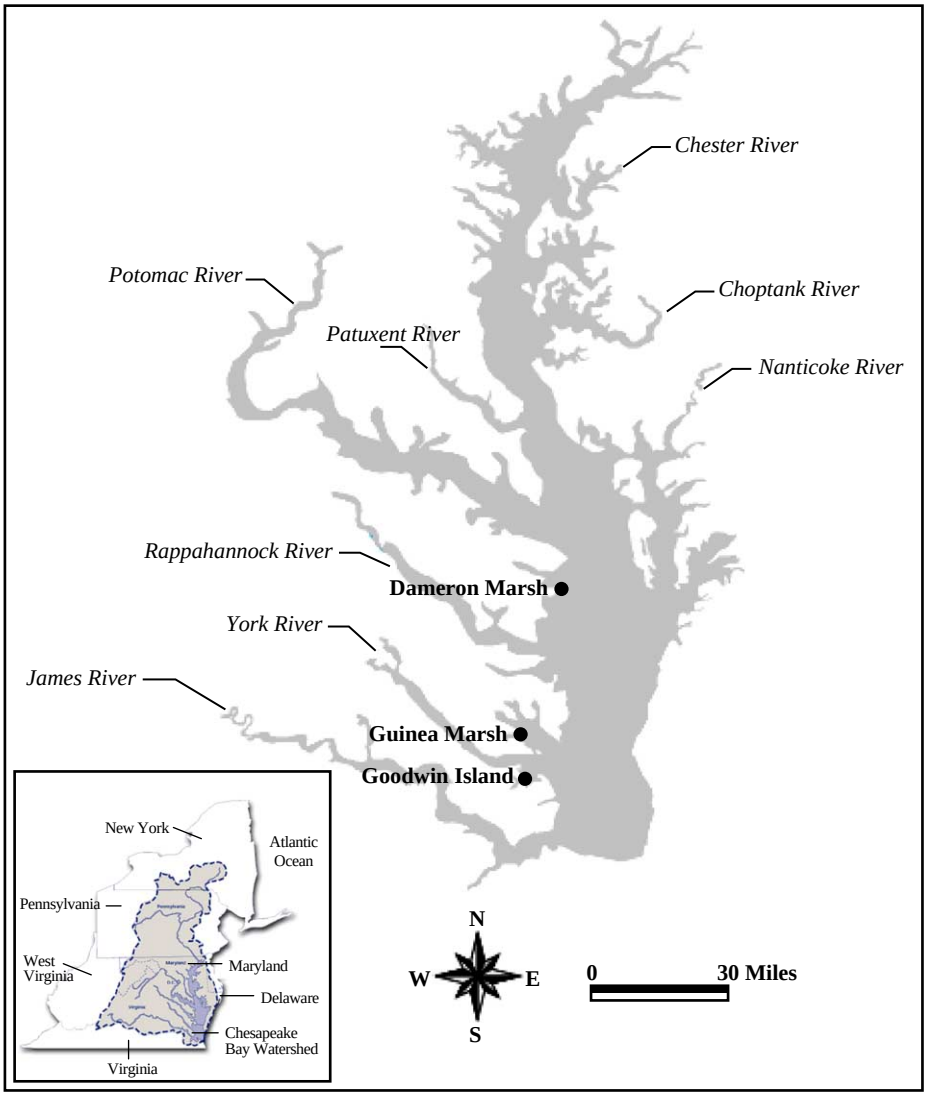

Fig. 2. Map showing location of York River and Guinea Marsh and Goodwin Island sampling sites. Also shown are Patuxent and Rappahannock River tributaries of Chesapeake Bay where early studies of ostracodes discovered *Loxoconcha matagordensis* living on *Zostera*.

temperature and salinity curves obtained in our study are within 1 °C and 1–2 ppt of temperature and salinity values from the main stem of the bay obtained from the Chesapeake Bay Program for the same period.

To isolate *Loxoconcha* from *Zostera*, the blades of seagrass were washed through a 63-μm sieve at the USGS in Reston. *Loxoconcha* specimens were picked using a fine brush under a light microscope and placed on microfaunal slides. *Zostera* from each collection dates were weighed to obtain estimates of the relative density of ostracodes for each sample.

In contrast to Chesapeake Bay, Florida Bay is a shallow, subtropical carbonate embayment subjected to wide spatial and temporal salinity extremes. *Loxoconcha matagordensis* also thrives in Florida Bay where it lives mainly on seagrass, most commonly on *Thalassia testudinum* (Cronin et al., 2001). Seagrass samples in Florida Bay were taken by hand in February and July 1998–2000 by Dr. L. Wingard (USGS) as part of a larger program investigating the paleoecology of Florida Bay. Samples were washed and picked in the same manner as those from Chesapeake Bay. Cronin et

al. (2001) gave location, salinity and temperature data for the ostracode samples used in the current study.

The ostracode population and their shell length data from Guinea Marsh and Goodwin Island are given in Appendix A; data from Florida Bay in Appendix B.

Geochemical analyses were carried out on adult individuals of three species of *Loxoconcha*. Most of the specimens were taken from the 1999 samples from Guinea Marsh and Goodwin Island, York River. Additional *Loxoconcha matagordensis* were obtained from Dameron Marsh, Chesapeake Bay collected March, 1999, and from Bogue Sound, North Carolina collected August 1999. Also included are specimens of *Loxoconcha* sp. collected from the main channel of Chesapeake Bay in June and September, 1999, on the *R/V Orion* and *Loxoconcha impressa* collected from Atlantic shelf and slope surface sediments during a large study in the 1960s (Hazel, 1970, Valentine, 1971).

Individual specimens were soaked overnight in Clorox bleach to remove organic material which can cause anomalously high Mg/Ca ratios in ostracodes (Kondo et al., 2005). They were then washed and sonicated in two-step bath of deionized water, then dissolved in 4 to 30 ml of 0.05 N nitric acid, depending on valve weight. Between 1 and 14 (mean of 6) individuals per sample were analyzed for magnesium and calcium (strontium and sodium also was measured but these are not considered in this paper) at Duke University on a Spectrascan 7 direct current plasma (DCP) emission spectrometer following the procedures in Dwyer et al. (1995). The analytical precision was $\pm 3\%$ based on replicate analyses of samples and standards. An in-house limestone standard Duke PE3 yielded Mg/Ca of 8.50 mmol/mol $\pm$ 0.04 (1σ) ($n=40$).

Several specimens were also analyzed on a JEOL JXA-8900R Electron Probe Microanalyzer (microprobe) in order to evaluate intra-shell Mg/Ca variability. Specimens were mounted lateral (convex) side up on glass slides in Buehler® Epoxide Resin and Hardener, ground with a 5-μm grit and polished with 1-μm polish paper. This procedure resulted in a ring-like cross-section through the carapace nearly perpendicular to the shell surface. Petrographic examination assured that the sectioned shell surface was smooth enough for microprobe analysis. Point measurements were made at several locations in the central part of three shells and a continuous sweep of the shell was also made.

3. Results

3.1. Population density and age structure

Loxoconcha matagordensis exhibits strong seasonal ecological patterns in terms of its density on *Zostera* blades in Chesapeake Bay and its tributaries. In early ecological studies of ostracodes from the Patuxent River (Fig. 2), Tressler and Smith (1948) found this species (referred to as *Loxoconcha impressa*) was almost absent during winter months in 1941 and 1942 but its abundance rose sharply in May and was maintained through October. Elliott et al. (1966) also found that *Loxoconcha matagordensis* lived almost exclusively on *Zostera* in the Rappahannock River. Additionally, Grossman (1965) and Morales (1966) also found it was the dominant species in Redfish Bay, Texas and Laguna de Terminos, Mexico in the Gulf of Mexico. King and Kornicker (1970) carried out seasonal sampling of ostracodes in Texas bays in 1958–1959 and observed that *Loxoconcha matagordensis* was rare (<50 individuals per m^2) during winter months, increased during spring (~200 individuals per m^2) and rose sharply to peak abundance in July (~600 per m^2) (Fig. 3). The seasonal increases in abundance coincided with a rise in water temperature from 15 to >25 °C.

Our results on the density of *Loxoconcha matagordensis*, measured as the number of adults per 100 g of *Zostera*, from Chesapeake Bay (Fig. 4) confirm those of both Tressler and Smith (1948) and King and Kornicker (1970). There is a modest increase in the number of adult *Loxoconcha matagordensis* during spring and a sharper rise during summer of the year 2000 at both Guinea Marsh and Goodwin Island sites.

In addition to seasonal changes in the density of adult specimens, there are important changes in the proportions of adult and juvenile instars in Chesapeake Bay populations (Fig. 5). Despite the different sampling methods used during 1999 and 2000, there were a relatively large proportion of juveniles during the late summer and fall of both years and relatively few during the winter months. This relationship is evident at both Guinea Marsh and Goodwin Island. The abundance of juveniles in summer represents offspring produced during seasonal breeding beginning in spring and persisting into the early Fall. It is possible that the drop in juveniles during August 1999 (Fig. 5) repre-

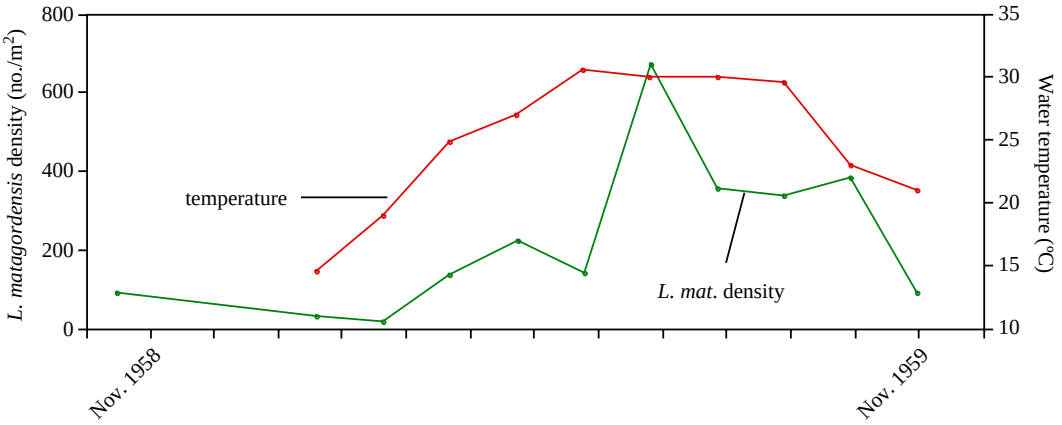

Fig. 3. Plot of density of *Loxoconcha matagordensis* and water temperature in Redfish Bay, Texas for the period November 1958 until November 1959 from King and Kornicker (1970).

sents a brief period in between separate spring and late summer breeding seasons, a concept supported by the trends in carapace length described below. It should also be emphasized that many factors might have influenced the relative proportions of adults and juveniles obtained in any particular sample, including artifacts of weather conditions and water quality. Still, the broad patterns identified at both sites are consistent with our understanding of the ecology of *Loxoconcha* species living in temperate regions, where there are

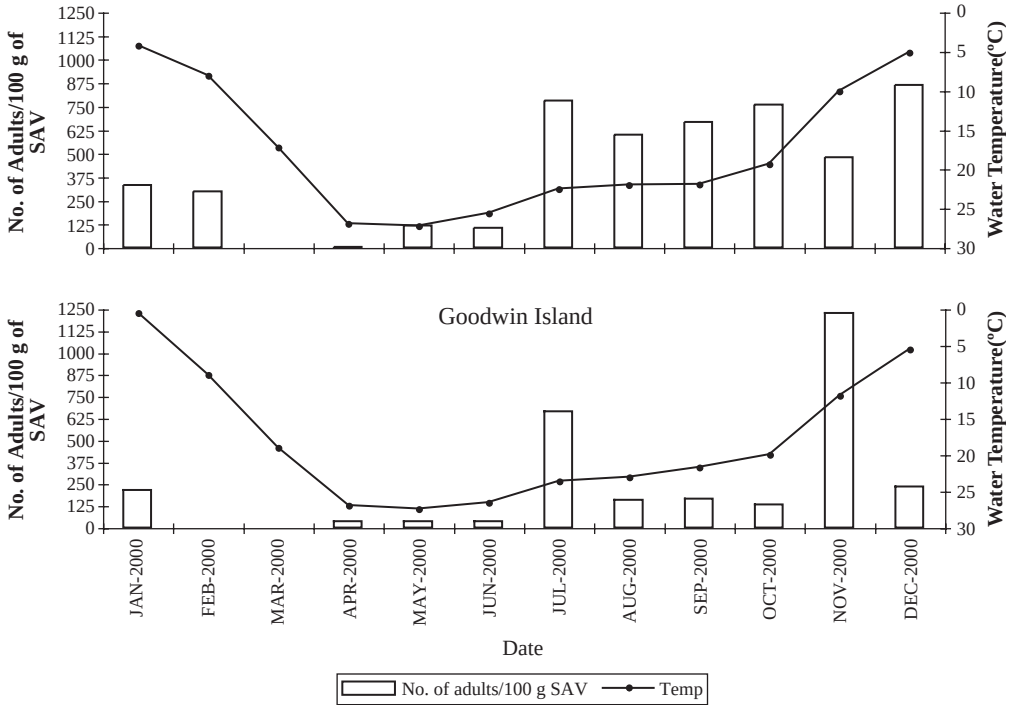

Fig. 4. Seasonal variability of abundance of adult *Loxoconcha matagordensis* (females and males) at Guinea Marsh and Goodwin Island, York River mouth, Chesapeake Bay during the year 2000, measured as density in subaquatic vegetation (SAV). Quantities of adult *Loxoconcha matagordensis* are generally lowest between February and June at both sites, and rise during summer and early fall.

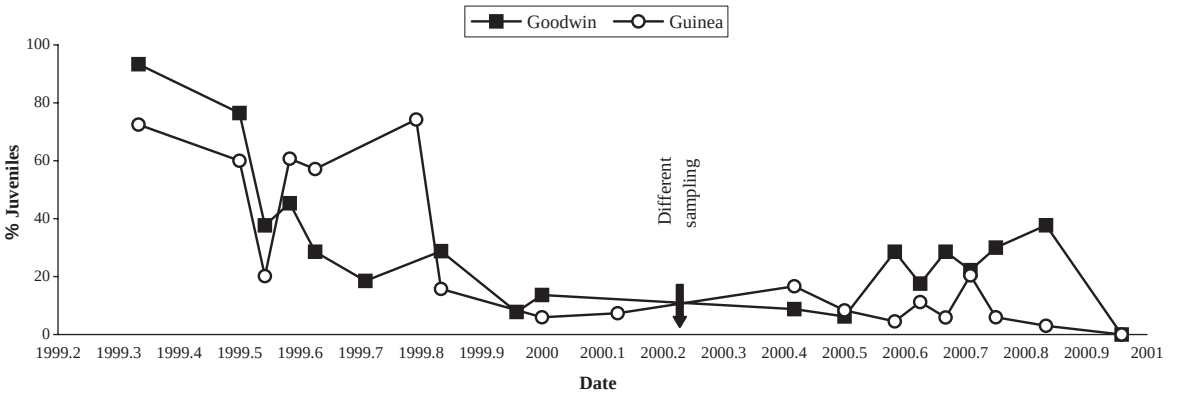

Fig. 5. Seasonal variability of juvenile *Loxoconcha matagordensis* (total of A-1 to A-8 instars) for the period 1999–2000 at Guinea Marsh and Goodwin Island sites, York River mouth, Chesapeake Bay, Virginia. Sampling method changed in April, 2000 (see Materials and methods).

large seasonal temperature oscillations, and the relationship of this epiphyte to the seasonal ecology of its host plant *Zostera*.

3.2. Trends in shell preservation

Kamiya (1988) demonstrated that the state of shell preservation (clean and translucent to extremely dirty and brown, referred to by Kamiya as "fouled") in living specimens of *Loxoconcha japonica* from Aburatsubo Cove, Japan is related to the age of the adult ostracode. Clean and translucent shells of *Loxoconcha japonica* represent adults that were the most recently secreted. With age (weeks to months), adults become progressively dirtier because epidermal cells and the epicutical become colored and/or organic detritus adheres to the outside of the shell. The level of organic detritus in the water is therefore an important factor in how quickly an adult carapace can lose its original translucent appearance; the more organic material the more quickly an adult can become discolored.

Kamiya (1988) also discovered an inverse relationship between carapace length and water temperature in *Loxoconcha japonica*. He showed that by separating adults into three categories (which we refer to as clean, intermediate, and dirty), and by measuring adult carapace size, he could recognize seasonal patterns in *Loxoconcha japonica* populations related to the age of the individuals and the timing of breeding and production of young instars. He recognized that the larger and dirtier adults were found in populations collected during the cooler seasons and surmised that these individuals had wintered over from the previous fall. Conversely, smaller, translucent (recently secreted) adults occurred in late spring and summer, peaking in abundance in July.

We investigated the relationship between carapace length and water temperature in *Loxoconcha matagordensis* using carapace length measurements in males and females from Guinea Marsh and Goodwin Island for the 2-year collection period. A total of 936 females and 688 males were measured under a light microscope for this analysis. Our results reveal a seasonal size pattern in *Loxoconcha matagordensis* similar to that observed in *Loxoconcha japonica*. Fig. 6 shows that during the winter and spring of 1999 very few clean shells were found because those collected during this time represented relatively old adult individuals. As is the case with *Loxoconcha japonica*, July populations of *Loxoconcha matagordensis* adults are both clean and relatively small (length ~600–605 μm) and appear to represent individuals from the spring breeding season. In sum, despite limited numbers of specimens of *Loxoconcha matagordensis* from several samples, the similarity in terms of population structure (age inferred from carapace preservation) for both species indicate that Kamiya's method of age identification in *Loxoconcha japonica* appears to apply to *Loxoconcha matagordensis* as well.

3.3. Seasonal and geographic variability in carapace length

To further examine the inverse relationship between size and temperature in *Loxoconcha*, we plotted mean female and male carapace length for

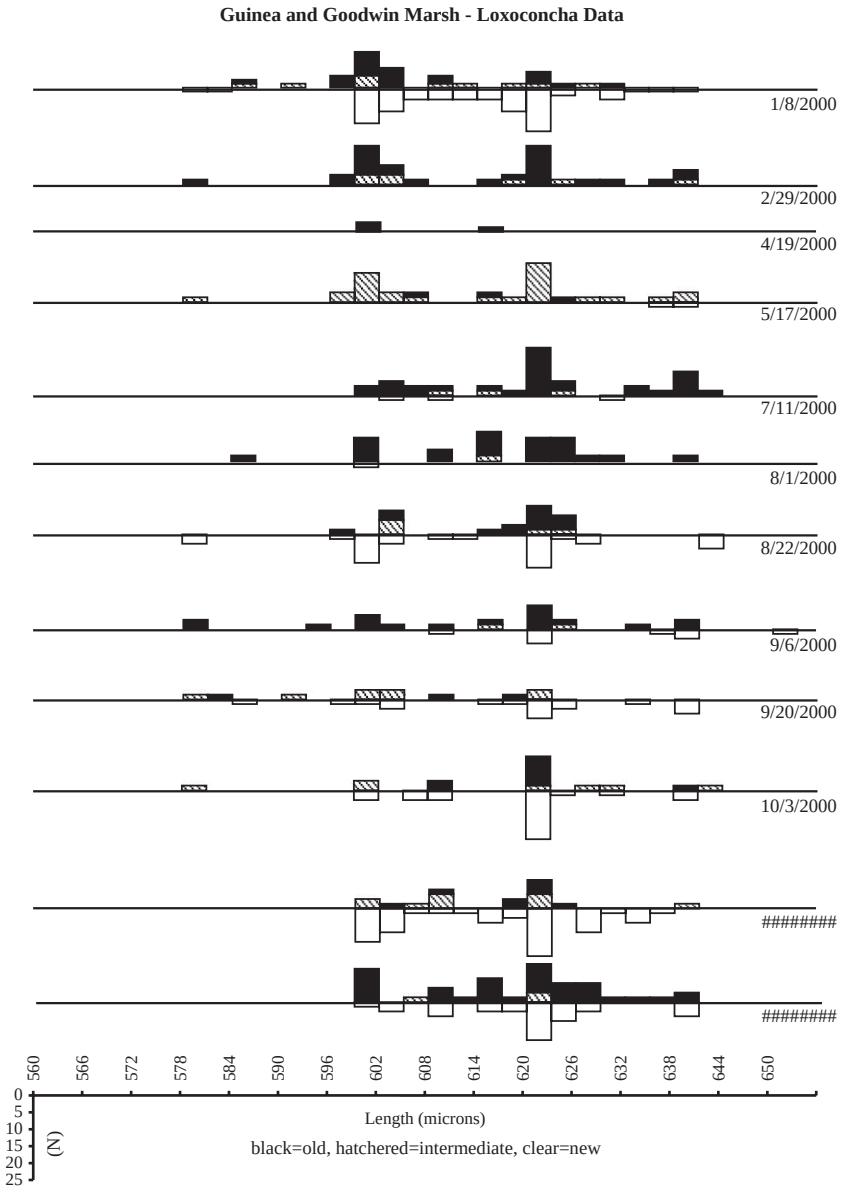

Fig. 6. Age distribution and carapace length of adult female *Loxoconcha matagordensis* in York River. Bars represent data pooled from Guinea Marsh and Goodwin Island with different colored bars indicating the approximate age of the carapace; clear=new carapace, hatchered=intermediate carapace, black=old carapace. The rate of carapace discoloration is generally more rapid in summer months due to an increased quantity of floating detritus in the water.

combined Guinea Marsh and Goodwin Island populations against measured water temperature (T_m) for the entire 1999–2000 study period (Fig. 7). Several important points emerge from this figure. First, there is a clear parallel between male (size range 680–715 μm) and female (590–640 μm) length variability during different seasons. Both sexes show a smaller annual range of lengths during the year 2000 compared to 1999. The reason for this greater variability during 1999 is unclear although it is unlikely to be related to temperature as seasonal patterns were similar in both years.

