

have come from Cat Island, and one was ostensibly from neighboring Horn Island. Of the ten two-year-old fish, seven were predicted to have come from Horn Island, two were predicted to have come from Cat Island, and one ostensibly developed in the Grand Bay region.

Louisiana Marshes - Most of the specimens that had been collected from the Louisiana Marshes were destroyed during Hurricane Katrina. Of the four two-year-old fish from this region, three had elemental signatures similar to juveniles collected at Horn Island, and one fish was predicted to have come from the Grand Bay region.

Chandeleur Islands - All 13 of the specimens analyzed from the Chandeleur Islands were three-year-olds (i.e. were from the 2001 year class). Four of the fish were predicted to have developed at the Chandeleur Islands, and seven fish had elemental signatures similar to juveniles collected at either Horn Island (n=5) or Cat Island (n=2). One specimen was predicted to have developed at each of the Louisiana Marsh and Grand Bay regions.

Pearl River - Twelve of the fish analyzed from the Pearl River region were age two, and one specimen was three-years-old. Two-year-olds were predicted to have come from Grand Bay (n=2), Biloxi Bay (n=5), Horn Island (n=3). Cat Island (n=1) and the Louisiana Marsh (n=1). The single three-year-old was ostensibly from the neighboring Louisiana Marsh.

DISCUSSION

In our preceeding study (Comyns et al. 2004) we analyzed otoliths from juvenile spotted seatrout collected in 2001, and from adults collected in 2002 and 2003. We included Na as one of the measured variables, but as we have subsequently learned, this was probably not appropriate because this element is under strong physiological control and is not likely to show spatial differences in water chemistry. We also made several modifications to our analyses, including using $\log_{10}$ transformations for all elemental concentrations, and including a MANOVA to determine which otolith variables should be included in a follow-up CDFA. As part of our current report that includes juveniles collected in 2006, we re-analyzed the 2001 data and found only minor differences with our previous results and no changes in the conclusions.

It is important to determine if there are ontogenetic influences on the concentration of elements in otoliths, because the size of juveniles collected from different regions usually varies, and this could confound the subsequent regional classifications based on otolith chemistry. In 2001, four of the seven otolith chemistry variables were significantly related to $\ln$ otolith weight, including magnesium, manganese, barium, and $\delta^{13}C$. In 2006, these same four variables had to be adjusted for significant ontogenetic effects, but lithium and $\delta^{18}O$ were also found to be significantly related to $\ln$ otolith weight. In fact, lithium showed the strongest ontogenetic relationship of any variable in either year. Dorval et al. (2005) also found ontogenetic relationships between otolith weight and trace elements of juvenile spotted seatrout in Chesapeake Bay, but only during one of the two years of study. Other careful studies have also found it necessary to adjust for ontogenetic trends (Mulligan et al. 1987, Campana et al. 2000, Rooker et al. 2001, Hanson et al. 2004); while some studies of otolith chemistry have failed to account for ontogenetic effects.

Potential source areas of early juvenile spotted seatrout collected during 2006 from nine *a priori* regions bordering Mississippi Sound were clearly distinguished based on the chemical composition of their otoliths. When all 201 juveniles were included in a CDFA, the overall percent of juveniles correctly classified with respect to their capture location was 93.0%, and ranged from 70.8 to 100% among regions. This is almost

identical to the findings for juveniles collected in 2001, when the overall percent of juveniles correctly classified was 93.4%.

Cross-validation through leave-one-out procedure estimates how well the CDFA should be able to correctly classify specimens from a new sample. Overall, 91.5% of the 2006 specimens (n=201) were correctly classified in the cross-validation, with classification success ranging from 70.8 to 100% among regions. Misclassified specimens were mainly placed into adjacent regions. For example, all 3 misclassified Saint Louis Bay specimens were classified by the cross-validation as having a Pearl River origin; and 4 of the 7 misclassified Pearl River specimens were classified by the cross-validation as having a Saint Louis Bay origin. Cross-validation of the 2001 specimens (n=197) was very similar, with an accuracy of 90.9% and an identical range for the classification success among regions (70.8 to 100%).

The order of decreasing influence of variables for distinguishing regions was δ^8O , Ba, δ^3C , Mn, Li, Mg, and Sr. This is similar to findings in 2001, although in 2001 Li replaced Ba as the second most important variable. The combined use of isotopes and trace elements was also warranted by the prominent roles that δ^8O and δ^3C played. A full 84.8 % of the variance in δ^8O and 81.9 % of the variance in δ^3C was explained by region in follow-up ANOVA's. The amount of variance explained by region was even higher in 2001 ($\delta^8O = 94.4\%$, $\delta^3C = 90.0\%$). Previous studies have found the combined use of isotopes and trace elements as regional tags to be superior to the sole use of trace elements. For example, by combined use of trace elements and stable isotopes, Thorrold et al. (1998b) clearly distinguished regional groups of juvenile weakfish (*C. regalis*) from three adjacent river systems, and Thorrold et al. (2001) even demonstrated natal homing in *C. regalis*.

Like in 2001, the arrangement of group centroids along CDF1 axis apparently reflects differences in discharge regimes rather than geographical affinity, with Chandeleur Island specimens falling at the high end of the CDF1 axis in both years, but with less separation from the other regional groups in 2006. Thus, otoliths of specimens from high salinity locations mainly had lower barium and higher δ^3C concentrations in

2006 vs. higher $\delta^{18}O$ and lower lithium concentrations in 2001. This inter-annual variability is likely due to changes in rainfall; mean monthly rainfall across Mississippi's coastal counties from May through September in 2001 was 18.5 cm, but during the same time period in 2006 it was only 10.2 cm (NOAA National Climatic Data Center).

Strontium largely drove CDF5, which had only minor influence on the overall discriminant function. However, in several previous studies strontium concentrations in otoliths have provided valuable life history information. Strontium concentration is known to be much greater in seawater than in freshwater (Rosenthal et al. 1970, Bagenal et al. 1973, Bruland 1983, Kalish 1990), and this has facilitated studies of anadromous behavior of various fishes, including salmonids (Kalish 1990), striped bass (Secor 1992) and American shad (*Alosa sapidissima*) (Limburg 1995). These studies are based on the usual direct relationship between Sr/Ca ratios in otoliths and salinity. This approach has also been used to study up-estuary movements in bay anchovy (*Anchoa mitchilli*) (Kimura et al. 2000), and offshore-inshore migrations of larval and juvenile Atlantic croaker (*Micropogonias undulatus*) (Thorrold et al. 1997).

In 2001 Sr/Ca followed the opposite trend (Comyns et al. 2004) and was surprisingly high in early juvenile otoliths from regions associated with relatively low salinity (*i.e.*, Pearl River, St. Louis Bay, Biloxi Bay and Pascagoula River). For example, in 2001 Sr/Ca was about 10% to 30% lower in fish otoliths at locations farther from the mainland, including Horn Island, Cat Island and the Chandeleur Islands. In 2006 there was no direct relationship between Sr concentrations in otoliths and salinity. For example, mean Sr/Ca was identical for juveniles collected at Horn Island and the Pascagoula River (0.00231), even though salinities were higher at Horn Island. The mean salinity at locations where juveniles were collected near the Pascagoula River was 12.5 p.s.u., whereas the mean salinity at Horn Island was 28.8 p.s.u. Fish from Biloxi Bay actually had similar Sr/Ca levels as fish from the Chandeleur Islands (0.0025 vs 0.0024), even though salinities in Biloxi Bay were lower than at the Chandeleur Islands. The lack of a definite relationship between otolith Sr/Ca and salinity for spotted seatrout from Chesapeake Bay was also reported by Dorval et al. (2005), who found that variation of Sr/Ca could not be explained by salinity. It is unclear why the typical direct

relationship between Sr/Ca and salinity was not apparent in otoliths of early juvenile spotted seatrout in Mississippi, but possible explanations include the use of earlier life-stages of fish in our study, species-specific differences in Sr uptake mechanisms, or species-specific metabolic pathways.

The influence of freshwater discharge from seven rivers along the Mississippi coastline likely made possible the delineation of source areas on such a small geographic scale as was seen in this study. Indeed, the mean interregional distance was only 25 km. Using otolith chemistry, Dorval et al. (2005) also recently distinguished juvenile spotted seatrout from seagrass within five regions of the Chesapeake Bay on a comparably small spatial scale (i.e., 15 km). Dorval et al. (2005) did not consider Li or Mg, but they did assess the rare earth element, La, for the first time.

Our results imply that early juvenile spotted seatrout remain within the same estuarine nursery region in Mississippi and thus, source areas for adults of this species can be accurately determined using otolith chemistry. A useful product of the CDFA of juvenile spotted seatrout otoliths was a set of function coefficients that can be used to identify in which regions adults developed as juveniles based on the elemental composition of the inner portion of their otoliths. Previous studies have examined the inner portion of adult otoliths by using various types of micro-probe analyses of otolith cross-sections (eg. Mulligan et al. 1987, Thorrold et al. 1997, Secor 1992, Limburg 1995, Proctor and Thresher 1998, Yamashita et al. 2000). Our study differed in that the inner portion of adult otoliths was extracted with six precision cuts, and after extensive cleaning the entire core was dissolved and analyzed using ICP-MS.

In 2002 and 2003 we collected one and two-year-old spotted seatrout in order to follow the 2001 year class (Comyns et al. 2004). Of the 339 adult spotted seatrout collected in 2004 for the present study, 50 were three years old. These fish were of primary concern because they were from the same year class (2001) as the juveniles for which our first otolith chemical fingerprint was developed. Unfortunately, fish collected in 2005 (otoliths or frozen heads) were lost during Hurricane Katrina.

