

BAY SCALLOP PROJECT 2008 ANNUAL REPORT

Florida Fish and Wildlife Conservation Commission
Fish and Wildlife Research Institute
100 Eighth Avenue SE
St. Petersburg, Florida 33701-5095

March 31, 2009

William S. Arnold
Stephen P. Geiger
Melanie L. Parker
Sarah P. Stephenson
Janessa C. Cobb
Mark Gambordella
Anthony Vasilis
Michael Drexler

Phone: (727) 896-8626

Fax: (727) 823-0166

E-mail: Sarah.Stephenson@MyFWC.com



BAY SCALLOP PROJECT 2008 ANNUAL REPORT

Acknowledgements

A project of this scope and duration requires the assistance of many individuals and groups from throughout Florida. Jay Leverone (Sarasota Bay Estuary Program), Jim Culter (Mote Marine Laboratory) and Loren Coen, Mark Thompson and A.J. Martignette (Sanibel-Captiva Conservation Foundation) assisted with the continuation of our recruitment monitoring and restoration efforts in Pine Island Sound. Elizabeth Staugler (University of Florida - IMAFS) and volunteer Steve Patterson and his 6-year-old son Jacob assisted in initiating recruitment monitoring in Charlotte Harbor area. John Ryan and Rene Janneman (Sarasota County) assisted in initiating both recruitment monitoring and community based restoration efforts throughout Sarasota County. Peter Clark and Chris Sullivan of Tampa Bay Watch assisted with scallop collections and scallop restoration efforts in Tampa Bay. Peter Klocksien and Tiffany Black (FWC-Cedar Key field lab) assisted with the continuation of our recruitment monitoring efforts in the Suwannee basin area, namely Steinhatchee and Keaton Beach. Kim Wren, Jessica Avant and Ricky Hathcock (Florida DEP) continued to manage our recruitment-monitoring program in St. Joseph Bay and initiated recruitment monitoring in Alligator Harbor. The St. Andrew Resource Management Association organization and its members, in particular Chris Metcalf (USFWS), Linda Fitzhugh and Melissa Moore (Gulf Coast Community College), and Carrie Fioramonti and Michelle Passerotti (NOAA) provided assistance in recruitment monitoring and restoration efforts in St. Andrew Bay. Ben Russell of FDEP assisted in initiating recruitment monitoring in Pensacola Bay.

With the completion and submittal of this report comes the end of an era within the Molluscan Fisheries program of the Florida Fish and Wildlife Research Institute. Dr. William Arnold, who has served as the principal investigator and leader of this department for 24 years, has accepted a Fishery Biologist position with the National Marine Fisheries Service's Southeast Regional Office in St. Petersburg. He will apply his considerable knowledge and fishery experience to the Limited Access

Privilege Program. His new job duties will include working on a wide-array of scientific and statistical analyses in direct support of management activities. Dr. Arnold takes with him a wealth of knowledge of and research experience with Molluscan species within Florida waters, but he also leaves with us the knowledge and ability to propose, fund and conduct exciting, sound, cutting edge and scientifically respected research. His "footprints" are large and will be difficult to match, but he has shown us the richness and fulfillment that true dedication to one's work has to offer, and he has provided us with the motivation, guidance and skills to "aim high" and achieve new goals on our own.

Table of Contents

Overview of Program	8
I. Adult Abundance	8
1.0 Introduction	8-9
1.1 Pine Island Sound	9
1.2 Sarasota Bay	9
1.3 Tampa Bay	10
1.4 Anclote	10
1.5 Hernando	10
1.6 Homosassa	10-11
1.7 Cedar Key	11
1.8 Steinhatchee	11
1.9 St. Marks	11
1.10 St. Joseph Bay	12
1.11 Crooked Island	12
1.12 St. Andrew Bay	12
1.13 Pensacola Bay	12
1.14 Summary	13
II. Recruitment	13
2.0 Introduction	13-14
2.1 Pine Island Sound	14
2.2 Charlotte County	14
2.3 Sarasota County	15
2.4 Sarasota Bay	15
2.5 Tampa Bay	15-16
2.6 Anclote	16
2.7 Hernando	16
2.8 Homosassa	16
2.9 Suwannee area	17
2.10 Alligator Harbor	17
2.11 St. Joseph Bay	17-18
2.12 St. Andrew Bay	18
2.13 Pensacola Bay	18
2.14 Summary	18-19
III. Restoration Activities	19
3.0 Introduction	19-20
3.1 Pine Island Sound	20-21
3.2 Sarasota County	21
3.3 Sarasota Bay	21
3.4 Tampa Bay	21-22
3.5 St. Andrew Bay	22-23
3.6 Pensacola Bay	23
3.7 Summary	23-24
IV. References	24

List of Tables

Table 1. Adult bay scallop density per station at the south Pine Island Sound, Florida study site during each summer from 2004 to 2008.	25
Table 2. Adult bay scallop density per station at the north Pine Island Sound, Florida study site during each summer from 1994 to 2008.	26
Table 3. Adult bay scallop density per station at the Sarasota Bay, Florida study site during each summer from 2007 to 2008.	27
Table 4. Adult bay scallop density per station at the Tampa Bay, Florida study site during each summer from 2007 to 2008.	28
Table 5. Adult bay scallop density per station at the Anclote, Florida study site during each summer from 1994 to 2008.	29
Table 6. Adult bay scallop density per station at the Hernando, Florida study site during each summer from 1997 to 2008.	30
Table 7. Adult bay scallop density per station at the Homosassa, Florida study site during each summer from 1994 to 2008.	31
Table 8. Adult bay scallop density per station at the Cedar Key, Florida study site during each summer from 1998 to 2007.	32
Table 9. Adult bay scallop density per station at the Steinhatchee, Florida study site during each summer from 1994 to 2008.	33
Table 10. Adult bay scallop density per station at the St. Marks, Florida study site during each summer in 1995 and 2008.	34
Table 11. Adult bay scallop density per station at the St. Joe Bay, Florida study site during each summer from 1994 to 2008.	35
Table 12. Adult bay scallop density per station at the Crooked Island Sound, Florida study site during each summer from 1994 to 2007.	36
Table 13. Adult bay scallop density per station at the St. Andrew Bay, Florida study site during each summer from 1994 to 2008.	37
Table 14. Adult bay scallop density per station at the Pensacola Bay, Florida study site during each summer from 1995 and 2002 to 2005.	38

List of Figures

Figure 1. Map of Florida illustrating bay scallop study sites.....	39
Figure 2. Bay scallop adult abundance plot.....	40
Figure 3. Recruitment and survey station locations for Pine Island Sound, Charlotte County, Sarasota County and Sarasota Bay study sites.	41
Figure 4. Recruitment and survey station locations for Tampa Bay, Anclote, Hernando, and Homosassa study sites.	42
Figure 5. Recruitment and survey station locations for Cedar Key, Steinhatchee, Keaton Beach, St. Marks, Alligator Harbor, and St. Joseph Bay study sites.	43
Figure 6. Recruitment and survey station locations Crooked Island Sound, St. Andrew Bay, and Pensacola Bay study sites.	44
Figure 7. Pine Island Sound recruitment plots for 2008.....	45-47
Figure 8. Sarasota County recruitment plot for 2008.....	48
Figure 9. Sarasota Bay recruitment plot for 2008.....	49
Figure 10. Tampa Bay recruitment plot for 2008.....	50
Figure 11. Anclote recruitment plot for 2008.....	51
Figure 12. Hernando recruitment plot for 2008.....	52
Figure 13. Homosassa recruitment plot for 2008.....	53
Figure 14. Steinhatchee recruitment plot for 2008.....	54
Figure 15. St. Joseph Bay recruitment plot for 2008.....	54
Figure 16. St. Andrew Bay recruitment plot for 2008.....	55
Figure 17. Restoration station locations with total number of scallops released in the Pine Island Sound, Sarasota Bay, Tampa Bay, and St. Andrew Bay study sites.	56
Figure 18. Restoration station locations with total number of scallops released in the Pensacola Bay study site.	57
Figure 19. Growth and mortality plots of community based restoration effort in Sarasota County.....	58
Figure 20. Mortality plot of community based restoration effort in Tampa Bay.	59

Figure 21. Weekly growth and mortality plots of bay and calico scallops.....	60
--	----

Overview of Program

This report summarizes bay scallop (*Argopecten irradians*) research conducted by the Molluscan Fisheries program at the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute during calendar year 2008. First, we report the results of adult population surveys conducted at sites along the west coast of Florida between Pine Island Sound in the south and St. Andrew Bay in the northwest (Figure 1). The intent of those surveys is to monitor the status of representative scallop populations in Florida and to assess changes in population abundance that may occur in response to management and restoration efforts instituted by the State of Florida since 1994. Second, we present the results of recruitment monitoring studies that are ongoing in Pine Island Sound, Sarasota Bay, Tampa Bay, the near shore zone between Anclote and Crystal River, St. Joseph Bay, and St. Andrew Bay, and new sites in Charlotte County, Sarasota County, the Suwannee River area including Homosassa, Cedar Key, Steinhatchee and Keaton Beach, and Alligator Harbor (Figure 1). Finally, we provide a summary of scallop restoration efforts that are underway in state waters.

I. Adult Abundance

1.0 Introduction

Consistent with each of the previous surveys (e.g., Arnold et al., 2008) our 2008 adult scallop sampling protocol consisted of diver transect surveys at replicate and randomly located stations at each of 11 study sites (see below) during the spring. At each station, we deployed one diver on each side of a 300 m transect line who searched within one meter of the line along its length. All scallops within that two by 300 meter area were counted. Surveys were conducted at study sites located in south Pine Island Sound, north Pine Island Sound, Sarasota Bay, Tampa Bay, Anclote, Hernando, Homosassa, Steinhatchee, St. Marks, St. Joseph Bay, and St. Andrew Bay (Figures 3 - 6) during May, June and July. Twenty stations were sampled at each site with the exception of south Pine Island Sound (N = four), Sarasota Bay (N =

ten), and St. Marks (N = eight). Each station comprised a 600 m² survey area, so we sampled 12,000 m² of potential bay scallop habitat at most sites. Within each site, differences in mean scallop abundance among years were statistically compared using a Waller-Duncan K-ratio t-test (SAS, 1985). If significant differences were found among years within a site, then those differences are noted in each table of population abundance.

1.1 Pine Island Sound

Scallop abundance increased from zero in both north and south Pine Island Sound during June 2008 (Tables 1 and 2). In the north we found a single scallop at each of two of the 20 total stations (Figure 3A) and one scallop at one of the four stations surveyed in the south. For both sites the 2008, the average was less than the average for all previous years combined. Despite its lush seagrass beds and amenable water quality this estuary continues to be the most challenging for scallops and we will continue larval release studies and recruitment planting projects in an attempt to restore this population.

1.2 Sarasota Bay

We found a record number of scallops (Table 3) at the station nearest the area known as the kitchen in Sarasota Bay in July of 2008 (Figure 3D). The average number per transect increased dramatically from the previous year (0.20 to 249.90 per 600m²) as well as the distribution among stations (scallops found at one station in 2007, and at all ten stations in 2008). This site was most improved; transitioning from a collapsed population to a healthy one with the total number of scallops observed increasing from two to 2,499.

1.3 Tampa Bay

In 2008, we relocated four survey stations from the upper reaches of the bay and repositioned them near areas of scallop restoration efforts (Figure 4A). The distribution of scallops increased in 2008, with scallops observed at 18 of 20 stations, up from last year's 11 of 20 (Table 4). Two of the stations near Tarpon Key were extremely rich with scallops, recording over 200 scallops per 600m². Comparatively, the highest number of scallops observed in 2007 was 33 scallops per 600m², and the total number of scallops observed within this estuary increased from 106 to 740.

1.4 Anclote

Although there was a decrease in scallop abundance from last year (Table 5), the average was still roughly five times higher than the mean for the previous 14 years, suggesting that this area contains a healthy and stable population. The status per station increased from 17 to 19 healthy stations with one transitional. Scallops were observed at all 20 survey stations for the second consecutive year (Figure 4B).

1.5 Hernando

In 2008, the average scallop abundance doubled at the Hernando study site (Table 6) and was roughly five times higher than the mean from the previous 11 years. The overall population density remained healthy and scallops were observed at all 20 survey stations for the second consecutive year (Figure 4C).

1.6 Homosassa

We observed an increase (>2x) in mean scallop abundance at our Homosassa study site in 2008, relative to 2007 (Table 7), and the yearly mean was higher than the total mean of the previous 15 years. We recorded scallops at all 20 survey stations for the first time since 2000, and only the second time in 16

years (Figure 4D). We recorded more than 25 scallops 600 m^{-2} , our criteria for a healthy density of scallops, at 16 of these stations.

1.7 Cedar Key

Due to the low levels of scallops at this site over the past ten years (Table 8), survey was suspended at this site. Previous survey stations are illustrated in Figure 5A.

1.8 Steinhatchee

Scallop abundance continued to increase at the Steinhatchee study site (Table 9) during 2008, with the average number per transect increasing by a factor of 3.5. The mean for the 2008 scallop surveys was higher than the mean of the previous 14 years. We found scallops at all 20 of our survey stations (Figure 5B), and 17 of these stations supported more than 25 scallops per transect. Steinhatchee consistently remains the healthiest and most resilient scallop population we monitor in Florida, with healthy means ($>25\text{ scallops }600\text{m}^{-2}$) in 12 out of 15 years surveyed, and with transitional means ($5\text{ scallops} < 25\text{ }600\text{m}^{-2}$) in the remaining three years.

1.9 St. Marks

We found scallops at all eight stations surveyed (Table 10) in summer 2008, and only one station had a less than healthy density. We plan to increase the area surveyed in 2009, adding 12 stations to the number surveyed this year (Figure 5C), expanding our panhandle scallop database. In our only previous survey in 1995, we found scallops at fewer than half of the 20 stations surveyed and averaged less than 0.5 scallops per station.