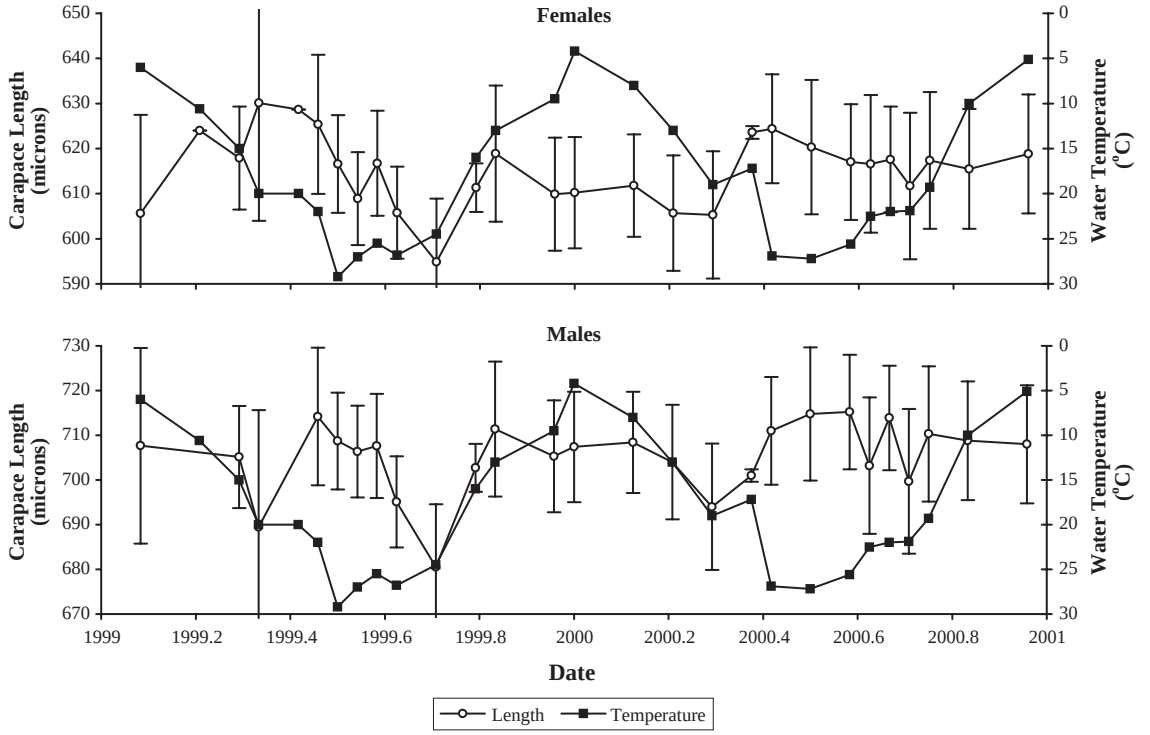

Fig. 7. Relationship between carapace length of female and male *Loxoconcha matagordensis* from York River and water temperature for the two year period 1999–2000. Carapace length and water temperature data are pooled from two sites, Guinea Marsh and Goodwin Island at the mouth of the York River. Graph shows mean carapace lengths and vertical bars represent ± 1 standard deviation.

Second, there appears to be a 1–2 month "lag" between the spring–summer increase in T_m from 15 to 30 °C and the June through September period when there is a significant decrease in shell size. The most likely explanation for this trend is that many or most shells collected during these months actually secreted their adult shell as much as 1–2 months before the collection date. In other words, secretion water temperature (T_s) is not equivalent to measured water temperature (T_m). Although the exact age, and therefore the timing of secretion cannot be determined, and these collections most likely include adults that grew at several periods during the spring breeding season, the fact that some adults from this period have brown coloration suggests that many are 1–2 months old.

In contrast to the spring–summer trend in decreasing length, the increase in carapace length in both males and females during fall (September–November) tracks closely to the seasonal drop in T_m (Fig. 7). This trend is more apparent for the year 1999. It appears that the adults collected during fall months had secreted their adult shell very close to the collection date; that is, there is no "lag" time between secretion and collection and T_s approximates T_m.

If a length–temperature relationship is a characteristic feature of *Loxoconcha matagordensis*, then it should also be evident in populations from other regions. Consequently, we compared size in female adult length for *Loxoconcha matagordensis* from cool and warm seasons in Chesapeake populations with populations collected from Florida Bay in February and July, 1998 (Fig. 8). Florida Bay is located in a subtropical region with a smaller seasonal temperature range (~12 to >30 °C) than Chesapeake Bay (~0 to 29 °C) and thus its ostracode population provides a warm water end-member for the species.

Fig. 8 shows greater size in northerly populations (Chesapeake Bay) and those that grew during the cold seasons. While we cannot be certain exactly when the Florida adults secreted their shells (i.e., if T_m, equals T_s,), we assume these February and July populations are representative of cool and warm season size

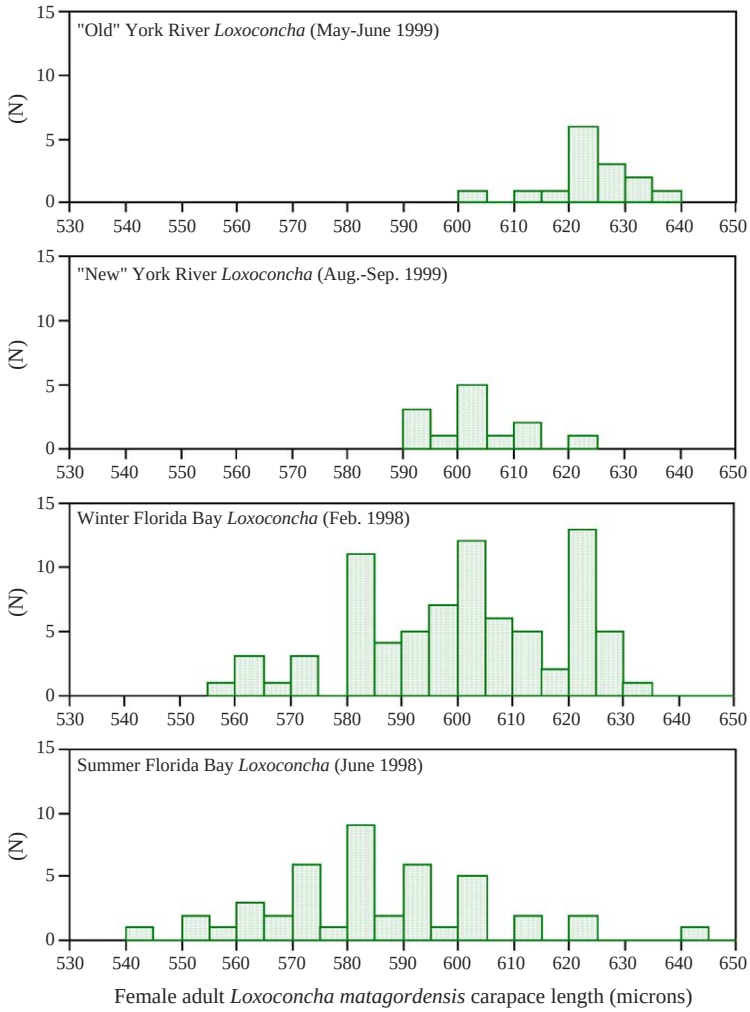

Fig. 8. Histogram showing size distribution of adult female *Loxoconcha matagordensis* that grew during winter and summer months in Chesapeake and Florida Bays. Adults that grew in warmer water (summer season, lower latitude) are generally smaller than those grown in cooler water (winter season, higher latitude).

classes, respectively. Nonetheless, Figs. 7 and 8 generally provide strong evidence that temperature variability resulting from both seasonality and geographic location result in size difference in populations of this species.

3.4. Carapace size–temperature regression model

Because carapace size might be a potential paleotemperature indicator, we derived several provisional regression models to express the inverse size–temperature relationship in *Loxoconcha matagordensis*. We first considered whether the preservation of the shell is a factor, that is, if we could determine whether T_m equals T_s. Fig. 9A shows an inverse relationship between mean female length and T_m using clean, intermediate, and dirty adult females from Guinea Marsh, Goodwin Island and two samples collected from Florida Bay during February and July, 1998–2000. Fig. 9B includes only clean and intermediate preservation female adults from March to November 1999 (Guinea and Goodwin samples) and the two Florida Bay populations. Although both plots reveal an inverse relationship between length and temperatures, there is little differ-

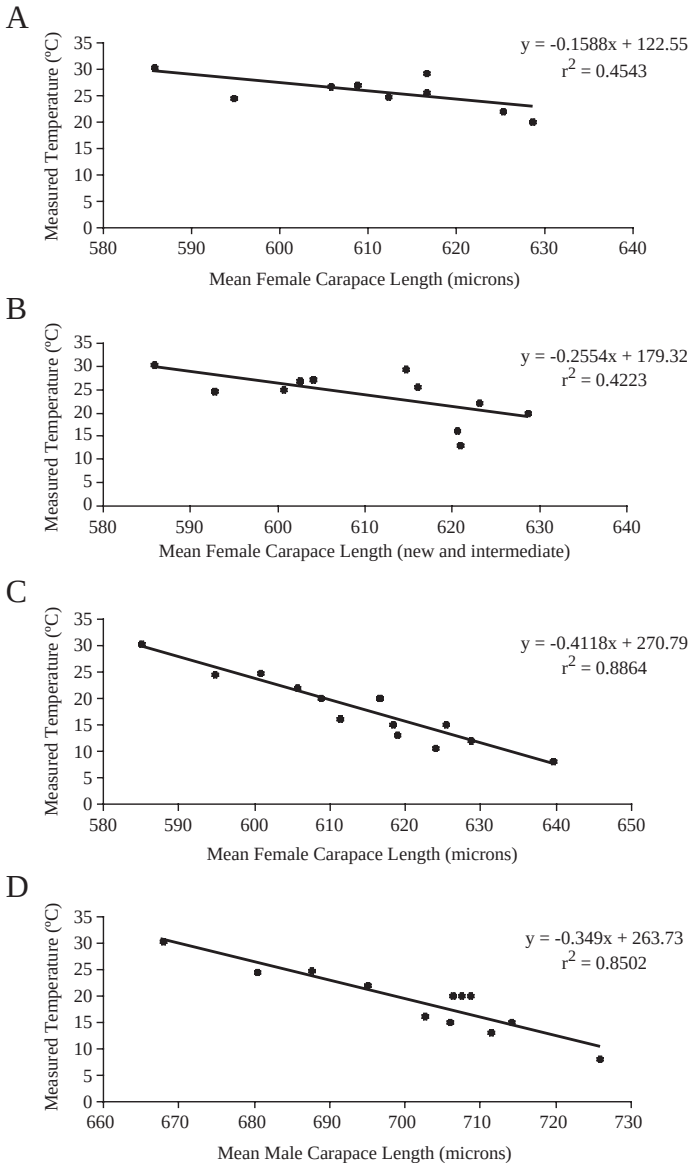

Fig. 9. Linear regressions of carapace length of adult *Loxoconcha matagordensis* and water temperature. (A) Mean female values using pooled populations from Guinea Marsh and Goodwin Island, Chesapeake Bay (June–September, 1999) and mean female values using pooled populations from Florida Bay (152 total females) from February to July, 1998. Includes clean, intermediate and dirty shells and T_m (measured) for temperature values. (B) Same as in panel A except Chesapeake values from June to November and only clean and intermediate shells included. (C) Same as panel B except T_s (estimated secretion temperature) used for June–September months. (D) Same as in panel C expect for males.

ence between the two and the correlation coefficients in both regressions are similar ($r^2 = 0.42$–0.45). The scatter is probably due to the fact that individuals comprising each sample population secreted their adult carapaces at slightly different times prior to the date of collection, and thus at slightly different water temperature.

We attempted to use a more realistic estimate of T_m on the basis of the seasonal population ecology in *Loxoconcha matagordensis*. In Fig. 9C and D, the same Chesapeake and Florida Bay data are plotted for both females and males, except for the June–September data points, where we used temperature taken 2

months prior to collection time because of the apparent lag time between collection and adult secretion. We used the actual measured temperatures at collection time for September–November, under the assumption the T_m is equivalent to T_s for this period. A single winter sample from $T_m = 6$ °C was omitted because it is unlikely that adults from Chesapeake populations grew at such low temperatures. These plots reveal that both females and males exhibit similar inverse relationship between length and temperature and that both have a much improved correlation ($r^2 = 0.85$ and 0.88). Although these procedures involved a degree of subjectivity and further work is needed, we believe the regression model illustrated in Fig. 9C and D best captures the carapace size–temperature relationship in *Loxoconcha matagordensis* based on its population ecology, zoogeography and our experience with other species of *Loxoconcha*.

3.5. Seasonal variability in magnesium/calcium ratios of *Loxoconcha matagordensis* in Chesapeake Bay

In this part of the paper we examine the relationship between Mg/Ca ratios and water temperature in populations of *Loxoconcha matagordensis* collected in February through December, 1999 mainly from Guinea Marsh (a few measurements were made on individuals from Goodwin Island, Fig. 10). Mean Mg/Ca ratios pooled from the two sites were about 25 mmol/mol in February–April, rose to maximum levels of 45–48 mmol/mol in July and August, and fell again to ~25 mmol/mol in December. The results suggest a positive relationship between mean Mg/Ca ratio and seasonal changes in T_m for much of the year. However, it should be kept in mind in light of the prior discussion, that the values for T_m, may slightly overestimate T_s for an unknown number of individuals which secreted their adults shells 1–2 months prior to collection date.

Before proceeding, it should be noted that Mg/Ca ratios in Chesapeake Bay water are relatively constant across the annual salinity range at the Guinea and Goodwin sites (~18–23 ppt for 1999) and thus salinity variability is unlikely to be an important factor in explaining the observed pattern in *Loxoconcha* Mg/Ca ratios. This is in contrast to Florida Bay waters where salinity (0–40 ppt) and Mg/Ca molar ratios (0–5 mmol/mol) are positively correlated due to fresh/marine water mixing processes (Dwyer and Cronin, 2001).

3.6. Magnesium/calcium–temperature calibration equation

To further examine the *Loxoconcha* Mg/Ca–temperature relationship, we assembled a group of samples from other regions along the eastern United States representing what we consider the entire temperature range at which adult *Loxoconcha* are secreted. In addition to the Guinea Marsh and Goodwin Island samples,

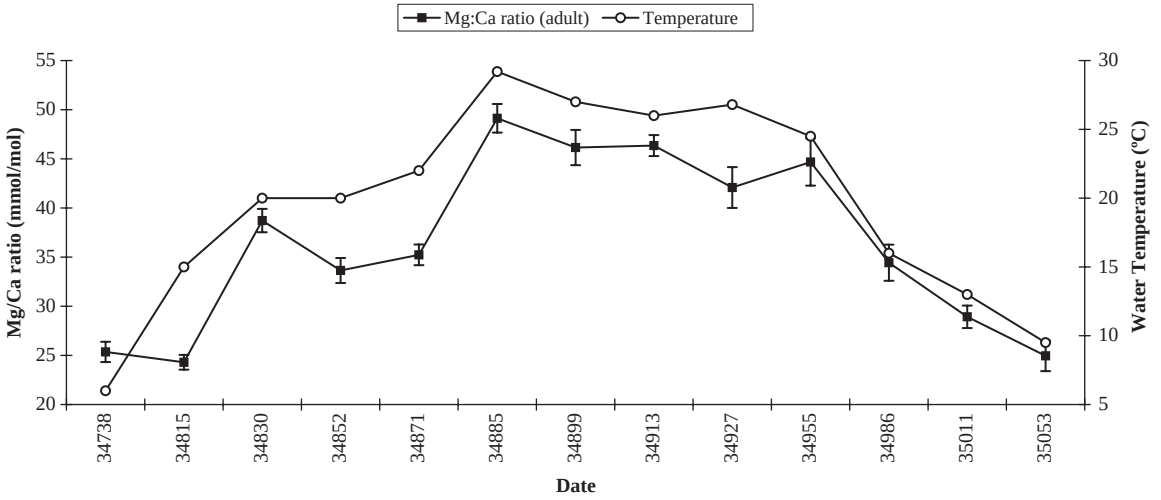

Fig. 10. Relationship between mean Mg/Ca ratio of adult *Loxoconcha matagordensis* from Guinea Marsh and Goodwin Island (pooled for each sampling date), Chesapeake Bay and T_m for the year 1999. Mg/Ca ratios are in mmol/mol, vertical bars are 1 standard error.

we measured Mg/Ca ratios in *Loxoconcha matagordensis* from Bogue Sound, North Carolina collected in August 1999 and from Dameron Marsh, Chesapeake Bay collected in March 1999, *Loxoconcha* sp. collected from the channel of Chesapeake Bay in June and September 1999, and *Loxoconcha* sp. and *Loxoconcha granulata* collected from surface sediments on the continental shelf of eastern North America. A total of 156 individual adult specimens from 36 samples were used in this analysis (Appendix C).

Fig. 11 shows the resulting regression model constructed from 36 mean Mg/Ca values covering a range in T_m of 7 °C to 30 °C. The correlation coefficient for this model is $r^2=0.82$ and the standard error is 2.6 °C. Other regression equations using slight modifications of this data set (i.e., inclusion of A-1 instars and pooling all samples from the June and September 1999 Chesapeake Bay collections) did not produce any major differences in slope, correlation coefficient, or standard error.

It is important to point out several limitations of these data. First, the inclusion of three species introduces potential interspecific taxonomic variability in Mg/Ca ratios. This does not appear to be of major concern for several reasons. These species are closely related to one another and their stratigraphic distribution suggests they evolved during the Pliocene and are all adapted to generally similar temperate climate regimes. This suggests similar ecological requirements, and we assume this also means they all have similar physiology with respect to the molting process. Moreover, it has been noted in other ostracode genera (Chivas et al., 1986; Dwyer et al., 1995) that Mg/Ca–temperature relationships hold at the genus level and that despite the limited data for *Loxoconcha* sp. and *Loxoconcha impressa*, this appears to be the case for *Loxoconcha*.

A second issue pertains to how well the measured temperature represents the actual temperature at the time of shell secretion. The York River samples are well con-

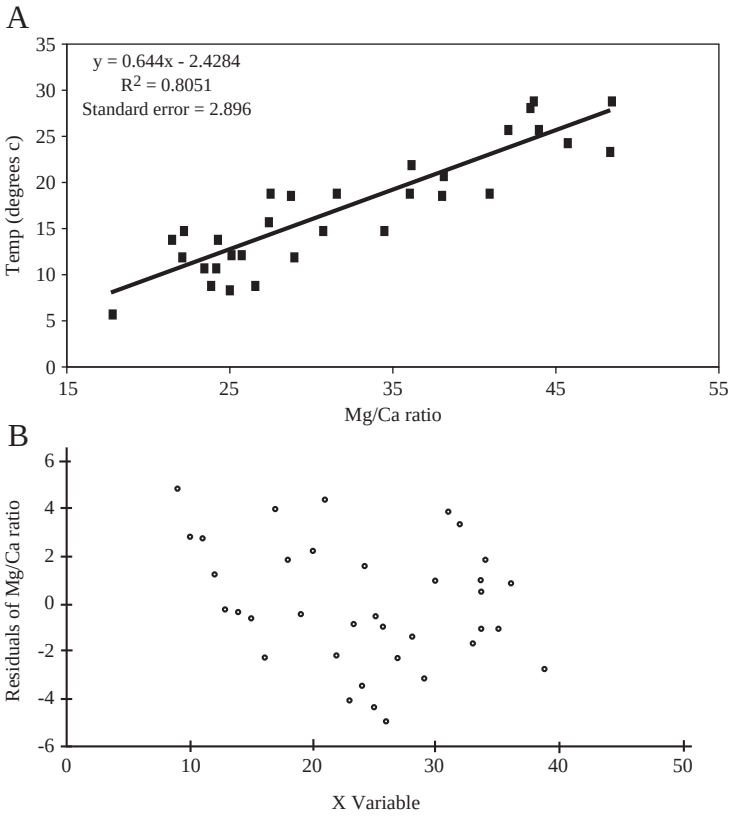

Fig. 11. (A) Linear regression model for Mg/Ca ratios in *Loxoconcha* and water temperature from 36 samples from regions along the eastern United States. (B) Plot of residuals from regression model. See text and Appendix C for discussion.

strained in terms of seasonal ecology and measured temperature and, as discussed above, there is strong evidence that T_m is either equivalent to, or slightly lower than T_s for most populations. *Loxoconcha* sp. collected from the main channel of Chesapeake in June and September, 1999 included well-preserved dead adult valves and carapaces. We assume that these *Loxoconcha* secreted their shells at or near the collection dates and we used mean June and September temperature for each site in the calibration equation obtained from the Chesapeake Bay Program, Annapolis, MD. In the case of *Loxoconcha* from the continental shelf surface sediment samples, it was assumed that adults grew during the summer months. This assumption seems valid because studies of ostracode biogeography along continental shelf off eastern North America show that these species are limited to the temperate marine climate zone, where there is large seasonal variability in water temperature (Hazel, 1970). If they had evolved to reproduce and survive in colder or warmer temperatures, we would expect them to live in high or lower latitudes, respectively. Summer temperature for each site was obtained from oceanographic sources given in previous ostracode faunal studies using these samples (Valentine, 1971; Cronin and Dowsett, 1990).

In sum, despite some uncertainty of the precise secretion temperature for some samples, the regression in Fig. 11 reflects a first order relationship between temperature and Mg/Ca in temperate species of the genus *Loxoconcha* obtained from a variety of natural estuarine and marine habitats.

3.7. Intra-shell Mg/Ca variability

Microprobe analyses of *Loxoconcha matagordensis* from Florida Bay are shown in Figs. 12 and 13. Magnesium/calcium ratios obtained by point measurements taken along transects at two locations in each shell are shown in Fig. 12A and B. Weight percent magnesium and calcium obtained using continuous sweeps across the entire shell width of both shells are shown in Fig. 13A and B. The first point revealed by these plots is that microprobe analyses yield Mg/Ca ratios ranging from ~40 to 65 mmol/mol. These values are near the high end of the range obtained in the DCP-based calibration model discussed above, which seems quite reasonable given the Florida Bay source of the microprobe specimens.

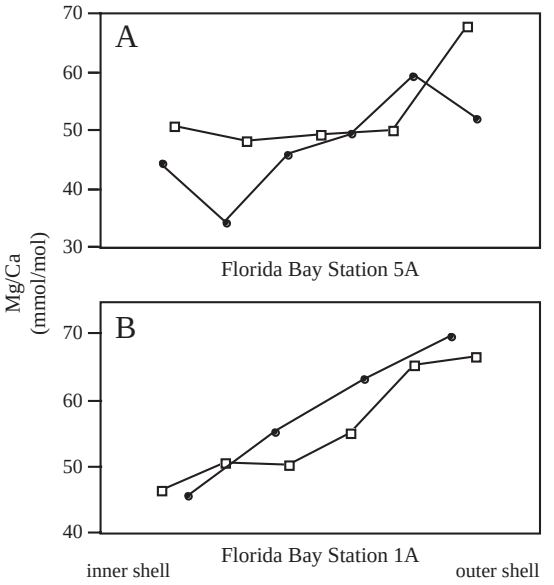

Fig. 12. Microprobe determined Mg/Ca ratios in Florida Bay *Loxoconcha matagordensis*. A and B show transects in two different adult specimens obtained by point measurements.

The second point is that Mg/Ca ratios from the inner part of all shells are lower than those from the outer part of the shell. This pattern is seen in both the point and the continuous transects. Intra-shell variability in Mg/Ca ratios was also observed by Cadot et al. (1972) in several ostracode genera and in the genus *Krithe* by Dwyer et al. (2002). It seems to be the result of differing rates of calcification during molting and the amount of organic material incorporated into the shell, but further studies are needed.