Three-year-old spotted seatrout were collected at the Chandeleur Islands (n=13), Biloxi Bay (n=15), Pearl River region (n=1), Grand Bay (n=1), Horn Island (n=10), and

Cat Island (n=3). All but one of the fish collected at the Chandeleur Islands were predicted to have come from either the Chandeleur Islands (n=4), or regions south of the Mississippi mainland; Horn Island (n=5), Cat Island (n=2), and the LA marshes (n=1). This trend of fish being predicted to have come from either the region in which they were caught or adjacent regions was also found at other locations. For example, of the three three-year-olds collected in 2004 at Cat Island, two of them were ostensibly from Cat Island, and one was predicted to have developed on neighboring Horn Island. Of the ten three-year-olds collected at Horn Island in 2004, almost half (n=4) were predicted to have developed as juveniles on the island. Three fish were ostensibly from the Pascagoula River area, the closest region of the mainland to Horn Island, and one specimen was predicted to have come from the Grand Bay region. Of the 15 three-year-old fish collected in Biloxi Bay, 33% (n=5) were predicted to have developed in Grand Bay. This is similar to findings from fish collected in 2002 and 2003 when 39% (n=9) of one and two year old adults were predicted to have developed in Grand Bay (Comyns et al. 2004). Three three-year-olds collected from Biloxi Bay in 2004 were ostensibly from Biloxi Bay, and one was from neighboring Pascagoula River. Three fish were predicted to have come from both Horn Island and the Chandeleur Islands. Only one three-year-old was collected in 2004 at both Grand Bay and the Pearl River, and these were predicted to have come from Horn Island and the LA Marsh, respectively.

Two-year-old spotted seatrout collected in 2004 (n=55) were included for six regions at which relatively few three-year-old fish were collected. Admittedly these fish were from the 2002 year class for which juvenile otolith chemical signatures had not been developed, but because of general similarities in otolith chemical signatures for 2001 and 2006, they were included. In addition, it is likely that otolith chemical signatures for 2001 and 2002 were quite similar because both years had similar amounts of rainfall during May through September. Mean monthly rainfall during this period for 2001 and 2002 was 18.5 and 19.3 cm, respectively, whereas for 2006 monthly rainfall during this period was only 10.2 cm.

The trend of fish being predicted to have come from either the region in which they were caught or adjacent regions was also found with two-year-olds. For example, of

the 14 two-year-olds collected in 2004 from the Pascagoula River, approximately 80% (n=11) were predicted to have come from either the Pascagoula River (n=3), or neighboring Biloxi (n=5) and Grand Bay (n=3). Ten two-year-olds were collected from Cat Island in 2004, and nine of these specimens were predicted to have come from either Cat Island (n=2) or Horn Island (n=7). Of the six two-year-olds collected at Grand Bay, 50% (n=3) were predicted to have developed as juveniles in Grand Bay, two were ostensibly from the Chandeleur Islands, and one was predicted to have come from Horn Island. It should be noted that in 2006, the juvenile otolith chemical signature from Horn Island and the Chandeleur Islands were the most similar to the Grand Bay chemical signature. If this also occurred in 2002, it is quite possible that some of the two-year-olds predicted to have come from the Chandeleur Islands or Horn Island may have originated in Grand Bay.

Based on adults collected in 2002 and 2003, Comyns et al. (2004) reported that Grand Bay located at the Mississippi-Alabama border was an important source area for the spotted seatrout stock in eastern Mississippi waters. Grand Bay, which now includes the Grand Bay National Estuarine Research Reserve, is the most extensive area of habitat for juvenile spotted seatrout along the Mississippi and western Alabama shoreline. Comyns et al. (2004) also concluded that western portions of the study area that include the Pearl River region and the LA marshes located south of Saint Louis Bay were not important source areas of spotted seatrout for other regions of the Mississippi coast. The same trends were found during the present study. Of the 15 three-year-olds collected during 2004 in Biloxi Bay, five were predicted to have come from Grand Bay. In fact 21% (n=9) of the three-year-olds collected across all nine locations (n=43) were predicted to have come from Grand Bay. In contrast, no three-year-old spotted seatrout were predicted to have come from the Pearl River region or the LA marshes for any of the nine study areas. When all age groups collected in 2004 were combined (n=105), 22% of the fish were ostensibly from Grand Bay, but only 3% of the spotted seatrout were predicted to have come from each of the Pearl River region and the LA marshes. The Pearl River sub-region, although apparently not an important source area of spotted seatrout for other regions of the Mississippi coast, supports a large population of spotted

seatrout as evidenced by historical monitoring data (Mississippi Department of Marine Resources and the Gulf Coast Research Laboratory). The fact that no evidence was found to support the idea that the Pearl River region is an important source area of spotted seatrout for other areas of the Mississippi coast in no way diminishes the importance of this region as a habitat for juveniles, as evidenced by the significant population of fish that it supports. In addition, it is quite possible that Pearl River sub-region is an important source area of fish for more westerly sections of the coast. Although evidence strongly suggests that the Louisiana marshes located south of Saint Louis Bay are also not an important source area for spotted seatrout in Mississippi waters, the importance of this region should also not be underestimated because it provides extensive habitat for juvenile spotted seatrout, and this area is well known by anglers for the population of spotted seatrout that it supports.

Hendon et al. (2002), in assessing longshore movement of tagged adult spotted seatrout, also found no easterly movement of fish along the Mississippi coastline. However, a general pattern of westerly movement was found in the eight recaptures that moved a significant distance along the coastline. Of the 15,206 spotted seatrout tagged by Hendon et al. (2002), 3% of the fish were recaptured ($n=408$). Of these recaptured fish ($n=408$), 82% had moved <3 km. Our study indicated more movement of spotted seatrout between regions of the Mississippi coast. This may be because our study extended over several years, whereas 81% of recaptures in the study by Hendon et al. (2003) occurred within eight weeks of tagging. Our study also showed a general east-west movement of adults by differences between where fish were captured and where they were predicted to have originated. Frequency distributions of 105 adults were aggregated into three major east-west regions across the Mississippi coast: East (Grand Bay, Pascagoula River, Horn Island); Central (Biloxi Bay, Chandeleur Islands, Cat Island), and West (Saint Louis Bay, Pearl River, Marsh Islands). A chi-square test between frequency distributions of where fish were captured and where they were predicted to have originated confirmed that the supply of fish was disproportionate across the three major regions (chi-square = 13.174; $df = 2$; $P < 0.005$). Fish were markedly

better represented by eastern fish (i.e., 1.34 predicted vs. 1 captured) and less well represented by western fish (i.e., 0.35 predicted vs. 1 captured).

IMPLICATIONS

Coastal Mississippi is currently undergoing extensive coastal development, and the ability to determine spotted seatrout source regions will be essential for justifying the conservation of key regions containing valuable nursery habitats. Grand Bay, which now includes the Grand Bay National Estuarine Research Reserve, is the most extensive area of habitat for juvenile spotted seatrout along the Mississippi and western Alabama shoreline. Comyns et al. (2004), following the 2001 year class as one and two-year-olds, found this region to be an important source area for spotted seatrout, particularly in the eastern half of the Mississippi coast. Surprisingly, Comyns et al. (2004) also found that the Hancock County marshes in the Pearl River region and the Louisiana marshes south of Saint Louis Bay (Biloxi marsh) had minimal influence as a source area for spotted seatrout further eastward across the Mississippi coast. This same trend was found during the present study; approximately 20% of two and three year-old fish collected across the Mississippi coast in 2004 were predicted to have come from Grand Bay. In contrast, no three-year-olds and only 3% of the two-year-olds were predicted to have come from either the Pearl River region or the Louisiana marshes for any of the other sampling areas in Mississippi. It should be noted that adults from Saint Louis Bay were destroyed during Hurricane Katrina and their natal regions could not be assessed. Although no evidence was found to support the idea that either the Pearl River region or the eastern Louisiana marshes (Biloxi marsh) are important source areas of spotted seatrout for other areas of the Mississippi coast, this in no way diminishes the importance of these regions as habitat for juveniles, as evidenced by the significant population of spotted seatrout that they support. In addition, it is quite possible that these areas are important source areas of fish for more westerly sections of the coast.

Our study showed a very fine spatial scale for the separation of juvenile spotted seatrout using otolith microchemistry. Juveniles collected in nine regions bordering Mississippi Sound could be differentiated with over 90% accuracy, and the mean distance

among regions was only 25 km. This distinction between fish collected in different sub-regions was likely possible because the Mississippi coastline is influenced by freshwater discharge from seven rivers. It is therefore likely that these techniques can be applied to other estuarine-dependent species in this area.

Inter-annual differences in otolith chemical signatures between 2001 and 2006 show that caution must be used when using the otolith chemical signature from a particular year to track more than one year class. For instance, the order of decreasing influence of variables for distinguishing regions in 2006 was $\delta^{18}O$, Ba, $\delta^{13}C$, Mn, Li, Mg, and Sr, but in 2001 Li replaced Ba as the second most important variable. These differences were likely influenced by rainfall; mean monthly rainfall was almost twice as much during May through September in 2001 (18.5 cm) than in 2006 (10.2 cm). In this report we did make some inferences about the 2002 year class based on 2001 otolith chemical signatures, but feel this was worthwhile because mean monthly rainfall during this period in 2001 and 2002 was very similar, differing by less than 1 cm.

Our otolith studies have revealed more mixing of fish between adjacent estuarine regions than has been shown with tagging studies (Hendon et al. 2002). However, spotted seatrout did show strong regional affinities, particularly when neighboring regions were combined. The tagging study did show some westward movement of fish, and this agrees with our findings: (1) of the apparent westward movement of fish that originated in the eastern portion of our study area, including Grand Bay, and (2) the apparent negligible eastward movement of fish that originated in the western portion of our study area (Pearl River region and LA marshes). Considering the current strong interest in stock-enhancement of spotted seatrout in Mississippi, regional movements should be taken into consideration for determining release locations for hatchery-reared young juveniles.