1.10 St. Joseph Bay

The scallop population in St. Joseph Bay decreased from a healthy population in 2007, to a transitional one in 2008 (Table 11). Scallops were not recorded at six of the 20 stations, the majority of these lining the western shore of the bay south of the state park (Figure 5D). In 2008, the average per transect was roughly one fifth of the mean of the previous 14 years. The bay is susceptible to red tide blooms, and the event observed in November 2007, most likely reduced the available spawning stock and number of recruits settling onto grass blades and collectors (see below), translating into low adult abundances during spring 2008.

1.11 Crooked Island Sound

Due to the low levels of scallops at this site (Table 12) over the past 14 years, survey was suspended at this site. Previous survey stations are illustrated in Figure 6A.

1.12 St. Andrew Bay

St. Andrew Bay scallop abundance decreased in 2008 (Table 13), and the population remains classified as collapsed at this site. The yearly mean was well below the previous 14 years mean. We recorded scallops at 11 of our 20 survey stations (Figure 6B), but in no case were they abundant. We will continue restoration efforts in this estuary.

1.13 Pensacola Bay

We did not survey within Pensacola Bay in 2008. Figure 6C and Table 14 show the station locations and abundances from previous surveys.

1.14 Summary

Scallop abundances at seven of the 11 sites sampled in 2008 were classified as healthy and the same percentage of the sites exhibited population growth. Within these healthy populations, with the exception of St. Marks in which no data was available for comparison, abundance increased at 60.8% of the stations surveyed, decreased at 36.9%, and remained constant at 2.3%. On the whole, statewide scallop populations were both more abundant and widespread in 2008. St. Andrew Bay and Pine Island Sound were the only two sites classified as collapsed and remain areas of concern. Historically both of these sites contained abundant scallop populations, and it's our goal to re-establish these estuaries closer to their historic levels.

II. Recruitment

2.0 Introduction

We estimate recruitment of new individuals to the scallop population using spat collectors. In most cases, these devices consist of a vexar mesh panel encased within a citrus bag that is tied to a polypropylene rope. The rope is anchored to a cement block and is supported with a round surface float (Arnold et al., 1998). Generally a single collector is deployed at each station and allowed to soak for eight weeks prior to retrieval. An additional collector is deployed at the same station, four weeks later, and similarly allowed to soak for eight weeks. This overlapping deployment/recovery schedule ensures that any recruitment event that occurs just prior to recovery of one series of collectors can be detected on the overlapping collector. Upon recovery, collectors are returned to the laboratory for visual examination and enumeration of all recruits. Collectors in Tampa Bay and Sarasota Bay are processed immediately upon retrieval and all recruits collected are returned to FWRI for growout within Bayboro Harbor. These scallops will be used at a later date during our ongoing restoration efforts. In addition to our ongoing recruitment monitoring we added stations within five sites during 2008: Charlotte County, Sarasota

County, Suwannee area, Alligator Harbor and Pensacola Bay. At these five sites, and at St. Joseph Bay and St. Andrew Bay, collectors are retrieved and deployed by various volunteer scientific agencies and shipped to FWRI for processing. Station locations for recruitment monitoring are depicted in Figure 8 for south Pine Island Sound, north Pine Island Sound, Sarasota Bay and Tampa Bay, in Figure 9 for Homosassa, Hernando, and Anclote, and in Figure 10 for St. Andrew Bay and St. Joseph Bay. Also note that the y-axis scale of the recruitment plots changes from site to site associated with changes in the magnitude of recruitment at each site.

2.1 Pine Island Sound

Starting in October 2008, the configuration of stations within Pine Island Sound was changed from five stations with three replicates to 18 stations with one replicate (Figure 5A). In Pine Island Sound we recorded spat on collectors retrieved during April (N=16) and May 2008 (N=1), albeit at relatively low levels (Figure 7). We are concerned that the low level of recruitment recorded during 2008, anticipates a continuation of low adult density at this site. Of the 159 collectors deployed in 2008, nine (5.7%) were not retrieved, 123 (77.4%) retrieved had zero scallops, three (1.9%) had bay scallops, and 26 (16.4%) had calico scallops (*Argopecten gibbus*).

2.2 Charlotte County

We added 12 new recruitment stations within Lemon Bay, Gasparilla Sound and Charlotte Harbor in October 2008 (Figure 3B). Only one set of collectors was retrieved during 2008, and of the 12 collectors deployed one was not retrieved, seven retrieved had zero scallops, two had bay scallops, and three had calico scallops. The total scallop recruitment in 2008, was four bay scallops and 36 calico scallops.

2.3 Sarasota County

In March 2008, we added 15 new recruitment stations (Figure 3C) located throughout Sarasota Bay, Roberts Bay, Little Sarasota Bay, Blackburn Bay, Dona Bay, Roberts Bay, and Lemon Bay, spanning the entire stretch of Sarasota County. Recruitment peaks were observed in May, June and December (Figure 8). Of the 120 collectors deployed in 2008, six (5.0%) were not retrieved, 63 (52.5%) retrieved had zero scallops, 45 (37.5%) had bay scallops, and 20 (16.7%) had calico scallops.

2.4 Sarasota Bay

We continued our monitoring efforts at the eight stations located in the northern end of Sarasota Bay (Figure 3D) and recorded recruitment of bay scallops throughout the year (Figure 9). There was a recruitment peak during January and February followed by minimal recruitment to collectors and ending in a record peak for this site during December. Fourteen collectors out of the 96 deployed (14.6%) over the course of the year were not retrieved. Of the 96 collectors deployed in 2008, 14 (14.6%) were not retrieved, 22 (22.9%) retrieved had zero scallops, 53 (55.2%) had bay scallops, and 27 (28.1%) had calico scallops.

2.5 Tampa Bay

At our six Tampa Bay stations (Figure 4A) strong pulses of recruitment occurred during January and December 2008 (Figure 10). Recruitment to collectors was observed during every retrieval event in 2008. This site recorded the highest overall recruitment with 4,666 scallops settling onto 69 traps. The presence of such a large number of recruits suggests that the combination of active restoration, management, and relatively stable environmental conditions is supporting a self-sustaining local population, a large amount of exogenous larval supply, or some combination of both. Of the 72 collectors deployed in 2008, three (4.2%) were not retrieved, 13 (18.1%) retrieved had zero scallops, 55 (76.4%)

had bay scallops, and 14 (19.4%) had calico scallops.

2.6 Anclote

We recorded recruitment during every retrieval event in 2008, and at each of our 12 Anclote monitoring stations (Figure 4B), with peaks during January through April and September through December (Figure 11). Recruits have been detected at Anclote during each month since November of 2005, suggesting that spawning has occurred continuously over 38 consecutive months. Of the 144 collectors deployed in 2008, 37 (25.7% - the highest recorded loss of collectors per site) were not retrieved, 26 (18.1%) retrieved had zero scallops, and 81 (56.3%) had bay scallops.

2.7 Hernando

At the Hernando study site stations (Figure 4C), we recorded an elevated peak in recruitment during January, minimal recruitment through August, and a noticeable fall peak in 2008 (Figure 12). We recorded at least some recruits during every month except September, albeit at much lower numbers than at Anclote, as well as recruits at each of the 12 monitoring stations. Of the 144 collectors deployed in 2008, six (4.2%) were not retrieved, 54 (37.5%) retrieved had zero scallops, and 84 (58.3%) had bay scallops.

2.8 Homosassa

At our 12 Homosassa stations (Figure 4D), we collected a total of 41 spat from 131 collectors (Figure 13), with small peaks in January through February and September through October. Homosassa continues to show little correlation between the location and timing of recruitment events and adult abundance patterns. Of the 144 collectors deployed in 2008, 13 (9.0%) were not retrieved, 109 (75.7%) retrieved had zero scallops, and 22 (15.3%) had bay scallops.

2.9 Suwannee area

In 2008 we added up to four stations per site at Homosassa (February), Cedar Key (February), Steinhatchee (January) and Keaton Beach (October) in concordance with stone crab research. Difficulties arose in managing the Homosassa and Cedar Key sites and as a result they were discontinued. The remaining station locations are shown in Figure 5 B and C.

Before discontinuation, a total of 20 spat on 19 retrieved collectors were observed at the Homosassa site, and one spat on five retrieved collectors at the Cedar Key site.

Steinhatchee has the longest running coverage with peaks in March, October and November (Figure 14) with 53 bay scallops observed. Of the 44 collectors deployed in 2008, six (13.6%) were not retrieved, 22 (50.0%) retrieved had zero scallops, and 16 (36.4%) had bay scallops.

A total of 41 spat were observed on the 16 collectors from the Keaton Beach site. Of these 16 collectors deployed in Keaton Beach in 2008 all were retrieved, seven (43.8%) had zero scallops, and nine (56.3%) had bay scallops.

2.10 Alligator Harbor

In late 2008 we added four recruitment monitoring stations in Alligator Harbor (Figure 5C). All four collectors were retrieved in December and there was no scallop spat attached.

2.11 St. Joseph Bay

Recruitment was limited at the four St. Joe Bay stations (Figure 5D) and was likely the result of a red tide event in November 2007. There was a small peak in February, the majority located at Station 1 near the mouth of the Bay, and then minimal recruitment until November (Figure 15). A strong peak, the highest in the state in 2008, was observed in December, with 3,258 scallops settling on the 12 collectors

deployed. While the December spatfall occurred at all stations, 86.8% was recorded at the two stations near the mouth of the bay, possibly suggesting that the larvae were transported into the bay from an alternative source. Of the 132 collectors deployed in 2008, 16 (12.1%) were not retrieved, 69 (52.3%) retrieved had zero scallops, and 47 (35.6%) had bay scallops.

2.12 St. Andrew Bay

At the ten St. Andrew Bay stations (Figure 6B), scallop recruits were recorded during each retrieval event in 2008 (Figure 16), with a peak in March and then again in November through December. This population appears to function in a manner similar to more northern populations that typically spawn at the end of spring in response to the spring phytoplankton bloom and rising temperatures (Barber and Blake, 1991). Of the 90 collectors deployed in 2008, nine (10.0%) were not retrieved, 11 (12.2%) retrieved had zero scallops, 50 (55.6%) had bay scallops, and five (5.6%) had calico scallops. We have also observed other Pectinid species on the collectors deployed at this site over the course of 2008, including Ravenel's (*Pecten raveneli*) and Rough (*Aequipecten muscosus*) scallops.

2.13 Pensacola Bay

In the fall of 2008, a new recruitment monitoring station with two replicate collectors was deployed within this estuary (Figure 6C) near Spanish Cove, just west of Ft. Pickens and Pensacola Pass. The first two sets of collectors, both pulled in November of 2008, held a total of 221 bay scallops. This number was greater by 100 scallops than the total sum of our prior recruitment monitoring effort which spanned from October, 2002 to February, 2006.

2.14 Summary

Calendar year 2008, was by and large a good year for bay scallop recruitment in Florida waters,

with the exception of Pine Island Sound. This Sound contains vast areas of lush seagrass but was essentially devoid of recruits, most likely reflective of the scarcity of adults available for reproduction. Sarasota Bay, Tampa Bay, and Anclote all had exceptionally high numbers of adults, and these numbers were reflected in high recruitment levels. St. Joseph Bay did not have a high level of adults, yet succeeded in having the highest recruitment during December 2008. The newly added sites show promise; for example, Keaton Beach logged the same number of recruits as Homosassa with a third of the number of traps. Hopefully these new monitoring sites will help to provide more insight into bay scallop larval movement around the Gulf coast and help to elucidate the apparent difference in recruit to adult ratios between bays and open coastal ecosystems. We have also communicated with John Fajans stationed at the FWC Keys Marine Lab and plan to deploy traps in Florida Bay during 2009.

III. Restoration Activities

3.0 Introduction

In 2008, we continued restoration efforts in Pine Island Sound, St. Andrew Bay, Pensacola Bay, Sarasota Bay, and Tampa Bay. We utilized several sources/techniques for restoration, chief among these being the retention and culture of scallop spat (i.e., new recruits) collected during recruitment monitoring efforts in Tampa Bay, Sarasota Bay, and St. Andrew Bay. In November 2007, and September 2008, we deployed a secondary set of collectors in St. Andrew Bay to soak over the winter months in order to amplify the number of recruits collected. These collectors consisted of either a one meter by 80 cm piece of netron mesh or a similar amount of black netting that was bunched up and stuffed into a citrus bag, adding both surface area and volume to the collector. Once the collectors were retrieved and immediately processed, the spat collected were transferred to mesh bags and transported back to the FWRI where they were placed in cages and deployed off the FWRI dock into Bayboro Harbor until they reached a size

capable of avoiding predation pressure (> 20 mm shell height). We also collected and reared scallop spat retained on the transport containers employed during our May 2007, larval release and that were initially spawned by Curt Hemmel at Bay Shellfish Inc. Once these spat reached this “plantable” size they were used as stock in various restoration schemes. We also partnered with Tampa Bay Watch staff to collect 600 adult scallops from Tampa Bay waters near Tarpon Key that were placed in cages and hung off of local volunteer docks. The scallops remained in the cages throughout their short life cycle with the assumption that they spawned before their death.

Using these simple techniques we successfully collected 3,800 scallops from St. Andrew Bay, 2,929 from Tampa Bay, and 581 from Sarasota Bay. The majority of the scallops we collected were used in free plantings where they were gently released back into suitable seagrass habitats within the target estuaries. Due to the lack of recruits and adults available from Pine Island Sound, the restoration activities in this area used scallops collected from the next closest estuary, in this case Sarasota Bay. Similarly 217 scallops collected from St. Andrew Bay were transported to Pensacola Bay and released at two locations. In collaboration with scientists at Sarasota County, a batch of approximately 455 scallops was divided into groups of 25 individuals and each group then placed loosely in a cage and suspended from a volunteer dock within the estuaries of Sarasota County (Sarasota – Lemon Bays). We also partnered with Mote Marine Lab to complete larval releases in Pine Island Sound, Sarasota Bay and Tampa Bay.