4. Discussion and conclusions

Most previous studies of ostracode shell chemistry variability have focused either on culturing (Chivas et al., 1986; Majoran et al., 1999; De Deckker et al., 1999), living individuals collected from natural habitats (Cadot and Kaesler, 1977), or mostly dead shells obtained from coretop samples (Corrège, 1993; Dwyer et al., 1995). To our knowledge, the current study is the first seasonal ecological study designed to calibrate Mg/Ca ratios using material collected live from natural estuarine/marine habitats at monthly and bimonthly intervals. The results confirm that the seasonal breeding cycle and carapace length–temperature

relationships observed in the genus *Loxoconcha* by Kamiya (1988) for *Loxoconcha japonica* hold for *Loxoconcha matagordensis*. The carapace size–temperature relationship in *Loxoconcha matagordensis* may have two explanations. The first is that carapace growth is slower in cooler temperatures due to slower metabolic activity during the molting process. The second may be related to the ecological strategy of *Loxoconcha* to produce large populations of juveniles for survival during winter months. Kamiya (1988)

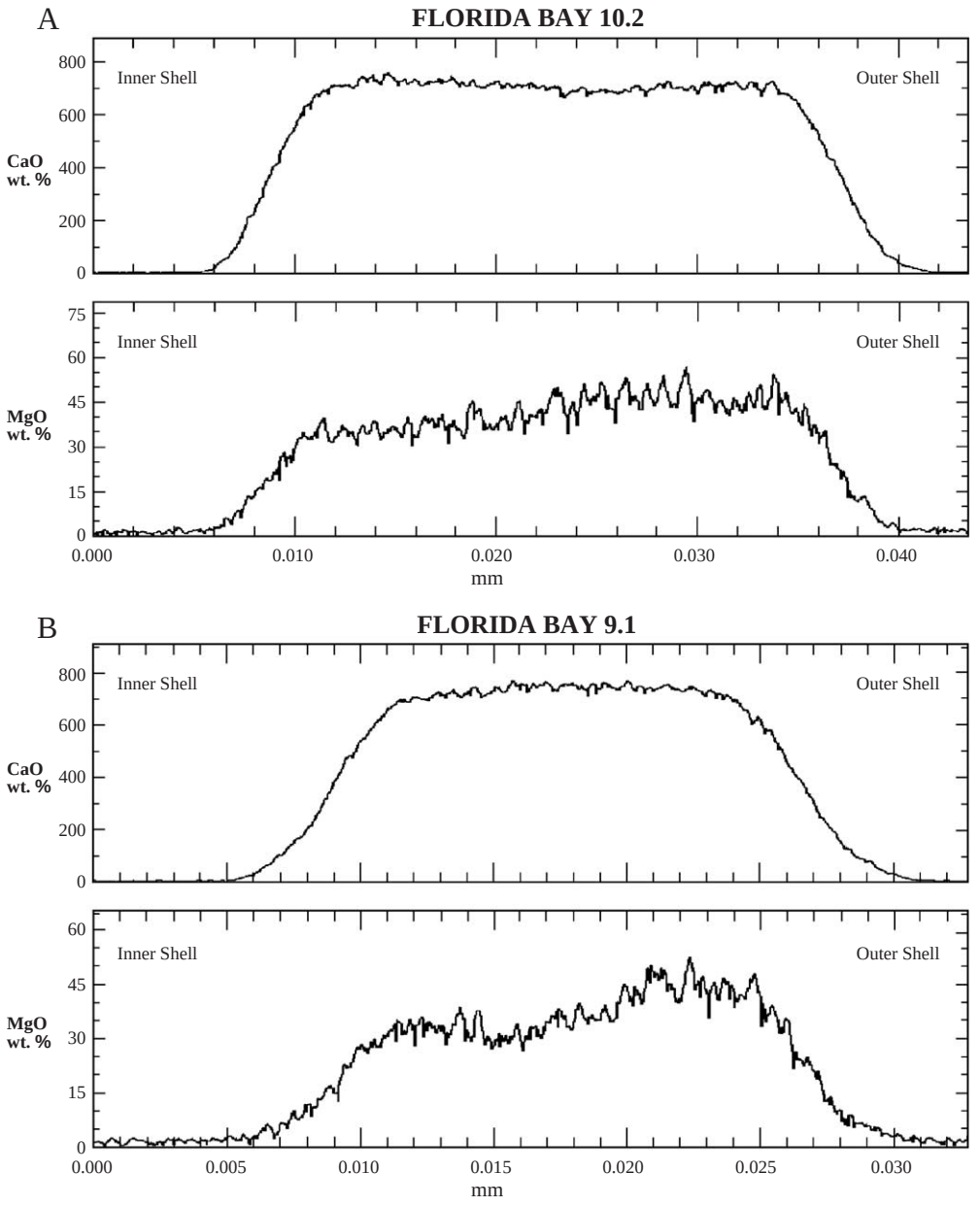

Fig. 13. A and B show the relative concentration of magnesium and calcium (counts/sec) from continuous electron microprobe line scans across entire shells of same two Florida Bay *Loxoconcha matagordensis* shown in Fig. 12. The right and left portions of the scans record the excitation volume of the electron beam passing into and out of the shell.

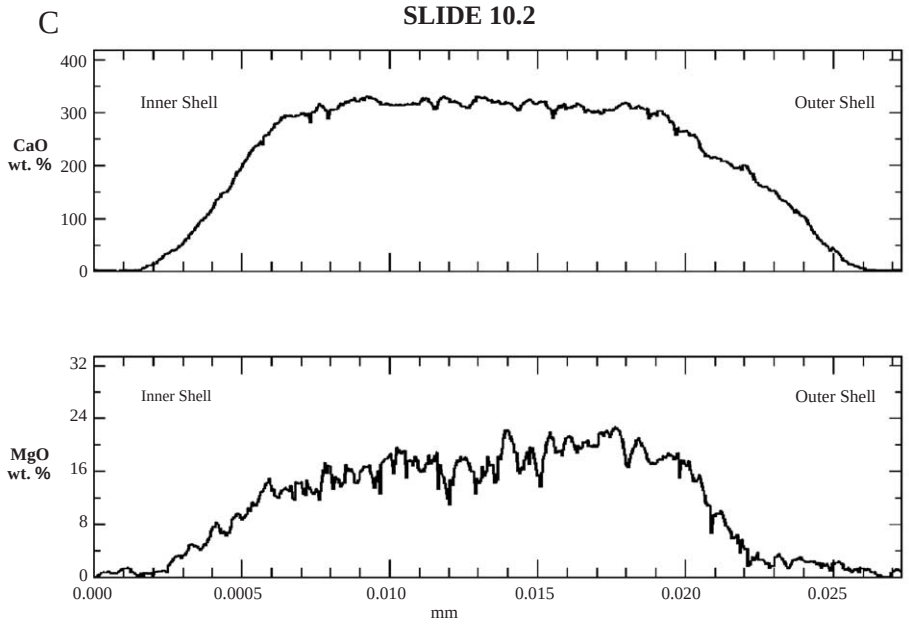

Fig. 13 (*continued*).

observed summer populations of relatively small-shelled *Loxoconcha japonica* had abundant, but very small eggs, which require less room in the female carapace. These populations live during a time when *Zostera* seagrass is dying off during late summer and fall. With reduced *Zostera* habitat, a large number of offspring may provide a selective advantage to *Loxoconcha japonica*, for those populations that must survive through the winter until the spring breeding season. Such a situation may also apply to *Loxoconcha matagordensis*, which has the same general population ecology as *Loxoconcha japonica* and this idea can be tested with further field and experimental studies.

The apparent lag between shell size and temperature during the spring–early summer populations is probably related to the processes controlling shell coloration and preservation in *Loxoconcha*. The *Loxoconcha* carapace becomes "dirty" in three distinct ways: discoloration of epidermal cells, epicutical or the adhesion of organic material to the outer carapace surface. Although we did not distinguish among these factors microscopically, two factors might influence these processes. First, the duration of time between adult shell secretion and collection — the more time, the dirtier the shell becomes. The second, water clarity — the more organic detritus, the dirtier and faster the shell becomes brown. Kamiya (1988) noted that water clarity is relatively good during spring in contrast to more turbid waters during summer and fall. This would mean that even relatively clean individuals collected during spring early summer may have actually secreted their shells 1–2 months prior to collection. Conversely, adult shells secreted during the late summer fall breeding season become dirty relatively quickly due to abundant organic detritus in the water. In general, shell coloration is a useful but not fail-safe method to estimate the age of adult shells and the approximate time since an individual shell was secreted. Even with the uncertainty about precise secretion time, using individuals collected from natural environments has advantages over using cultured specimens because the unnatural environment (i.e. artificial seawater, Kondo et al., 2005) can produce anomalously high Mg/Ca ratios and/or weakly calcified carapaces (Dwyer et al., 2002).

The population ecology and the size–temperature relationship in *Loxoconcha matagordensis* provides a simple means to estimate paleotemperature changes in a series of fossil populations, assuming adults secreted their shells at the same time of year. Fig. 14 provides such an example using male and female populations from two sediment cores from Russell Bank in central Florida Bay. The stratigraphy, age and ostracode faunas

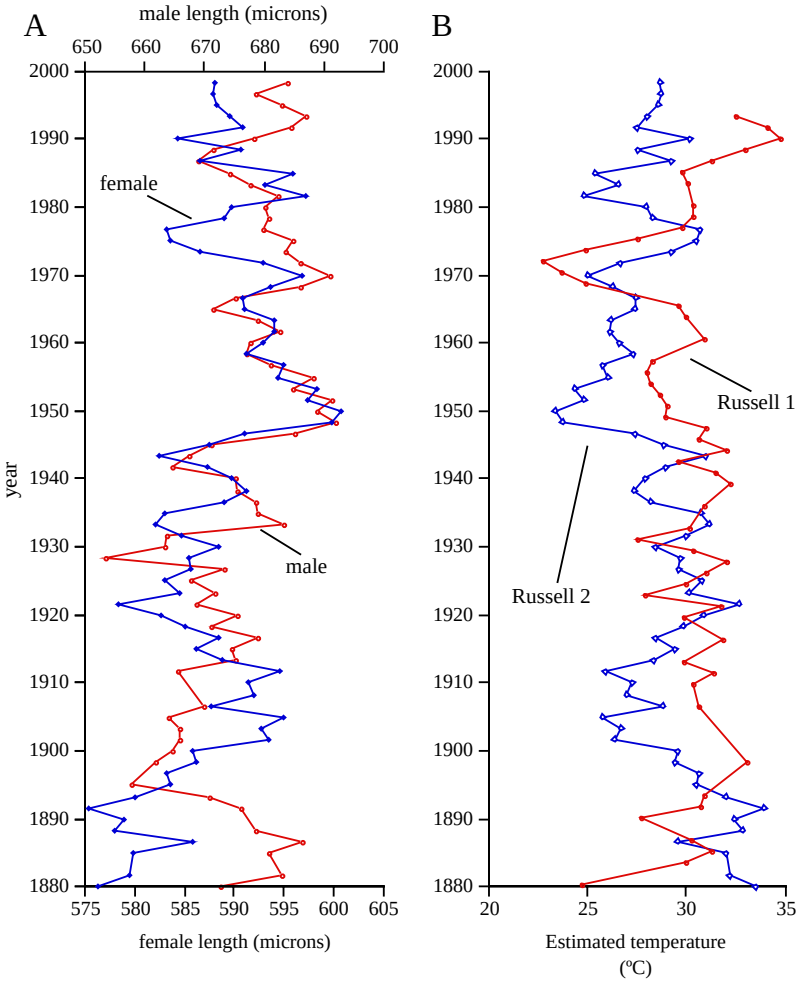

Fig. 14. (A) Variability of carapace length in male (○) and female (●) *Loxoconcha matagordensis* from Russell Bank core #2 for period 1880–1998. (B) Estimated temperature variability in Russell Bank core #1 (●) and core #2 (◇).

are discussed in detail in Cronin et al. (2001). The figure reveals strikingly similar trends in both male and female populations from the Russell # 2 core. Further, the size trends from the Russell # 1 core for females are replicated in the Russell # 2 core within the limits of the stratigraphy and sampling intervals. Finally, the figure also shows a preliminary plot of temperature history using the size–temperature regression equation given in Fig. 9C. The results indicate that temperature in this part of Florida Bay varied from about 24 to 34 °C, estimates that are reasonably close to measured summer temperatures there. In sum, these data provide evidence that the size relationship observed in *Loxoconcha* male and female populations from the York River holds true for Florida Bay populations. Further studies of this simple indicator may prove useful as a means of estimating past water temperature variability.

The ecological data obtained on *Loxoconcha* also aid in the interpretation of the Mg/Ca–temperature relationships from the standpoint of distinguishing between time of adult shell secretion and collection time. At first examination, the match between water temperature and Mg/Ca ratios in Fig. 10A seems excellent, suggesting adults secreted their adult shell very close to the time of collection. Such an interpretation, however, requires qualification in two respects. First, adults collected in winter and early spring, 1999 (February–May) most likely represent individual that grew

their adult shells during the prior fall, and thus at a slightly higher temperature than those of the February–May collection date. The dominance of extremely dirty shells collected during these months as well as the patterns observed in *Loxoconcha japonica* support this view. Second, if adult *Loxoconcha matagordensis* collected in May–July actually secreted their shells 1–2 months earlier than the collection date, as suggested by the size–temperature relationship, then the temperature at the time of secretion of these adults may have been slightly lower than that measured. Although these problems do not diminish the value of the Mg/Ca temperature relationship, it is likely that an improved Mg/Ca temperature calibration might be obtained with additional material collected bimonthly for which shell preservation is carefully evaluated. Studies of *Loxoconcha matagordensis* collected bimonthly from Dameron Marsh in Chesapeake Bay are underway to refine the calibration using adults secreted during the spring/summer season.

Acknowledgments

We are extremely grateful to Drs. K. Moore, Dr. R. Orth and B. Berry-Niekirk and their staff at the Virginia Institute of Marine Science for collection of York River seagrass samples under the auspices of the Virginia Nearshore SAV Habitat Monitoring Program. Dr. Dan Dauer of Old Dominion University provided assistance with sampling the deep Chesapeake Channel. Dr. G. Tanaka, J. Repetski, D. Willard and an anonymous reviewer provided useful comments of the manuscript.

Appendix A

Size data for *Loxoconcha matagordensis* from Chesapeake Bay: Males

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Goodwin Island	2/9/1999	Brown	Old	716	M		710		707.6666667
Goodwin Island	2/9/1999	Brown	Old	704	M				
Guinea Marsh	2/9/1999	Trans-brown	Intermediate	726	M	706.5			
Guinea Marsh	2/9/1999	Trans-brown	Intermediate	700	M				
Guinea Marsh	2/9/1999	Trans-brown	Intermediate	730	M				
Guinea Marsh	2/9/1999	Brown	Old	670	M				
Guinea Marsh	4/27/1999	Transparent	New	706	M	705.1428571			705.1428571
Guinea Marsh	4/27/1999	Brown	Old	720	M				
Guinea Marsh	4/27/1999	Brown	Old	704	M				
Guinea Marsh	4/27/1999	Brown	Old	720	M				
Guinea Marsh	4/27/1999	Brown	Old	690	M				
Guinea Marsh	4/27/1999	Brown	Old	696	M				
Guinea Marsh	4/27/1999	Brown	Old	700	M				
Goodwin Island	5/12/1999	Brown	Old	664	M		664		689.5
Guinea Marsh	5/12/1999	Transparent	New	726	M	698			
Guinea Marsh	5/12/1999	Brown	Old	682	M	684			
Guinea Marsh	5/12/1999	Brown	Old	686	M				
Goodwin Island	6/22/1999	Trans-brown	Intermediate	724	M		707.7142857		714.1714286
Goodwin Island	6/22/1999	Transparent	New	682	M				
Goodwin Island	6/22/1999	Transparent	New	690	M				
Goodwin Island	6/22/1999	Transparent	New	700	M				
Goodwin Island	6/22/1999	Brown	Old	720	M				
Goodwin Island	6/22/1999	Brown	Old	718	M				
Goodwin Island	6/22/1999	Brown	Old	720	M				
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	712	M	715.7857143			
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	698	M				
Guinea Marsh	6/22/1999	Transparent	New	684	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	6/22/1999	Transparent	New	704	M				
Guinea Marsh	6/22/1999	Transparent	New	702	M				
Guinea Marsh	6/22/1999	Transparent	New	720	M				
Guinea Marsh	6/22/1999	Brown	Old	720	M				
Guinea Marsh	6/22/1999	Brown	Old	706	M				
Guinea Marsh	6/22/1999	Brown	Old	720	M				
Guinea Marsh	6/22/1999	Brown	Old	714	M				
Guinea Marsh	6/22/1999	Brown	Old	736	M				
Guinea Marsh	6/22/1999	Brown	Old	734	M				
Guinea Marsh	6/22/1999	Brown	Old	724	M				
Guinea Marsh	6/22/1999	Brown	Old	726	M				
Guinea Marsh	6/22/1999	Brown	Old	706	M				
Guinea Marsh	6/22/1999	Brown	Old	712	M				
Guinea Marsh	6/22/1999	Brown	Old	684	M				
Guinea Marsh	6/22/1999	Brown	Old	706	M				
Guinea Marsh	6/22/1999	Brown	Old	700	M				
Guinea Marsh	6/22/1999	Brown	Old	726	M				
Guinea Marsh	6/22/1999	Brown	Old	724	M				
Guinea Marsh	6/22/1999	Brown	Old	730	M				
Guinea Marsh	6/22/1999	Brown	Old	740	M				
Guinea Marsh	6/22/1999	Brown	Old	738	M				
Guinea Marsh	6/22/1999	Brown	Old	722	M				
Guinea Marsh	6/22/1999	Brown	Old	706	M				
Guinea Marsh	6/22/1999	Yellow-brown	Old	730	M				
Guinea Marsh	6/22/1999	Very brown	Very old	718	M				
Goodwin Island	7/6/1999	Trans-brown	Intermediate	696	M		704		708.727273
Goodwin Island	7/6/1999	Brown	Old	694	M				
Goodwin Island	7/6/1999	Yellow-brown	Old	706	M				
Goodwin Island	7/6/1999	Yellow-brown	Old	720	M				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	706	M	711.4285714			
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	702	M				
Guinea Marsh	7/6/1999	Transparent	New	710	M				
Guinea Marsh	7/6/1999	Transparent	New	716	M				
Guinea Marsh	7/6/1999	Transparent	New	708	M				
Guinea Marsh	7/6/1999	Brown	Old	732	M				
Guinea Marsh	7/6/1999	Brown	Old	706	M				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	704	M		711		706.350877
Goodwin Island	7/20/1999	Trans-brown	Intermediate	702	M				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	698	M				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	708	M				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	700	M				
Goodwin Island	7/20/1999	Transparent	New	692	M				
Goodwin Island	7/20/1999	Brown	Old	704	M				
Goodwin Island	7/20/1999	Brown	Old	720	M				
Goodwin Island	7/20/1999	Brown	Old	706	M				
Goodwin Island	7/20/1999	Opaque	Old	710	M				
Goodwin Island	7/20/1999	Yellow-opaque	Old	726	M				
Goodwin Island	7/20/1999	Yellow-opaque	Old	696	M				
Goodwin Island	7/20/1999	Yellow-opaque	Old	722	M				
Goodwin Island	7/20/1999	Yellow-opaque	Old	722	M				
Goodwin Island	7/20/1999	Brown-opaque	Very old	720	M				
Goodwin Island	7/20/1999	Brown-opaque	Very old	746	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	714	M	704.5365854			

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	704	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	700	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	704	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	716	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	706	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	708	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	704	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	704	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	690	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	700	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	692	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	700	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	710	M				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	714	M				
Guinea Marsh	7/20/1999	Transparent	New	700	M				
Guinea Marsh	7/20/1999	Transparent	New	706	M				
Guinea Marsh	7/20/1999	Transparent	New	704	M				
Guinea Marsh	7/20/1999	Transparent	New	702	M				
Guinea Marsh	7/20/1999	Transparent	New	700	M				
Guinea Marsh	7/20/1999	Transparent	New	706	M				
Guinea Marsh	7/20/1999	Transparent	New	706	M				
Guinea Marsh	7/20/1999	Transparent	New	690	M				
Guinea Marsh	7/20/1999	Transparent	New	702	M				
Guinea Marsh	7/20/1999	Transparent	New	706	M				
Guinea Marsh	7/20/1999	Transparent	New	686	M				
Guinea Marsh	7/20/1999	Transparent	New	700	M				
Guinea Marsh	7/20/1999	Transparent	New	694	M				
Guinea Marsh	7/20/1999	Transparent	New	710	M				
Guinea Marsh	7/20/1999	Brown	Old	706	M				
Guinea Marsh	7/20/1999	Brown	Old	702	M				
Guinea Marsh	7/20/1999	Brown	Old	712	M				
Guinea Marsh	7/20/1999	Brown	Old	708	M				
Guinea Marsh	7/20/1999	Brown	Old	704	M				
Guinea Marsh	7/20/1999	Brown	Old	698	M				
Guinea Marsh	7/20/1999	Brown	Old	708	M				
Guinea Marsh	7/20/1999	Brown	Old	708	M				
Guinea Marsh	7/20/1999	Brown	Old	720	M				
Guinea Marsh	7/20/1999	Brown-opaque	Very old	700	M				
Guinea Marsh	7/20/1999	Brown-opaque	Very old	720	M				
Guinea Marsh	7/20/1999	Brown-opaque	Very old	722	M				
Goodwin Island	8/3/1999	Transparent	New	700	M		706		707.625
Goodwin Island	8/3/1999	Transparent	New	704	M				
Goodwin Island	8/3/1999	Transparent	New	720	M				
Goodwin Island	8/3/1999	Transparent	New	708	M				
Goodwin Island	8/3/1999	Brown	Old	720	M				
Goodwin Island	8/3/1999	Brown	Old	716	M				
Goodwin Island	8/3/1999	Brown	Old	702	M				
Goodwin Island	8/3/1999	Brown	Old	700	M				
Goodwin Island	8/3/1999	Brown-white	Old	690	M				
Goodwin Island	8/3/1999	Brown-white	Old	700	M				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	700	M	708.3636364			
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	718	M				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	706	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	722	M				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	704	M				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	698	M				
Guinea Marsh	8/3/1999	Transparent	New	692	M				
Guinea Marsh	8/3/1999	Transparent	New	720	M				
Guinea Marsh	8/3/1999	Transparent	New	702	M				
Guinea Marsh	8/3/1999	Transparent	New	714	M				
Guinea Marsh	8/3/1999	Transparent	New	696	M				
Guinea Marsh	8/3/1999	Transparent	New	692	M				
Guinea Marsh	8/3/1999	Transparent	New	704	M				
Guinea Marsh	8/3/1999	Transparent	New	682	M				
Guinea Marsh	8/3/1999	Brown	Old	706	M				
Guinea Marsh	8/3/1999	Brown	Old	730	M				
Guinea Marsh	8/3/1999	Brown	Old	724	M				
Guinea Marsh	8/3/1999	Brown	Old	726	M				
Guinea Marsh	8/3/1999	Brown	Old	710	M				
Guinea Marsh	8/3/1999	Brown-opaque	Very old	720	M				
Guinea Marsh	8/3/1999	Brown-opaque	Very old	704	M				
Guinea Marsh	8/3/1999	Brown-opaque	Very old	714	M				
Goodwin Island	8/17/1999	Trans-brown	Intermediate	692	M		693.7894737		695.0909091
Goodwin Island	8/17/1999	Trans-brown	Intermediate	682	M				
Goodwin Island	8/17/1999	Trans-brown	Intermediate	706	M				
Goodwin Island	8/17/1999	Trans-white	Intermediate/old	678	M				
Goodwin Island	8/17/1999	Transparent	New	686	M				
Goodwin Island	8/17/1999	Transparent	New	680	M				
Goodwin Island	8/17/1999	Transparent	New	688	M				
Goodwin Island	8/17/1999	Transparent	New	704	M				
Goodwin Island	8/17/1999	Brown	Old	700	M				
Goodwin Island	8/17/1999	Brown	Old	682	M				
Goodwin Island	8/17/1999	Brown	Old	706	M				
Goodwin Island	8/17/1999	Brown	Old	700	M				
Goodwin Island	8/17/1999	Brown	Old	688	M				
Goodwin Island	8/17/1999	Brown	Old	698	M				
Goodwin Island	8/17/1999	Brown	Old	706	M				
Goodwin Island	8/17/1999	Brown-opaque	Very old	702	M				
Goodwin Island	8/17/1999	Brown-opaque	Very old	700	M				
Goodwin Island	8/17/1999	Brown-opaque	Very old	702	M				
Goodwin Island	8/17/1999	n/a	n/a	682	M				
Guinea Marsh	8/17/1999	Trans-brown	Intermediate	710	M	703.3333333			
Guinea Marsh	8/17/1999	Trans-brown	Intermediate	706	M				
Guinea Marsh	8/17/1999	Transparent	New	694	M				
Goodwin Island	9/14/1999	Brown	Old	682	M		682		680.5333333
Goodwin Island	9/14/1999	Brown	Old	680	M				
Goodwin Island	9/14/1999	Brown-opaque	Very old	684	M				
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	690	M	680.1666667			
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	676	M				
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	680	M				
Guinea Marsh	9/14/1999	Transparent	New	696	M				
Guinea Marsh	9/14/1999	Transparent	New	664	M				
Guinea Marsh	9/14/1999	Brown	Old	660	M				
Guinea Marsh	9/14/1999	Brown	Old	682	M				
Guinea Marsh	9/14/1999	Brown	Old	656	M				
Guinea Marsh	9/14/1999	Brown	Old	694	M				