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Appendix 1. Molar concentrations of otolith microchemical variables (standardized by molar calcium concentrations), and stable isotope ratios of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ in otoliths of juvenile *Cynoscion nebulosus* collected during 2006 in the northcentral Gulf of Mexico.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
1	Biloxi Bay	-5.07879	-2.38494	0.0000033540	0.0001923937	0.0000493629	0.0024321672	0.0000275635
2	Biloxi Bay	-5.11874	-2.31842	0.0000032966	0.0002032700	0.0000432199	0.0023927740	0.0000261336
3	Biloxi Bay	-4.86351	-2.33273	0.0000035105	0.0002090350	0.0000562277	0.0024951689	0.0000329820
4	Biloxi Bay	-4.49538	-2.27319	0.0000032646	0.0001972294	0.0000429930	0.0023049669	0.0000262529
5	Biloxi Bay	-5.08652	-2.24688	0.0000033433	0.0002098719	0.0000641643	0.0024088421	0.0000293831
6	Biloxi Bay	-5.79727	-2.52361	0.0000031449	0.0002003848	0.0000602418	0.0023713134	0.0000223150
7	Biloxi Bay	-5.01653	-2.28682	0.0000034221	0.0001972412	0.0000435022	0.0024186489	0.0000294960
8	Biloxi Bay	-4.90848	-2.28438	0.0000034888	0.0001964368	0.0000506874	0.0023519307	0.0000248069
9	Biloxi Bay	-5.08995	-2.27110	0.0000031353	0.0002315374	0.0000420513	0.0024158005	0.0000215728
10	Biloxi Bay	-4.87085	-2.21183	0.0000030359	0.0001749840	0.0000338895	0.0028421023	0.0000355276
11	Biloxi Bay	-5.26340	-2.27134	0.0000032236	0.0001861914	0.0000392498	0.0023047700	0.0000273621
12	Biloxi Bay	-4.52745	-2.07419	0.0000031680	0.0002049413	0.0000376333	0.0022966027	0.0000307647
13	Biloxi Bay	-4.96349	-2.29742	0.0000032472	0.0002021173	0.0000402197	0.0023869615	0.0000334475
14	Biloxi Bay	-5.02570	-2.56937	0.0000032088	0.0002521034	0.0000420833	0.0024398707	0.0000297855
15	Biloxi Bay	-5.32461	-2.42144	0.0000034717	0.0002272785	0.0000436017	0.0024671255	0.0000244697
16	Biloxi Bay	-4.94014	-2.28270	0.0000034919	0.0002263807	0.0000345881	0.0025860427	0.0000315708
17	Biloxi Bay	-6.38726	-2.72863	0.0000028689	0.0001854895	0.0000369866	0.0024595444	0.0000214441
18	Biloxi Bay	-5.82981	-2.47931	0.0000032866	0.0002350630	0.0000363199	0.0024277891	0.0000241235
19	Biloxi Bay	-5.75615	-2.44176	0.0000029257	0.0002003769	0.0000407874	0.0025915812	0.0000272860
20	Biloxi Bay	-6.28519	-2.08374	0.0000025187	0.0001808939	0.0000504255	0.0025736283	0.0000339097
21	Biloxi Bay	-6.14542	-2.46565	0.0000028274	0.0001701984	0.0000395707	0.0024829632	0.0000262700
22	Biloxi Bay	-4.61783	-1.92353	0.0000029493	0.0002054113	0.0000474819	0.0024847952	0.0000183590
23	Biloxi Bay	-6.53997	-2.37828	0.0000031202	0.0002048514	0.0000471584	0.0023412162	0.0000336403
24	Biloxi Bay	-6.05338	-2.53001	0.0000032575	0.0001991790	0.0000415338	0.0027571601	0.0000355721
28	Horn Island	-2.26138	-1.51179	0.0000036671	0.0001834420	0.0000206753	0.0021974658	0.0000142597
29	Horn Island	-1.56445	-1.40480	0.0000038950	0.0001819812	0.0000151418	0.0022808528	0.0000135700

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
30	Horn Island	-2.76438	-1.58228	0.0000043318	0.0001937849	0.0000152380	0.0025686004	0.0000162682
31	Horn Island	-2.07107	-1.58775	0.0000041186	0.0001841194	0.0000201635	0.0024737555	0.0000195726
32	Horn Island	-1.96460	-1.15268	0.0000041954	0.0001856030	0.0000262580	0.0021558516	0.0000132915
33	Horn Island	-2.29314	-1.48502	0.0000042126	0.0001672479	0.0000197564	0.0023412550	0.0000125360
34	Horn Island	-2.96318	-1.76698	0.0000039775	0.0001724309	0.0000181550	0.0023952670	0.0000178283
35	Horn Island	-2.63213	-1.43395	0.0000041489	0.0001802512	0.0000183011	0.0022104183	0.0000223137
36	Horn Island	-3.23215	-1.54193	0.0000042358	0.0001994348	0.0000148439	0.0025039634	0.0000179212
37	Horn Island	-1.32879	-1.14313	0.0000035423	0.0001900248	0.0000169579	0.0022830622	0.0000149248
38	Horn Island	-2.24881	-1.57199	0.0000039147	0.0001803009	0.0000198024	0.0024916053	0.0000188299
39	Horn Island	-2.04679	-1.51707	0.0000042657	0.0001772921	0.0000188079	0.0025745142	0.0000198704
40	Horn Island	-1.66766	-1.28154	0.0000037330	0.0001590739	0.0000199469	0.0021929486	0.0000143635
41	Horn Island	-2.19898	-1.63291	0.0000036171	0.0001660802	0.0000133450	0.0021303719	0.0000123385
42	Horn Island	-1.31942	-1.48153	0.0000038743	0.0001995018	0.0000198502	0.0022702893	0.0000126109
43	Horn Island	-1.63562	-1.29014	0.0000039832	0.0001686499	0.0000154488	0.0021630988	0.0000129810
44	Horn Island	-2.22793	-1.20024	0.0000048946	0.0002043801	0.0000286224	0.0023684272	0.0000193376
45	Horn Island	-2.45106	-1.52795	0.0000033710	0.0001691451	0.0000218793	0.0021930134	0.0000204662
46	Horn Island	-1.33820	-1.23589	0.0000039406	0.0002097042	0.0000168667	0.0021918760	0.0000161976
47	Horn Island	-1.54596	-1.24456	0.0000037098	0.0001689307	0.0000188642	0.0022458780	0.0000159985
48	Horn Island	-2.95231	-1.30410	0.0000039102	0.0001760585	0.0000257164	0.0020261776	0.0000239971
49	Horn Island	-1.83654	-1.36797	0.0000043477	0.0001703563	0.0000226030	0.0025900467	0.0000200269
50	Horn Island	-1.70684	-1.40961	0.0000043469	0.0001838062	0.0000188281	0.0024884644	0.0000193718
51	Horn Island	-3.07068	-1.34093	0.0000040928	0.0002054678	0.0000303640	0.0022304455	0.0000188506
52	Chandeleur Isl	-1.21248	-1.31232	0.0000045497	0.0001751758	0.0000860707	0.0024159066	0.0000092300
53	Chandeleur Isl	-2.57254	-1.48160	0.0000045006	0.0002343529	0.0000535201	0.0022270237	0.0000097141
54	Chandeleur Isl	-1.98832	-1.42375	0.0000044959	0.0002093743	0.0000568985	0.0021358486	0.0000087184
55	Chandeleur Isl	-1.80417	-1.45931	0.0000046828	0.0001667799	0.0000477282	0.0027134970	0.0000126560
56	Chandeleur Isl	-2.08357	-1.53070	0.0000044622	0.0001829338	0.0000562869	0.0022805229	0.0000100164
57	Chandeleur Isl	-1.91325	-1.32998	0.0000044268	0.0002134722	0.0000418512	0.0019334427	0.0000083847

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
58	Chandeleur Isl	-1.68410	-1.70587	0.0000038006	0.0001684739	0.0000413699	0.0020207510	0.0000081938
59	Chandeleur Isl	-2.12311	-1.29213	0.0000050926	0.0002182564	0.0000549273	0.0027006861	0.0000117213
60	Chandeleur Isl	-2.57411	-1.34485	0.0000050273	0.0002069223	0.0000536670	0.0025252378	0.0000088565
61	Chandeleur Isl	-1.66218	-1.49696	0.0000043783	0.0001777937	0.0000508556	0.0020191543	0.0000086974
62	Chandeleur Isl	-1.68939	-1.46645	0.0000045301	0.0002025778	0.0000532817	0.0023837576	0.0000099050
63	Chandeleur Isl	-1.74760	-1.32037	0.0000044491	0.0002003728	0.0000584755	0.0028228913	0.0000117570
64	Chandeleur Isl	-2.25070	-1.28089	0.0000044487	0.0001962486	0.0000437345	0.0021368372	0.0000097637
65	Chandeleur Isl	-2.26410	-1.44006	0.0000051663	0.0001747566	0.0000517542	0.0024303820	0.0000099593
66	Chandeleur Isl	-1.62470	-1.09668	0.0000050042	0.0001585905	0.0000549244	0.0025653929	0.0000204735
67	Chandeleur Isl	-1.81725	-1.22037	0.0000050095	0.0002037174	0.0001008644	0.0027360719	0.0000198763
68	Chandeleur Isl	-2.51991	-1.14800	0.0000050421	0.0001803048	0.0000476596	0.0023598803	0.0000098864
69	Chandeleur Isl	-1.77468	-1.22575	0.0000049578	0.0001789981	0.0000446246	0.0028117885	0.0000156309
70	Chandeleur Isl	-1.86751	-1.26995	0.0000045842	0.0001854659	0.0000724736	0.0022940787	0.0000136374
71	Chandeleur Isl	-1.85479	-1.27536	0.0000045957	0.0001962202	0.0000392877	0.0027453483	0.0000112573
73	Chandeleur Isl	-2.61331	-1.21766	0.0000045014	0.0001487053	0.0000497208	0.0022420782	0.0000079009
74	Chandeleur Isl	-1.89457	-1.08664	0.0000046486	0.0001772431	0.0000403081	0.0027214121	0.0000118483
75	Chandeleur Isl	-2.24287	-1.35090	0.0000045597	0.0002078005	0.0000504446	0.0020971744	0.0000086503
76	Pascagoula	-5.95825	-3.27133	0.0000026640	0.0002055227	0.0000430287	0.0025001627	0.0000185377
77	Pascagoula	-4.97961	-2.18162	0.0000032214	0.0002335460	0.0000334121	0.0022025435	0.0000086574
78	Pascagoula	-5.58687	-2.22680	0.0000042405	0.0001962783	0.0000441248	0.0022436088	0.0000136897
79	Pascagoula	-6.59234	-3.22270	0.0000030013	0.0002449790	0.0000442616	0.0025448133	0.0000158976
80	Pascagoula	-5.47967	-2.81766	0.0000034390	0.0002064192	0.0000305398	0.0021686997	0.0000110739
81	Pascagoula	-6.15808	-2.88551	0.0000031615	0.0002204435	0.0000345760	0.0022288762	0.0000107409
82	Pascagoula	-5.96833	-3.04088	0.0000034734	0.0002544741	0.0000429861	0.0022215832	0.0000108060
83	Pascagoula	-5.72780	-3.23807	0.0000027701	0.0002083691	0.0000363901	0.0021927330	0.0000105442
84	Pascagoula	-5.47741	-3.06828	0.0000033389	0.0002235248	0.0000361222	0.0019623984	0.0000076214
85	Pascagoula	-6.06119	-3.44603	0.0000028424	0.0002286451	0.0000441810	0.0022711939	0.0000114681
86	Pascagoula	-5.40884	-2.71136	0.0000031584	0.0002087937	0.0000390746	0.0022023047	0.0000125819