3.1 Pine Island Sound

On February 23, 2008, Dr. Jay Leverone transported 600 scallops from the Bayboro Harbor stock and released them at Pine Island Sound survey Stations 3 and 4 (Figure 17A). On May 16, 2008, Dr. Leverone transported 412 scallops from Bayboro Harbor and released at Pine Island Sound survey Station 3. Despite these efforts, no scallops were detected at survey stations nearest the release sites during June. Restoration efforts continued on November 24, 2008, when Jim Culter transported ~three million larvae

spawned by Bay Shellfish Inc. and 85 scallops from Bayboro Harbor to Pine Island Sound and released them near survey Stations 3 and 4. A total of 1,097 adults and ~three million larvae were released into Pine Island Sound in 2008.

3.2 Sarasota County

On July 21 and 23, 2008, Sarah Stephenson of FWRI and Rene Jannemann of Sarasota County transported 455 scallops from Bayboro Harbor and deployed them in 18 cages off volunteer homeowner docks in Sarasota Bay, Roberts Bay, Little Sarasota Bay, Blackburn Bay, Dona Bay, Roberts Bay, and Lemon Bay. The volunteers monitored the caged scallops at least once a month for mortality and growth rates. During the December cage monitoring efforts, 95 of the original 455 scallops (20.9%) remained alive and the average shell heights ranged from 40.0 to 64.5 mm (Figure 19). Initial results indicate that only one site, near Philippee Creek, may be uninhabitable by bay scallops as all scallops planted at this location were deceased by the first cage check.

3.3 Sarasota Bay

On January 15, 2008, FWRI staff transported 200 scallops from Bayboro Harbor and released them into seagrass beds near Coon Key in Sarasota Bay (Figure 17B). On March 18, 2008, FWRI staff transported 312 scallops from Bayboro Harbor and released them into seagrass beds near Coon Key. On April 21, 2008, FWRI staff transported 177 scallops from Bayboro Harbor and released them into seagrass beds near Jewfish Key. On December 8, 2008, Jim Culter transported ~ one million larvae from Bay Shellfish Inc. and released them into seagrass beds in the southern area of Sarasota Bay. A total of 689 adults and ~one million larvae were released into the Sarasota Bay system in 2008.

3.4 Tampa Bay

On February 7, 2008, FWRI staff transported 300 scallops from Bayboro Harbor and released them into seagrass beds near Wheedon Island (Figure 17C). On March 13, 2008, FWRI staff transported 453 scallops from Bayboro Harbor and released 296 into seagrass beds near north of the Gandy Bridge, 57 into a cage north of the Gandy Bridge, and 100 into a seagrass bed south of the Gandy Bridge. The juvenile scallops released into the seagrass beds were tagged with colored plastic strips and released with the goal of relocating them during summer surveys. However, we were unable to recover any of the tagged scallops in July of 2008, during the Tampa Bay annual survey. The 57 caged scallops were deployed to determine if the water quality in this portion of Tampa Bay was conducive to scallop survivorship. The cage was retrieved on May 29, 2008, and shell heights and scallop density recorded. Fifty-four of the original 57 (94.7%) were still alive and the average shell height increased from 19.5 to 41.9 mm. On April 22, 2008, FWRI staff within the Fisheries Independent Monitoring program transported 270 scallops from Bayboro Harbor and released them into seagrass beds near MacDill Air Force Base. On May 29, 2008, FWRI staff transported 203 scallops from Bayboro Harbor and released them into seagrass beds near Apollo Beach. On October 2, 2008, 621 scallops were collected from Tampa Bay survey Stations 11 and 14 by FWRI and Tampa Bay Watch staff. These scallops were transported back to Bay Watch headquarters and divvied into groups, transported to volunteer docks, placed into cages and suspended into Tampa Bay waters. Tampa Bay Watch staff monitored the cages monthly and counted the total number of live scallops per date. Survival rates by site are plotted in Figure 20 and to date 19% of the initial batch remains alive. On December 8, 2008, FWRI staff transported ~ three million larvae from Bay Shellfish Inc. and released them into seagrass beds near Wheedon Island, Gulfport, and Ft. DeSoto. A total of 1,226 adults and ~three million larvae were released into Tampa Bay in 2008.

3.5 St. Andrew Bay

On January 29, 2008, FWRI staff collected 1,699 scallops off the secondary set of collectors

deployed in 2007, several of which were large enough to free plant back into local waters. We released 531 near the Panama City airport and 209 near Gulf Coast Community College in North Bay (Figure 17D). The remaining scallops were transported back to FWRI for growout. On March 27, 2008, FWRI staff transported 474 scallops from Bayboro Harbor to St. Andrew Bay and released them at four locations throughout the bay. On May 26, 2008, FWRI staff transported 200 scallops from Bayboro to St. Andrew Bay and released them into seagrass beds near two bay scallop survey stations. On September 26, we deployed 50 secondary collectors spread among at five stations (10 collectors per station) spread through the St. Andrew Bay system. On December 15 and 16, 2008, FWRI staff collected a total of 2,841 scallops off the ten Vexar collectors regularly deployed and off the 50 secondary set of collectors. Scallops that were above 15 mm in shell height were divided into groups of 25 individuals and placed in mesh bags within plastic cages and hung from docks at the NOAA facility. These scallops will be distributed to volunteers and Gulf Coast Community College students and monitored monthly for growth and mortality rates.

3.6 Pensacola Bay

On May 5, 2008 FWRI staff transported 217 scallops from Bayboro Harbor to Pensacola Bay and released them into seagrass beds near Spanish Point and the EPA lab (Figure 18). These scallops originated from the January St. Andrew Bay spat collection effort.

3.7 Summary

Harvesting scallop recruits via spat collectors and using natural waters to grow them to an acceptable size is an inexpensive and easy method of restoring depleted populations. We will continue to employ this method in 2009. This approach also presents opportunities to discover and study new specifics about various Molluscan species that attach to and are recovered on the collectors. In 2008 we conducted basic growth and mortality trials on bay and calico scallops that were collected from Tampa

Bay and grown out in cages hung off the FWRI dock in Bayboro Harbor. Results are shown in figure 21.

IV. References

Arnold, W.S., D.C. Marelli, C.P. Bray and M.M. Harrison, 1998. Recruitment of bay scallops

Argopecten irradians in Floridan Gulf of Mexico waters: scales of coherence. Mar. Ecol. Prog.

Ser. 170: 143-157.

Arnold, W.S., S.P. Geiger, M. Parker, S. Stephenson, J. Cobb, M. Gambordella, M. Poplaski, J. Stone and

B. Brown, 2008. Annual report of the bay scallop project, 2007. Report to the Division of

Marine Fisheries, Florida Fish and Wildlife Conservation Commission, 37 pp.

Barber, B.J. and Blake, N.J. 1991. Reproductive Physiology. *In* Scallops: Biology, Ecology and

Aquaculture. *Edited by* S.E. Shumway. Elsevier, Amsterdam pp. 377-420.

SAS Institute, Inc., 1985. SAS User's Guide: Statistics, Version 5 Edition. SAS Institute, Inc., Cary,

North Carolina, 956 pp.

Table 1. Adult bay scallop density at each of 20 stations sampled at the south Pine Island Sound, Florida study site during each June from 2004 through 2006, at each of 10 stations during June 2007, and at each of four stations during June 2008. Scallop density at each station is reported per 600 m² transect. The ‘Z’ indicates that the station was not sampled.

STA	2004	2005	2006	2007	2008
1	0	0	0	Z	Z
2	0	0	0	Z	Z
3	0	1	4	0	Z
4	0	0	0	Z	Z
5	0	0	0	0	Z
6	0	0	1	Z	Z
7	0	0	0	Z	Z
8	0	0	0	Z	Z
9	0	1	1	Z	Z
10	0	0	0	Z	Z
11	0	0	1	0	0
12	0	0	1	0	Z
13	0	0	1	0	0
14	0	3	0	0	Z
15	0	1	3	Z	Z
16	0	0	0	Z	Z
17	0	21	0	0	Z
18	0	8	6	0	1
19	1	0	3	0	Z
20	0	13	5	0	0
MEAN	0.1	2.4	1.3	0.0	0.3
S.D.	0.2	5.5	1.9	0.0	0.5

Table 2. Adult bay scallop density at each of 20 stations sampled at the north Pine Island Sound study site during each June from 1994 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0	0	0	0	0	0	8	0	0	0	0	13	7	0	0
2	0	0	0	0	0	0	0	0	0	0	0	38	13	0	0
3	0	0	0	0	0	0	2	0	0	0	1	123	7	0	0
4	0	0	0	0	0	0	22	25	0	3	3	545	40	0	0
5	0	0	0	0	0	0	1	0	1	0	0	39	3	0	0
6	0	0	1	0	0	0	0	0	1	0	0	5	1	0	0
7	0	0	1	1	0	0	1	0	1	0	0	5	3	0	0
8	0	0	0	0	2	1	0	0	0	1	0	18	15	0	0
9	0	0	0	0	0	0	2	0	0	0	0	1	4	0	0
10	0	1	0	3	1	0	0	0	1	0	0	0	2	0	0
11	0	1	0	0	0	0	1	1	0	0	0	7	4	0	0
12	0	34	1	5	5	1	0	22	1	0	1	122	2	0	0
13	0	9	0	4	0	0	0	37	0	2	1	99	2	0	0
14	0	0	0	15	0	0	0	2	7	0	2	59	2	0	0
15	0	1	0	5	0	0	0	1	1	0	0	39	9	0	0
16	0	1	0	2	0	1	2	7	0	1	1	203	7	0	0
17	0	0	9	9	22	12	8	12	0	4	2	255	14	0	1
18	0	0	3	0	14	25	1	3	0	1	1	44	0	0	1
19	0	1	0	2	0	7	0	0	0	0	1	27	12	0	0
20	0	1	0	0	3	5	8	0	0	0	8	226	16	0	0
MEAN	0.0	2.5	0.8	2.3	2.4	2.6	2.8	5.5	0.7	0.6	1.1	93.4	8.2	0.0	0.1
S.D.	0.0	7.7	2.1	3.9	5.7	6.1	5.3	10.5	1.6	1.1	1.9	131.9	9.1	0.0	0.3
W.D.	B	B	B	B	B	B	B	B	B	B	B	A	B	B	B

Table 3. Adult bay scallop density at each of 10 stations sampled at the Sarasota Bay study site during each June from 2007 through 2008. Scallop density at each station is reported per 600 m² transect.

STA	2007	2008
1	2	46
2	0	43
3	0	1931
4	0	1
5	0	2
6	0	323
7	0	116
8	0	6
9	0	25
10	0	6
MEAN	0.2	249.9
S.D.	0.6	598.8

Table 4. Adult bay scallop density at each of 20 stations sampled at the Tampa Bay study site during each June from 2007 through 2008. Scallop density at each station is reported per 600 m² transect.

STA	2007	2008
1	0	1
2	0	1
3	0	6
4	0	10
5	16	2
6	1	17
7	6	24
8	0	0
9	26	10
10	0	22
11	1	262
12	0	2
13	0	37
14	2	284
15	0	0
16	3	22
17	11	6
18	3	4
19	33	26
20	4	4
MEAN	5.3	37.0
S.D.	9.3	81.5

Table 5. Adult bay scallop density at each of 20 stations sampled at the Ancloste study site during each June from 1994 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	1	0	4	43	0	0	1	0	6	0	0	0	1	78	277
2	72	0	3	49	0	1	171	8	49	9	1	60	6	306	113
3	15	0	2	307	0	8	177	8	20	3	0	8	10	182	56
4	0	0	0	1	0	1	1	0	22	4	0	14	0	58	55
5	106	0	0	20	0	0	7	14	26	25	1	27	3	60	49
6	3	0	0	4	0	0	6	2	61	100	0	50	18	21	19
7	21	0	0	1	0	1	3	26	25	3	0	49	2	117	68
8	14	0	12	136	0	2	8	0	14	4	0	10	7	319	115
9	2	3	0	4	0	0	0	12	8	167	2	4	9	110	68
10	1	0	1	30	0	0	2	0	64	4	0	7	2	231	270
11	1	0	2	27	0	0	3	0	0	1	0	0	0	50	397
12	14	0	0	1	0	0	0	0	2	0	0	1	1	7	69
13	12	0	0	8	0	0	0	1	4	19	0	0	3	10	270
14	0	0	11	14	1	4	12	12	9	48	0	11	3	99	95
15	1	0	1	141	17	13	4	0	10	125	30	148	15	135	182
16	5	0	23	87	46	9	4	7	280	110	15	12	27	232	76
17	9	0	6	20	313	8	27	24	16	50	0	24	70	931	212
18	1	0	3	42	17	0	7	3	9	4	0	27	31	337	102
19	1	0	0	8	12	2	9	1	4	5	0	15	12	150	162
20	14	0	0	4	0	1	2	0	115	34	8	61	17	45	102
MEAN	14.7	0.2	3.4	47.4	20.3	2.5	22.2	5.9	37.2	35.8	2.9	26.4	11.9	173.9	137.9
S.D.	26.8	0.7	5.8	74.1	69.8	3.9	52.3	8.1	63.7	49.8	7.37	34.9	16.3	16.3	99.7
W.D.	B,C	C	C	B	B,C	C	B,C	C	B,C	B,C	C	B,C	B,C	A	A