(continued on next page)

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	9/14/1999	Brown	Old	674	M				
Guinea Marsh	9/14/1999	Brown	Old	680	M				
Guinea Marsh	9/14/1999	Brown-opaque	Very old	710	M				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	696	M	702.7272727			702.72727273
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	702	M				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	702	M				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	696	M				
Guinea Marsh	10/15/1999	Transparent	New	712	M				
Guinea Marsh	10/15/1999	Transparent	New	710	M				
Guinea Marsh	10/15/1999	Transparent	New	704	M				
Guinea Marsh	10/15/1999	Brown	Old	700	M				
Guinea Marsh	10/15/1999	Brown	Old	702	M				
Guinea Marsh	10/15/1999	Brown	Old	698	M				
Guinea Marsh	10/15/1999	Brown	Old	708	M				
Goodwin Island	11/9/1999	Trans-brown	Intermediate	704	M		711.4		711.2698413
Goodwin Island	11/9/1999	Trans-white	Intermediate/old	720	M				
Goodwin Island	11/9/1999	Trans-white	Intermediate/old	720	M				
Goodwin Island	11/9/1999	Trans-white	Intermediate/old	724	M				
Goodwin Island	11/9/1999	Trans-white	Intermediate/old	700	M				
Goodwin Island	11/9/1999	Transparent	New	700	M				
Goodwin Island	11/9/1999	Transparent	New	720	M				
Goodwin Island	11/9/1999	Transparent	New	722	M				
Goodwin Island	11/9/1999	Transparent	New	720	M				
Goodwin Island	11/9/1999	Brown-white	Old	684	M				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	718	M	711.245283			
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	680	M				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	720	M				
Guinea Marsh	11/9/1999	Transparent	New	702	M				
Guinea Marsh	11/9/1999	Transparent	New	714	M				
Guinea Marsh	11/9/1999	Transparent	New	690	M				
Guinea Marsh	11/9/1999	Transparent	New	716	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	708	M				
Guinea Marsh	11/9/1999	Transparent	New	712	M				
Guinea Marsh	11/9/1999	Transparent	New	724	M				
Guinea Marsh	11/9/1999	Transparent	New	710	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	722	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	704	M				
Guinea Marsh	11/9/1999	Transparent	New	736	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	716	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	706	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	684	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	708	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	706	M				
Guinea Marsh	11/9/1999	Transparent	New	716	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	708	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	696	M				
Guinea Marsh	11/9/1999	Transparent	New	714	M				
Guinea Marsh	11/9/1999	Transparent	New	700	M				
Guinea Marsh	11/9/1999	Transparent	New	718	M				
Guinea Marsh	11/9/1999	Transparent	New	724	M				
Guinea Marsh	11/9/1999	Transparent	New	690	M				
Guinea Marsh	11/9/1999	Transparent	New	736	M				
Guinea Marsh	11/9/1999	Transparent	New	730	M				
Guinea Marsh	11/9/1999	Transparent	New	720	M				
Guinea Marsh	11/9/1999	Transparent	New	716	M				
Guinea Marsh	11/9/1999	Transparent	New	696	M				
Guinea Marsh	11/9/1999	Brown	Old	710	M				
Guinea Marsh	11/9/1999	Brown	Old	704	M				
Guinea Marsh	11/9/1999	Brown	Old	724	M				
Guinea Marsh	11/9/1999	Brown	Old	720	M				
Guinea Marsh	11/9/1999	Brown	Old	704	M				
Guinea Marsh	11/9/1999	Brown-white	Old	714	M				
Guinea Marsh	11/9/1999	Brown-white	Old	740	M				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	718	M		703.4117647		702.7894737
Goodwin Island	12/21/1999	Trans-brown	Intermediate	704	M				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	700	M				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	720	M				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	700	M				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	710	M				
Goodwin Island	12/21/1999	Transparent	New	714	M				
Goodwin Island	12/21/1999	Transparent	New	684	M				
Goodwin Island	12/21/1999	Transparent	New	700	M				
Goodwin Island	12/21/1999	Brown	Old	724	M				
Goodwin Island	12/21/1999	Brown-white	Old	704	M				
Goodwin Island	12/21/1999	Very brown	Very old	700	M				
Goodwin Island	12/21/1999	Very brown	Very old	712	M				
Goodwin Island	12/21/1999	White-opaque	Very old	700	M				
Goodwin Island	12/21/1999	White-opaque	Very old	704	M				
Goodwin Island	12/21/1999	White-opaque	Very old	684	M				
Goodwin Island	12/21/1999	White-opaque	Very old	680	M				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	718	M	702.2857143			
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	718	M				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	724	M				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	700	M				
Guinea Marsh	12/21/1999	Transparent	New	700	M				
Guinea Marsh	12/21/1999	Transparent	New	714	M				
Guinea Marsh	12/21/1999	Transparent	New	712	M				
Guinea Marsh	12/21/1999	Transparent	New	700	M				
Guinea Marsh	12/21/1999	Transparent	New	690	M				
Guinea Marsh	12/21/1999	Transparent	New	700	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	680	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	688	M				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	12/21/1999	White-opaque	Very old	720	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	724	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	704	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	720	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	698	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	704	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	710	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	620	M				
Guinea Marsh	12/21/1999	White-opaque	Very old	704	M				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	700	M		710.4444444		707.3571429
Goodwin Island	1/8/2000	Trans-brown	Intermediate	710	M				
Goodwin Island	1/8/2000	Transparent	New	712	M				
Goodwin Island	1/8/2000	Transparent	New	704	M				
Goodwin Island	1/8/2000	Transparent	New	706	M				
Goodwin Island	1/8/2000	Brown	Old	720	M				
Goodwin Island	1/8/2000	Brown	Old	720	M				
Goodwin Island	1/8/2000	Brown-white	Old	720	M				
Goodwin Island	1/8/2000	Very brown	Very old	702	M				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	718	M	705.8947368			
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	702	M				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	706	M				
Guinea Marsh	1/8/2000	Transparent	New	710	M				
Guinea Marsh	1/8/2000	Transparent	New	720	M				
Guinea Marsh	1/8/2000	Transparent	New	664	M				
Guinea Marsh	1/8/2000	Transparent	New	700	M				
Guinea Marsh	1/8/2000	Transparent	New	700	M				
Guinea Marsh	1/8/2000	Transparent	New	700	M				
Guinea Marsh	1/8/2000	Brown	Old	720	M				
Guinea Marsh	1/8/2000	Brown	Old	710	M				
Guinea Marsh	1/8/2000	Brown	Old	700	M				
Guinea Marsh	1/8/2000	Brown	Old	730	M				
Guinea Marsh	1/8/2000	Brown	Old	694	M				
Guinea Marsh	1/8/2000	Brown	Old	704	M				
Guinea Marsh	1/8/2000	Brown	Old	710	M				
Guinea Marsh	1/8/2000	Brown	Old	720	M				
Guinea Marsh	1/8/2000	Brown-white	Old	704	M				
Guinea Marsh	1/8/2000	Very brown	Very old	700	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	688	M	708.36			708.36
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	716	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	702	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	706	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	700	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	708	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	706	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	716	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	724	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	718	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	712	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	2/29/2000	Transparent	New	690	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	2/29/2000	Transparent	New	724	M				
Guinea Marsh	2/29/2000	Transparent	New	722	M				
Guinea Marsh	2/29/2000	Transparent	New	724	M				
Guinea Marsh	2/29/2000	Transparent	New	700	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	704	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	710	M				
Guinea Marsh	2/29/2000	Brown	Old	708	M				
Guinea Marsh	2/29/2000	Brown	Old	720	M				
Guinea Marsh	2/29/2000	Brown	Old	704	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	690	M				
Guinea Marsh	2/29/2000	Brown	Old	720	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	696	M				
Guinea Marsh	2/29/2000	Brown	Old	720	M				
Guinea Marsh	2/29/2000	Brown	Old	702	M				
Guinea Marsh	2/29/2000	Brown	Old	714	M				
Guinea Marsh	2/29/2000	Brown	Old	718	M				
Guinea Marsh	2/29/2000	Brown	Old	694	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	722	M				
Guinea Marsh	2/29/2000	Brown	Old	684	M				
Guinea Marsh	2/29/2000	Brown	Old	710	M				
Guinea Marsh	2/29/2000	Brown	Old	690	M				
Guinea Marsh	2/29/2000	Brown	Old	726	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown	Old	720	M				
Guinea Marsh	2/29/2000	Brown	Old	700	M				
Guinea Marsh	2/29/2000	Brown-white	Old	706	M				
Guinea Marsh	2/29/2000	Brown-white	Old	718	M				
Guinea Marsh	2/29/2000	Brown-white	Old	700	M				
Guinea Marsh	2/29/2000	Very brown	Very old	724	M				
Guinea Marsh	2/29/2000	White-opaque	Very old	702	M				
Guinea Marsh	3/29/2000	Trans-white	Intermediate/old	686	M	704			704
Guinea Marsh	3/29/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	3/29/2000	Brown-white	Old	722	M				
Guinea Marsh	3/29/2000	Brown-white	Old	700	M				
Guinea Marsh	3/29/2000	Brown-white	Old	724	M				
Guinea Marsh	3/29/2000	White-opaque	Very old	698	M				
Guinea Marsh	3/29/2000	White-opaque	Very old	704	M				
Guinea Marsh	3/29/2000	White-opaque	Very old	698	M				
Goodwin Island	4/19/2000	Brown-white	Old	704	M		694		694
Goodwin Island	4/19/2000	Brown-white	Old	684	M				
Dameron Marsh	5/17/2000	Transparent	New	700	M			701	701
Dameron Marsh	5/17/2000	Transparent	New	702	M				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	708	M		710.7368421		711
Goodwin Island	6/13/2000	Trans-brown	Intermediate	716	M				
Goodwin Island	6/13/2000	Trans-white	Intermediate/old	702	M				
Goodwin Island	6/13/2000	Transparent	New	730	M				
Goodwin Island	6/13/2000	Transparent	New	700	M				
Goodwin Island	6/13/2000	Transparent	New	700	M				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Goodwin Island	6/13/2000	Transparent	New	730	M				
Goodwin Island	6/13/2000	Transparent	New	702	M				
Goodwin Island	6/13/2000	Transparent	New	720	M				
Goodwin Island	6/13/2000	Transparent	New	720	M				
Goodwin Island	6/13/2000	Transparent	New	704	M				
Goodwin Island	6/13/2000	Transparent	New	704	M				
Goodwin Island	6/13/2000	Transparent	New	690	M				
Goodwin Island	6/13/2000	Transparent	New	720	M				
Goodwin Island	6/13/2000	Transparent	New	700	M				
Goodwin Island	6/13/2000	Transparent	New	724	M				
Goodwin Island	6/13/2000	Transparent	New	720	M				
Goodwin Island	6/13/2000	Brown	Old	690	M				
Goodwin Island	6/13/2000	Brown	Old	724	M				
Guinea Marsh	6/13/2000	Trans-brown	Intermediate	720	M	712.6666667			
Guinea Marsh	6/13/2000	Trans-white	Intermediate/old	714	M				
Guinea Marsh	6/13/2000	Transparent	New	704	M				
Goodwin Island	7/11/2000	Trans-brown	Intermediate	720	M		713.1428571		714.7692308
Goodwin Island	7/11/2000	Transparent	New	718	M				
Goodwin Island	7/11/2000	Transparent	New	700	M				
Goodwin Island	7/11/2000	Transparent	New	720	M				
Goodwin Island	7/11/2000	Transparent	New	718	M				
Goodwin Island	7/11/2000	Brown	Old	700	M				
Goodwin Island	7/11/2000	Brown	Old	740	M				
Goodwin Island	7/11/2000	Brown	Old	700	M				
Goodwin Island	7/11/2000	Brown	Old	710	M				
Goodwin Island	7/11/2000	Brown	Old	680	M				
Goodwin Island	7/11/2000	Brown	Old	720	M				
Goodwin Island	7/11/2000	Brown-white	Old	730	M				
Goodwin Island	7/11/2000	Brown-white	Old	710	M				
Goodwin Island	7/11/2000	White-opaque	Very old	718	M				
Guinea Marsh	7/11/2000	Trans-white	Intermediate/old	740	M	716.6666667			
Guinea Marsh	7/11/2000	Trans-white	Intermediate/old	706	M				
Guinea Marsh	7/11/2000	Trans-white	Intermediate/old	716	M				
Guinea Marsh	7/11/2000	Brown	Old	720	M				
Guinea Marsh	7/11/2000	Brown-white	Old	740	M				
Guinea Marsh	7/11/2000	Brown-white	Old	700	M				
Guinea Marsh	7/11/2000	Brown-white	Old	740	M				
Guinea Marsh	7/11/2000	Brown-white	Old	702	M				
Guinea Marsh	7/11/2000	Very brown	Very old	704	M				
Guinea Marsh	7/11/2000	White-opaque	Very old	718	M				
Guinea Marsh	7/11/2000	White-opaque	Very old	704	M				
Guinea Marsh	7/11/2000	White-opaque	Very old	710	M				
Goodwin Island	8/1/2000	White-opaque	Very old	720	M		712		715.1666667
Goodwin Island	8/1/2000	White-opaque	Very old	704	M				
Guinea Marsh	8/1/2000	Trans-brown	Intermediate	700	M	715.8			
Guinea Marsh	8/1/2000	Trans-white	Intermediate/old	724	M				
Guinea Marsh	8/1/2000	Transparent	New	724	M				
Guinea Marsh	8/1/2000	Brown	Old	700	M				
Guinea Marsh	8/1/2000	Brown	Old	730	M				
Guinea Marsh	8/1/2000	Brown	Old	714	M				
Guinea Marsh	8/1/2000	Brown-white	Old	700	M				
Guinea Marsh	8/1/2000	Brown-white	Old	708	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	8/1/2000	Brown-white	Old	720	M				
Guinea Marsh	8/1/2000	Brown-white	Old	738	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	724	M		707.5		703.2307692
Goodwin Island	8/22/2000	Trans-brown	Intermediate	704	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	702	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	680	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	718	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	700	M				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	680	M				
Goodwin Island	8/22/2000	Trans-white	Intermediate/old	720	M				
Goodwin Island	8/22/2000	Trans-white	Intermediate/old	710	M				
Goodwin Island	8/22/2000	Trans-white	Intermediate/old	704	M				
Goodwin Island	8/22/2000	Transparent	New	704	M				
Goodwin Island	8/22/2000	Transparent	New	684	M				
Goodwin Island	8/22/2000	Transparent	New	688	M				
Goodwin Island	8/22/2000	Transparent	New	700	M				
Goodwin Island	8/22/2000	Transparent	New	720	M				
Goodwin Island	8/22/2000	Transparent	New	720	M				
Goodwin Island	8/22/2000	Transparent	New	710	M				
Goodwin Island	8/22/2000	Transparent	New	724	M				
Goodwin Island	8/22/2000	Transparent	New	704	M				
Goodwin Island	8/22/2000	Brown	Old	740	M				
Goodwin Island	8/22/2000	Brown	Old	722	M				
Goodwin Island	8/22/2000	Brown	Old	704	M				
Goodwin Island	8/22/2000	Brown-white	Old	722	M				
Goodwin Island	8/22/2000	Brown-white	Old	722	M				
Goodwin Island	8/22/2000	Brown-white	Old	710	M				
Goodwin Island	8/22/2000	Brown-white	Old	706	M				
Goodwin Island	8/22/2000	White-opaque	Very old	724	M				
Goodwin Island	8/22/2000	White-opaque	Very old	664	M				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	700	M	698.25			
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	700	M				
Guinea Marsh	8/22/2000	Trans-white	Intermediate/old	680	M				
Guinea Marsh	8/22/2000	Trans-white	Intermediate/old	680	M				
Guinea Marsh	8/22/2000	Transparent	New	680	M				
Guinea Marsh	8/22/2000	Transparent	New	704	M				
Guinea Marsh	8/22/2000	Transparent	New	720	M				
Guinea Marsh	8/22/2000	Transparent	New	690	M				
Guinea Marsh	8/22/2000	Transparent	New	710	M				
Guinea Marsh	8/22/2000	Transparent	New	684	M				
Guinea Marsh	8/22/2000	Transparent	New	716	M				
Guinea Marsh	8/22/2000	Transparent	New	700	M				
Guinea Marsh	8/22/2000	Transparent	New	700	M				
Guinea Marsh	8/22/2000	Transparent	New	704	M				
Guinea Marsh	8/22/2000	Transparent	New	700	M				
Guinea Marsh	8/22/2000	Transparent	New	700	M				
Guinea Marsh	8/22/2000	Transparent	New	680	M				
Guinea Marsh	8/22/2000	Transparent	New	684	M				
Guinea Marsh	8/22/2000	Transparent	New	704	M				
Guinea Marsh	8/22/2000	Transparent	New	706	M				
Guinea Marsh	8/22/2000	Transparent	New	710	M				
Guinea Marsh	8/22/2000	Transparent	New	706	M				
Guinea Marsh	8/22/2000	Brown	Old	700	M				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	8/22/2000	Very brown	Very old	700	M				
Goodwin Island	9/6/2000	Trans-white	Intermediate/old	700	M		705.6		713.8666667
Goodwin Island	9/6/2000	Transparent	New	690	M				
Goodwin Island	9/6/2000	Brown-white	Old	710	M				
Goodwin Island	9/6/2000	Brown-white	Old	720	M				
Goodwin Island	9/6/2000	Brown-white	Old	708	M				
Guinea Marsh	9/6/2000	Trans-white	Intermediate/old	720	M	718			
Guinea Marsh	9/6/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	9/6/2000	Trans-white	Intermediate/old	724	M				
Guinea Marsh	9/6/2000	Transparent	New	720	M				
Guinea Marsh	9/6/2000	Brown	Old	704	M				
Guinea Marsh	9/6/2000	Brown	Old	730	M				
Guinea Marsh	9/6/2000	Brown	Old	720	M				
Guinea Marsh	9/6/2000	Brown-white	Old	712	M				
Guinea Marsh	9/6/2000	Brown-white	Old	730	M				
Guinea Marsh	9/6/2000	Brown-white	Old	720	M				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	684	M		691.4285714		699.68
Goodwin Island	9/20/2000	Trans-brown	Intermediate	720	M				
Goodwin Island	9/20/2000	Transparent	New	700	M				
Goodwin Island	9/20/2000	Transparent	New	660	M				
Goodwin Island	9/20/2000	Transparent	New	700	M				
Goodwin Island	9/20/2000	Transparent	New	696	M				
Goodwin Island	9/20/2000	Brown	Old	680	M				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	680	M	702.8888889			
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	714	M				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	710	M				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	9/20/2000	Trans-white	Intermediate/old	680	M				
Guinea Marsh	9/20/2000	Transparent	New	690	M				
Guinea Marsh	9/20/2000	Transparent	New	722	M				
Guinea Marsh	9/20/2000	Transparent	New	720	M				
Guinea Marsh	9/20/2000	Transparent	New	726	M				
Guinea Marsh	9/20/2000	Transparent	New	698	M				
Guinea Marsh	9/20/2000	Transparent	New	700	M				
Guinea Marsh	9/20/2000	Transparent	New	704	M				
Guinea Marsh	9/20/2000	Transparent	New	708	M				
Guinea Marsh	9/20/2000	Transparent	New	700	M				
Guinea Marsh	9/20/2000	Brown	Old	702	M				
Guinea Marsh	9/20/2000	Brown	Old	680	M				
Guinea Marsh	9/20/2000	Brown	Old	698	M				
Guinea Marsh	9/20/2000	White-opaque	Very old	700	M				
Goodwin Island	10/3/2000	Transparent	New	716	M		701.7142857		710.2962963
Goodwin Island	10/3/2000	Transparent	New	700	M				
Goodwin Island	10/3/2000	Transparent	New	700	M				
Goodwin Island	10/3/2000	Transparent	New	704	M				
Goodwin Island	10/3/2000	Transparent	New	686	M				
Goodwin Island	10/3/2000	Transparent	New	726	M				
Goodwin Island	10/3/2000	Brown	Old	680	M				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	700	M	713.3			
Guinea Marsh	10/3/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	10/3/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	10/3/2000	Transparent	New	718	M				
Guinea Marsh	10/3/2000	Transparent	New	710	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	10/3/2000	Transparent	New	740	M				
Guinea Marsh	10/3/2000	Transparent	New	690	M				
Guinea Marsh	10/3/2000	Transparent	New	730	M				
Guinea Marsh	10/3/2000	Transparent	New	724	M				
Guinea Marsh	10/3/2000	Transparent	New	720	M				
Guinea Marsh	10/3/2000	Brown	Old	712	M				
Guinea Marsh	10/3/2000	Brown	Old	724	M				
Guinea Marsh	10/3/2000	Brown	Old	720	M				
Guinea Marsh	10/3/2000	Brown	Old	712	M				
Guinea Marsh	10/3/2000	Brown	Old	684	M				
Guinea Marsh	10/3/2000	Brown	Old	714	M				
Guinea Marsh	10/3/2000	Brown	Old	720	M				
Guinea Marsh	10/3/2000	Brown	Old	728	M				
Guinea Marsh	10/3/2000	Very brown	Very old	700	M				
Guinea Marsh	10/3/2000	White-opaque	Very old	720	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	724	M		707.030303		708.8085106
Goodwin Island	11/14/2000	Trans-brown	Intermediate	720	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	698	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	702	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	722	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	724	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	718	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	720	M				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	680	M				
Goodwin Island	11/14/2000	Trans-white	Intermediate/old	720	M				
Goodwin Island	11/14/2000	Trans-white	Intermediate/old	700	M				
Goodwin Island	11/14/2000	Transparent	New	692	M				
Goodwin Island	11/14/2000	Transparent	New	698	M				
Goodwin Island	11/14/2000	Transparent	New	690	M				
Goodwin Island	11/14/2000	Transparent	New	700	M				
Goodwin Island	11/14/2000	Transparent	New	718	M				
Goodwin Island	11/14/2000	Transparent	New	704	M				
Goodwin Island	11/14/2000	Transparent	New	704	M				
Goodwin Island	11/14/2000	Transparent	New	722	M				
Goodwin Island	11/14/2000	Transparent	New	716	M				
Goodwin Island	11/14/2000	Transparent	New	704	M				
Goodwin Island	11/14/2000	Transparent	New	704	M				
Goodwin Island	11/14/2000	Transparent	New	702	M				
Goodwin Island	11/14/2000	Transparent	New	684	M				
Goodwin Island	11/14/2000	Transparent	New	720	M				
Goodwin Island	11/14/2000	Brown	Old	702	M				
Goodwin Island	11/14/2000	Brown	Old	700	M				
Goodwin Island	11/14/2000	Brown	Old	700	M				
Goodwin Island	11/14/2000	Brown	Old	720	M				
Goodwin Island	11/14/2000	Brown	Old	722	M				
Goodwin Island	11/14/2000	Brown	Old	700	M				
Goodwin Island	11/14/2000	Brown-white	Old	706	M				
Goodwin Island	11/14/2000	Brown-white	Old	696	M				
Guinea Marsh	11/14/2000	Trans-brown	Intermediate	710	M	713			
Guinea Marsh	11/14/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	11/14/2000	Trans-white	Intermediate/old	724	M				
Guinea Marsh	11/14/2000	Trans-white	Intermediate/old	702	M				
Guinea Marsh	11/14/2000	Transparent	New	700	M				
Guinea Marsh	11/14/2000	Transparent	New	724	M				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	11/14/2000	Transparent	New	680	M				
Guinea Marsh	11/14/2000	Brown	Old	718	M				
Guinea Marsh	11/14/2000	Brown	Old	738	M				
Guinea Marsh	11/14/2000	Brown	Old	720	M				
Guinea Marsh	11/14/2000	Brown	Old	720	M				
Guinea Marsh	11/14/2000	Brown	Old	720	M				
Guinea Marsh	11/14/2000	Brown	Old	726	M				
Guinea Marsh	11/14/2000	Brown	Old	700	M				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	704	M		708.5217391		708
Goodwin Island	12/18/2000	Trans-brown	Intermediate	720	M				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	680	M				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	710	M				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	720	M				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	700	M				
Goodwin Island	12/18/2000	Transparent	New	700	M				
Goodwin Island	12/18/2000	Transparent	New	700	M				
Goodwin Island	12/18/2000	Transparent	New	704	M				
Goodwin Island	12/18/2000	Transparent	New	722	M				
Goodwin Island	12/18/2000	Transparent	New	712	M				
Goodwin Island	12/18/2000	Transparent	New	702	M				
Goodwin Island	12/18/2000	Transparent	New	690	M				
Goodwin Island	12/18/2000	Transparent	New	720	M				
Goodwin Island	12/18/2000	Transparent	New	740	M				
Goodwin Island	12/18/2000	Transparent	New	700	M				
Goodwin Island	12/18/2000	Transparent	New	700	M				
Goodwin Island	12/18/2000	Transparent	New	726	M				
Goodwin Island	12/18/2000	Transparent	New	706	M				
Goodwin Island	12/18/2000	Transparent	New	698	M				
Goodwin Island	12/18/2000	Transparent	New	720	M				
Goodwin Island	12/18/2000	Brown	Old	702	M				
Goodwin Island	12/18/2000	Very brown	Very old	720	M				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	696	M	707.75			
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	720	M				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	724	M				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	704	M				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	700	M				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	698	M				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	702	M				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	720	M				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	730	M				
Guinea Marsh	12/18/2000	Transparent	New	708	M				
Guinea Marsh	12/18/2000	Transparent	New	684	M				
Guinea Marsh	12/18/2000	Transparent	New	702	M				
Guinea Marsh	12/18/2000	Transparent	New	720	M				
Guinea Marsh	12/18/2000	Transparent	New	700	M				
Guinea Marsh	12/18/2000	Transparent	New	716	M				
Guinea Marsh	12/18/2000	Brown	Old	700	M				
Guinea Marsh	12/18/2000	Brown	Old	708	M				
Guinea Marsh	12/18/2000	Brown	Old	710	M				
Guinea Marsh	12/18/2000	Brown	Old	700	M				
Guinea Marsh	12/18/2000	Brown	Old	720	M				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean (μm)
Guinea Marsh	12/18/2000	Brown	Old	710	M				
Guinea Marsh	12/18/2000	Brown	Old	680	M				
Guinea Marsh	12/18/2000	Brown	Old	720	M				
Guinea Marsh	12/18/2000	Brown	Old	720	M				
Guinea Marsh	12/18/2000	Brown	Old	716	M				
Guinea Marsh	12/18/2000	Brown	Old	720	M				
Guinea Marsh	12/18/2000	Brown	Old	696	M				
Guinea Marsh	12/18/2000	Brown	Old	720	M				
Guinea Marsh	12/18/2000	Brown	Old	722	M				
Guinea Marsh	12/18/2000	Brown	Old	700	M				
Guinea Marsh	12/18/2000	Brown-white	Old	704	M				
Guinea Marsh	12/18/2000	Brown-white	Old	700	M				
Guinea Marsh	12/18/2000	Brown-white	Old	700	M				
Guinea Marsh	12/18/2000	Brown-white	Old	700	M				
Guinea Marsh	12/18/2000	Very brown	Very old	700	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	700	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	720	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	730	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	684	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	720	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	680	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	696	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	686	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	700	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	722	M				
Guinea Marsh	12/18/2000	White-opaque	Very old	724	M				
Goodwin Island	2/9/1999	Brown	Old	610	F		602		605.6
Goodwin Island	2/9/1999	Brown	Old	614	F				
Goodwin Island	2/9/1999	Brown	Old	598	F				
Goodwin Island	2/9/1999	Brown	Old	588	F				
Goodwin Island	2/9/1999	Brown-opaque	Very old	600	F				
Guinea Marsh	2/9/1999	Brown-white	Old	628	F	609.2			
Guinea Marsh	2/9/1999	Trans-brown	Intermediate	612	F				
Guinea Marsh	2/9/1999	Trans-brown	Intermediate	624	F				
Guinea Marsh	2/9/1999	Very brown	Very old	582	F				
Guinea Marsh	2/9/1999	Very brown	Very old	600	F				
Guinea Marsh	3/30/1999	Trans-brown	Intermediate	624	F	624			624
Goodwin Island	4/27/1999	Brown-white	Old	628	F		628		617.9090909
Guinea Marsh	4/27/1999	Brown	Old	624	F	617.4285714			
Guinea Marsh	4/27/1999	Brown	Old	640	F				
Guinea Marsh	4/27/1999	Brown	Old	604	F				
Guinea Marsh	4/27/1999	Brown	Old	628	F				
Guinea Marsh	4/27/1999	Brown	Old	606	F				
Guinea Marsh	4/27/1999	Brown	Old	606	F				
Guinea Marsh	4/27/1999	Brown	Old	608	F				
Guinea Marsh	4/27/1999	Brown	Old	604	F				
Guinea Marsh	4/27/1999	Brown	Old	596	F				
Guinea Marsh	4/27/1999	Brown-opaque	Very old	632	F				
Guinea Marsh	4/27/1999	Brown-white	Old	626	F				
Guinea Marsh	4/27/1999	Brown-white	Old	628	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	624	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	602	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	626	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	4/27/1999	Trans-brown	Intermediate	630	F				
Guinea Marsh	4/27/1999	Transparent	New	606	F				
Guinea Marsh	4/27/1999	Very brown/opaque	Very old	616	F				
Goodwin Island	5/12/1999	Brown	Old	616	F		607.3333333		630.0869565
Goodwin Island	5/12/1999	Brown-opaque	Very old	600	F				
Goodwin Island	5/12/1999	Very brown	Very old	606	F				
Guinea Marsh	5/12/1999	Brown	Old	614	F	633.5			
Guinea Marsh	5/12/1999	Brown	Old	628	F				
Guinea Marsh	5/12/1999	Brown-opaque	Very old	620	F				
Guinea Marsh	5/12/1999	Brown-opaque	Very old	610	F				
Guinea Marsh	5/12/1999	Brown-red	Very old	608	F				
Guinea Marsh	5/12/1999	Transparent	New	630	F				
Guinea Marsh	5/12/1999	Transparent	New	626	F				
Guinea Marsh	5/12/1999	Transparent	New	632	F				
Guinea Marsh	5/12/1999	Transparent	New	638	F				
Guinea Marsh	5/12/1999	Transparent	New	640	F				
Guinea Marsh	5/12/1999	Transparent	New	646	F				
Guinea Marsh	5/12/1999	Transparent	New	648	F				
Guinea Marsh	5/12/1999	Transparent	New	644	F				
Guinea Marsh	5/12/1999	Transparent	New	640	F				
Guinea Marsh	5/12/1999	Transparent	New	644	F				
Guinea Marsh	5/12/1999	Trans-red	New	636	F				
Guinea Marsh	5/12/1999	Trans-red	New	656	F				
Guinea Marsh	5/12/1999	Trans-red	New	630	F				
Guinea Marsh	5/12/1999	Trans-red	New	644	F				
Guinea Marsh	5/12/1999	White-opaque	Very old	636	F				
Goodwin Island	6/3/1999	Trans-brown	Intermediate	640	F		640		628.6666667
Guinea Marsh	6/3/1999	Trans-white	Intermediate/old	624	F	623			
Guinea Marsh	6/3/1999	Trans-white	Intermediate/old	622	F				
Goodwin Island	6/22/1999	Brown	Old	604	F		621		625.3846154
Goodwin Island	6/22/1999	Trans-brown	Intermediate	640	F				
Goodwin Island	6/22/1999	Transparent	New	624	F				
Goodwin Island	6/22/1999	Transparent	New	616	F				
Guinea Marsh	6/22/1999	Brown	Old	626	F	625.8857143			
Guinea Marsh	6/22/1999	Brown	Old	636	F				
Guinea Marsh	6/22/1999	Brown	Old	634	F				
Guinea Marsh	6/22/1999	Brown	Old	600	F				
Guinea Marsh	6/22/1999	Brown	Old	614	F				
Guinea Marsh	6/22/1999	Brown	Old	620	F				
Guinea Marsh	6/22/1999	Brown	Old	624	F				
Guinea Marsh	6/22/1999	Brown	Old	632	F				
Guinea Marsh	6/22/1999	Brown	Old	620	F				
Guinea Marsh	6/22/1999	Brown	Old	620	F				
Guinea Marsh	6/22/1999	Brown	Old	622	F				
Guinea Marsh	6/22/1999	Brown	Old	628	F				
Guinea Marsh	6/22/1999	Brown	Old	624	F				
Guinea Marsh	6/22/1999	Brown-opaque	Very old	646	F				
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	626	F				
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	646	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	6/22/1999	Trans-brown	Intermediate	640	F				
Guinea Marsh	6/22/1999	Transparent	New	608	F				
Guinea Marsh	6/22/1999	Transparent	New	618	F				
Guinea Marsh	6/22/1999	Transparent	New	616	F				
Guinea Marsh	6/22/1999	Transparent	New	622	F				
Guinea Marsh	6/22/1999	Transparent	New	624	F				
Guinea Marsh	6/22/1999	Transparent	New	616	F				
Guinea Marsh	6/22/1999	Transparent	New	614	F				
Guinea Marsh	6/22/1999	Transparent	New	610	F				
Guinea Marsh	6/22/1999	Trans-yellow-brown	Old	632	F				
Guinea Marsh	6/22/1999	Very brown	Very old	620	F				
Guinea Marsh	6/22/1999	Very brown	Very old	652	F				
Guinea Marsh	6/22/1999	Very brown	Very old	636	F				
Guinea Marsh	6/22/1999	Very brown	Very old	638	F				
Guinea Marsh	6/22/1999	Very brown	Very old	640	F				
Guinea Marsh	6/22/1999	Very brown	Very old	634	F				
Guinea Marsh	6/22/1999	Very brown	Very old	628	F				
Goodwin Island	7/6/1999	Brown	Old	620	F		612.4		616.6086957
Goodwin Island	7/6/1999	Brown	Old	624	F				
Goodwin Island	7/6/1999	Brown	Old	608	F				
Goodwin Island	7/6/1999	Brown	Old	618	F				
Goodwin Island	7/6/1999	Brown	Old	620	F				
Goodwin Island	7/6/1999	Brown-opaque	Very old	604	F				
Goodwin Island	7/6/1999	Brown-opaque	Very old	618	F				
Goodwin Island	7/6/1999	Brown-opaque	Very old	600	F				
Goodwin Island	7/6/1999	Trans-brown	Intermediate	602	F				
Goodwin Island	7/6/1999	Transparent	New	610	F				
Guinea Marsh	7/6/1999	Brown	Old	642	F	619.8461538			
Guinea Marsh	7/6/1999	Brown	Old	624	F				
Guinea Marsh	7/6/1999	Brown	Old	626	F				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	640	F				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	622	F				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	616	F				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	614	F				
Guinea Marsh	7/6/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	7/6/1999	Transparent	New	614	F				
Guinea Marsh	7/6/1999	Transparent	New	604	F				
Guinea Marsh	7/6/1999	Transparent	New	626	F				
Guinea Marsh	7/6/1999	Transparent	New	606	F				
Guinea Marsh	7/6/1999	Transparent	New	618	F				
Goodwin Island	7/20/1999	Brown	Old	596	F		605.7241379		608.9090909
Goodwin Island	7/20/1999	Brown	Old	602	F				
Goodwin Island	7/20/1999	Brown	Old	622	F				
Goodwin Island	7/20/1999	Brown	Old	620	F				
Goodwin Island	7/20/1999	Brown	Old	624	F				
Goodwin Island	7/20/1999	Brown	Old	620	F				
Goodwin Island	7/20/1999	Brown	Old	624	F				
Goodwin Island	7/20/1999	Brown	Old	638	F				
Goodwin Island	7/20/1999	Brown	Old	600	F				
Goodwin Island	7/20/1999	Brown	Old	608	F				
Goodwin Island	7/20/1999	Brown-opaque	Very old	612	F				
Goodwin Island	7/20/1999	Brown-opaque	Very old	622	F				
Goodwin Island	7/20/1999	Brown-opaque	Very old	616	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Goodwin Island	7/20/1999	Opaque	Very old	622	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	604	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	590	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	538	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	580	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	582	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	602	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	620	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	596	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	606	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	602	F				