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
87	Pascagoula	-5.65303	-3.16460	0.0000028421	0.0002266179	0.0000323143	0.0020782906	0.0000098837
88	Pascagoula	-5.39442	-2.86368	0.0000035235	0.0002293555	0.0000496816	0.0020581767	0.0000102838
89	Pascagoula	-5.96431	-3.16903	0.0000027316	0.0002049978	0.0000379112	0.0023885669	0.0000157482
90	Pascagoula	-6.10176	-2.90061	0.0000032497	0.0002117468	0.0000396584	0.0025568259	0.0000180356
91	Pascagoula	-2.44482	-1.86659	0.0000032495	0.0001985000	0.0000323315	0.0025387536	0.0000365187
92	Pascagoula	-5.85771	-3.49901	0.0000020130	0.0002206096	0.0000457638	0.0023824614	0.0000145969
93	Pascagoula	-5.73121	-3.62109	0.0000020678	0.0002007215	0.0000390185	0.0024522065	0.0000148897
94	Pascagoula	-5.92061	-3.52608	0.0000017050	0.0001848239	0.0000439173	0.0025388521	0.0000132140
95	Pascagoula	-4.89885	-2.61616	0.0000023000	0.0002055791	0.0000336894	0.0023611991	0.0000095325
97	Pascagoula	-5.43743	-2.83598	0.0000029622	0.0002041380	0.0000530604	0.0019921379	0.0000124856
98	Pascagoula	-6.25258	-3.34828	0.0000024974	0.0002196493	0.0000391519	0.0025322372	0.0000156561
99	Pascagoula	-6.22592	-3.44273	0.0000025091	0.0002285256	0.0000393951	0.0025697501	0.0000145345
100	LA Marshes	-4.65476	-0.83371	0.0000037914	0.0001975081	0.0000331726	0.0021041822	0.0000166415
101	LA Marshes	-1.67341	-0.87752	0.0000037380	0.0002046401	0.0000308527	0.0021178792	0.0000188424
102	LA Marshes	-4.12411	-1.58294	0.0000036849	0.0001806494	0.0000358284	0.0022245280	0.0000179673
103	LA Marshes	-3.93601	-1.41263	0.0000031913	0.0001646403	0.0000430463	0.0022582363	0.0000203360
104	LA Marshes	-4.22981	-0.89538	0.0000050804	0.0002200000	0.0000208015	0.0019359377	0.0000238129
105	LA Marshes	-4.48736	-0.93238	0.0000047784	0.0001970234	0.0000240281	0.0019585686	0.0000235572
106	LA Marshes	-4.68961	-1.22291	0.0000043223	0.0001862400	0.0000260935	0.0020026653	0.0000276913
107	LA Marshes	-5.03426	-0.99637	0.0000045204	0.0001786906	0.0000223178	0.0019965696	0.0000268867
108	LA Marshes	-4.52900	-0.88207	0.0000046080	0.0001901010	0.0000245807	0.0019193250	0.0000211335
109	LA Marshes	-4.11867	-0.95745	0.0000044020	0.0002014514	0.0000356105	0.0020042192	0.0000208502
110	LA Marshes	-4.41152	-0.83650	0.0000046508	0.0001991463	0.0000223312	0.0020702163	0.0000245416
111	LA Marshes	-4.66349	-1.02085	0.0000044856	0.0001972988	0.0000232324	0.0019324878	0.0000151094
112	LA Marshes	-4.49654	-1.06728	0.0000043996	0.0001935231	0.0000248545	0.0019313043	0.0000229992
113	LA Marshes	-4.49879	-1.12609	0.0000040058	0.0001885293	0.0000222314	0.0018815792	0.0000117406
114	LA Marshes	-4.60602	-0.89870	0.0000042856	0.0001898529	0.0000312063	0.0020388243	0.0000258379
115	LA Marshes	-4.31625	-0.65973	0.0000038996	0.0001763733	0.0000210845	0.0020503882	0.0000289910

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
116	LA Marshes	-3.75729	-0.87219	0.0000040004	0.0001839507	0.0000285299	0.0021562521	0.0000298440
117	LA Marshes	-3.42180	-0.84795	0.0000035420	0.0001899617	0.0000331881	0.0021828173	0.0000245814
118	LA Marshes	-4.46983	-1.11407	0.0000031103	0.0001278802	0.0000343841	0.0020631921	0.0000229428
119	LA Marshes	-4.47910	-1.01539	0.0000041905	0.0001801581	0.0000259548	0.0020363127	0.0000216174
120	LA Marshes	-4.49200	-0.98138	0.0000043781	0.0001716136	0.0000305054	0.0020817116	0.0000361134
121	LA Marshes	-4.50072	-0.84224	0.0000044861	0.0002111156	0.0000323667	0.0022107434	0.0000413185
122	LA Marshes	-4.38392	-1.04292	0.0000033310	0.0001566073	0.0000320039	0.0021759011	0.0000279084
123	LA Marshes	-4.21857	-0.78853	0.0000031371	0.0001602233	0.0000308700	0.0024190002	0.0000206517
124	St. Louis Bay	-5.94031	-1.86753	0.0000023605	0.0002137034	0.0000656698	0.0024380442	0.0000228885
125	St. Louis Bay	-6.13917	-2.02181	0.0000032257	0.0001870979	0.0000641866	0.0023981477	0.0000852733
131	St. Louis Bay	-6.23553	-1.73647	0.0000042969	0.0002730000	0.0000724243	0.0023130266	0.0000645347
133	St. Louis Bay	-6.63637	-1.93021	0.0000045854	0.0003570000	0.0000649531	0.0021293064	0.0000433087
140	St. Louis Bay	-6.65781	-2.12442	0.0000039088	0.0002479438	0.0000677618	0.0023709564	0.0000609018
141	St. Louis Bay	-6.78510	-2.32620	0.0000034926	0.0002061081	0.0000731089	0.0023432871	0.0000688944
142	St. Louis Bay	-4.94425	-1.44388	0.0000049171	0.0002550000	0.0000823661	0.0022052798	0.0000293062
144	St. Louis Bay	-5.09602	-1.51053	0.0000048678	0.0002520000	0.0000550195	0.0022704206	0.0000223313
145	St. Louis Bay	-4.82182	-1.47194	0.0000048156	0.0002290000	0.0000640057	0.0022477143	0.0000201459
146	St. Louis Bay	-5.05660	-1.64365	0.0000040907	0.0002436272	0.0000768387	0.0022459510	0.0000278556
147	St. Louis Bay	-5.21590	-1.55294	0.0000042193	0.0001954167	0.0000750123	0.0023590572	0.0000203633
148	Cat Island	-5.05629	-1.73661	0.0000043883	0.0002206475	0.0000384621	0.0026131475	0.0000378579
149	Cat Island	-5.63416	-1.75402	0.0000041254	0.0001964278	0.0000327157	0.0023050200	0.0000342490
150	Cat Island	-4.91595	-1.77827	0.0000041026	0.0001858440	0.0000386373	0.0025438063	0.0000369023
151	Cat Island	-4.30463	-1.83170	0.0000037008	0.0001915733	0.0000448518	0.0023230594	0.0000282378
152	Cat Island	-5.31449	-1.83689	0.0000040871	0.0002139437	0.0000465737	0.0024067615	0.0000341666
153	Cat Island	-5.48639	-1.76344	0.0000036781	0.0001944331	0.0000289801	0.0024269015	0.0000364917
154	Cat Island	-4.47830	-1.75204	0.0000044538	0.0002017176	0.0000333245	0.0025755908	0.0000355918
155	Cat Island	-2.93551	-1.78731	0.0000031865	0.0001898833	0.0000371953	0.0023663412	0.0000199731
156	Cat Island	-4.40085	-1.66639	0.0000040872	0.0002009313	0.0000286996	0.0023730305	0.0000379706