Table 6. Adult bay scallop density at each of 20 stations sampled at the Hernando study site during each June from 1997 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	3	0	0	13	13	2	4	0	7	1	16	353
2	11	0	33	76	110	5	4	0	7	14	46	320
3	134	3	17	213	555	12	73	0	222	13	118	125
4	80	6	43	48	105	1	30	0	86	65	204	123
5	9	0	1	29	61	17	8	1	3	0	19	54
6	1	0	2	31	2	10	1	0	0	1	19	23
7	0	0	0	10	0	9	0	0	0	1	3	23
8	0	0	0	14	2	5	0	0	0	3	5	45
9	1	0	1	66	6	6	0	2	1	4	9	35
10	3	0	1	43	6	3	9	13	1	4	5	33
11	0	0	5	17	5	4	0	1	0	3	2	29
12	0	0	1	61	2	5	0	0	2	0	7	22
13	10	0	4	18	7	6	0	2	2	2	23	53
14	1	0	0	15	6	9	0	3	2	0	12	46
15	10	1	2	54	14	6	2	9	4	9	15	14
16	2	1	1	7	5	9	1	2	1	2	11	24
17	8	0	3	27	7	5	6	0	2	13	13	174
18	6	0	0	28	10	9	7	10	6	4	25	108
19	6	0	0	25	5	8	8	23	3	6	48	88
20	0	0	0	49	1	13	6	0	0	0	9	3
MEAN	14.3	0.6	5.7	42.2	46.1	7.2	8.0	3.3	17.5	6.7	30.5	79.8
S.D.	33.1	1.5	11.8	45.0	124.2	3.9	16.8	6.0	51.7	14.3	48.4	94.8
W.D.	B,C	C	C	B	B	C	C	C	B,C	C	B,C	A

Table 7. Adult bay scallop density at each of 20 stations sampled at the Homosassa study site during each June from 1994 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	3	0	0	9	0	3	23	74	16	6	0	2	6	3	11
2	38	9	2	17	0	3	87	209	51	522	5	20	8	27	59
3	5	9	5	18	2	7	29	185	31	93	0	57	24	14	32
4	1	4	0	19	0	36	323	735	113	170	0	39	8	121	58
5	0	14	5	15	0	33	395	489	78	194	1	47	30	37	34
6	0	1	9	7	0	70	724	121	68	119	0	87	74	24	14
7	1	2	5	5	34	47	817	174	79	201	1	159	39	43	39
8	5	27	4	27	3	13	850	663	69	210	6	85	29	24	90
9	3	7	4	13	13	54	614	391	82	498	6	340	37	70	215
10	19	3	2	58	6	9	165	1237	63	62	59	186	29	116	79
11	0	1	0	5	1	2	23	39	7	29	2	4	0	32	128
12	0	1	3	0	0	0	12	5	0	0	0	0	0	2	16
13	23	6	2	12	0	13	231	380	63	114	9	192	7	213	74
14	15	0	9	23	2	48	352	339	13	125	11	158	30	49	38
15	4	1	2	7	0	3	45	173	45	61	12	34	15	92	287
16	3	3	1	6	0	5	28	197	21	5	2	0	2	7	175
17	3	1	6	0	0	13	25	133	109	1	0	5	22	15	201
18	9	3	3	55	0	212	88	431	122	102	0	31	69	68	109
19	5	2	1	8	0	2	25	11	4	1	0	0	9	3	64
20	0	0	0	0	0	0	1	0	2	0	0	0	0	0	1
MEAN	6.9	4.7	3.2	15.2	3.1	28.7	242.9	299.3	51.8	125.7	5.7	72.3	21.9	48.0	86.2
S.D.	9.8	6.4	2.7	16.0	7.9	48.1	290.0	305.4	38.9	149.8	13.2	90.9	21.3	53.5	78.1
W.D.	D	D	D	D	D	C,D	A	A	C,D	B	D	B,C,D	C,D	C,D	B,C

Table 8. Adult bay scallop density at each of 6 stations sampled at the Cedar Key study site during each June from 1998 through 2007. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	0	1	1	5	0	12	0	0	3	1
2	0	0	0	8	2	4	0	1	1	1
3	1	4	0	26	5	2	0	20	16	0
4	0	4	0	1	1	6	0	5	2	1
5	1	0	1	5	0	10	0	2	0	1
6	3	7	0	1	6	2	0	0	1	0
MEAN	0.8	2.7	0.3	7.7	2.3	6.0	0.0	4.7	3.8	0.7
S.D.	1.2	2.8	0.5	9.4	2.6	4.2	0.0	7.7	6.1	0.5
W.D.	A,B	A,B	B	A	A,B	A,B	B	A,B	A,B	A,B

Table 9. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee study site during each June from 1994 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	189	13	527	1	9	43	946	19	61	115	0	0	1	64	68
2	284	48	36	5	100	97	17	41	61	54	51	5	41	3	27
3	89	16	128	103	90	97	24	70	139	6	186	53	56	21	84
4	338	14	269	13	18	34	196	93	24	0	0	31	1	47	25
5	650	14	1878	25	16	105	99	430	90	10	4	36	4	94	128
6	234	22	210	37	0	137	75	48	204	3	8	83	19	12	37
7	81	4	73	3	4	29	115	47	170	57	2	49	5	20	27
8	0	1	0	3	0	2	5	8	1	0	0	3	2	8	19
9	169	43	498	23	40	158	84	57	563	7	2	15	20	60	42
10	10	0	76	1	3	10	0	33	62	1	0	22	7	15	2
11	1	0	0	0	0	0	0	0	12	2	0	2	0	62	1
12	281	0	415	30	0	638	1603	804	185	61	2	2	15	51	231
13	10	8	41	6	0	46	124	214	152	6	18	1	5	17	191
14	257	4	119	7	7	129	9	7	18	129	2	3	1	123	281
15	120	1	65	6	0	52	8	21	69	168	0	4	2	36	657
16	1	30	71	30	20	545	49	48	22	82	2	37	16	42	311
17	13	23	118	42	35	789	208	150	142	84	15	36	11	13	149
18	133	3	44	14	3	19	313	44	370	129	1	10	1	8	161
19	121	313	284	135	111	332	278	101	182	132	78	10	4	4	269
20	85	27	151	34	91	27	213	220	247	180	4	52	12	35	89
MEAN	153.3	29.2	250.2	25.9	27.4	164.5	218.3	122.8	138.7	61.3	18.8	22.7	11.2	36.8	140.0
S.D.	159.0	68.3	414.4	35.0	38.2	227.3	388.5	190.0	136.9	62.1	44.1	23.4	14.5	32.0	156.9
W.D.	A,B,C	D,E,F	A	D,E,F	D,E,F	A,B,C	A,B	B,C,D ,E,F	A,B,C ,D,E	C,D, E,F	F	E,F	F	D,E,F	A,B ,C,D

Table 10. Adult bay scallop density at each of 20 stations sampled in 1995 and 8 stations sampled in 2008 at the St. Marks study site. Scallop density at each station is reported per 600 m² transect.

STA	1995	2008
1	0	255
2	1	553
3	0	207
4	0	36
5	0	48
6	0	2
7	1	155
8	0	104
9	0	Z
10	0	Z
11	0	Z
12	0	Z
13	1	Z
14	1	Z
15	1	Z
16	1	Z
17	1	Z
18	0	Z
19	0	Z
20	0	Z
MEAN	0.5	170.0
S.D.	0.6	177.7

Table 11. Adult bay scallop density at each of 20 stations sampled at the St. Joseph Bay study site during each June from 1994 through 2008. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	16	1	4	2	0	1	0	0	11	0	2	2	0	113	1
2	2	1	64	10	0	35	9	0	48	1	2	3	7	112	5
3	12	6	2	3	0	10	22	0	26	5	1	6	13	36	7
4	1	2	0	0	12	11	18	0	42	8	1	0	7	60	4
5	8	67	2	2	0	29	5	0	32	2	1	1	14	8	6
6	15	205	114	19	3	43	3	0	4	0	0	2	56	22	3
7	5	114	55	7	4	30	0	0	79	4	0	1	69	17	4
8	265	348	140	93	90	105	4	41	243	30	0	486	48	90	46
9	61	118	43	11	7	29	0	4	7	201	23	214	10	26	28
10	7	711	363	111	18	53	3	3	86	67	12	154	30	41	42
11	0	5	759	10	25	31	1	1	3	14	0	9	7	58	0
12	5	233	1143	40	26	13	1	167	46	54	0	30	5	49	29
13	3	195	369	62	45	9	0	4	59	26	0	2	121	11	4
14	19	270	820	10	2	4	0	10	30	5	5	28	22	26	9
15	5	11	44	1	9	22	0	0	0	2	0	22	2	16	0
16	9	14	228	14	10	5	0	0	1	5	0	20	32	14	0
17	2	44	282	2	7	7	0	1	0	3	0	9	13	11	0
18	1	25	240	0	4	7	1	0	0	10	0	20	84	10	0
19	2	17	179	7	5	14	0	1	3	42	0	12	14	13	0
20	279	257	103	142	2	164	10	10	30	95	0	165	159	92	38
MEAN	35.9	132.2	247.7	27.3	13.5	31.1	3.9	12.1	37.5	28.7	2.4	59.3	35.7	41.3	11.3
S.D.	81.9	175.5	312.2	41.5	21.3	48.3	6.3	37.6	55.2	48.2	5.6	118.3	43.0	35.1	15.6
W.D.	C	B	A	C	C	C	C	C	C	C	C	C	C	C	C

Table 12. Adult bay scallop density at each of 7 stations sampled at the Crooked Island Sound study site during each June from 1994 through 2007. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
14	23	2	2	0	0	0	0	0	1	0	0	0	0	0
15	0	9	7	0	0	8	0	0	1	2	13	0	4	8
16	0	1	0	0	0	0	0	0	6	0	0	2	0	0
17	2	0	0	0	0	0	0	0	3	1	0	2	0	0
18	5	3	1	0	1	0	0	0	4	0	0	7	2	0
19	24	1	13	3	0	8	1	0	0	0	6	0	0	1
20	0	1	5	3	4	4	0	0	1	1	0	0	0	3
MEAN	7.7	2.4	4.0	0.9	0.7	2.9	0.1	0.0	2.3	0.6	2.7	1.6	0.9	1.7
S.D.	10.9	3.1	4.8	1.5	1.5	3.8	0.4	0.0	2.1	0.8	5.1	2.6	1.56	3.0
W.D.	A	A,B	A,B	B	B	A,B	B	B	A,B	B	A,B	B	B	B

Table 13. Adult bay scallop density at each of 13 stations sampled at the St. Andrew Bay study site during each June from 1994 through 2006, and for those same 13 stations plus an additional seven stations added for the 2007-2008 survey. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means only for the original 13 sample stations for which the experimental design was balanced; similar letters denote averages that were not different at a significance level of 0.05. The 'Z' indicates that the station was not sampled during that year. Note that the mean and standard deviation for each of 2007 and 2008 presented in the table are calculated from the original 13 stations only.

STA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	1	4	12	1	1	0	0	0	1	2	3	10	0	2	1
2	5	13	6	5	0	0	2	0	0	15	1	10	0	4	1
3	70	16	155	9	0	1	2	0	2	3	0	2	0	2	1
4	244	8	23	0	0	1	1	0	1	5	0	24	0	12	2
5	50	1	20	2	2	0	0	0	12	2	0	3	0	5	2
6	96	20	13	0	0	1	0	0	5	2	0	8	0	5	0
7	144	6	2	0	2	4	0	0	7	1	1	8	0	2	7
8	173	13	11	0	31	3	1	0	7	1	3	41	0	0	0
9	149	8	39	1	0	0	1	1	7	5	0	12	0	6	0
10	68	0	26	1	0	5	1	0	36	3	0	37	0	8	0
11	69	5	5	0	1	9	12	0	38	83	0	13	0	2	2
12	6	2	6	4	0	1	1	0	0	4	1	1	0	4	5
13	6	2	56	8	1	2	2	0	25	1	0	7	2	3	1
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	0	1
15	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	3	0
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	0	19
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	0	0
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	0	0
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	2	0
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	0	0
MEAN	83.2	7.5	28.8	2.4	2.9	2.1	1.8	0.1	10.9	9.8	0.7	13.5	0.1	4.2	1.7
S.D.	75.6	6.3	40.9	3.2	8.5	2.6	3.2	0.3	13.4	22.3	1.1	12.7	0.5	3.1	2.1
W.D.	A	C	B	C	C	C	C	C	C	C	C	B,C	C	C	C

Table 14. Adult bay scallop density at each of 20 stations sampled at the Pensacola Bay study site during each June from 1995 and 2002 through 2005. Scallop density at each station is reported per 600 m² transect. Results of the Waller-Duncan (W.D.) comparison of means (letters) are presented with the population means; similar letters denote averages that were not different at a significance level of 0.05.

STA	1995	2002	2003	2004	2005
1	0	0	0	0	0
2	0	1	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	1	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	1	0	0
14	0	0	4	0	0
15	0	1	2	0	0
16	0	0	4	0	0
17	0	0	1	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
MEAN	0.0	0.2	0.6	0.0	0.0
S.D.	0.0	0.4	1.3	0.0	0.0
W,D.	B	B	A	B	B

Figure 1. Bay Scallop study sites.



Figure 2. Bay scallop annual abundances. Asterisks denote years in which scallop surveys were not performed.