Goodwin Island	7/20/1999	Trans-brown	Intermediate	602	F				
Goodwin Island	7/20/1999	Trans-opaque	Intermediate	604	F				
Goodwin Island	7/20/1999	Transparent	New	606	F				
Goodwin Island	7/20/1999	Transparent	New	606	F				
Goodwin Island	7/20/1999	Transparent	New	602	F				
Guinea Marsh	7/20/1999	Brown	Old	624	F	610.4745763			
Guinea Marsh	7/20/1999	Brown	Old	618	F				
Guinea Marsh	7/20/1999	Brown	Old	590	F				
Guinea Marsh	7/20/1999	Brown	Old	598	F				
Guinea Marsh	7/20/1999	Brown	Old	620	F				
Guinea Marsh	7/20/1999	Brown	Old	614	F				
Guinea Marsh	7/20/1999	Brown	Old	626	F				
Guinea Marsh	7/20/1999	Brown	Old	622	F				
Guinea Marsh	7/20/1999	Brown	Old	632	F				
Guinea Marsh	7/20/1999	Brown	Old	642	F				
Guinea Marsh	7/20/1999	Brown	Old	620	F				
Guinea Marsh	7/20/1999	Brown	Old	622	F				
Guinea Marsh	7/20/1999	Brown	Old	620	F				
Guinea Marsh	7/20/1999	Brown	Old	610	F				
Guinea Marsh	7/20/1999	Brown	Old	628	F				
Guinea Marsh	7/20/1999	Brown-opaque	Very old	636	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	580	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	622	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	604	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	610	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	596	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	600	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	608	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	608	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	616	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	596	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	614	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	616	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	602	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	612	F				
Guinea Marsh	7/20/1999	Trans-brown	Intermediate	604	F				
Guinea Marsh	7/20/1999	Transparent	New	620	F				
Guinea Marsh	7/20/1999	Transparent	New	604	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	7/20/1999	Transparent	New	602	F				
Guinea Marsh	7/20/1999	Transparent	New	600	F				
Guinea Marsh	7/20/1999	Transparent	New	618	F				
Guinea Marsh	7/20/1999	Transparent	New	600	F				
Guinea Marsh	7/20/1999	Transparent	New	612	F				
Guinea Marsh	7/20/1999	Transparent	New	608	F				
Guinea Marsh	7/20/1999	Transparent	New	604	F				
Guinea Marsh	7/20/1999	Transparent	New	604	F				
Guinea Marsh	7/20/1999	Transparent	New	622	F				
Guinea Marsh	7/20/1999	Transparent	New	608	F				
Guinea Marsh	7/20/1999	Transparent	New	612	F				
Guinea Marsh	7/20/1999	Transparent	New	600	F				
Guinea Marsh	7/20/1999	Transparent	New	598	F				
Guinea Marsh	7/20/1999	Transparent	New	596	F				
Guinea Marsh	7/20/1999	Transparent	New	590	F				
Guinea Marsh	7/20/1999	Transparent	New	610	F				
Guinea Marsh	7/20/1999	Transparent	New	614	F				
Guinea Marsh	7/20/1999	Transparent	New	622	F				
Guinea Marsh	7/20/1999	Transparent	New	604	F				
Guinea Marsh	7/20/1999	Transparent	New	602	F				
Guinea Marsh	7/20/1999	Transparent	New	606	F				
Guinea Marsh	7/20/1999	Trans-yellow	Old	600	F				
Goodwin Island	8/3/1999	Brown	Old	622	F		622		616.7407407
Goodwin Island	8/3/1999	Brown-white	Old	622	F				
Goodwin Island	8/3/1999	Brown-white	Old	622	F				
Goodwin Island	8/3/1999	Trans-brown	Intermediate	622	F				
Goodwin Island	8/3/1999	Trans-brown	Intermediate	622	F				
Goodwin Island	8/3/1999	Trans-brown	Intermediate	622	F				
Goodwin Island	8/3/1999	Trans-brown	Intermediate	622	F				
Goodwin Island	8/3/1999	Trans-brown	Intermediate	622	F				
Goodwin Island	8/3/1999	Transparent	New	622	F				
Goodwin Island	8/3/1999	Transparent	New	622	F				
Guinea Marsh	8/3/1999	Brown	Old	626	F	613.6470588			
Guinea Marsh	8/3/1999	Brown	Old	616	F				
Guinea Marsh	8/3/1999	Brown-opaque	Very old	620	F				
Guinea Marsh	8/3/1999	Brown-opaque	Very old	602	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	624	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	618	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	614	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	614	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	608	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	614	F				
Guinea Marsh	8/3/1999	Trans-brown	Intermediate	622	F				
Guinea Marsh	8/3/1999	Transparent	New	612	F				
Guinea Marsh	8/3/1999	Transparent	New	604	F				
Guinea Marsh	8/3/1999	Transparent	New	606	F				
Goodwin Island	8/17/1999	Brown	Old	624	F		603.4		605.7777778
Goodwin Island	8/17/1999	Brown	Old	604	F				
Goodwin Island	8/17/1999	Brown	Old	620	F				
Goodwin Island	8/17/1999	Brown-opaque	Very old	612	F				
Goodwin Island	8/17/1999	Brown-opaque	Very old	596	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Goodwin Island	8/17/1999	Transparent	New	592	F				
Goodwin Island	8/17/1999	Transparent	New	590	F				
Goodwin Island	8/17/1999	Transparent	New	602	F				
Goodwin Island	8/17/1999	Transparent	New	604	F				
Goodwin Island	8/17/1999	Transparent	New	590	F				
Guinea Marsh	8/17/1999	Trans-brown	Intermediate	604	F	608.75			
Guinea Marsh	8/17/1999	Trans-brown	Intermediate	606	F				
Guinea Marsh	8/17/1999	Trans-brown	Intermediate	610	F				
Guinea Marsh	8/17/1999	Transparent	New	624	F				
Guinea Marsh	8/17/1999	Transparent	New	600	F				
Guinea Marsh	8/17/1999	Transparent	New	598	F				
Guinea Marsh	8/17/1999	Transparent	New	610	F				
Guinea Marsh	8/17/1999	Very brown/opaque	Very old	618	F				
Goodwin Island	9/14/1999	Brown	Old	596	F		594.5		594.8571429
Goodwin Island	9/14/1999	Brown	Old	594	F				
Goodwin Island	9/14/1999	Brown-opaque	Very old	600	F				
Goodwin Island	9/14/1999	Brown-opaque	Very old	602	F				
Goodwin Island	9/14/1999	Trans-brown	Intermediate	590	F				
Goodwin Island	9/14/1999	Trans-brown	Intermediate	570	F				
Goodwin Island	9/14/1999	Trans-brown	Intermediate	596	F				
Goodwin Island	9/14/1999	Trans-brown	Intermediate	608	F				
Guinea Marsh	9/14/1999	Brown	Old	624	F	595.0769231			
Guinea Marsh	9/14/1999	Brown	Old	586	F				
Guinea Marsh	9/14/1999	Brown	Old	596	F				
Guinea Marsh	9/14/1999	Brown	Old	578	F				
Guinea Marsh	9/14/1999	Brown-opaque	Very old	602	F				
Guinea Marsh	9/14/1999	Brown-opaque	Very old	566	F				
Guinea Marsh	9/14/1999	Opaque-white	Very old	608	F				
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	596	F				
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	576	F				
Guinea Marsh	9/14/1999	Trans-brown	Intermediate	590	F				
Guinea Marsh	9/14/1999	Transparent	New	610	F				
Guinea Marsh	9/14/1999	Transparent	New	600	F				
Guinea Marsh	9/14/1999	White-opaque	Very old	604	F				
Guinea Marsh	10/15/1999	Brown	Old	604	F	611.3333333			611.3333333
Guinea Marsh	10/15/1999	Brown	Old	602	F				
Guinea Marsh	10/15/1999	Brown	Old	600	F				
Guinea Marsh	10/15/1999	Brown	Old	596	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	608	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	588	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	624	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	622	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	640	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	618	F				
Guinea Marsh	10/15/1999	Trans-brown	Intermediate	600	F				
Guinea Marsh	10/15/1999	Transparent	New	620	F				
Guinea Marsh	10/15/1999	Transparent	New	610	F				
Guinea Marsh	10/15/1999	Transparent	New	622	F				
Guinea Marsh	10/15/1999	Transparent	New	622	F				
Guinea Marsh	10/15/1999	Transparent	New	624	F				
Guinea Marsh	10/15/1999	Transparent	New	618	F				
Guinea Marsh	10/15/1999	Transparent	New	628	F				
Guinea Marsh	10/15/1999	Very brown/opaque	Very old	610	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	10/15/1999	Very brown/opaque	Very old	596	F				
Guinea Marsh	10/15/1999	Very opaque	Very old	586	F				
Goodwin Island	11/9/1999	Brown	Old	620	F		612.8		618.8888889
Goodwin Island	11/9/1999	Brown	Old	620	F				
Goodwin Island	11/9/1999	Brown-white	Old	620	F				
Goodwin Island	11/9/1999	Trans-brown	Intermediate	600	F				
Goodwin Island	11/9/1999	Trans-brown	Intermediate	610	F				
Goodwin Island	11/9/1999	Trans-brown	Intermediate	606	F				
Goodwin Island	11/9/1999	Transparent	New	624	F				
Goodwin Island	11/9/1999	Transparent	New	600	F				
Goodwin Island	11/9/1999	Transparent	New	604	F				
Goodwin Island	11/9/1999	Trans-white	Intermediate/old	624	F				
Guinea Marsh	11/9/1999	Brown	Old	620	F	620.0377358			
Guinea Marsh	11/9/1999	Brown-white	Old	622	F				
Guinea Marsh	11/9/1999	Brown-white	Old	606	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	610	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	630	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	636	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	626	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	624	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	610	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	600	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	630	F				
Guinea Marsh	11/9/1999	Trans-brown	Intermediate	620	F				
Guinea Marsh	11/9/1999	Trans-opaque	Intermediate	620	F				
Guinea Marsh	11/9/1999	Transparent	New	622	F				
Guinea Marsh	11/9/1999	Transparent	New	640	F				
Guinea Marsh	11/9/1999	Transparent	New	624	F				
Guinea Marsh	11/9/1999	Transparent	New	630	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	622	F				
Guinea Marsh	11/9/1999	Transparent	New	642	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	626	F				
Guinea Marsh	11/9/1999	Transparent	New	632	F				
Guinea Marsh	11/9/1999	Transparent	New	624	F				
Guinea Marsh	11/9/1999	Transparent	New	630	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	640	F				
Guinea Marsh	11/9/1999	Transparent	New	630	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	600	F				
Guinea Marsh	11/9/1999	Transparent	New	610	F				
Guinea Marsh	11/9/1999	Transparent	New	624	F				
Guinea Marsh	11/9/1999	Transparent	New	616	F				
Guinea Marsh	11/9/1999	Transparent	New	640	F				
Guinea Marsh	11/9/1999	Transparent	New	612	F				
Guinea Marsh	11/9/1999	Transparent	New	616	F				
Guinea Marsh	11/9/1999	Transparent	New	610	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	584	F				
Guinea Marsh	11/9/1999	Transparent	New	604	F				
Guinea Marsh	11/9/1999	Transparent	New	580	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	640	F				
Guinea Marsh	11/9/1999	Transparent	New	630	F				
Guinea Marsh	11/9/1999	Transparent	New	606	F				
Guinea Marsh	11/9/1999	Transparent	New	620	F				
Guinea Marsh	11/9/1999	Transparent	New	618	F				
Guinea Marsh	11/9/1999	Transparent	New	616	F				
Goodwin Island	12/21/1999	Brown	Old	616	F		609.1818182		609
Goodwin Island	12/21/1999	Brown-white	Old	610	F				
Goodwin Island	12/21/1999	Brown-white	Old	604	F				
Goodwin Island	12/21/1999	Transparent	New	596	F				
Goodwin Island	12/21/1999	Transparent	New	610	F				
Goodwin Island	12/21/1999	Transparent	New	606	F				
Goodwin Island	12/21/1999	Transparent	New	604	F				
Goodwin Island	12/21/1999	Transparent	New	620	F				
Goodwin Island	12/21/1999	Transparent	New	602	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	616	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	618	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	626	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	600	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	604	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	602	F				
Goodwin Island	12/21/1999	Trans-brown	Intermediate	600	F				
Goodwin Island	12/21/1999	Transparent	New	610	F				
Goodwin Island	12/21/1999	Trans-white	Intermediate/old	618	F				
Goodwin Island	12/21/1999	White-opaque	Very old	620	F				
Goodwin Island	12/21/1999	White-opaque	Very old	600	F				
Goodwin Island	12/21/1999	White-opaque	Very old	618	F				
Goodwin Island	12/21/1999	White-opaque	Very old	602	F				
Guinea Marsh	12/21/1999	Brown	Old	602	F	608.9130435			
Guinea Marsh	12/21/1999	Brown	Old	600	F				
Guinea Marsh	12/21/1999	Brown	Old	580	F				
Guinea Marsh	12/21/1999	Brown	Old	620	F				
Guinea Marsh	12/21/1999	Brown-white	Old	600	F				
Guinea Marsh	12/21/1999	Transparent	New	606	F				
Guinea Marsh	12/21/1999	Transparent	New	620	F				
Guinea Marsh	12/21/1999	Transparent	New	614	F				
Guinea Marsh	12/21/1999	Transparent	New	608	F				
Guinea Marsh	12/21/1999	Transparent	New	618	F				
Guinea Marsh	12/21/1999	Transparent	New	600	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	610	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	580	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	600	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	630	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	620	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	620	F				
Guinea Marsh	12/21/1999	Trans-white	Intermediate/old	620	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	584	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	12/21/1999	White-opaque	Very old	610	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	600	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	610	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	600	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	638	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	626	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	620	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	624	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	622	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	614	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	600	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	622	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	620	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	606	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	590	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	620	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	604	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	590	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	640	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	600	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	620	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	580	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	622	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	600	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	580	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	640	F				
Guinea Marsh	12/21/1999	White-opaque	Very old	580	F				
Goodwin Island	1/8/2000	Brown	Old	610	F		612.4583333		610.2093023
Goodwin Island	1/8/2000	Brown-white	Old	584	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	608	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	630	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	610	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	612	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	618	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	618	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	622	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	616	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	606	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	636	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	630	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	596	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	582	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Goodwin Island	1/8/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	616	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	630	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	1/8/2000	Trans-brown	Intermediate	610	F				
Goodwin Island	1/8/2000	Transparent	New	620	F				
Goodwin Island	1/8/2000	Transparent	New	618	F				
Goodwin Island	1/8/2000	Transparent	New	604	F				
Goodwin Island	1/8/2000	Transparent	New	600	F				
Goodwin Island	1/8/2000	Transparent	New	620	F				
Goodwin Island	1/8/2000	Transparent	New	632	F				
Goodwin Island	1/8/2000	Transparent	New	630	F				
Goodwin Island	1/8/2000	Transparent	New	640	F				
Goodwin Island	1/8/2000	Transparent	New	580	F				
Goodwin Island	1/8/2000	Transparent	New	606	F				
Goodwin Island	1/8/2000	Transparent	New	608	F				
Goodwin Island	1/8/2000	Transparent	New	618	F				
Goodwin Island	1/8/2000	Very brown	Very old	600	F				
Guinea Marsh	1/8/2000	Brown	Old	600	F	607.3684211			
Guinea Marsh	1/8/2000	Brown	Old	620	F				
Guinea Marsh	1/8/2000	Brown	Old	622	F				
Guinea Marsh	1/8/2000	Brown	Old	604	F				
Guinea Marsh	1/8/2000	Brown	Old	612	F				
Guinea Marsh	1/8/2000	Brown	Old	604	F				
Guinea Marsh	1/8/2000	Brown	Old	600	F				
Guinea Marsh	1/8/2000	Brown	Old	604	F				
Guinea Marsh	1/8/2000	Brown	Old	628	F				
Guinea Marsh	1/8/2000	Brown	Old	618	F				
Guinea Marsh	1/8/2000	Brown	Old	596	F				
Guinea Marsh	1/8/2000	Brown	Old	600	F				
Guinea Marsh	1/8/2000	Brown	Old	624	F				
Guinea Marsh	1/8/2000	Brown	Old	620	F				
Guinea Marsh	1/8/2000	Brown-white	Old	604	F				
Guinea Marsh	1/8/2000	Brown-white	Old	586	F				
Guinea Marsh	1/8/2000	Brown-white	Old	602	F				
Guinea Marsh	1/8/2000	Transparent	New	612	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	612	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	606	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	618	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	596	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	618	F				
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	616	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	1/8/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	1/8/2000	Transparent	New	608	F				
Guinea Marsh	1/8/2000	Transparent	New	600	F				
Guinea Marsh	1/8/2000	Transparent	New	600	F				
Guinea Marsh	1/8/2000	Transparent	New	620	F				
Guinea Marsh	1/8/2000	Very brown	Very old	590	F				
Guinea Marsh	2/29/2000	Brown	Old	620	F	611.0175439			611.76
Guinea Marsh	2/29/2000	Brown	Old	606	F				
Guinea Marsh	2/29/2000	Brown	Old	600	F				
Guinea Marsh	2/29/2000	Brown	Old	600	F				
Guinea Marsh	2/29/2000	Brown	Old	620	F				
Guinea Marsh	2/29/2000	Brown	Old	640	F				
Guinea Marsh	2/29/2000	Brown	Old	640	F				
Guinea Marsh	2/29/2000	Brown	Old	620	F				
Guinea Marsh	2/29/2000	Brown	Old	618	F				
Guinea Marsh	2/29/2000	Brown	Old	616	F				
Guinea Marsh	2/29/2000	Brown	Old	604	F				
Guinea Marsh	2/29/2000	Brown	Old	600	F				
Guinea Marsh	2/29/2000	Brown	Old	560	F				
Guinea Marsh	2/29/2000	Brown	Old	644	F				
Guinea Marsh	2/29/2000	Brown	Old	604	F				
Guinea Marsh	2/29/2000	Brown	Old	620	F				
Guinea Marsh	2/29/2000	Brown	Old	620	F				
Guinea Marsh	2/29/2000	Brown	Old	624	F				
Guinea Marsh	2/29/2000	Brown	Old	604	F				
Guinea Marsh	2/29/2000	Brown	Old	584	F				
Guinea Marsh	2/29/2000	Brown	Old	602	F				
Guinea Marsh	2/29/2000	Brown	Old	640	F				
Guinea Marsh	2/29/2000	Brown	Old	636	F				
Guinea Marsh	2/29/2000	Brown	Old	616	F				
Guinea Marsh	2/29/2000	Brown	Old	600	F				
Guinea Marsh	2/29/2000	Brown-white	Old	630	F				
Guinea Marsh	2/29/2000	Brown-white	Old	604	F				
Guinea Marsh	2/29/2000	Brown-white	Old	624	F				
Guinea Marsh	2/29/2000	Brown-white	Old	620	F				
Guinea Marsh	2/29/2000	Brown-white	Old	618	F				
Guinea Marsh	2/29/2000	Brown-white	Old	620	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	594	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	608	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	604	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	614	F				
Guinea Marsh	2/29/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	2/29/2000	Trans-opaque	Intermediate	626	F				
Guinea Marsh	2/29/2000	Trans-opaque	Intermediate	620	F				
Guinea Marsh	2/29/2000	Trans-white	Intermediate/old	598	F				
Guinea Marsh	2/29/2000	Trans-white	Intermediate/old	600	F				
Guinea Marsh	2/29/2000	Very brown	Very old	620	F				
Guinea Marsh	2/29/2000	Very brown	Very old	580	F				
Guinea Marsh	2/29/2000	Very brown	Very old	596	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	2/29/2000	Very brown	Very old	614	F				
Guinea Marsh	2/29/2000	Very brown	Very old	600	F				
Guinea Marsh	3/29/2000	Brown-white	Old	620	F				605.7142857
Guinea Marsh	3/29/2000	Brown-white	Old	600	F				
Guinea Marsh	3/29/2000	Brown-white	Old	596	F				
Guinea Marsh	3/29/2000	White-opaque	Very old	604	F				
Guinea Marsh	3/29/2000	White-opaque	Very old	620	F				
Guinea Marsh	3/29/2000	White-opaque	Very old	600	F				
Guinea Marsh	3/29/2000	White-opaque	Very old	600	F				
Goodwin Island	4/19/2000	Brown-white	Old	616	F		605.3333333		605.3333333
Goodwin Island	4/19/2000	Brown-white	Old	600	F				
Goodwin Island	4/19/2000	Brown-white	Old	600	F				
Dameron Marsh	5/17/2000	Brown-white	Old	606	F			623.6	623.6
Dameron Marsh	5/17/2000	Brown-white	Old	624	F				
Dameron Marsh	5/17/2000	Trans-brown	Intermediate	614	F				
Dameron Marsh	5/17/2000	Transparent	New	636	F				
Dameron Marsh	5/17/2000	Transparent	New	638	F				
Goodwin Island	6/13/2000	Brown	Old	638	F		624.5454545		624.4324324
Goodwin Island	6/13/2000	Brown	Old	640	F				
Goodwin Island	6/13/2000	Brown	Old	620	F				
Goodwin Island	6/13/2000	Brown	Old	624	F				
Goodwin Island	6/13/2000	Brown	Old	626	F				
Goodwin Island	6/13/2000	Brown	Old	626	F				
Goodwin Island	6/13/2000	Brown	Old	620	F				
Goodwin Island	6/13/2000	Brown	Old	630	F				
Goodwin Island	6/13/2000	Transparent	New	624	F				
Goodwin Island	6/13/2000	Transparent	New	616	F				
Goodwin Island	6/13/2000	Transparent	New	630	F				
Goodwin Island	6/13/2000	Transparent	New	642	F				
Goodwin Island	6/13/2000	Transparent	New	636	F				
Goodwin Island	6/13/2000	Transparent	New	624	F				
Goodwin Island	6/13/2000	Transparent	New	620	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	624	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	634	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	636	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	638	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	640	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	640	F				
Goodwin Island	6/13/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	6/13/2000	Very brown	Very old	624	F				
Goodwin Island	6/13/2000	White-opaque	Very old	626	F				
Goodwin Island	6/13/2000	White-opaque	Very old	624	F				
Goodwin Island	6/13/2000	White-opaque	Very old	612	F				
Goodwin Island	6/13/2000	White-opaque	Very old	600	F				
Guinea Marsh	6/13/2000	Trans-brown	Intermediate	620	F	623.5			
Guinea Marsh	6/13/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	6/13/2000	Transparent	New	626	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	6/13/2000	Transparent	New	628	F				
Goodwin Island	7/11/2000	Brown	Old	602	F		616.6315789		620.3243243
Goodwin Island	7/11/2000	Brown	Old	624	F				
Goodwin Island	7/11/2000	Brown	Old	622	F				
Goodwin Island	7/11/2000	Brown	Old	620	F				
Goodwin Island	7/11/2000	Brown-white	Old	600	F				
Goodwin Island	7/11/2000	Brown-white	Old	620	F				
Goodwin Island	7/11/2000	Brown-white	Old	620	F				
Goodwin Island	7/11/2000	Brown-white	Old	604	F				
Goodwin Island	7/11/2000	Brown-white	Old	640	F				
Goodwin Island	7/11/2000	Transparent	New	608	F				
Goodwin Island	7/11/2000	Transparent	New	630	F				
Goodwin Island	7/11/2000	Trans-brown	Intermediate	614	F				
Goodwin Island	7/11/2000	Trans-brown	Intermediate	610	F				
Goodwin Island	7/11/2000	Trans-brown	Intermediate	604	F				
Goodwin Island	7/11/2000	Trans-white	Intermediate/old	632	F				
Goodwin Island	7/11/2000	Very brown	Very old	618	F				
Goodwin Island	7/11/2000	White-opaque	Very old	622	F				
Goodwin Island	7/11/2000	White-opaque	Very old	620	F				
Goodwin Island	7/11/2000	White-opaque	Very old	606	F				
Guinea Marsh	7/11/2000	Brown	Old	640	F	624.2222222			
Guinea Marsh	7/11/2000	Brown-white	Old	622	F				
Guinea Marsh	7/11/2000	Transparent	New	610	F				
Guinea Marsh	7/11/2000	Transparent	New	620	F				
Guinea Marsh	7/11/2000	Transparent	New	614	F				
Guinea Marsh	7/11/2000	Transparent	New	620	F				
Guinea Marsh	7/11/2000	Transparent	New	620	F				
Guinea Marsh	7/11/2000	Transparent	New	640	F				
Guinea Marsh	7/11/2000	Transparent	New	636	F				
Guinea Marsh	7/11/2000	Transparent	New	606	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	604	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	640	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	640	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	642	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	634	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	624	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	600	F				
Guinea Marsh	7/11/2000	White-opaque	Very old	624	F				
Goodwin Island	8/1/2000	Brown	Old	600	F		613.4545455		617.04
Goodwin Island	8/1/2000	Brown-white	Old	626	F				
Goodwin Island	8/1/2000	Trans-brown	Intermediate	616	F				
Goodwin Island	8/1/2000	Trans-white	Intermediate/old	600	F				
Goodwin Island	8/1/2000	Trans-white	Intermediate/old	620	F				
Goodwin Island	8/1/2000	White-opaque	Very old	620	F				
Goodwin Island	8/1/2000	White-opaque	Very old	614	F				
Goodwin Island	8/1/2000	White-opaque	Very old	584	F				
Goodwin Island	8/1/2000	White-opaque	Very old	614	F				
Goodwin Island	8/1/2000	White-opaque	Very old	640	F				
Goodwin Island	8/1/2000	White-opaque	Very old	614	F				
Guinea Marsh	8/1/2000	Brown	Old	600	F	619.8571429			
Guinea Marsh	8/1/2000	Brown	Old	620	F				
Guinea Marsh	8/1/2000	Brown	Old	608	F				
Guinea Marsh	8/1/2000	Brown	Old	624	F				
Guinea Marsh	8/1/2000	Brown-white	Old	620	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	8/1/2000	Brown-white	Old	624	F				
Guinea Marsh	8/1/2000	Brown-white	Old	600	F				
Guinea Marsh	8/1/2000	Brown-white	Old	600	F				
Guinea Marsh	8/1/2000	Brown-white	Old	616	F				
Guinea Marsh	8/1/2000	Trans-white	Intermediate/old	630	F				
Guinea Marsh	8/1/2000	Trans-white	Intermediate/old	624	F				
Guinea Marsh	8/1/2000	Very brown	Very old	608	F				
Guinea Marsh	8/1/2000	White-opaque	Very old	624	F				
Goodwin Island	8/22/2000	Brown	Old	620	F		621.0769231		616.6153846
Goodwin Island	8/22/2000	Brown-white	Old	634	F				
Goodwin Island	8/22/2000	Brown-white	Old	624	F				
Goodwin Island	8/22/2000	Brown-white	Old	630	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	642	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	640	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	596	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	626	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	642	F				
Goodwin Island	8/22/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	8/22/2000	Transparent	New	640	F				
Goodwin Island	8/22/2000	Transparent	New	604	F				
Goodwin Island	8/22/2000	Transparent	New	612	F				
Goodwin Island	8/22/2000	Transparent	New	608	F				
Goodwin Island	8/22/2000	Transparent	New	600	F				
Goodwin Island	8/22/2000	Transparent	New	620	F				
Goodwin Island	8/22/2000	Transparent	New	600	F				
Goodwin Island	8/22/2000	White-opaque	Very old	640	F				
Goodwin Island	8/22/2000	White-opaque	Very old	624	F				
Goodwin Island	8/22/2000	White-opaque	Very old	620	F				
Goodwin Island	8/22/2000	White-opaque	Very old	624	F				
Goodwin Island	8/22/2000	White-opaque	Very old	620	F				
Goodwin Island	8/22/2000	White-opaque	Very old	622	F				
Guinea Marsh	8/22/2000	Brown	Old	604	F	612.1538462			
Guinea Marsh	8/22/2000	Brown	Old	626	F				
Guinea Marsh	8/22/2000	Brown	Old	604	F				
Guinea Marsh	8/22/2000	Brown	Old	618	F				
Guinea Marsh	8/22/2000	Brown	Old	604	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	624	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	580	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	596	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	604	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	580	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	624	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	626	F				
Guinea Marsh	8/22/2000	Trans-brown	Intermediate	604	F				
Guinea Marsh	8/22/2000	Transparent	New	600	F				
Guinea Marsh	8/22/2000	Transparent	New	600	F				
Guinea Marsh	8/22/2000	Transparent	New	604	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	8/22/2000	Transparent	New	620	F				
Guinea Marsh	8/22/2000	Transparent	New	616	F				
Guinea Marsh	8/22/2000	Transparent	New	622	F				
Guinea Marsh	8/22/2000	Transparent	New	616	F				
Guinea Marsh	8/22/2000	Transparent	New	640	F				
Guinea Marsh	8/22/2000	Transparent	New	642	F				
Guinea Marsh	8/22/2000	Transparent	New	622	F				
Goodwin Island	9/6/2000	Brown-white	Old	620	F		622.8		617.6428571
Goodwin Island	9/6/2000	White-opaque	Very old	640	F				
Goodwin Island	9/6/2000	White-opaque	Very old	600	F				
Goodwin Island	9/6/2000	White-opaque	Very old	634	F				
Goodwin Island	9/6/2000	White-opaque	Very old	620	F				
Guinea Marsh	9/6/2000	Brown	Old	616	F	616.5217391			
Guinea Marsh	9/6/2000	Brown	Old	620	F				
Guinea Marsh	9/6/2000	Brown-white	Old	620	F				
Guinea Marsh	9/6/2000	Brown-white	Old	580	F				
Guinea Marsh	9/6/2000	Brown-white	Old	624	F				
Guinea Marsh	9/6/2000	Brown-white	Old	640	F				
Guinea Marsh	9/6/2000	Brown-white	Old	600	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	624	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	640	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	638	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	610	F				
Guinea Marsh	9/6/2000	Trans-brown	Intermediate	650	F				
Guinea Marsh	9/6/2000	Transparent	New	620	F				
Guinea Marsh	9/6/2000	Transparent	New	636	F				
Guinea Marsh	9/6/2000	Transparent	New	608	F				
Guinea Marsh	9/6/2000	Transparent	New	600	F				
Guinea Marsh	9/6/2000	White-opaque	Very old	594	F				
Guinea Marsh	9/6/2000	White-opaque	Very old	604	F				
Guinea Marsh	9/6/2000	White-opaque	Very old	620	F				
Guinea Marsh	9/6/2000	White-opaque	Very old	580	F				
Guinea Marsh	9/6/2000	White-opaque	Very old	616	F				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	604	F		612		611.7142857
Goodwin Island	9/20/2000	Trans-brown	Intermediate	616	F				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	9/20/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	9/20/2000	Transparent	New	604	F				
Guinea Marsh	9/20/2000	Brown	Old	582	F	611.6190476			
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	618	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	618	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	624	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	604	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	624	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	590	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	598	F				
Guinea Marsh	9/20/2000	Trans-brown	Intermediate	580	F				
Guinea Marsh	9/20/2000	Transparent	New	584	F				
Guinea Marsh	9/20/2000	Transparent	New	604	F				
Guinea Marsh	9/20/2000	Transparent	New	638	F				
Guinea Marsh	9/20/2000	Transparent	New	640	F				
Guinea Marsh	9/20/2000	Transparent	New	632	F				
Guinea Marsh	9/20/2000	Transparent	New	638	F				
Guinea Marsh	9/20/2000	White-opaque	Very old	610	F				
Goodwin Island	10/3/2000	Trans-brown	Intermediate	600	F		616.8571429		617.3513514
Goodwin Island	10/3/2000	Trans-brown	Intermediate	628	F				
Goodwin Island	10/3/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	10/3/2000	Trans-brown	Intermediate	640	F				
Goodwin Island	10/3/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	10/3/2000	Transparent	New	620	F				
Goodwin Island	10/3/2000	Transparent	New	610	F				
Guinea Marsh	10/3/2000	Brown	Old	580	F	617.4666667			
Guinea Marsh	10/3/2000	Brown	Old	608	F				
Guinea Marsh	10/3/2000	Brown	Old	610	F				
Guinea Marsh	10/3/2000	Brown	Old	620	F				
Guinea Marsh	10/3/2000	Brown	Old	600	F				
Guinea Marsh	10/3/2000	Brown-white	Old	638	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	642	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	600	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	630	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	606	F				
Guinea Marsh	10/3/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	10/3/2000	Transparent	New	610	F				
Guinea Marsh	10/3/2000	Transparent	New	620	F				
Guinea Marsh	10/3/2000	Transparent	New	640	F				
Guinea Marsh	10/3/2000	Transparent	New	620	F				
Guinea Marsh	10/3/2000	Transparent	New	624	F				
Guinea Marsh	10/3/2000	Transparent	New	606	F				
Guinea Marsh	10/3/2000	Transparent	New	630	F				
Guinea Marsh	10/3/2000	Transparent	New	620	F				
Guinea Marsh	10/3/2000	Transparent	New	620	F				
Guinea Marsh	10/3/2000	Transparent	New	620	F				
Guinea Marsh	10/3/2000	Transparent	New	600	F				
Guinea Marsh	10/3/2000	Trans-white	Intermediate/old	620	F				
Guinea Marsh	10/3/2000	Trans-white	Intermediate/old	620	F				
Guinea Marsh	10/3/2000	White-opaque	Very old	620	F				
Guinea Marsh	10/3/2000	White-opaque	Very old	620	F				
Guinea Marsh	10/3/2000	White-opaque	Very old	620	F				
Goodwin Island	11/14/2000	Brown	Old	610	F		615.2972973		615.5
Goodwin Island	11/14/2000	Brown	Old	606	F				
Goodwin Island	11/14/2000	Brown-white	Old	604	F				
Goodwin Island	11/14/2000	Transparent	New	612	F				
Goodwin Island	11/14/2000	Transparent	New	632	F				
Goodwin Island	11/14/2000	Transparent	New	620	F				
Goodwin Island	11/14/2000	Transparent	New	620	F				

Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Goodwin Island	11/14/2000	Transparent	New	636	F				
Goodwin Island	11/14/2000	Transparent	New	620	F				
Goodwin Island	11/14/2000	Transparent	New	626	F				
Goodwin Island	11/14/2000	Transparent	New	620	F				
Goodwin Island	11/14/2000	Transparent	New	604	F				
Goodwin Island	11/14/2000	Transparent	New	602	F				
Goodwin Island	11/14/2000	Transparent	New	626	F				
Goodwin Island	11/14/2000	Transparent	New	630	F				
Goodwin Island	11/14/2000	Transparent	New	600	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	610	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	602	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	640	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	616	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	626	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	600	F				
Goodwin Island	11/14/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	11/14/2000	Transparent	New	618	F				
Goodwin Island	11/14/2000	Transparent	New	626	F				
Goodwin Island	11/14/2000	Transparent	New	632	F				
Goodwin Island	11/14/2000	Transparent	New	614	F				
Goodwin Island	11/14/2000	Transparent	New	600	F				
Goodwin Island	11/14/2000	Very brown	Very old	620	F				
Goodwin Island	11/14/2000	White-opaque	Very old	604	F				
Goodwin Island	11/14/2000	White-opaque	Very old	610	F				
Guinea Marsh	11/14/2000	Brown	Old	620	F	616.1818182			
Guinea Marsh	11/14/2000	Brown	Old	618	F				
Guinea Marsh	11/14/2000	Brown	Old	620	F				
Guinea Marsh	11/14/2000	Brown	Old	624	F				
Guinea Marsh	11/14/2000	Brown	Old	610	F				
Guinea Marsh	11/14/2000	Brown	Old	600	F				
Guinea Marsh	11/14/2000	Brown	Old	620	F				
Guinea Marsh	11/14/2000	Trans-brown	Intermediate	620	F				
Guinea Marsh	11/14/2000	Trans-brown	Intermediate	606	F				
Guinea Marsh	11/14/2000	Transparent	New	622	F				
Guinea Marsh	11/14/2000	Very brown	Very old	618	F				
Goodwin Island	12/18/2000	Brown-white	Old	624	F		619.6		618.7575758
Goodwin Island	12/18/2000	Brown-white	Old	614	F				
Goodwin Island	12/18/2000	Brown-white	Old	610	F				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	620	F				
Goodwin Island	12/18/2000	Trans-brown	Intermediate	606	F				
Goodwin Island	12/18/2000	Transparent	New	620	F				
Goodwin Island	12/18/2000	Transparent	New	630	F				
Goodwin Island	12/18/2000	Transparent	New	640	F				
Goodwin Island	12/18/2000	Transparent	New	602	F				
Goodwin Island	12/18/2000	Transparent	New	622	F				
Goodwin Island	12/18/2000	Transparent	New	640	F				
Goodwin Island	12/18/2000	Transparent	New	626	F				
Goodwin Island	12/18/2000	Transparent	New	616	F				