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
157	Cat Island	-4.97938	-1.65977	0.0000046973	0.0002327745	0.0000404587	0.0026491705	0.0000409871
158	Cat Island	-3.58722	-1.89912	0.0000041688	0.0002010904	0.0000341400	0.0024144403	0.0000232417
159	Cat Island	-4.37448	-1.75383	0.0000039916	0.0001945317	0.0000459333	0.0024497187	0.0000272146
160	Cat Island	-4.75680	-1.83358	0.0000043087	0.0002094108	0.0000273372	0.0024999863	0.0000357475
161	Cat Island	-4.87858	-1.79204	0.0000041253	0.0002254345	0.0000337407	0.0024554677	0.0000378167
162	Cat Island	-4.92526	-1.70508	0.0000039263	0.0002221291	0.0000286711	0.0023725062	0.0000345842
163	Cat Island	-4.78401	-1.77559	0.0000045405	0.0002288760	0.0000239549	0.0024523016	0.0000352664
164	Cat Island	-4.54020	-1.75811	0.0000037807	0.0002174662	0.0000300880	0.0024934929	0.0000374054
165	Cat Island	-4.72731	-1.75105	0.0000042085	0.0002071477	0.0000288688	0.0024233478	0.0000359631
166	Cat Island	-4.43243	-1.76000	0.0000040399	0.0001890457	0.0000265377	0.0026752842	0.0000377995
167	Cat Island	-4.94078	-1.86813	0.0000043047	0.0002312653	0.0000277584	0.0025052125	0.0000366683
168	Cat Island	-4.56540	-1.73584	0.0000038754	0.0002027456	0.0000239893	0.0024890230	0.0000411879
169	Cat Island	-4.65863	-1.48250	0.0000038435	0.0002294863	0.0000273351	0.0026263697	0.0000452410
170	Cat Island	-4.76414	-1.78828	0.0000039137	0.0002142501	0.0000248688	0.0023437141	0.0000292354
171	Cat Island	-4.41834	-1.72384	0.0000040621	0.0002304240	0.0000231752	0.0023591554	0.0000333921
172	Pearl River	-6.24683	-2.34806	0.0000029500	0.0001879889	0.0000765472	0.0022643458	0.0000231658
173	Pearl River	-5.88872	-2.08042	0.0000034996	0.0002411268	0.0000855516	0.0024252459	0.0000345475
174	Pearl River	-4.82427	-1.99587	0.0000025028	0.0002102769	0.0000779506	0.0022400749	0.0000236553
175	Pearl River	-5.75111	-1.81463	0.0000029940	0.0001938166	0.0000645171	0.0021040218	0.0000444203
176	Pearl River	-5.87664	-1.99112	0.0000033347	0.0002430000	0.0000628839	0.0020845387	0.0000426184
177	Pearl River	-5.17143	-1.83379	0.0000028440	0.0002051416	0.0000429129	0.0018859931	0.0000312390
178	Pearl River	-6.17144	-1.94286	0.0000035108	0.0002663194	0.0000605293	0.0020121040	0.0000428270
179	Pearl River	-3.47812	-1.45959	0.0000028246	0.0002245552	0.0000273702	0.0022489495	0.0000189735
180	Pearl River	-3.71540	-1.73624	0.0000024649	0.0001476225	0.0000335895	0.0020850215	0.0000219155
181	Pearl River	-6.82202	-2.76458	0.0000015285	0.0001971651	0.0000787082	0.0022682175	0.0000266053
182	Pearl River	-4.98576	-1.92538	0.0000022571	0.0001620443	0.0000397921	0.0022924597	0.0000305813
183	Pearl River	-5.07936	-2.04959	0.0000023022	0.0001785203	0.0000537488	0.0023157332	0.0000246523
184	Pearl River	-3.58192	-2.03742	0.0000023431	0.0002135975	0.0000408226	0.0022145084	0.0000289017

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
185	Pearl River	-4.22571	-1.77914	0.0000021425	0.0001676663	0.0000442223	0.0023332017	0.0000210636
186	Pearl River	-6.02914	-2.69720	0.0000015997	0.0001582637	0.0000557231	0.0023380032	0.0000357052
187	Pearl River	-4.28962	-1.70416	0.0000023539	0.0001769408	0.0000413534	0.0022467567	0.0000238325
188	Pearl River	-4.00328	-1.92705	0.0000020327	0.0001675671	0.0000301755	0.0023815752	0.0000266775
189	Pearl River	-5.48629	-2.37641	0.0000023361	0.0001774727	0.0000357839	0.0022252173	0.0000251753
190	Pearl River	-5.29118	-1.80240	0.0000021061	0.0001677642	0.0000435797	0.0023215087	0.0000262786
191	Pearl River	-3.52054	-1.94625	0.0000022215	0.0001874353	0.0000510906	0.0021858757	0.0000252738
192	Pearl River	-4.51118	-2.07021	0.0000020326	0.0001617585	0.0000332343	0.0020773657	0.0000181436
193	Pearl River	-4.79699	-1.86986	0.0000019503	0.0001764831	0.0000494871	0.0022905638	0.0000244876
194	Pearl River	-5.47368	-1.81649	0.0000022474	0.0001727533	0.0000448593	0.0022663379	0.0000214990
195	Pearl River	-5.23823	-1.72638	0.0000022711	0.0001741950	0.0000583146	0.0020018079	0.0000191851
196	Grand Bay	-3.83059	-1.31232	0.0000037641	0.0001530226	0.0000316328	0.0022936660	0.0000092511
197	Grand Bay	-4.06043	-1.71243	0.0000033029	0.0001792988	0.0000594168	0.0022663717	0.0000082507
198	Grand Bay	-3.21129	-1.51953	0.0000034102	0.0001877041	0.0000288061	0.0024339070	0.0000126693
199	Grand Bay	-5.86059	-1.88487	0.0000039370	0.0001587367	0.0000418949	0.0023836657	0.0000066106
200	Grand Bay	-4.83593	-1.61939	0.0000038474	0.0001641187	0.0000455099	0.0023836397	0.0000076342
201	Grand Bay	-5.07308	-1.84384	0.0000039384	0.0001670235	0.0000388598	0.0021707763	0.0000062298
202	Grand Bay	-5.36225	-1.75496	0.0000033630	0.0001311095	0.0000342579	0.0022427736	0.0000050059
203	Grand Bay	-5.30766	-1.67356	0.0000037245	0.0001655398	0.0000380879	0.0022158715	0.0000060366
204	Grand Bay	-4.69417	-1.62440	0.0000037212	0.0001469379	0.0000283758	0.0022385572	0.0000062303
205	Grand Bay	-5.60847	-1.79157	0.0000037413	0.0001406072	0.0000476633	0.0023343064	0.0000060238
206	Grand Bay	-4.90619	-1.99877	0.0000028892	0.0001251391	0.0000617536	0.0023293389	0.0000064789
207	Grand Bay	-4.35629	-1.61309	0.0000033506	0.0001569128	0.0000425573	0.0022207982	0.0000060873
208	Grand Bay	-5.37657	-1.94546	0.0000027012	0.0001223597	0.0000443065	0.0022339048	0.0000074032
209	Grand Bay	-4.03486	-1.82988	0.0000040705	0.0001797908	0.0000400466	0.0019648116	0.0000058683
210	Grand Bay	-4.85871	-1.63531	0.0000043607	0.0002166314	0.0000572109	0.0023034644	0.0000092489
211	Grand Bay	-4.89634	-1.65974	0.0000043274	0.0001785682	0.0000371823	0.0021340521	0.0000080153
212	Grand Bay	-3.96044	-1.56512	0.0000037335	0.0001552868	0.0000315043	0.0023981110	0.0000087646

Appendix 1 continued.

Spec #	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
213	Grand Bay	-5.43334	-1.59732	0.0000039910	0.0001687311	0.0000377263	0.0022027125	0.0000081696
214	Grand Bay	-4.70133	-1.86911	0.0000039533	0.0001757554	0.0000465911	0.0022846054	0.0000076510
215	Grand Bay	-4.63397	-1.57416	0.0000038725	0.0001882664	0.0000396625	0.0023968295	0.0000100401
216	Grand Bay	-4.01818	-1.66476	0.0000037783	0.0001673193	0.0000290774	0.0020752296	0.0000061920
217	Grand Bay	-4.21304	-1.74361	0.0000038066	0.0001545280	0.0000402720	0.0021877732	0.0000078542
218	Grand Bay	-3.48046	-1.52066	0.0000041476	0.0001854967	0.0000320132	0.0021863299	0.0000089129
219	Grand Bay	-4.23354	-1.71476	0.0000035432	0.0001709564	0.0000598529	0.0019981254	0.0000057411

Appendix 2. Collection location and ages of adult spotted seatrout collected in 2004. Specimens with parenthesized specimen numbers were used for otolith analyses.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Biloxi Bay (Front Beach)	4/27/04	401(1)	3	519	F
"	5/5/04	402	2	416	F
"	5/5/04	403(2)	3	503	F
"	5/5/04	404	deformed	460	F
"	5/5/04	405	4	515	F
"	5/5/04	406(3)	3	511	F
"	5/5/04	407	4	609	F
Biloxi Bay (Point Cadet)	4/5/04	408(4)	3	478	F
"	4/5/04	409	4	570	F
"	4/5/04	410	2	402	F
"	4/5/04	411	2	422	F
"	4/5/04	412	5	660	F
Biloxi Bay (East Beach)	4/30/04	413(5)	3	500	F
"	4/30/04	414	4	560	F
"	4/30/04	415	2	400	U
"	4/30/04	416(6)	3	530	F
"	5/3/04	417	2	409	F
"	5/3/04	418	2	404	F
"	5/3/04	419(7)	3	483	F
Biloxi Bay (Point Cadet)	5/4/04	420	2	392	F
"	5/4/04	421	deformed	490	F
"	5/4/04	422	2	462	F
Biloxi Bay (East Beach)	4/5/04	423(8)	3	522	U
"	4/5/04	424(9)	3	523	M
"	4/5/04	425(10)	3	449	M