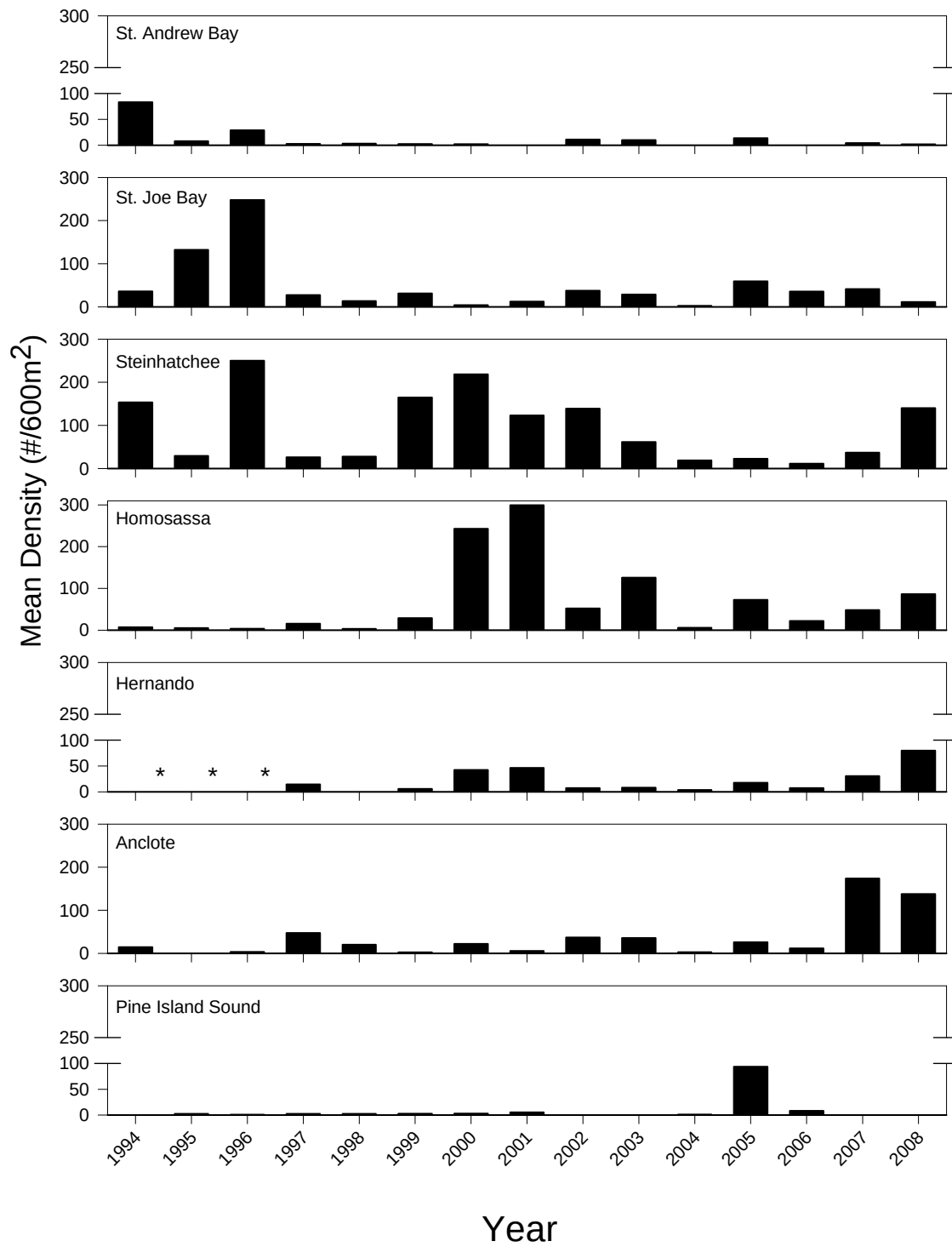


Figure 3. Survey and recruitment monitoring stations in A) Pine Island Sound, B) Charlotte Harbor, C) Sarasota County, and D) Sarasota Bay. Blue numbers represent survey stations and black squares represent recruitment monitoring stations. In Pine Island Sound (A) the dotted line divides the areas designated as north and south, and the white squares represent the discontinued configuration of recruitment collectors.

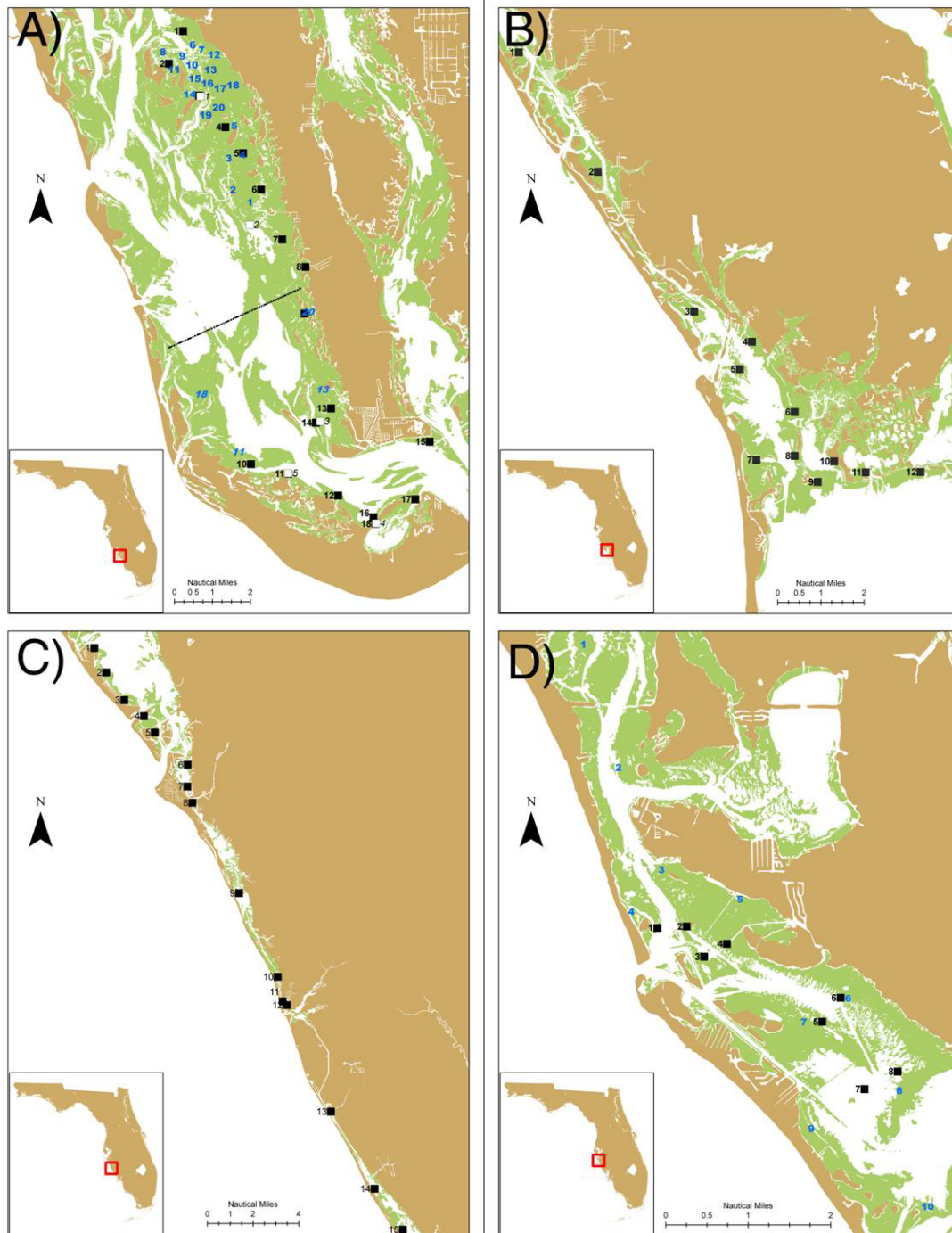


Figure 4. Survey and recruitment monitoring stations in A) Tampa Bay, B) Anclote, C) Hernando, and D) Homosassa. Blue numbers represent survey stations and black squares represent recruitment monitoring stations.

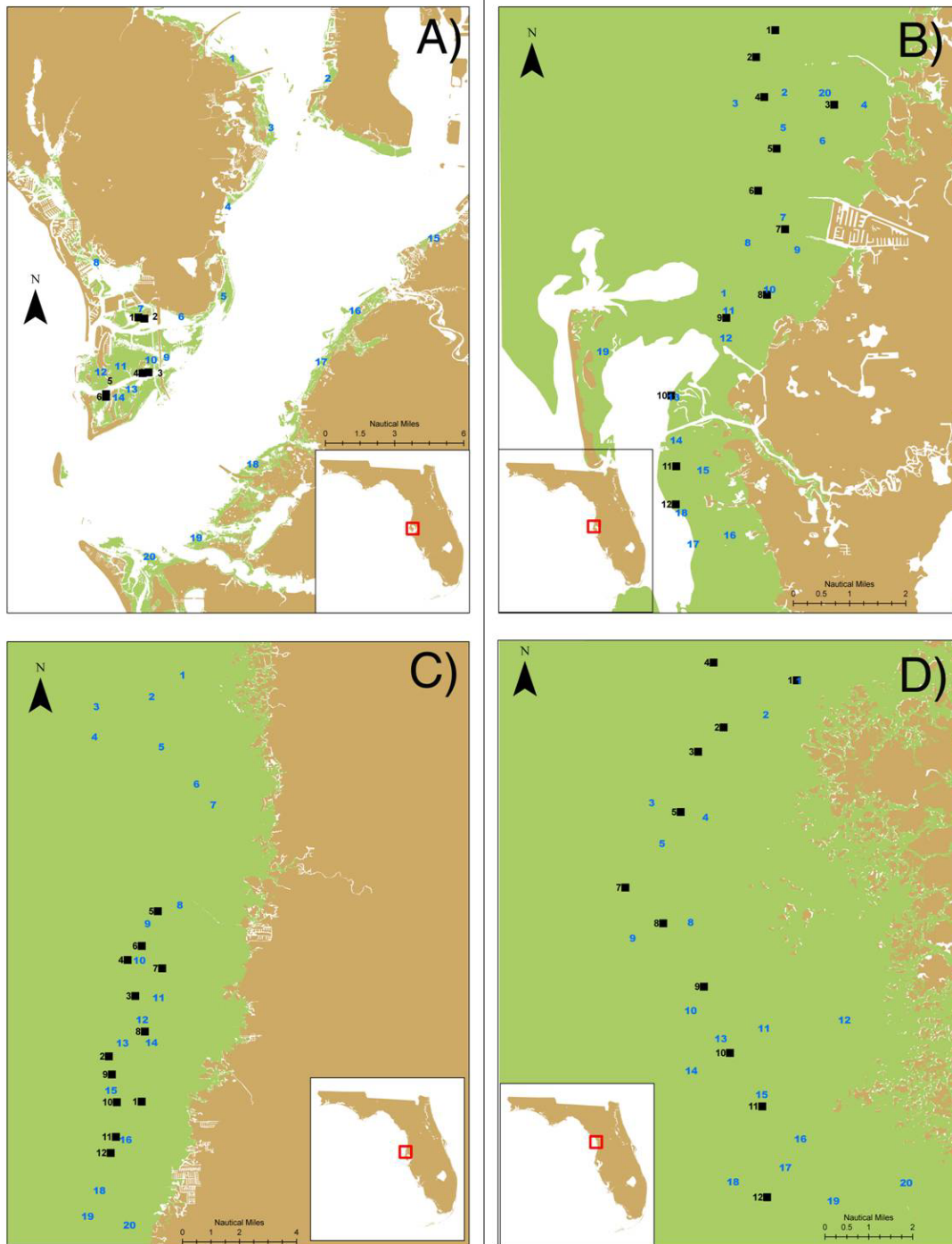


Figure 5. Survey and recruitment stations in A) Cedar Key, B) Steinhatchee, C) Keaton Beach, St. Marks, and Alligator Harbor, and D) St. Joseph Bay. Blue numbers represent survey stations and black squares represent recruitment monitoring stations.

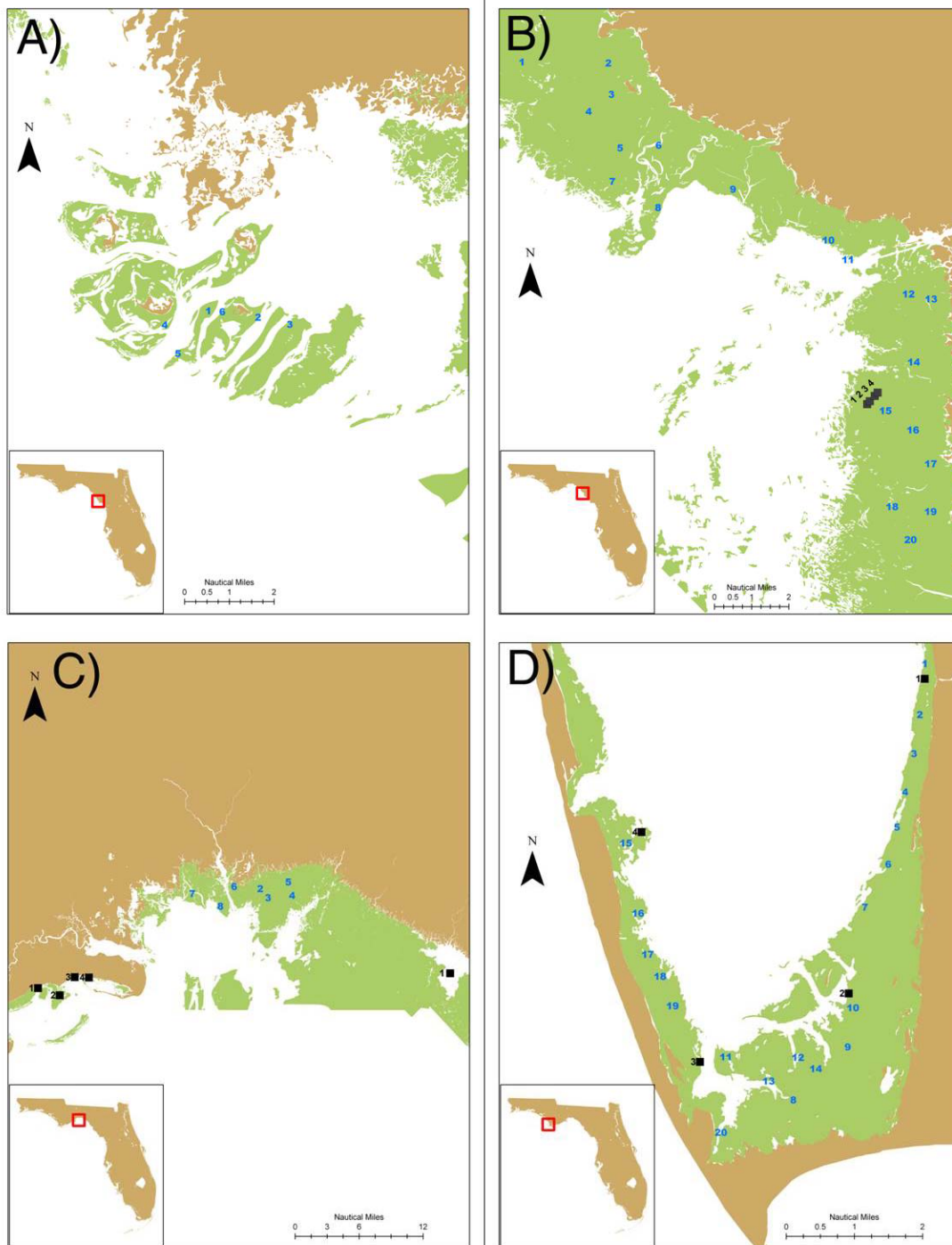


Figure 6. Survey and recruitment stations in A) Crooked Island Sound, B) St. Andrew Bay, and C) Pensacola Bay. Blue numbers represent survey stations and black squares represent recruitment monitoring stations.