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Appendix A (*continued*)

Site	Date	Color	Age	Size (μm)	Sex	Mean size Guinea (μm)	Mean size Goodwin (μm)	Mean size Dameron (μm)	Grand mean size (μm)
Goodwin Island	12/18/2000	Transparent	New	620	F				
Goodwin Island	12/18/2000	Transparent	New	622	F				
Goodwin Island	12/18/2000	Transparent	New	624	F				
Goodwin Island	12/18/2000	Transparent	New	610	F				
Goodwin Island	12/18/2000	Transparent	New	600	F				
Goodwin Island	12/18/2000	Transparent	New	620	F				
Goodwin Island	12/18/2000	Transparent	New	626	F				
Guinea Marsh	12/18/2000	Brown	Old	600	F	618.3913043			
Guinea Marsh	12/18/2000	Brown	Old	600	F				
Guinea Marsh	12/18/2000	Brown	Old	620	F				
Guinea Marsh	12/18/2000	Brown	Old	612	F				
Guinea Marsh	12/18/2000	Brown	Old	614	F				
Guinea Marsh	12/18/2000	Brown	Old	620	F				
Guinea Marsh	12/18/2000	Brown	Old	620	F				
Guinea Marsh	12/18/2000	Brown	Old	618	F				
Guinea Marsh	12/18/2000	Brown	Old	610	F				
Guinea Marsh	12/18/2000	Brown	Old	624	F				
Guinea Marsh	12/18/2000	Brown	Old	640	F				
Guinea Marsh	12/18/2000	Brown	Old	620	F				
Guinea Marsh	12/18/2000	Brown-white	Old	626	F				
Guinea Marsh	12/18/2000	Brown-white	Old	622	F				
Guinea Marsh	12/18/2000	Brown-white	Old	628	F				
Guinea Marsh	12/18/2000	Brown-white	Old	616	F				
Guinea Marsh	12/18/2000	Trans-brown	Intermediate	622	F				
Guinea Marsh	12/18/2000	Transparent	New	640	F				
Guinea Marsh	12/18/2000	Transparent	New	610	F				
Guinea Marsh	12/18/2000	Transparent	New	618	F				
Guinea Marsh	12/18/2000	Transparent	New	618	F				
Guinea Marsh	12/18/2000	Transparent	New	624	F				
Guinea Marsh	12/18/2000	Transparent	New	620	F				
Guinea Marsh	12/18/2000	Transparent	New	614	F				
Guinea Marsh	12/18/2000	Transparent	New	620	F				
Guinea Marsh	12/18/2000	Transparent	New	620	F				
Guinea Marsh	12/18/2000	Transparent	New	624	F				
Guinea Marsh	12/18/2000	Transparent	New	604	F				
Guinea Marsh	12/18/2000	Transparent	New	624	F				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	620	F				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	616	F				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	600	F				
Guinea Marsh	12/18/2000	Trans-white	Intermediate/old	632	F				
Guinea Marsh	12/18/2000	Very brown	Very old	636	F				
Guinea Marsh	12/18/2000	Very brown	Very old	626	F				
Guinea Marsh	12/18/2000	Very brown	Very old	630	F				
Guinea Marsh	12/18/2000	Very brown	Very old	626	F				
Guinea Marsh	12/18/2000	Very brown	Very old	600	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	600	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	608	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	624	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	600	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	616	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	600	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	640	F				
Guinea Marsh	12/18/2000	White-opaque	Very old	624	F				

Appendix B

Modern *Loxoconcha matagordensis* shell size data, Florida Bay

Site	Date	Color	Age	Size (μm)	Sex
FB12#2.3	Feb-98	Dead?	Dead?	610	F
FB12#2.4	Feb-98	Dead?	Dead?	600	F
FB12#1.2	Feb-98	Dead?	Dead?	650	F
FB16#2.6	Feb-98	Dead?	Dead?	716	M
FB16#2.7	Feb-98	Dead?	Dead?	700	M
FB1A#3.1	Jul-98	Trans-brown?	Dead?	616	F
FB5#1.2	Feb-98	Trans-yellow	Intermediate	622	F
FB16#1.2	Feb-98	Trans-yellow	Intermediate	620	F
FB5#5.4	Feb-98	Trans-yellow	Intermediate	704	F
FB21#1.1	Feb-98	Trans-brown	Intermediate	610	F
FB11#2.2	Feb-98	Trans-brown	Intermediate	594	F
FB11#2.3	Feb-98	Trans-brown	Intermediate	606	F
FB26#1.1	Feb-98	Trans-brown	Intermediate	622	F
FB26#1.7	Feb-98	Trans-brown	Intermediate	586	F
FB17#1.1	Jul-98	Trans-brown	Intermediate	570	F
FB6A#1.2	Jul-98	Trans-brown	Intermediate	592	F
FB16#3.14	Feb-98	Trans-brown	Intermediate	558	F
FB16#3.15	Feb-98	Trans-brown	Intermediate	582	F
FB16#3.16	Feb-98	Trans-brown	Intermediate	594	F
FB16#3.23	Feb-98	Trans-brown	Intermediate	602	F
FB16#3.26	Feb-98	Trans-brown	Intermediate	560	F
FB16#3.32	Feb-98	Trans-brown	Intermediate	560	F
FB16#3.35	Feb-98	Trans-brown	Intermediate	598	F
FB16#3.36	Feb-98	Trans-brown	Intermediate	584	F
FB16#3.38	Feb-98	Trans-brown	Intermediate	562	F
FB16#3.41	Feb-98	Trans-brown	Intermediate	590	F
FB16#3.45	Feb-98	Trans-brown	Intermediate	580	F
FB16#1.4	Jul-98	Trans-brown	Intermediate	552	F
FB16#1.8	Jul-98	Trans-brown	Intermediate	576	F
FB16#1.11	Jul-98	Trans-opaque	Intermediate	590	F
FB16#1.13	Jul-98	Trans-brown	Intermediate	600	F
FB16#1.14	Jul-98	Trans-brown	Intermediate	590	F
FB16#1.15	Jul-98	Trans-brown	Intermediate	580	F
FB16#1.18	Jul-98	Trans-brown	Intermediate	570	F
FB16#1.22	Jul-98	Trans-brown	Intermediate	582	F
FB16#1.23	Jul-98	Trans-brown	Intermediate	588	F
FB16#1.32	Jul-98	Trans-brown	Intermediate	650	F
FB16#1.36	Jul-98	Trans-brown	Intermediate	570	F
FB12#1.1	Feb-00	Trans-brown	Intermediate	690	F
FB12#1.7	Feb-00	Trans-brown	Intermediate	620	F
FB12#1.9	Feb-00	Trans-brown	Intermediate	604	F
FB12#1.19	Feb-00	Trans-brown	Intermediate	584	F
FB12#2.5	Feb-98	Trans-brown	Intermediate	692	M
FB17#3.2	Feb-98	Trans-yellow	Intermediate	690	M
FB21#1.4	Feb-98	Trans-brown	Intermediate	718	M
FB20#1.2	Feb-98	Trans-brown	Intermediate	686	M
FB8A#2.1	Jul-98	Trans-brown	Intermediate	650	M
FB26#2.1	Jul-98	Trans-brown	Intermediate	676	M
FB16#3.1	Feb-98	Trans-brown	Intermediate	670	M
FB16#3.2	Feb-98	Trans-brown	Intermediate	682	M
FB16#3.11	Feb-98	Trans-brown	Intermediate	720	M
FB16#3.12	Feb-98	Trans-brown	Intermediate	700	M
FB16#3.30	Feb-98	Trans-brown	Intermediate	684	M
FB16#3.43	Feb-98	Trans-brown	Intermediate	680	M
FB16#3.46	Feb-98	Trans-brown	Intermediate	670	M
FB16#3.57	Feb-98	Trans-brown	Intermediate	714	M
FB16#1.27	Jul-98	Trans-brown	Intermediate	676	M
FB16#1.33	Jul-98	Trans-brown	Intermediate	630	M
FB16#1.45	Jul-98	Trans-brown	Intermediate	664	M
FB1A#3.2	Jul-98	Trans-brown?	Intermediate	600	
FB1#1.1	Feb-98	Trans-yellow	Inter-old	610	F
FB12#2.2	Feb-98	Yellow-brown	Intermediate?	616	F
FB4#4.1	Feb-98	Trans-yellow	Intermediate	628	F
FB17#2.1	Feb-98	Trans	New	608	F
FB5#1.1	Feb-98	Trans	New	624	F
FB16#1.1	Feb-98	Trans	New	626	F
FB5#5.2	Feb-98	Trans	New	626	F
FB12#2.1	Feb-98	Trans	New	620	F
FB16#2.1	Feb-98	Trans	New	620	F
FB16#2.5	Feb-98	Trans	New	626	F
FB20#5.2	Feb-98	Trans	New	594	F
FB26#1.2	Feb-98	Trans	New	600	F
FB26#1.3	Feb-98	Trans	New	626	F
FB26#1.4	Feb-98	Trans	New	572	F
FB26#1.6	Feb-98	Trans	New	614	F
FB17#1.2	Jul-98	Trans	New	556	F
FB17#1.3	Jul-98	Trans	New	568	F
FB17#1.4	Jul-98	Trans	New	592	F
FB17#1.5	Jul-98	Trans	New	574	F
FB17#1.6	Jul-98	Trans	New	584	F
FB6A#1.3	Jul-98	Trans	New	590	F
FB6A#1.4	Jul-98	Trans	New	600	F
FB12#1.1	Oct-99	White-trans	New	604	F
FB16#3.3	Feb-98	Trans	New	604	F
FB16#3.5	Feb-98	Trans	New	600	F
FB16#3.9	Feb-98	Trans	New	580	F
FB16#3.18	Feb-98	Trans	New	566	F
FB16#3.19	Feb-98	Trans	New	584	F
FB16#3.20	Feb-98	Trans	New	604	F
FB16#3.21	Feb-98	Trans	New	620	F
FB16#3.22	Feb-98	Trans-opaque	New	624	F
FB16#3.24	Feb-98	Trans	New	596	F
FB16#3.31	Feb-98	Trans	New	588	F
FB16#3.37	Feb-98	Trans	New	586	F
FB16#3.42	Feb-98	Trans	New	600	F
FB16#3.47	Feb-98	Trans	New	584	F
FB16#3.50	Feb-98	Trans	New	624	F
FB16#3.51	Feb-98	Trans	New	598	F
FB16#3.52	Feb-98	Trans	New	632	F
FB16#3.53	Feb-98	Trans	New	606	F
FB16#1.1	Jul-98	Trans	New	560	F
FB16#1.2	Jul-98	Trans	New	568	F

(continued on next page)

Appendix B (*continued*)

Site	Date	Color	Age	Size (μm)	Sex
FB16#1.3	Jul-98	Trans	New	610	F
FB16#1.6	Jul-98	Trans	New	624	F
FB16#1.9	Jul-98	Trans	New	600	F
FB16#1.16	Jul-98	Trans-white	New	590	F
FB16#1.17	Jul-98	Trans	New	562	F
FB16#1.19	Jul-98	Trans	New	582	F
FB16#1.25	Jul-98	Trans	New	542	F
FB16#1.28	Jul-98	Trans	New	586	F
FB16#1.29	Jul-98	Trans	New	598	F
FB16#1.35	Jul-98	Trans	New	610	F
FB16#1.37	Jul-98	Trans	New	582	F
FB16#1.38	Jul-98	Trans	New	600	F
FB16#1.39	Jul-98	Trans	New	580	F
FB16#1.40	Jul-98	Trans	New	622	F
FB16#1.41	Jul-98	Trans	New	564	F
FB16#1.42	Jul-98	Trans	New	640	F
FB16#1.44	Jul-98	Trans	New	550	F
FB12#1.2	Feb-00	Trans	New	548	F
FB12#1.4	Feb-00	Trans	New	540	F
FB12#1.12	Feb-00	Trans	New	604	F
FB12#1.13	Feb-00	Trans	New	594	F
FB12#1.15	Feb-00	Trans	New	580	F
FB12#1.16	Feb-00	Trans	New	586	F
FB12#1.18	Feb-00	Trans	New	580	F
FB26#1.9	Feb-98	Trans	New	678	M
FB17#1.7	Jul-98	Trans	New	672	M
FB17#1.8	Jul-98	Trans	New	654	M
FB17#1.9	Jul-98	Trans	New	648	M
FB6A#1.6	Jul-98	Trans	New	702	M
FB18#2.2	Jul-98	Trans	New	680	M
FB18#2.3	Jul-98	Trans	New	708	M
FB16#3.6	Feb-98	Trans	New	684	M
FB16#3.8	Feb-98	Trans	New	662	M
FB16#3.17	Feb-98	Trans	New	684	M
FB16#3.28	Feb-98	Trans	New	646	M
FB16#3.33	Feb-98	Trans	New	700	M
FB16#3.39	Feb-98	Trans	New	682	M
FB16#3.54	Feb-98	Trans	New	696	M
FB16#3.55	Feb-98	Trans	New	702	M
FB16#3.56	Feb-98	Trans	New	688	M
FB16#1.5	Jul-98	Trans	New	680	M
FB16#1.10	Jul-98	Trans	New	696	M
FB16#1.20	Jul-98	Trans-white	New	670	M
FB16#1.24	Jul-98	Trans	New	702	M
FB16#1.26	Jul-98	Trans	New	680	M
FB16#1.30	Jul-98	Trans	New	658	M
FB16#1.31	Jul-98	Trans	New	680	M
FB16#1.34	Jul-98	Trans	New	640	M
FB16#1.43	Jul-98	Trans-opaque	New	696	M
FB12#1.2	Feb-99	Trans	New	660	M
FB5#5.3	Feb-98	Trans-yellow	New-inter	614	F
FB12#1.3	Oct-99	Trans-brown	New-inter	598	F
FB21#1.3	Feb-98	Trans-brown	New-inter	724	M
FB26#1.10	Feb-98	Trans-brown	New-inter	700	M
FB26#1.11	Feb-98	Trans-brown	New-inter	702	M
FB1#5.1	Feb-98	Yellow-brown	Old	608	F
FB5#5.1	Feb-98	Yellow-brown	Old	600	F
FB11#5.2	Feb-98	Yellow-brown	Old	606	F
FB11#5.3	Feb-98	Yellow-brown	Old	586	F
FB20#3.1	Feb-98	Brown	Old	596	F
FB20#3.2	Feb-98	Brown	Old	584	F
FB26#2.1	Feb-98	Yellow-opaque	Old	620	F
FB16#2.3	Feb-98	Yellow-brown	Old	606	F
FB21#1.2	Feb-98	Brown	Old	620	F
FB20#1.1	Feb-98	Brown	Old	594	F
FB11#2.1	Feb-98	Brown	Old	602	F
FB26#1.5	Feb-98	Brown	Old	602	F
FB26#1.8	Feb-98	Brown	Old	596	F
FB20A#3.1	Jul-98	Brown?	Old	574	F
FB12#1.2	Oct-99	Brown	Old	558	F
FB16#3.4	Feb-98	Opaque-white	Old	580	F
FB16#3.7	Feb-98	White-opaque	Old	580	F
FB16#3.10	Feb-98	White-opaque	Old	622	F
FB16#3.25	Feb-98	Brown	Old	604	F
FB16#3.34	Feb-98	Brown	Old	574	F
FB16#3.40	Feb-98	Brown	Old	574	F
FB16#3.44	Feb-98	Brown	Old	580	F
FB16#3.48	Feb-98	Brown	Old	600	F
FB16#3.49	Feb-98	Brown	Old	622	F
FB16#1.7	Jul-98	White-opaque	Old	570	F
FB16#1.12	Jul-98	Brown	Old	580	F
FB16#1.21	Jul-98	Brown	Old	580	F
FB12#1.2	Feb-99	Brown	Old	604	F
FB12#1.3	Feb-00	White-opaque	Old	620	F
FB12#1.5	Feb-00	Brown	Old	596	F
FB12#1.6	Feb-00	Brown	Old	600	F
FB12#1.8	Feb-00	Brown	Old	604	F
FB12#1.10	Feb-00	White	Old	580	F
FB12#1.11	Feb-00	Brown	Old	600	F
FB12#1.14	Feb-00	Brown	Old	596	F
FB12#1.17	Feb-00	Brown	Old	590	F
FB20#5.3	Feb-98	Brown	Old	672	M
FB6A#1.5	Jul-98	Brown?	Old	684	M
FB16#3.13	Feb-98	Brown	Old	650	M
FB16#3.27	Feb-98	Brown	Old	684	M
FB16#3.29	Feb-98	White-opaque	Old	690	M
FB12#1.1	Feb-99	Brown	Old	680	M
FB11#5.1	Feb-98	Yellow-brown	Old?	596	F
FB20#5.1	Feb-98	Brown	Old?	616	F
FB18#2.1	Jul-98	Brown?	Old?	604	F
FB12#1.1	Feb-98	Brown-opaque	Very old	598	F
FB6A#1.1	Jul-98	Brown-opaque	Very old	580	F
FB12#1.3	Feb-98	Brown-opaque	Very old	678	M
FB17#3.1	Feb-98	White-opaque	Very old, dead?	580	F