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Biloxi Bay (East Beach)	4/5/04	426	2	438	M
"	4/5/04	427	2	392	M
"	4/5/04	428	2	407	M
Chandeleur	8/8/04	429	2	385	M
"	8/8/04	430	2	390	M
"	8/8/04	431	4	640	F
"	8/8/04	432(11)	3	530	F
"	8/8/04	433(12)	3	477	F
"	8/8/04	434	2	402	M
"	8/8/04	435(13)	3	545	F
"	8/8/04	436(14)	3	500	F
"	8/8/04	437(15)	3	488	F
"	8/8/04	438(16)	3	504	F
"	8/8/04	439(17)	3	495	F
"	8/8/04	440(18)	3	420	M
"	8/8/04	441	2	431	F
"	8/8/04	442(19)	3	570	M
"	8/8/04	443	2	400	M
"	8/8/04	444(20)	3	493	F
"	8/8/04	445(21)	3	514	F
Chandeleur (3 miles north)	8/28/04	446	2	417	F
"	8/28/04	447	2	396	F
"	8/28/04	448	1	425	M
"	8/28/04	449	2	412	F
"	8/28/04	450	2	428	F
"	8/28/04	451	1	388	M
"	8/28/04	452	2	427	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Chandeleur	8/28/04	453	2	410	F
"	8/28/04	454	2	392	M
"	8/28/04	455	2	421	M
Horn Island (south side)	8/28/04	456	2	420	F
"	7/21/04	457(22)	2	380	F
"	7/21/04	458	4	396	M
"	7/21/04	459(23)	2	403	F
"	7/21/04	460(24)	2	384	F
"	7/21/04	461(25)	3	407	M
"	7/21/04	462	4	402	M
"	7/21/04	463(26)	2	427	F
"	7/21/04	464	deformed	554	F
Horn Island (north side in grass beds)	7/21/04	465(27)	3	483	F
"	7/21/04	466(28)	2	423	F
"	7/21/04	467(29)	2	424	F
Petit Bois Island (east end)	9/11/04	468	1	446	F
"	9/11/04	469	2	393	F
Mouth of Graveline	9/19/04	470	2	390	F
"	9/19/04	471	2	427	F
"	9/19/04	472	2	410	F
"	9/19/04	473	2	446	F
"	9/19/04	474	2	425	F
"	9/19/04	475	2	449	F
Horn Island (south side)	6/6/04	476	4	577	U
"	6/6/04	477(30)	2	385	U
"	6/6/04	478	2	390	U
"	5/21/04	479	2	heads only	U

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Horn Island (south side)	5/21/04	480(31)	3	"	U
"	5/21/04	481	2	"	U
"	5/21/04	482(32)	3	"	U
"	5/21/04	483(33)	3	"	U
"	5/21/04	484(34)	3	"	U
"	5/21/04	485	2	"	U
"	5/21/04	486(35)	3	"	U
"	5/21/04	487	4	"	U
"	5/21/04	488	2	"	U
"	5/21/04	489	4	"	U
"	5/21/04	490	2	"	U
"	5/21/04	491	2	"	U
"	5/21/04	492	2	"	U
"	5/21/04	493(36)	3	"	U
Biloxi Bay (East Beach)	4/6/04	494	2	450	F
"	3/23/04	495(37)	3	530	F
"	3/25/04	496(38)	3	495	F
"	3/25/04	497(39)	3	433	F
Horn Island	6/22/04	498	4	612	F
"	6/22/04	499(40)	3	516	F
"	6/22/04	4100(41)	2	428	F
"	6/22/04	4101	4	411	M
"	6/22/04	4102	4	570	F
Chandeleur	10/3/04	4103(42)	3	446	M
"	10/3/04	4104	2	490	M
"	10/3/04	4105(43)	3	410	M
"	10/3/04	4106	2	540	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Chandeleur	10/3/04	4107	2	490	F
"	10/3/04	4108	2	430	F
"	10/3/04	4109	1	433	F
Biloxi Bay (mouth Davis Bayou)	10/18/04	4110	2	443	F
Pascagoula	10/22/04	4111	1	413	U
"	10/22/04	4112(44)	2	431	F
"	10/22/04	4113(45)	2	420	U
"	10/22/04	4114(46)	2	407	U
"	10/22/04	4115(47)	2	411	F
"	10/22/04	4116(48)	2	413	U
"	10/13/04	4117(49)	2	436	U
"	10/13/04	4118	1	421	U
"	10/13/04	4119(50)	2	424	F
"	10/5/04	4120	1	410	F
"	10/5/04	4121(51)	2	400	U
"	10/5/04	4122(52)	2	405	U
"	10/5/04	4123	1	410	F
"	10/5/04	4124	1	390	U
"	10/5/04	4125(53)	2	429	U
"	10/5/04	4126(54)	2	396	U
"	10/15/04	4127(55)	2	411	U
"	10/15/04	4128(56)	2	408	U
"	10/15/04	4129(57)	2	415	F
"	10/15/04	4130	1	396	U
Grand Bay	10/26/04	4131(58)	1	348	F
"	10/26/04	4132(59)	2	336	M
"	10/26/04	4133(60)	1	356	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Grand Bay	10/26/04	4134(61)	2	479	F
"	10/26/04	4135(62)	1	415	F
"	10/26/04	4136(63)	1	355	F
"	10/26/04	4137(64)	1	380	F
"	10/26/04	4138	1	392	F
"	10/26/04	4139(65)	1	383	F
"	10/26/04	4140(66)	2	338	M
"	10/26/04	4141(67)	2	414	F
Biloxi Bay (Point cadet)	10/28/04	4142	2	447	F
"	10/28/04	4143	2	505	F
"	10/28/04	4144	2	447	F
"	10/28/04	4145	2	417	F
"	10/28/04	4146	1	394	F
"	10/28/04	4147	2	435	F
"	10/28/04	4148	2	412	F
"	10/28/04	4149	2	411	F
"	10/28/04	4150	2	424	F
Biloxi Bay (East Beach)	10/28/04	4151	deformed	436	F
"	10/28/04	4152	2	466	F
Biloxi Bay (Point cadet)	10/25/04	4153	2	447	F
"	10/25/04	4154	2	426	F
"	10/25/04	4155	2	454	F
"	10/25/04	4156(68)	3	411	M
Horn Island (north side in grass beds)	10/18/04	4157(69)	2	505	F
LA Marshes	10/23/04	4158(70)	2	423	F
"	10/23/04	4159(71)	2	431	F
"	10/23/04	4160(72)	2	390	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
LA Marshes	10/23/04	4161(73)	2	432	F
Horn Island	10/31/04	4162	2	464	F
"	10/31/04	4163(74)	3	523	U
"	10/31/04	4164	2	417	F
"	10/31/04	4165	1	422	F
"	10/31/04	4166	2	415	U
"	10/31/04	4167	4	524	M
"	10/31/04	4168	1	402	F
"	10/31/04	4169	1	502	F
"	10/31/04	4170	1	425	F
"	10/31/04	4171	1	400	F
"	10/31/04	4172	2	415	U
"	10/31/04	4173	1	426	F
"	10/31/04	4174	2	415	F
"	10/31/04	4175	4	488	M
Biloxi Bay (mouth Davis Bayou)	10/25/04	4176	2	396	U
"	10/28/04	4177	1	375	F
Freemason Island	10/16/04	4178	2	470	U
"	10/16/04	4179	2	460	U
"	10/16/04	4180	2	440	U
"	10/16/04	4181	1	418	U
"	10/16/04	4182	2	435	U
"	10/16/04	4183	2	440	U
"	10/16/04	4184	2	462	U
"	10/16/04	4185	2	445	U
"	10/16/04	4186	1	410	U
"	10/16/04	4187	2	402	U

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Freemason Island	10/16/04	4188(75)	3	468	U
"	10/16/04	4189	1	465	U
Pearl River	11/5/04	4190(76)	2	323	M
"	11/5/04	4191(77)	2	449	F
"	11/5/04	4192(78)	2	358	F
"	11/5/04	4193	1	350	F
"	11/5/04	4194	1	344	F
"	11/5/04	4195	1	353	F
"	11/5/04	4196	1	330	F
"	11/5/04	4197(79)	2	373	F
"	11/5/04	4198	1	365	F
"	11/5/04	4199	1	308	F
"	11/5/04	4200(80)	2	313	M
"	11/5/04	4201	1	281	U
"	11/5/04	4202	1	394	F
"	11/5/04	4203	1	334	F
"	11/5/04	4204	1	352	F
"	11/5/04	4205(81)	3	460	M
"	11/5/04	4206(82)	2	337	F
Biloxi Bay (Deer Island)	10/30/04	4207	2	508	F
"	10/30/04	4208	2	552	F
Biloxi Bay (Front Beach)	11/16/04	4209(83)	3	560	F
Biloxi Bay (Point cadet)	11/16/04	4210	2	528	F
"	11/16/04	4211	2	537	F
"	11/16/04	4212	2	516	F
Biloxi Bay (Front Beach)	11/16/04	4213	2	473	F
"	11/16/04	4214	lost	448	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Biloxi Bay (Front Beach)	11/16/04	4215	2	437	F
	11/16/04	4216	2	450	F
	11/16/04	4217	2	462	F
	11/16/04	4218	2	483	F
	11/16/04	4219	2	445	F
	11/16/04	4220	2	453	F
	11/16/04	4221	2	450	F
	11/16/04	4222	2	461	F
	11/16/04	4223	2	460	F
	11/16/04	4224	2	457	F
	11/16/04	4225	2	463	F
	11/16/04	4226	2	482	F
	11/16/04	4227	2	429	F
	11/16/04	4228	2	470	F
	11/16/04	4229(84)	3	548	F
	11/16/04	4230	2	515	F
	11/1/04	4231(85)	3	417	M
	11/1/04	4232(86)	2	455	F
	11/1/04	4233(87)	2	390	F
	11/1/04	4234(88)	2	430	F
	11/1/04	4235(89)	2	356	F
Pearl River	11/1/04	4236	1	388	F
	11/1/04	4237	1	352	F
	11/1/04	4238	1	360	F
	11/1/04	4239	1	352	F
	11/1/04	4240	1	370	F
	11/1/04	4241	1	378	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Pearl River	11/1/04	4242	1	385	F
"	11/1/04	4243(90)	2	437	F
"	11/1/04	4244	1	376	U
"	11/1/04	4245(91)	2	400	F
"	11/1/04	4246	2	367	F
"	11/1/04	4247	2	419	F
"	11/1/04	4248	1	363	U
"	11/1/04	4249	2	383	F
"	11/1/04	4250	1	363	F
"	11/1/04	4251	1	365	F
"	11/1/04	4252	2	360	F
"	11/1/04	4253	2	418	F
"	11/1/04	4254	1	381	F
"	11/1/04	4255	1	377	F
"	11/1/04	4256	2	416	F
"	11/1/04	4257	2	380	F
"	11/1/04	4258	1	372	F
"	11/1/04	4259	2	410	F
"	11/1/04	4260	2	375	F
"	11/1/04	4261	1	406	F
"	11/1/04	4262	2	437	F
"	11/1/04	4263	4	426	M
Grand Bay	11/20/04	4264(92)	1	405	F
"	11/20/04	4265(93)	2	377	F
"	11/20/04	4266	1	385	F
"	11/20/04	4267(94)	2	400	F
"	11/20/04	4268(95)	3	346	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Grand Bay	11/20/04	4269(96)	1	408	F
Cat Island	11/22/04	4270(97)	2	335	M
"	11/22/04	4271(98)	2	370	M
"	11/22/04	4272(99)	2	364	M
"	11/22/04	4273(100)	3	389	M
"	11/22/04	4274	1	311	M
"	11/22/04	4275(101)	2	381	F
"	11/22/04	4276	1	403	F
"	11/22/04	4277(102)	2	395	F
"	11/22/04	4278(103)	2	474	F
"	11/22/04	4279	1	415	F
"	11/22/04	4280(104)	2	373	F
"	11/22/04	4281	1	396	F
"	11/22/04	4282	1	342	F
"	11/22/04	4283(105)	2	410	F
"	11/22/04	4284(106)	3	380	M
"	11/22/04	4285	1	421	F
"	11/22/04	4286	deformed	452	F
"	11/22/04	4287	1	402	F
"	11/22/04	4288	deformed	324	M
"	11/22/04	4289	1	392	F
"	11/22/04	4290	otoliths	348	M
"	11/22/04	4291	not	389	U
"	11/22/04	4292	properly	391	F
"	11/22/04	4293	embedded	344	M
"	11/22/04	4294	in	364	F
"	11/22/04	4295	resin	370	F