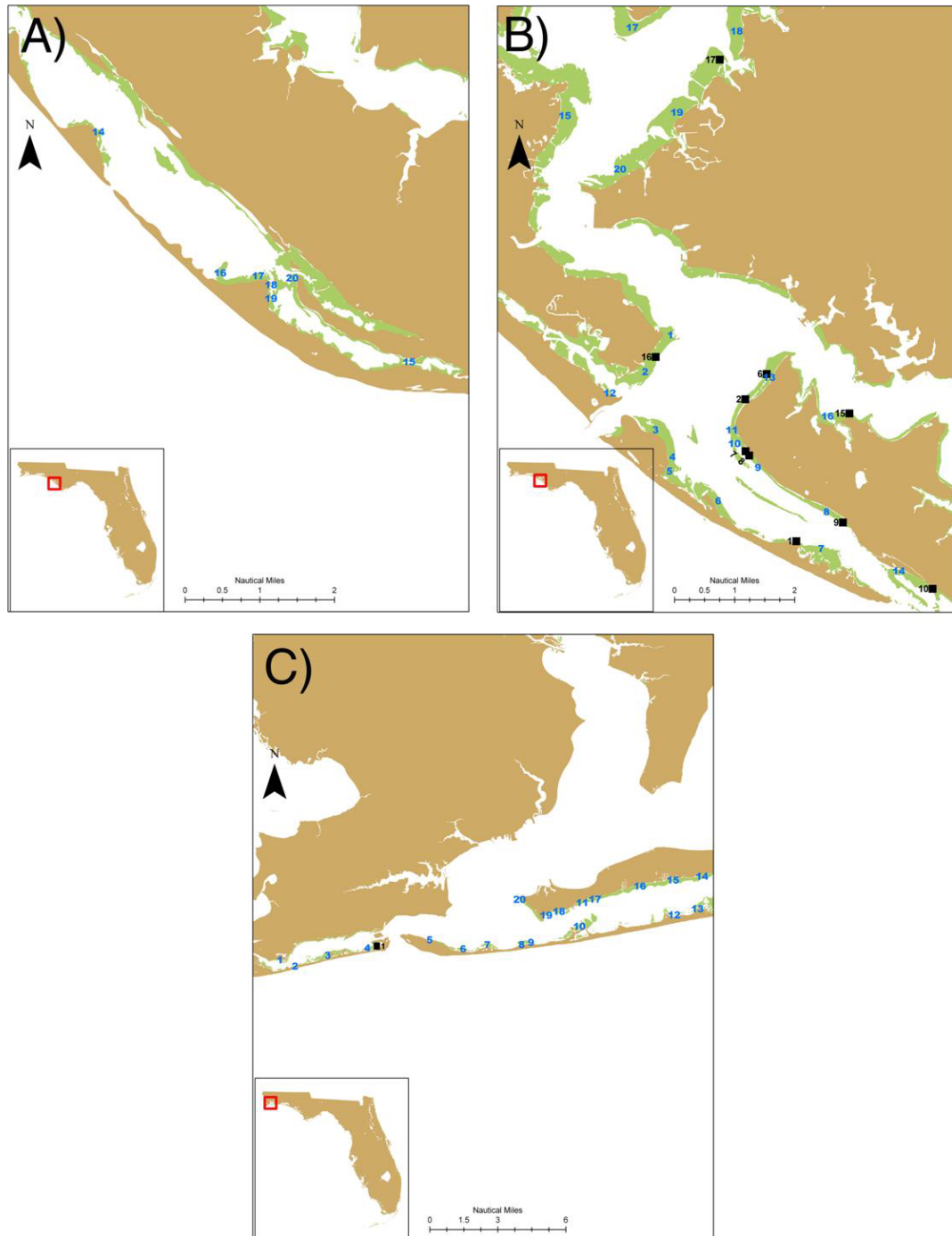


Figure 7. Average daily recruitment of bay scallops to collectors at the Pine Island Sound study site during 2008. Asterisks denote lost traps. Shaded areas denote discontinued or pre-recruitment periods.

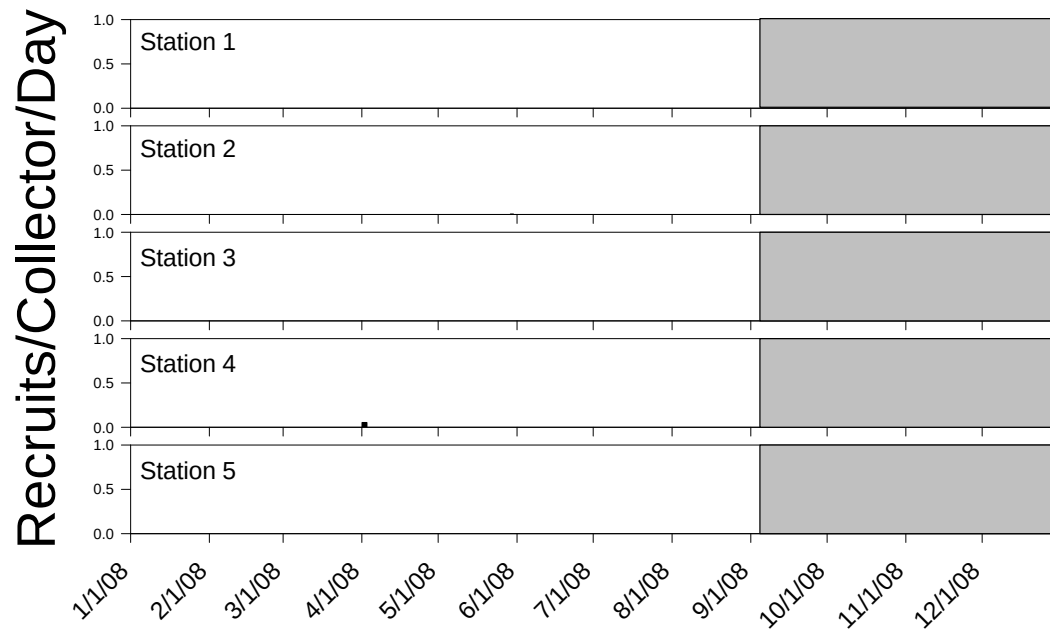


Figure 7 continued

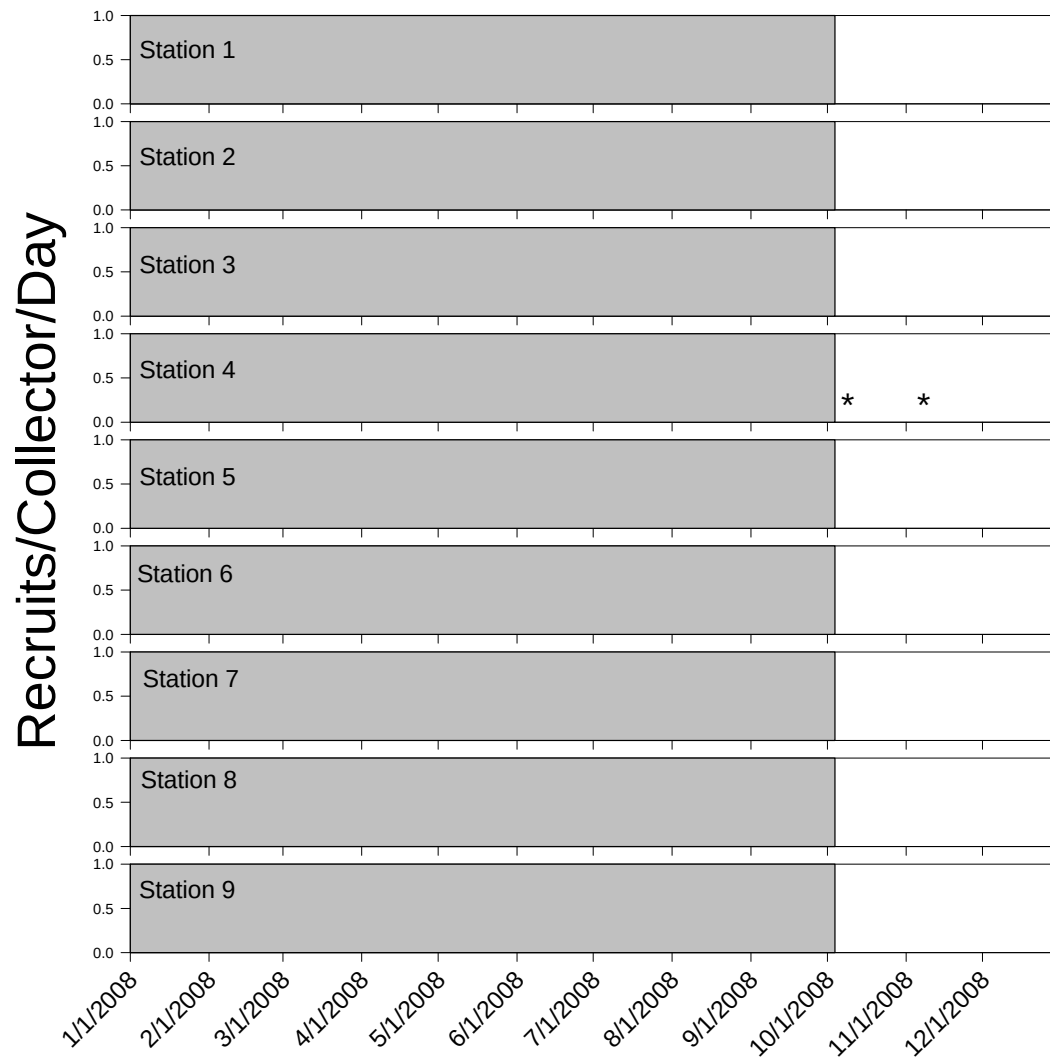


Figure 7 continued

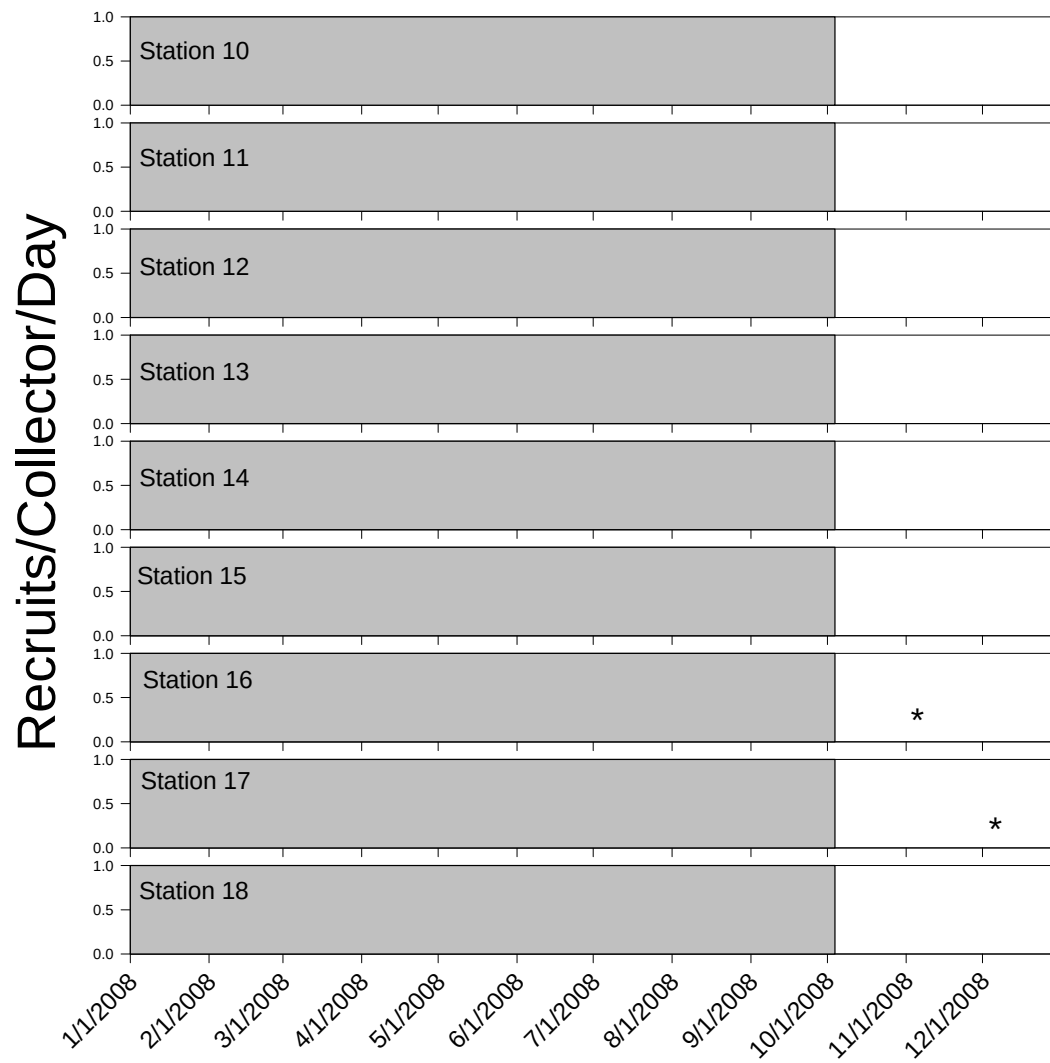


Figure 8. Average daily recruitment of bay scallops to collectors at the Sarasota County study site during 2008. Shaded areas denote pre-recruitment periods and asterisks denote lost traps.