Appendix C

Living *Loxoconcha matagordensis* shell chemistry data

Location	Date	Salinity (ppt)	Measured temperature (°C)	Secretion temperature (°C)	vpi	Species	Molt	Valve/ Carapace	Sex	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Na/Ca (mmol/mol)	Weight (mg)	Mean Mg/Ca adult	Mean Mg/Ca A and A-1
MMS STA #58	6/19/1996		20	20	5	spp.	A	R	M	20.1718323	3.40655	6.146833	5.70794		
MMS STA #96	6/19/1996		20	20	5	*williamsi*	A	L	M	29.2511582	3.64734	22.76568	6.222238		
MMS STA #R11	6/19/1996		20	20	2	spp.	A	L	F	21.3152137	3.29635	11.74143	13.80238		
MMS STA #R12	6/19/1996		20	20	4	spp.	A	L	M	21.3712786	3.12904	9.055816	10.5859		
MMS STA #R7	6/19/1996		20	20	3	spp.	A	R	M	24.3586577	3.28888	13.20077	10.93334		
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		25.27	4.18	17.45		25.09902781	25.09903
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		28.66	3.98	17.95			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		27.50	3.97	15.86			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		27.81	3.96	14.19			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		18.77	3.95	13.21			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		21.46	3.64	14.45			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		29.13	4.12	15.64			
Goodwin Island	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		22.18	3.80	23.08			
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		32.38	3.91	14.39		25.69571962	25.69572
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		25.16	4.03	14.99			
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		20.82	3.67	13.27			
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		27.24	3.94	16.38			
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		26.84	3.96	14.69			
Guinea marsh	2/9/1999	21	6	13.45		*matagordensis*	A	10 cars		21.73	3.93	15.72			
Dameron Marsh	3/1/1999	16.1	12	12		*matagordensis*	A	2 cars		23.26	4.33	15.08		23.40532506	23.40533
Dameron Marsh	3/1/1999	16.1	12	12		*matagordensis*	A	2 cars		23.55	4.01	14.73			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		23.54	3.67	15.89		24.29949503	24.29950
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		23.04	3.93	14.23			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		21.94	3.89	14.32			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		29.30	3.90	15.48			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		20.18	3.53	14.04			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		23.48	3.91	13.23			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		21.92	3.93	16.50			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		25.01	3.81	13.20			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		24.96	3.58	15.39			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		28.07	4.10	14.95			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		25.86	3.87	14.15			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		27.90	3.37	15.06			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		20.27	3.56	13.16			
Guinea Marsh	4/27/1999	19	15	15		*matagordensis*	A	10 cars		24.71	3.77	14.88			
Guinea Marsh	5/12/1999	17.1	20	20	2	*matagordensis*	A	A	M	36.53	4.03	22.57		38.72167149	39.40969
Guinea Marsh	5/12/1999	17.1	20	20	2	*matagordensis*	A		M	41.25	4.37	19.07			
Guinea Marsh	5/12/1999	17.1	20	20	2	*matagordensis*	A		F	38.38	4.47	15.74			

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Appendix C (*continued*)

Location	Date	Salinity (ppt)	Measured temperature (°C)	Secretion temperature (°C)	vpi	Species	Molt	Valve/ Carapace	Sex	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Na/Ca (mmol/mol)	Weight (mg)	Mean Mg/Ca adult	Mean Mg/Ca A and A-1
Guinea Marsh	5/12/1999	17.1	20	20		*matagordensis*	A-1		M	41.47	4.29	18.76			
Goodwin Island	6/3/1999	20	20	20	2	*matagordensis*	A		F	32.67	3.85	19.00		33.64	33.64
Goodwin Island	6/3/1999	20	20	20	2	*matagordensis*	A		F	32.09	4.20	17.91			
Guinea Marsh	6/3/1999	17.8	20	20	2	*matagordensis*	A		F	36.15	4.15	19.34			
#8.1	6/7/1999	30.50	16.90	16.90	2	*williamsi*	A	Right	M	17.7708091	2.9251	11.5515		29.54033492	28.43837
#8.1	6/7/1999	30.50	16.90	16.90	2	*williamsi*	A-1	Right	M	28.4446475	3.63493	21.52269			
CB5.4	6/7/1999	21.70	18.50	18.50	1	*williamsi*	A	Left	M	22.6010436	3.38446	11.53694			
CB5.4	6/7/1999	18.50	21.70	21.70	2	*williamsi*	A-1	Left	M	17.8458195	3.07734	18.14812			
CB6.1	6/7/1999	22.30	20.50	20.50	2	*williamsi*	A	Right	F	33.5595833	3.58502	15.1389			
CB6.1	6/7/1999	22.30	20.50	20.50	1	*williamsi*	A	Left	M	28.2502705	3.56791	12.94282			
CB6.1	6/7/1999	22.30	20.50	20.50	1	*williamsi*	A	Left	M	35.3846242	3.44399	13.252			
CB6.1	6/7/1999	22.30	20.50	20.50	2	*williamsi*	A-1	Right	M	25.2827488	3.39934	13.89081			
CB6.1	6/7/1999	22.30	20.50	20.50	2	*williamsi*	A-1	Right	M	31.0586932	3.34798	53.43278			
CB6.4	6/7/1999	27.40	19.20	19.20	1	*williamsi*	A	Carapace	M	21.2117721	3.28178	11.98603			
CB6.4	6/7/1999	27.40	19.20	19.20	2	*williamsi*	A	Right	M	29.0218435	3.65074	13.33604			
CB6.4	6/7/1999	27.40	19.20	19.20	2	*williamsi*	A	Left	M	27.7328107	3.71128	13.69128			
CB6.4	6/7/1999	27.40	19.20	19.20	1	*williamsi*	A-1	Right	M	30.2924317	3.64279	42.5504			
CB6.4	6/7/1999	27.40	19.20	19.20	2	*williamsi*	A-1	Left	F	29.4219679	3.37545	28.35716			
CB7.3E	6/7/1999	28.90	19.80	19.80	2	*williamsi*	A	Right	M	24.0476891	3.43832	14.83851			
CB7.3E	6/7/1999	28.90	19.80	19.80	2	*williamsi*	A	Carapace	M	38.8038738	3.89791	21.10997			
CB7.3E	6/7/1999	28.90	19.80	19.80	2	*williamsi*	A	Carapace	F	27.277179	3.48078	13.26126			
CB7.3E	6/7/1999	28.90	19.80	19.80	2	*williamsi*	A	Carapace	M	35.7927438	3.50073	15.23238			
CB7.3E	6/7/1999	28.90	19.80	19.80	1	*williamsi*	A	Carapace	M	26.6317106	3.46148	17.84451			
CB7.3E	6/7/1999	28.90	19.80	19.80	3	*williamsi*	A	Carapace	M	22.2926318	3.51278	18.2388			
CB7.3E	6/7/1999	28.90	19.80	19.80	1	*williamsi*	A	Left	M	23.6305519	3.11057	11.19043			
CB7.3E	6/7/1999	28.90	19.80	19.80	2	*williamsi*	A-1	Right	M	22.606778	3.33508	13.42305			
CB5.4	6/8/1999	21.70	18.50	18.50	1	*williamsi*	A	L	F	44.7777401	4.1473	14.60473	7.262151		
CB6.1	6/8/1999	22.30	20.50	20.50	2	*williamsi*	A	L	M	37.4013438	3.26558	7.8422	8.327827		
CB6.4	6/8/1999	27.40	19.20	19.20	2	*williamsi*	A	R	M	24.5859998	3.37396	13.42411	9.135408		
CB7.3E	6/8/1999	28.90	19.80	19.80	1	*williamsi*	A	R	M	40.1215594	3.52403	13.32882	12.29965		
CB7.3E	6/8/1999	28.90	19.80	19.80	2	*williamsi*	A	L	M	24.7882579	3.51274	9.294947	9.372412		
CB7.3E	6/8/1999	28.90	19.80	19.80	1	*williamsi*	A	R	F	37.5840474	3.45336	9.426554	8.691313		
CB7.3E	6/8/1999	28.90	19.80	19.80	2	*williamsi*	A	L	M	26.3614515	3.44384	9.735881	8.355782		
LE4.3B	6/8/1999	25.30	19.80	19.80	2	*williamsi*	A	Right	M	29.7981661	3.09302	14.16399			
LE4.3	6/9/1999	18.80	20.30	20.30	2	*williamsi*	A-1	Right	M	24.8776814	3.80843	16.96566			
LE4.3	6/9/1999	18.80	20.30	20.30	2	*williamsi*	A-1	Right	M	20.7693916	2.95754	18.71912			
Goodwin Island	6/22/1999	20.2	22	22	1	*matagordensis*	A		F	34.09	4.33	21.12		35.51	35.45803
Goodwin Island	6/22/1999	20.2	22	22	2	*matagordensis*	A		F	36.93	4.15	17.77			
Goodwin Island	6/22/1999	20.2	22	22		*matagordensis*	A-1		F	35.35	4.30	32.46			
Guinea Marsh	6/22/1999	19.5	22	22	1	*matagordensis*	A		M	37.87	4.14	18.78		37.87	34.88962
Guinea Marsh	6/22/1999	19.5	22	22	1	*matagordensis*	A-1		M	31.91	4.19	19.34			
Guinea Marsh	7/6/1999	21.5	29.2	29.2	1	*matagordensis*	A		F	47.50	4.07	17.99		49.1269926	50.23979
Guinea Marsh	7/6/1999	21.5	29.2	29.2	1	*matagordensis*	A		F	50.76	3.85	19.43			
Guinea Marsh	7/6/1999	21.5	29.2	29.2	1	*matagordensis*	A-1		M	52.47	4.37	20.24			
Goodwin Island	7/20/1999	21.5	27	27		*matagordensis*	A		F	38.6176744	4.58497	20.1059	8.309723	46.15248453	45.29008244
Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A		F	39.82	4.20	17.17			

Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A	F	39.82	4.20	17.17			
Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A	F	48.59	4.46	19.12	7.3		
Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A	F	47.42	4.18	20.01	7.5		
Guinea Marsh	7/20/1999	19.9	27	27	3	*matagordensis*	A	F	44.51	4.46	18.21	7.3		
Guinea Marsh	7/20/1999	19.9	27	27	3	*matagordensis*	A	F	58.10	4.36	19.01	8.0		
Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A	F	49.64	4.53	20.28	9.3		
Guinea Marsh	7/20/1999	19.9	27	27	2	*matagordensis*	A	F	48.85	4.35	20.20	7.9		
Guinea Marsh	7/20/1999	19.9	27	27	1	*matagordensis*	A-1	M	43.31	4.02	19.34			
Guinea Marsh	7/20/1999	19.9	27	27	1	*matagordensis*	A-1	M	39.51	4.23	24.45			
Goodwin Island	8/3/1999	21	26	26		*matagordensis*	A	M	52.1527656	3.20599	12.65017	7.640268	46.34829943	46.91412
Guinea Marsh	8/3/1999	19.9	25.5	25.5	1	*matagordensis*	A	F	46.00	4.23	26.39			
Guinea Marsh	8/3/1999	19.9	25.5	25.5	3	*matagordensis*	A	F	44.76	4.62	18.38	7.3		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	4	*matagordensis*	A	F	44.38	4.72	18.47	7.0		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	3	*matagordensis*	A	F	45.72	4.55	17.43	7.5		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	3	*matagordensis*	A	F	40.93	4.50	17.79	7.7		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	4	*matagordensis*	A	F	46.81	4.61	20.07	7.8		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	4	*matagordensis*	A	F	50.04	4.33	17.68	8.0		
Guinea Marsh	8/3/1999	19.9	25.5	25.5	2	*matagordensis*	A-1	F	47.39	4.33	19.79			
Guinea Marsh	8/3/1999	19.9	25.5	25.5	2	*matagordensis*	A-1	F	50.97	4.49	22.60			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	44.10	4.14	40.67		43.63	43.62714
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	40.26	4.23	18.98			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	44.01	4.36	20.38			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	45.00	4.21	33.84			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	38.80	4.23	20.23			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	43.18	4.14	20.68			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	F	46.23	4.17	21.36			
Bogue Sound	8/13/1999	35.5	30	30	2	*matagordensis*	A	M	47.44	4.20	21.65			
Guinea Marsh	8/17/1999	21.3	26.8	26.8		*matagordensis*	A	Frag	44.1559449	3.84951	16.17257	4.674272	42.07989826	42.07990
Guinea Marsh	8/17/1999	21.3	26.8	26.8		*matagordensis*	A	M	40.0038517	4.51393	16.3357	8.176594		
4CB.11	9/9/1999	23.50	23.00	23.00	4	*williamsi*	A	F	34.6553671	3.71993	11.09409	7.9	36.16229299	36.16229
4CB.14	9/9/1999	23.50	23.00	23.00	3	*williamsi*	A	F	34.9781433	3.84298	12.63651	4.2		
4CB.16	9/9/1999	23.50	23.00	23.00	4	*williamsi*	A	M	37.7363332	3.77752	12.54796	7.4		
4CB.3	9/9/1999	23.50	23.00	23.00	4	*williamsi*	A	F	48.9380419	3.60716	12.61866	4.3		
4CB.5	9/9/1999	23.50	23.00	23.00	3	*williamsi*	A	?	39.7655671	4.30991	10.25821	4.1		
4CB.7	9/9/1999	23.50	23.00	23.00	3	*williamsi*	A	M	45.3878827	4.26755	15.83328	4.8		
4CB.8	9/9/1999	23.50	23.00	23.00	3	*williamsi*	A	F	35.9724146	4.15899	10.26151	6.4		
4CB.9	9/9/1999	23.50	23.00	23.00	5	*williamsi*	A	F	39.3895908	3.49205	11.60376	7.8		
5CB.1	9/9/1999	23.50	22.70	22.70	4	*williamsi*	A	F	23.2748309	3.2373	10.40084	9.2		
5CB.2	9/9/1999	23.50	22.70	22.70	4	*williamsi*	A	F	41.0394686	3.2722	11.05275	8.6		
5CB.3	9/9/1999	23.50	22.70	22.70	4	*williamsi*	A	F	50.2747731	3.95052	13.73262	7.4		
5CB.4	9/9/1999	23.50	22.70	22.70	3	*williamsi*	A	M	24.00934	3.38102	10.77795	8.9		
5CB.5	9/9/1999	23.50	22.70	22.70	4	*williamsi*	A	M	38.201106	3.65057	11.02844	7.4		
5CB.6	9/9/1999	23.50	22.70	22.70	6	*williamsi*	A	M	33.7616681	3.38279	10.38423	6.9		
3CB.10	9/11/1999	23.50	23.30	23.30	5	*williamsi*	A	F	39.4008719	3.63225	12.50319	8.5		
3CB.11	9/11/1999	23.50	23.30	23.30	5	*williamsi*	A	M	29.0908099	3.43318	13.70511	10.2		
3CB.2	9/11/1999	23.50	23.30	23.30	5	*williamsi*	A	F	28.3169509	3.5296	10.97745	9.5		
3CB.5	9/11/1999	23.50	23.30	23.30	4	*williamsi*	A	F	31.434376	3.85596	13.50269	7.6		
3CB.7	9/11/1999	23.50	23.30	23.30	5	*williamsi*	A	M	31.5284326	3.85102	12.78602	6.3		
3CB.9	9/11/1999	23.50	23.30	23.30	6	*williamsi*	A	M	36.0898909	4.17594	12.70133	5.0		

(continued on next page)

Appendix C (*continued*)

Location	Date	Salinity (ppt)	Measured temperature (°C)	Secretion temperature (°C)	vpi	Species	Molt	Valve/ Carapace	Sex	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Na/Ca (mmol/mol)	Weight (mg)	Mean Mg/Ca adult	Mean Mg/Ca A and A-1
Guinea Marsh	9/14/1999	23	24.5	24.5	3	*matagordensis*	A		F	43.59	3.91	16.76	7.7	44.68023281	44.68023
Guinea Marsh	9/14/1999	23	24.5	24.5	3	*matagordensis*	A		M	45.28	4.41	18.17	8.3		
Guinea Marsh	9/14/1999	23	24.5	24.5	3	*matagordensis*	A		F	53.55	4.82	19.67	8.5		
Guinea Marsh	9/14/1999	23	24.5	24.5	3	*matagordensis*	A		F	40.03	3.85	16.16	7.3		
Guinea Marsh	9/14/1999	23	24.5	24.5	5	*matagordensis*	A		F	40.94	4.58	17.30	7.0		
Guinea Marsh	10/15/1999	21	16	16	3	*matagordensis*	A		F	31.86	4.30	16.22	8.9	34.43084277	34.43084
Guinea Marsh	10/15/1999	21	16	16	4	*matagordensis*	A		F	34.07	4.38	18.25	8.0		
Guinea Marsh	10/15/1999	21	16	16	3	*matagordensis*	A		F	28.71	3.77	15.34	9.4		
Guinea Marsh	10/15/1999	21	16	16	2	*matagordensis*	A		F	35.02	4.11	15.35	8.5		
Guinea Marsh	10/15/1999	21	16	16	5	*matagordensis*	A		F	42.28	4.36	16.65	7.3		
Guinea Marsh	10/15/1999	21	16	16	3	*matagordensis*	A		F	34.64	4.09	16.74	8.8		
Guinea Marsh	11/9/1999	20	13	13	3	*matagordensis*	A		M	32.24	4.07	16.31	8.0	28.92525688	28.92526
Guinea Marsh	11/9/1999	20	13	13	3	*matagordensis*	A		F	26.37	3.88	13.18	7.4		
Guinea Marsh	11/9/1999	20	13	13	5	*matagordensis*	A		F	30.45	4.00	16.48	7.5		
Guinea Marsh	11/9/1999	20	13	13	3	*matagordensis*	A		F	24.94	3.99	14.35	6.6		
Guinea Marsh	11/9/1999	20	13	13	2	*matagordensis*	A		M	30.80	4.15	14.92	8.1		
Guinea Marsh	11/9/1999	20	13	13	2	*matagordensis*	A		M	28.75	4.00	14.74	8.8		
Guinea Marsh	12/21/1999	26	9.5	9.5	5	*matagordensis*	A		F	30.75	4.17	15.32	7.7	24.95413071	24.95413
Guinea Marsh	12/21/1999	26	9.5	9.5	4	*matagordensis*	A		F	24.66	3.97	13.59	7.5		
Guinea Marsh	12/21/1999	26	9.5	9.5	6	*matagordensis*	A		F	24.09	4.20	14.37	7.6		
Guinea Marsh	12/21/1999	26	9.5	9.5	6	*matagordensis*	A		F	23.91	3.94	14.95	6.7		
Guinea Marsh	12/21/1999	26	9.5	9.5	6	*matagordensis*	A		F	21.35	4.14	15.62	7.5		
1007	1960s	35	10	10	2	*impressa*	A	1 car	Females	27.6170204	3.86779	15.81031	7.114429	26.58032464	26.58032
1009	1960s	35	10	10	5	*impressa*	A	1 car	Mostly	25.5436289	4.12663	14.50365	6.948336		
1175	1960s	35	7	7	4	*impressa*	A	2 valves		17.6024543	2.94165	8.811903	6.955119	17.84959791	17.84960
1175	1960s	35	7	7	4	*impressa*	A	2 valves		18.0967415	3.03503	9.432979	7.255514		
1319	1960s	35	12	12	5	*williamsi*	A	2 valves		24.6331626	3.14567	9.869401	5.735748	24.15084848	24.15085
1319	1960s	35	12	12	4	*williamsi*	A	2 valves		23.6685344	3.08767	12.03087	7.749565		
1340	1960s	35	10	10	3	*impressa*	A	2 cars		21.9375217	3.46483	11.92977	11.93322	23.82517422	23.82517
1340	1960s	35	10	10	2	*impressa*	A	2 cars		25.7128267	3.491	16.381	11.82737		
1415	1960s	35	13	13	4	*impressa*	A	1 valve, 1 car		26.3513643	3.47591	13.17942	9.759425	22.05901627	22.05902
1415	1960s	35	13	13	4	*impressa*	A	1 valve, 1 car		17.7666682	3.55086	11.08875	8.837932		
1423	1960s	35	16	16	4	*impressa*	A	1 valve, 1 car		21.6526938	3.42433	10.72918	12.77937	22.2337484	22.23375
1423	1960s	35	16	16	4	*impressa*	A	1 valve, 1 car		22.814803	3.36557	12.36179	9.727965		
1425	1960s	35	15	15	2	*impressa*	A	4 cars		19.8775645	3.22813	12.78063	8.530206	21.49945637	21.49946
1425	1960s	35	15	15	3	*impressa*	A	4 cars		23.0975653	2.88928	10.49227	10.1643		
1425	1960s	35	15	15	3	*impressa*	A	4 cars		19.9331263	3.20278	11.37684	11.84626		
1425	1960s	35	15	15	4	*impressa*	A	4 cars		23.0895694	3.26447	11.96681	10.07488		
1431	1960s	35	16	16	3	*impressa*	A	1 valve, 1 car		26.611434	3.33788	14.96463	9.145316	30.73339467	30.73339
1431	1960s	35	16	16	3	*impressa*	A	1 valve, 1 car		34.8553553	3.06652	12.9789	8.70478		
1436	1960s	35	20	20	2	*williamsi*	A	3 valves		29.5207248	3.37029	11.9639	10.15926	31.57929032	31.57929
1436	1960s	35	20	20	2	*williamsi*	A	3 valves		36.3866462	3.37809	15.14778	9.743105		
1436	1960s	35	20	20	2	*williamsi*	A	3 valves		28.8305	3.34325	12.24692	10.10592		
2050	1960s	35	20	20	3	*williamsi*	A	1 car		36.0706553	3.60467	12.76168	7.446499	36.07065534	36.07066
1558	1960s	35	30	30	3	*matagordensis*	A	2 valves		49.7725972	3.90318	16.5134	6.666085	48.38845319	48.38845
1558	1960s	35	30	30	3	*matagordensis*	A	2 valves		47.0043092	4.05498	18.54688	3.344911		

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