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
Cat Island	11/22/04	4296(107)	2	447	M
"	11/22/04	4297(108)	3	542	F
Gulfport	5/15/04	4298	4	453	M
"	5/15/04	4299	2	426	F
"	5/15/04	4300(109)	3	560	F
"	5/15/04	4301(110)	3	540	F
"	5/15/04	4302	2	425	F
"	5/15/04	4303(111)	3	540	U
Cat Island	5/15/04	4304(112)	3	491	F
"	5/15/04	4305(113)	2	382	F
Long Beach	5/15/04	4306	2	438	F
"	5/15/04	4307	2	395	F
Bayou Caddy	12/20/04	4308	deformed	heads only	U
"	12/20/04	4309	2	"	U
"	12/20/04	4310	1	"	U
"	12/20/04	4311	1	"	U
"	12/20/04	4312	1	"	U
"	12/20/04	4313	1	"	U
"	12/20/04	4314	1	"	U
"	12/20/04	4315	1	"	U
"	12/20/04	4316	1	"	U
"	1/3/04	4317	1	"	U
"	1/3/04	4318	2	"	U
St. Louis Bay (Jordan River)	12/26/04	4319	2	"	U
"	12/26/04	4320	2	"	U
"	12/26/04	4321	2	"	U
"	12/26/04	4322		"	U

Appendix 2 Continued.

Location	Date	Specimen #	AGE	TL (mm)	Sex (U=undetermined)
St. Louis Bay (Jordan River)	12/26/04	4323	2	"	U
"	12/26/04	4324	1	"	U
"	12/26/04	4325	2	"	U
"	12/26/04	4326	2	"	U
"	12/27/04	4327	1	"	U
"	12/27/04	4328	2	"	U
"	12/27/04	4329	1	"	U
"	12/27/04	4330	1	"	U
"	12/27/04	4331	2	"	U
"	12/27/04	4332	2	"	U
Bayou Arcadia	12/20/04	4333	1	384	U
"	12/20/04	4334	2	445	U
"	12/20/04	4335	1	384	U
"	12/20/04	4336	2	403	U
Bayou Delisle	1/16/04	4337	2	387	U
"	1/17/04	4338	2	400	U
St. Louis Bay (Wolf River)	1/10/04	4339	2	381	U

Appendix 3. Molar concentrations of otolith microchemical variables (standardized by molar calcium concentrations), and stable isotope ratios of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ in otolith cores of adult *Cynoscion nebulosus* collected in the northcentral Gulf of Mexico.

Spec #	Age/Yr. Collected	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
1	3/04	Biloxi Bay	-4.55884	-1.59912	0.0000014814	0.0001239	0.00002561	0.002196	0.00002518
2	3/04	Biloxi Bay	-3.67361	-2.71236	0.0000026289	0.0001585	0.00002649	0.001721	0.00000640
3	3/04	Biloxi Bay	-7.36800	-2.75928	0.0000012398	0.0001304	0.00002678	0.002560	0.00002009
4	3/04	Biloxi Bay	-5.17998	-1.05651	0.0000024521	0.0001373	0.00001384	0.001949	0.00001064
5	3/04	Biloxi Bay	-7.98414	-4.63395	0.0000010028	0.0001707	0.00008366	0.002509	0.00003348
6	3/04	Biloxi Bay	-1.96885	-0.36151	0.0000034366	0.0001042	0.00003887	0.001874	0.00000761
7	3/04	Biloxi Bay	-7.54296	-2.99424	0.0000014524	0.0001134	0.00002838	0.002367	0.00001525
8	3/04	Biloxi Bay	-8.63646	-4.01857	0.0000008139	0.0001319	0.00001959	0.002481	0.00003244
10	3/04	Biloxi Bay	-5.12001	-2.87038	0.0000015620	0.0001317	0.00003506	0.002643	0.00001425
11	3/04	Chandeleur Isle	-2.40939	-1.76028	0.0000033221	0.0001454	0.00007665	0.002159	0.00000754
12	3/04	Chandeleur Isle	-5.96620	-2.63003	0.0000009227	0.0001081	0.00003275	0.002514	0.00005002
13	3/04	Chandeleur Isle	-2.43179	-2.16500	0.0000032867	0.0001468	0.00006306	0.002113	0.00001426
14	3/04	Chandeleur Isle	-0.83710	-1.79135	0.0000033152	0.0001563	0.00008676	0.002021	0.00000767
15	3/04	Chandeleur Isle	-1.63297	-0.54227	0.0000038239	0.0001120	0.00005224	0.001818	0.00000606
16	3/04	Chandeleur Isle	-0.90468	-0.33820	0.0000029845	0.0001175	0.00004683	0.002162	0.00000890
17	3/04	Chandeleur Isle	-1.76933	-1.49667	0.0000030264	0.0001224	0.00006606	0.002154	0.00000826
18	3/04	Chandeleur Isle	-2.19173	-0.49983	0.0000037000	0.0001428	0.00004793	0.001862	0.00000679
19	3/04	Chandeleur Isle	-0.48942	-2.29184	0.0000016427	0.0000524	0.00000490	0.001995	0.00000295
20	3/04	Chandeleur Isle	-3.11181	-2.54457	0.0000025303	0.0001498	0.00003068	0.001940	0.00001380
21	3/04	Chandeleur Isle	-2.91386	-2.76810	0.0000023862	0.0001697	0.00005221	0.002095	0.00002116
22	2/04	Horn Island	-7.76082	-3.86115	0.0000017473	0.0001625	0.00004166	0.002186	0.00001502
23	2/04	Horn Island	-5.14471	-3.09902	0.0000024811	0.0001686	0.00001481	0.001873	0.00000523
24	2/04	Horn Island	-2.36985	-1.87125	0.0000034030	0.0001738	0.00007667	0.002048	0.00000739
25	3/04	Horn Island	-7.82201	-2.96011	0.0000013532	0.0001181	0.00002204	0.002221	0.00001581
26	2/04	Horn Island	-5.83151	-4.41405	0.0000008536	0.0001426	0.00009246	0.001991	0.00006966
27	3/04	Horn Island	-8.30017	-4.48864	0.0000011026	0.0001593	0.00005624	0.002347	0.00002391
28	2/04	Horn Island	-2.59075	-2.59620	0.0000032294	0.0001802	0.00010126	0.002020	0.00000702
29	2/04	Horn Island	-6.75518	-3.70547	0.0000015518	0.0001711	0.00002746	0.002589	0.00001966
30	2/04	Horn Island	-3.52175	-2.28749	0.0000024259	0.0001896	0.00002508	0.001852	0.00001265
31	3/04	Horn Island	-2.56231	-2.58513	0.0000032107	0.0001548	0.00004012	0.001749	0.00000744

Appendix 3 continued.