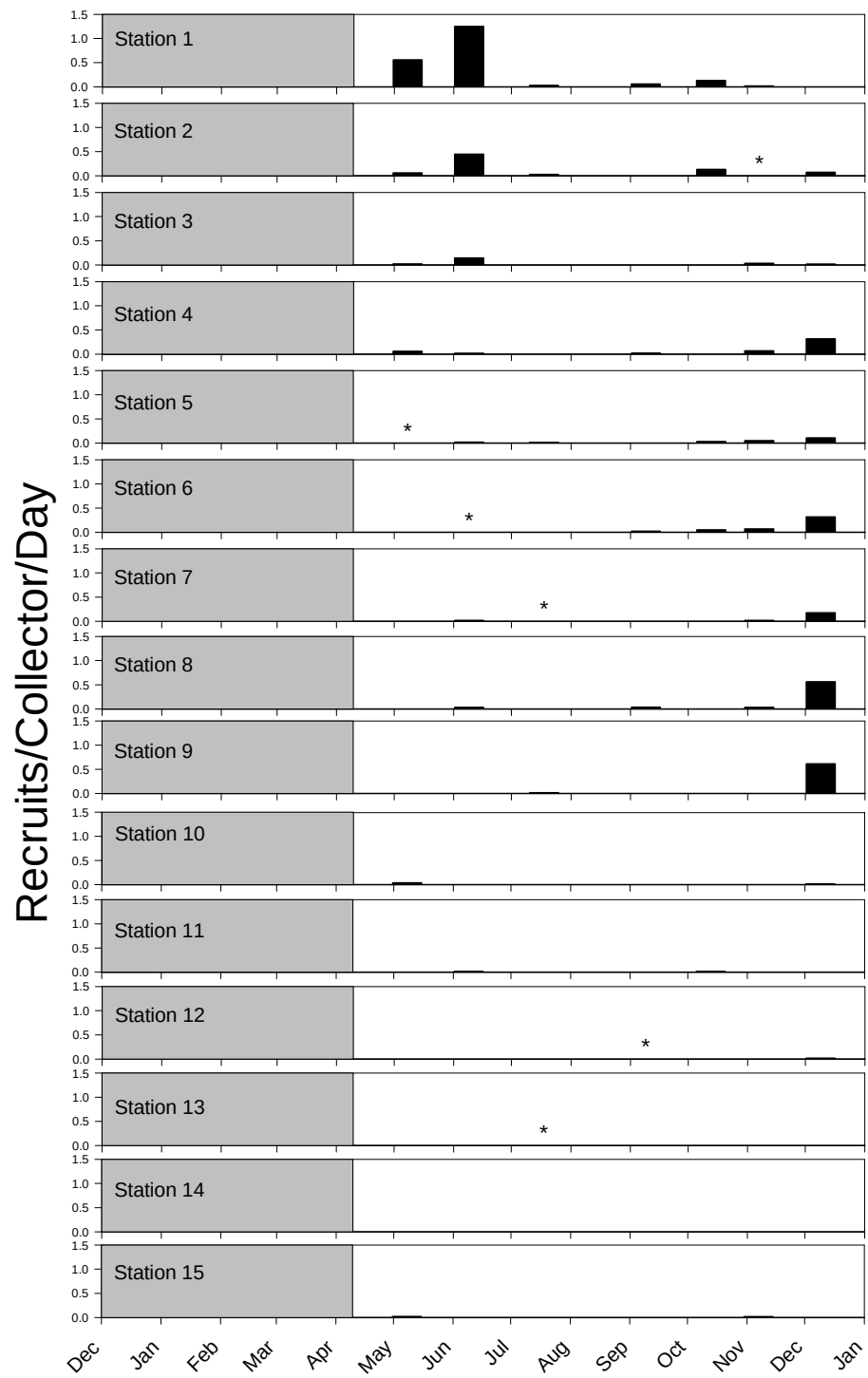


Figure 9. Average daily recruitment of bay scallops to collectors at the Sarasota Bay study site during 2008. Asterisks denote lost traps.

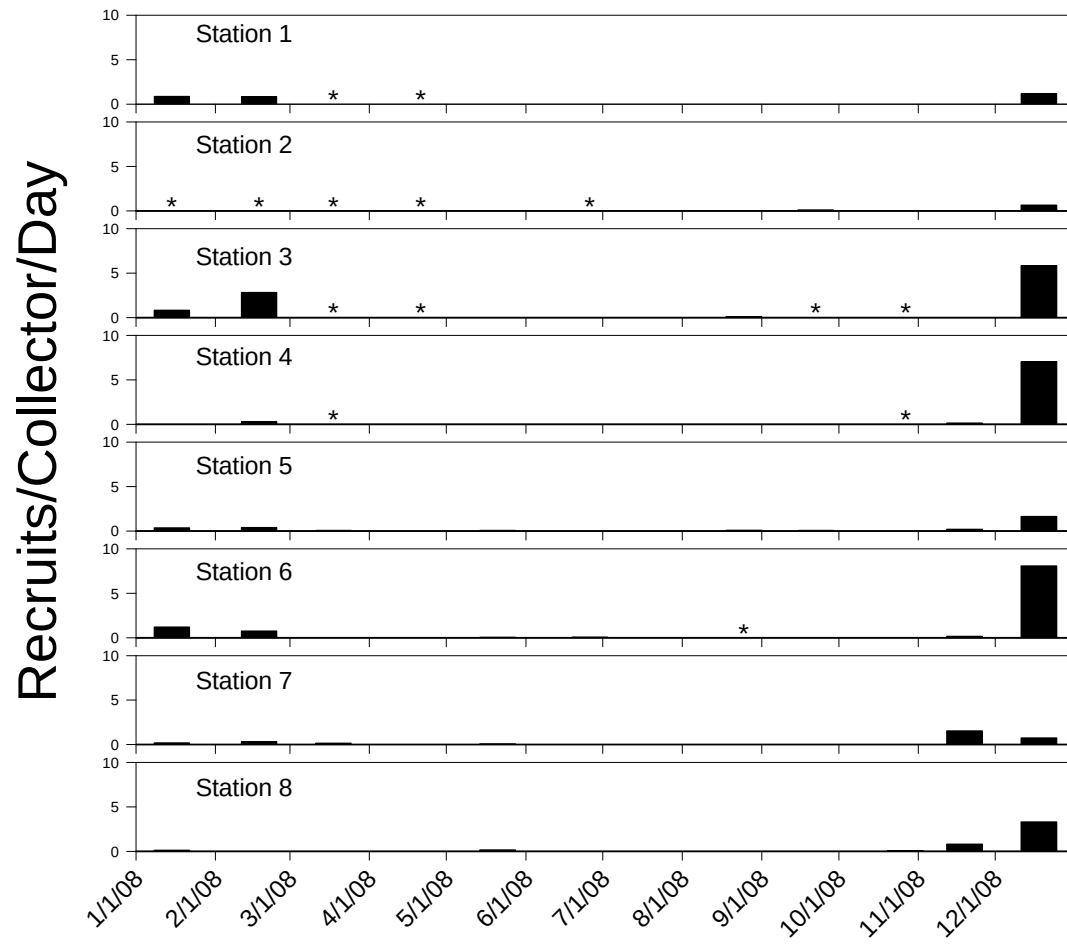


Figure 10. Average daily recruitment of bay scallops to collectors at the Tampa Bay study site during 2008. Asterisks denote lost traps.

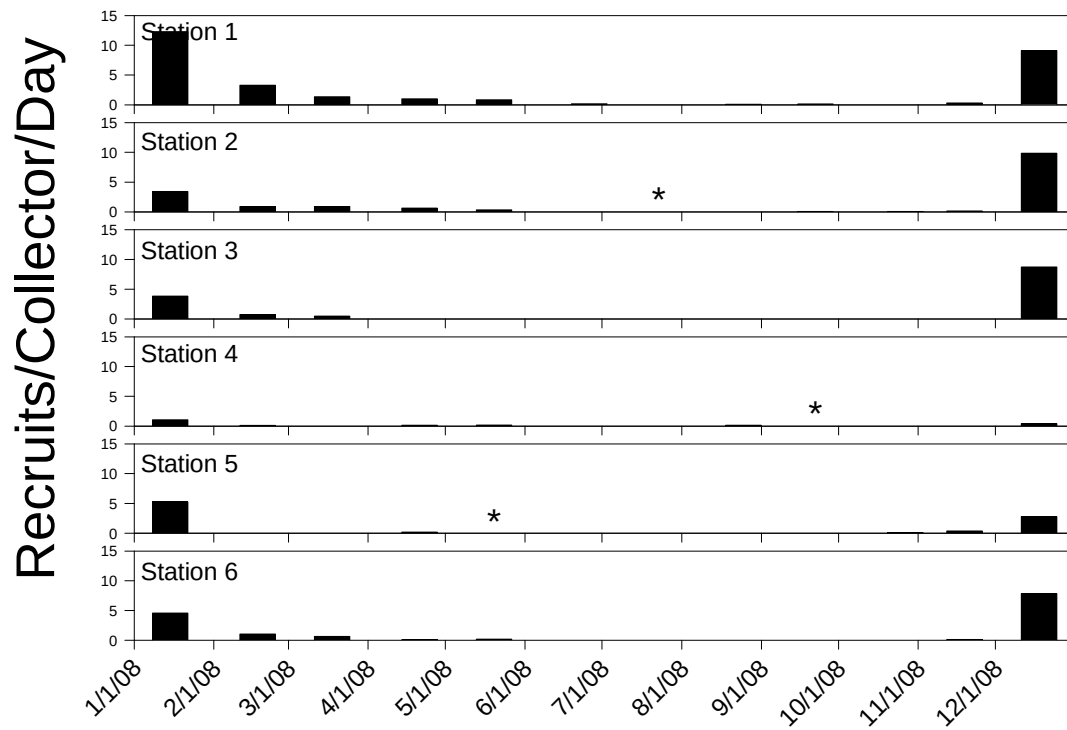


Figure 11. Average daily recruitment of bay scallops to collectors at the Ancote study site during 2008. Asterisks denote lost traps.

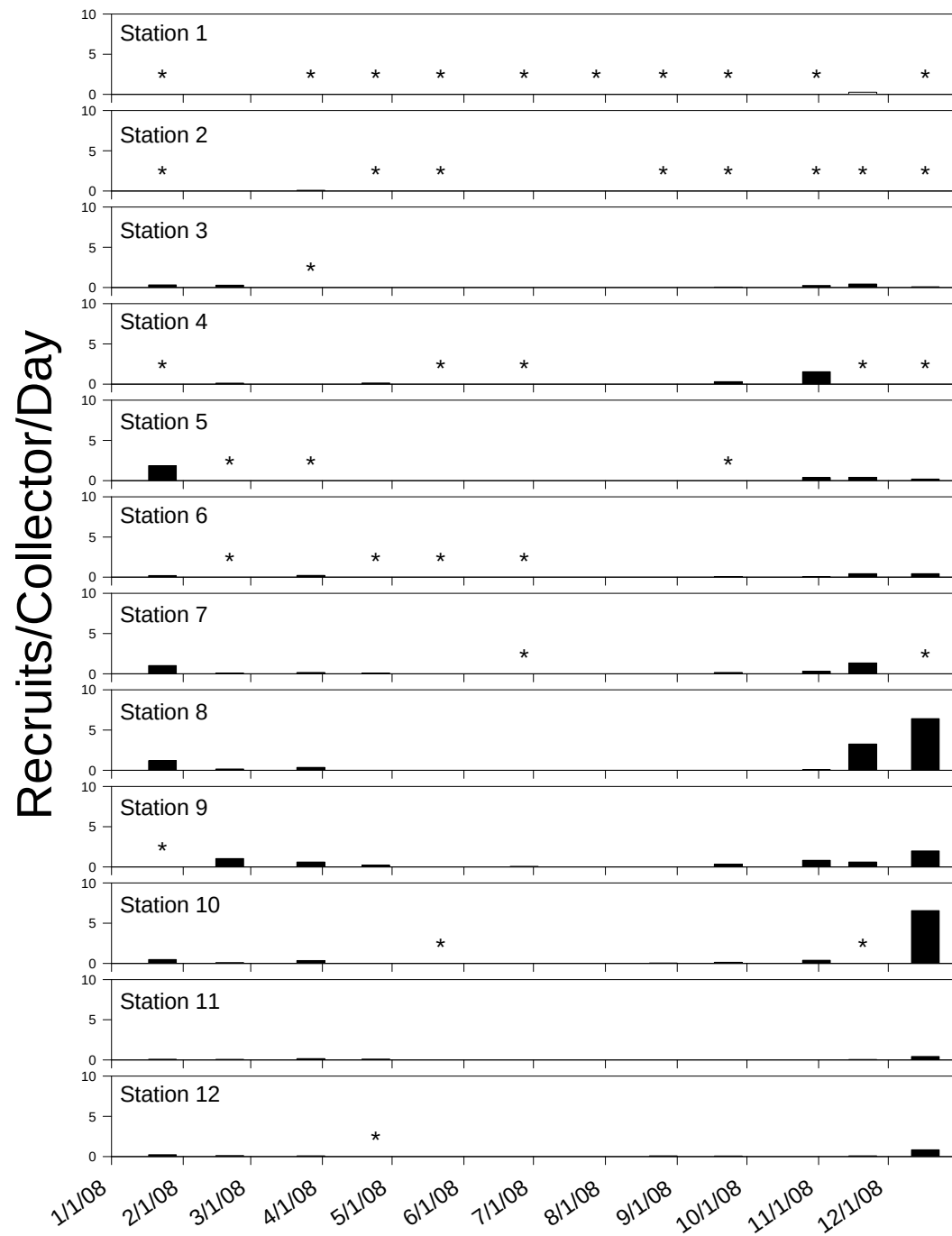


Figure 12. Average daily recruitment of bay scallops to collectors at the Hernando study site during 2008. Asterisks denote lost traps.