Spec #	Age/Yr. Collected	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
32	3/04	Horn Island	-7.52426	-3.80642	0.0000021897	0.0001361	0.00005317	0.001861	0.00002002
33	3/04	Horn Island	-6.51884	-3.97733	0.0000015557	0.0001466	0.00008418	0.002455	0.00001732
34	3/04	Horn Island	-5.47056	-1.73129	0.0000028490	0.0001288	0.00001975	0.002296	0.00000786
35	3/04	Horn Island	-0.16484	-2.04154	0.0000029429	0.0001422	0.00005133	0.001978	0.00001156
36	3/04	Horn Island	-4.07866	-2.66939	0.0000028175	0.0001523	0.00004008	0.001804	0.00001064
37	3/04	Biloxi Bay	-6.19473	-3.57160	0.0000011374	0.0001650	0.00003155	0.002073	0.00000912
38	3/04	Biloxi Bay	-4.23025	-2.19144	0.0000014307	0.0001249	0.00002010	0.001837	0.00001558
39	3/04	Biloxi Bay	-6.64529	-3.18013	0.0000014129	0.0001069	0.00002486	0.002238	0.00001695
40	3/04	Horn Island	-2.29604	-2.35957	0.0000032469	0.0001710	0.00003815	0.002029	0.00001068
41	2/04	Horn Island	-7.60865	-2.82787	0.0000004952	0.0001448	0.00010120	0.002327	0.00004948
42	3/04	Chandeleur Isle	-0.78071	-2.50462	0.0000030754	0.0001380	0.00003466	0.002140	0.00000809
43	3/04	Chandeleur Isle	-3.51956	-2.80478	0.0000009949	0.0001491	0.00008860	0.002197	0.00008055
44	2/04	Pascagoula	-6.62975	-2.20237	0.0000028895	0.0001659	0.00002616	0.001968	0.00000741
45	2/04	Pascagoula	-8.64904	-4.17175	0.0000010399	0.0001040	0.00002056	0.002251	0.00001467
46	2/04	Pascagoula	-7.85133	-2.51100	0.0000006660	0.0001574	0.00007644	0.002344	0.00006090
47	2/04	Pascagoula	-2.59767	-1.79160	0.0000033520	0.0001737	0.00006141	0.001982	0.00000634
48	2/04	Pascagoula	-8.08351	-3.64785	0.0000016597	0.0001275	0.00002893	0.002054	0.00000618
49	2/04	Pascagoula	-7.08048	-2.63976	0.0000015303	0.0001241	0.00003442	0.002018	0.00001380
50	2/04	Pascagoula	-7.33965	-3.59120	0.0000014519	0.0001805	0.00003775	0.001885	0.00000634
51	2/04	Pascagoula	-7.70892	-3.58826	0.0000016352	0.0001126	0.00002609	0.001898	0.00000762
52	2/04	Pascagoula	-6.97468	-2.57791	0.0000009909	0.0001575	0.00007383	0.002318	0.00004468
53	2/04	Pascagoula	-6.64765	-3.73146	0.0000019235	0.0001946	0.00004847	0.002433	0.00001120
54	2/04	Pascagoula	-7.45570	-3.98301	0.0000010313	0.0001323	0.00003270	0.002191	0.00001007
55	2/04	Pascagoula	-9.76048	-4.36614	0.0000010732	0.0001789	0.00004578	0.002365	0.00001641
56	2/04	Pascagoula	-3.20789	-2.48412	0.0000014243	0.0001290	0.00006570	0.001910	0.00001435
57	2/04	Pascagoula	-7.34997	-4.07526	0.0000013877	0.0001288	0.00002230	0.002563	0.00001220
58	1/04	Grand Bay	-3.35745	3.07286	0.0000025792	0.0001510	0.00001584	0.002067	0.00000831
59	2/04	Grand Bay	-4.60439	-2.24413	0.0000025532	0.0001506	0.00003687	0.002194	0.00001459
61	2/04	Grand Bay	-6.55829	-2.68009	0.0000023105	0.0001537	0.00001290	0.001837	0.00000379
62	1/04	Grand Bay	-6.65351	-2.54665	0.0000021849	0.0001101	0.00001923	0.001945	0.00000634
63	1/04	Grand Bay	-8.31548	-2.75944	0.0000020493	0.0001384	0.00002554	0.001753	0.00000434

Appendix 3 continued.

Spec #	Age/Yr. Collected	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
64	1/04	Grand Bay	-5.41696	-2.48093	0.0000027716	0.0001434	0.00002629	0.002117	0.00000943
65	1/04	Grand Bay	-8.50706	-3.44823	0.0000018405	0.0001063	0.00001665	0.001914	0.00000564
66	2/04	Grand Bay	-3.50421	-1.77714	0.0000026016	0.0001541	0.00007231	0.002285	0.00000495
67	2/04	Grand Bay	-6.50318	-2.39844	0.0000014959	0.0001076	0.00002340	0.001967	0.00000569
68	3/04	Biloxi Bay	-4.02892	-2.05422	0.0000010207	0.0001479	0.00003532	0.002381	0.00004784
69	2/04	Horn Island	-2.61563	-2.27301	0.0000030614	0.0001529	0.00003290	0.002126	0.00000771
70	2/04	LA Marshes	-3.74355	-2.05757	0.0000022148	0.0001286	0.00003451	0.001936	0.00000981
71	2/04	LA Marshes	-3.96488	-2.52043	0.0000027374	0.0001387	0.00002327	0.001812	0.00000861
72	2/04	LA Marshes	-4.00498	-2.68983	0.0000023739	0.0001285	0.00002776	0.002010	0.00001477
73	2/04	LA Marshes	-5.03751	-2.50375	0.0000023936	0.0001788	0.00005248	0.002529	0.00002015
74	3/04	Horn Island	-3.14074	-1.48210	0.0000025468	0.0001359	0.00002572	0.002190	0.00002514
75	3/04	Freemason	-4.39878	-2.34691	0.0000014971	0.0000828	0.00000893	0.001826	0.00000831
76	2/04	Pearl River	-6.12493	-2.96427	0.0000014079	0.0001168	0.00006051	0.002456	0.00002700
77	2/04	Pearl River	-2.97245	-2.24429	0.0000012095	0.0001281	0.00001890	0.002038	0.00001849
78	2/04	Pearl River	-6.99963	-3.42523	0.0000013950	0.0001528	0.00004243	0.002275	0.00001650
79	2/04	Pearl River	-6.41078	-3.27442	0.0000011285	0.0000976	0.00004981	0.002185	0.00002084
80	2/04	Pearl River	-3.54142	-2.33847	0.0000023679	0.0001388	0.00003012	0.002096	0.00001321
81	3/04	Pearl River	-5.26920	-2.95220	0.0000010303	0.0001180	0.00007694	0.002877	0.00005733
82	2/04	Pearl River	-7.26627	-3.80645	0.0000009458	0.0001418	0.00005180	0.002544	0.00006039
83	3/04	Biloxi Bay	-5.05611	-2.41284	0.0000014570	0.0001423	0.00004267	0.002293	0.00001462
84	3/04	Biloxi Bay	-6.38762	-3.21783	0.0000022258	0.0001497	0.00003352	0.002342	0.00001216
86	2/04	Pearl River	-4.98506	-2.83232	0.0000011812	0.0001161	0.00004329	0.002454	0.00003699
87	2/04	Pearl River	-6.48714	-3.87506	0.0000009919	0.0001473	0.00007129	0.002187	0.00002273
88	2/04	Pearl River	-4.51663	-2.61132	0.0000008175	0.0001385	0.00005460	0.002101	0.00002054
89	2/04	Pearl River	-7.20293	-3.58088	0.0000010986	0.0001504	0.00009046	0.002013	0.00002237
90	2/04	Pearl River	-4.83664	-2.67923	0.0000012977	0.0001344	0.00004033	0.002219	0.00001630
91	2/04	Pearl River	-4.53476	-2.06632	0.0000025222	0.0001415	0.00004009	0.002038	0.00000926
92	1/04	Grand Bay	-4.49325	-3.42237	0.0000015422	0.0001309	0.00002641	0.002154	0.00002018
93	2/04	Grand Bay	-2.28370	-2.57482	0.0000013564	0.0001740	0.00006294	0.002158	0.00003839
94	2/04	Grand Bay	-3.71550	-1.66312	0.0000027167	0.0001501	0.00009191	0.002309	0.00000641
95	3/04	Grand Bay	-5.01107	-1.70567	0.0000022339	0.0001182	0.00001779	0.002217	0.00001418

Appendix 3 continued.

Spec #	Age/Yr. Collected	Site	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	Li	Mg	Mn	Sr	Ba
96	1/04	Grand Bay	-8.40128	-5.32400	0.0000008803	0.0001403	0.00004118	0.002764	0.00002063
97	2/04	Cat Isl	-2.57878	-2.12018	0.0000019587	0.0001393	0.00002625	0.001794	0.00001299
98	2/04	Cat Isl	-2.81835	-2.29720	0.0000013814	0.0000977	0.00001976	0.002200	0.00001973
99	2/04	Cat Isl	-2.77832	-2.13564	0.0000022929	0.0001100	0.00002683	0.002176	0.00000671
100	3/04	Cat Isl	-3.75589	-2.29780	0.0000012619	0.0001506	0.00004829	0.002345	0.00004286
101	2/04	Cat Isl	-3.03447	-2.10906	0.0000027518	0.0001577	0.00003033	0.002150	0.00001238
102	2/04	Cat Isl	-2.76030	-1.85561	0.0000024199	0.0001219	0.00002931	0.002106	0.00000901
103	2/04	Cat Isl	-2.99079	-2.68509	0.0000010022	0.0001475	0.00006807	0.001849	0.00005303
104	2/04	Cat Isl	-4.57892	-2.28276	0.0000022151	0.0001232	0.00002741	0.001696	0.00000952
105	2/04	Cat Isl	-4.01615	-2.32052	0.0000023308	0.0001496	0.00004226	0.001763	0.00001192
106	3/04	Cat Isl	-3.55071	-2.26493	0.0000013584	0.0001563	0.00005419	0.002108	0.00003569
107	2/04	Cat Isl	-5.13672	-2.62154	0.0000017110	0.0001290	0.00002995	0.001746	0.00001103
108	3/04	Cat Isl	-2.67162	-2.73684	0.0000022253	0.0001288	0.00001858	0.002021	0.00002019
109	3/04	Gulfport	-8.58401	-4.46618	0.0000006849	0.0001162	0.00003360	0.003070	0.00005295
110	3/04	Gulfport	-8.16366	-4.14744	0.0000008063	0.0001298	0.00004860	0.002598	0.00003669
111	3/04	Gulfport	-3.73180	-1.65988	0.0000011004	0.0001070	0.00002161	0.001949	0.00002377
113	2/04	Cat Isl	-2.13621	-2.21245	0.0000028376	0.0001686	0.00001736	0.001870	0.00000739