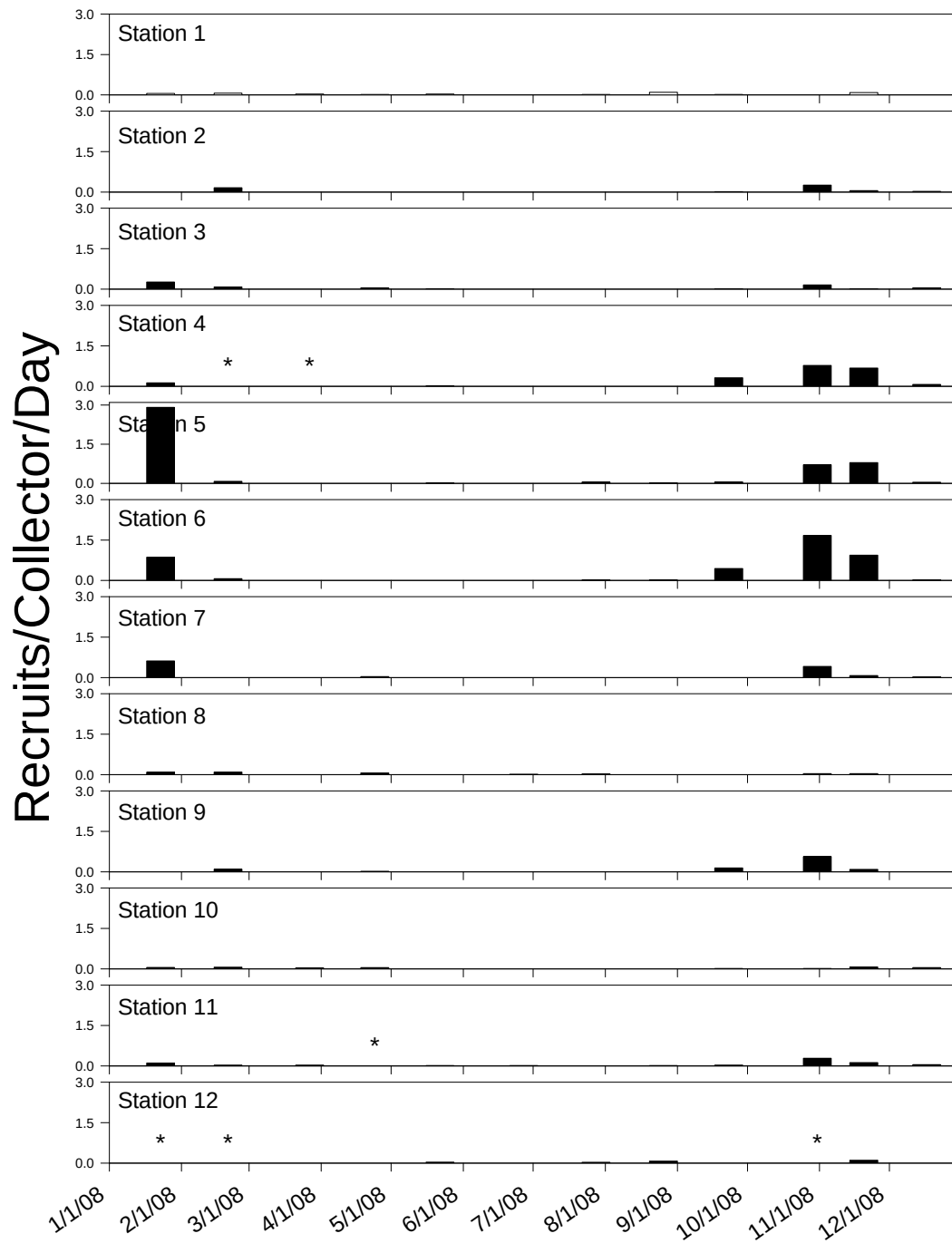


Figure 13. Average daily recruitment of bay scallops to collectors at the Homosassa study site during 2008. Asterisks denote lost traps.

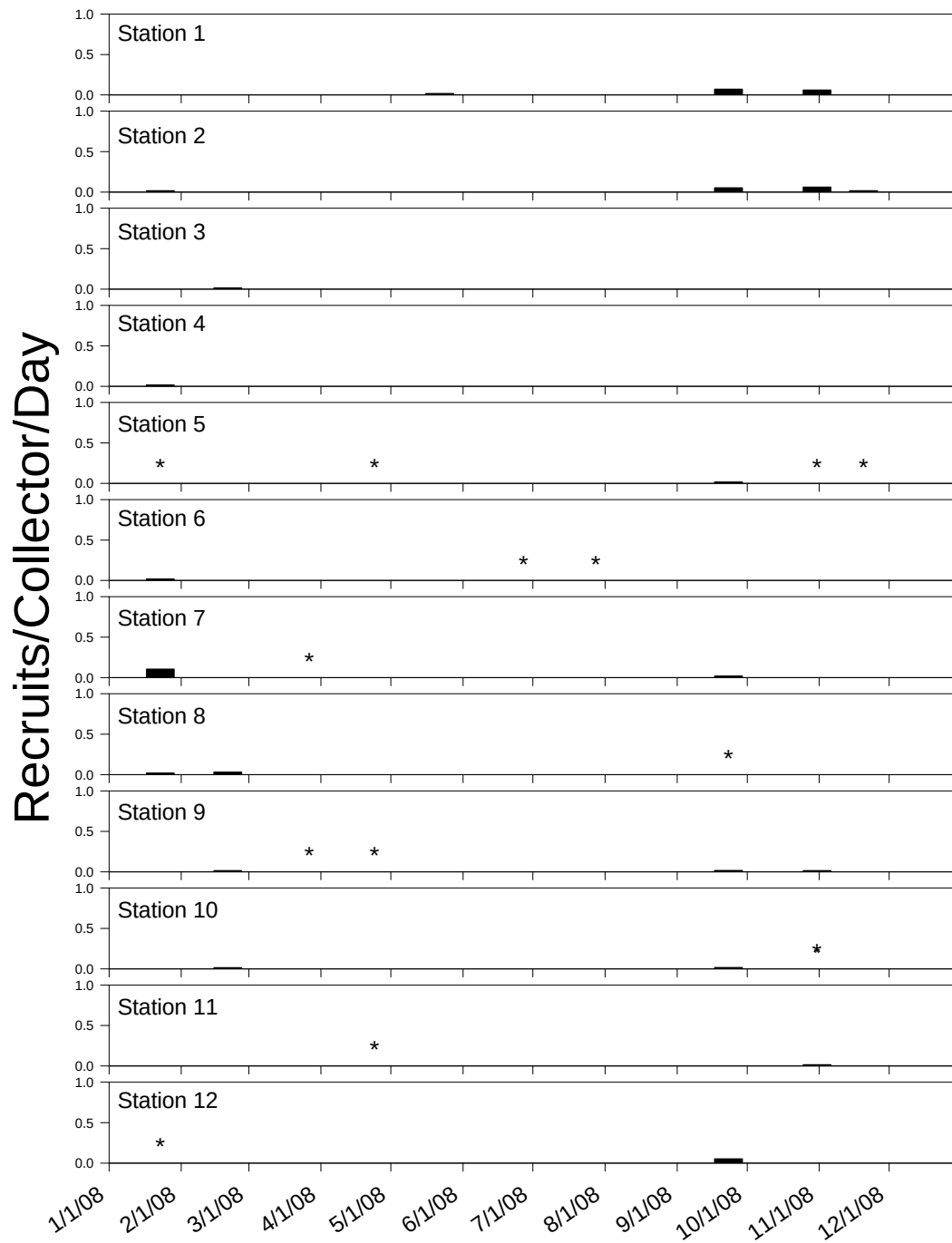


Figure 14. Average daily recruitment of bay scallops to collectors at the Steinhatchee study site during 2008. Asterisks denote lost traps.

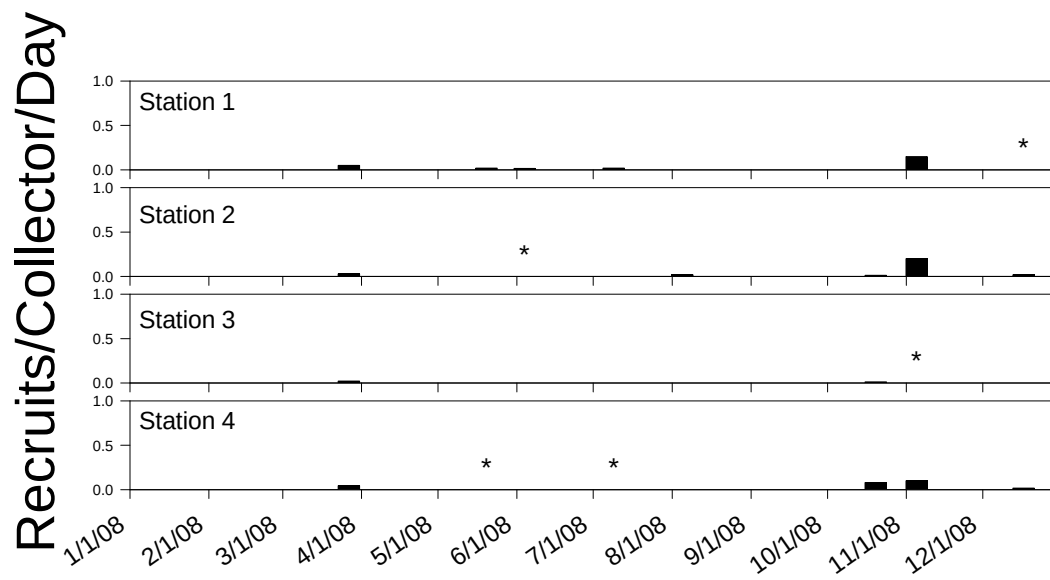


Figure 15. Average daily recruitment of bay scallops to collectors at the St. Joseph Bay study site during 2008. Asterisks denote lost traps.

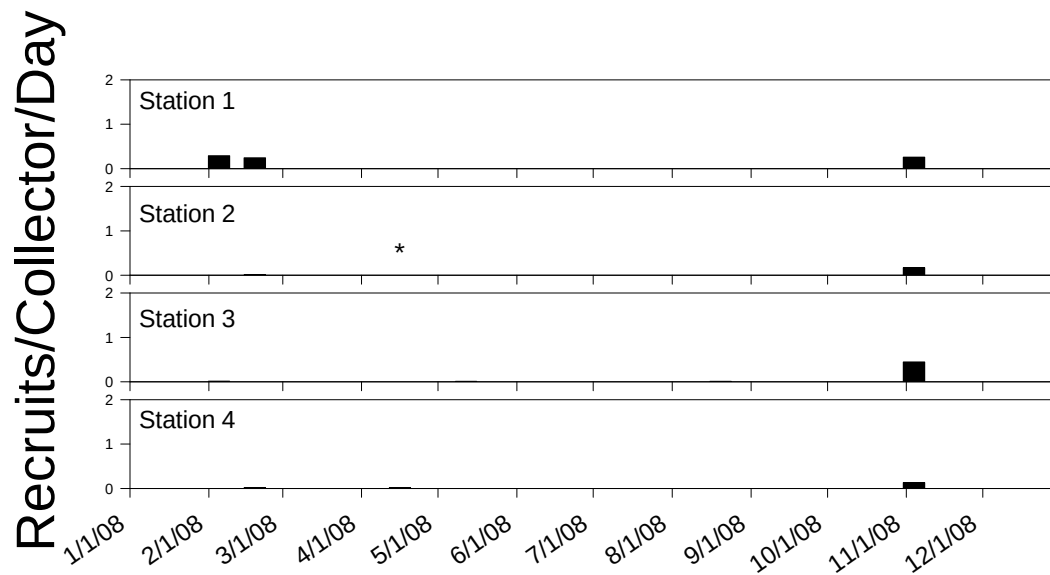


Figure 16. Average daily recruitment of bay scallops to collectors at the St. Andrew Bay study site during 2008. Asterisks denote lost traps.

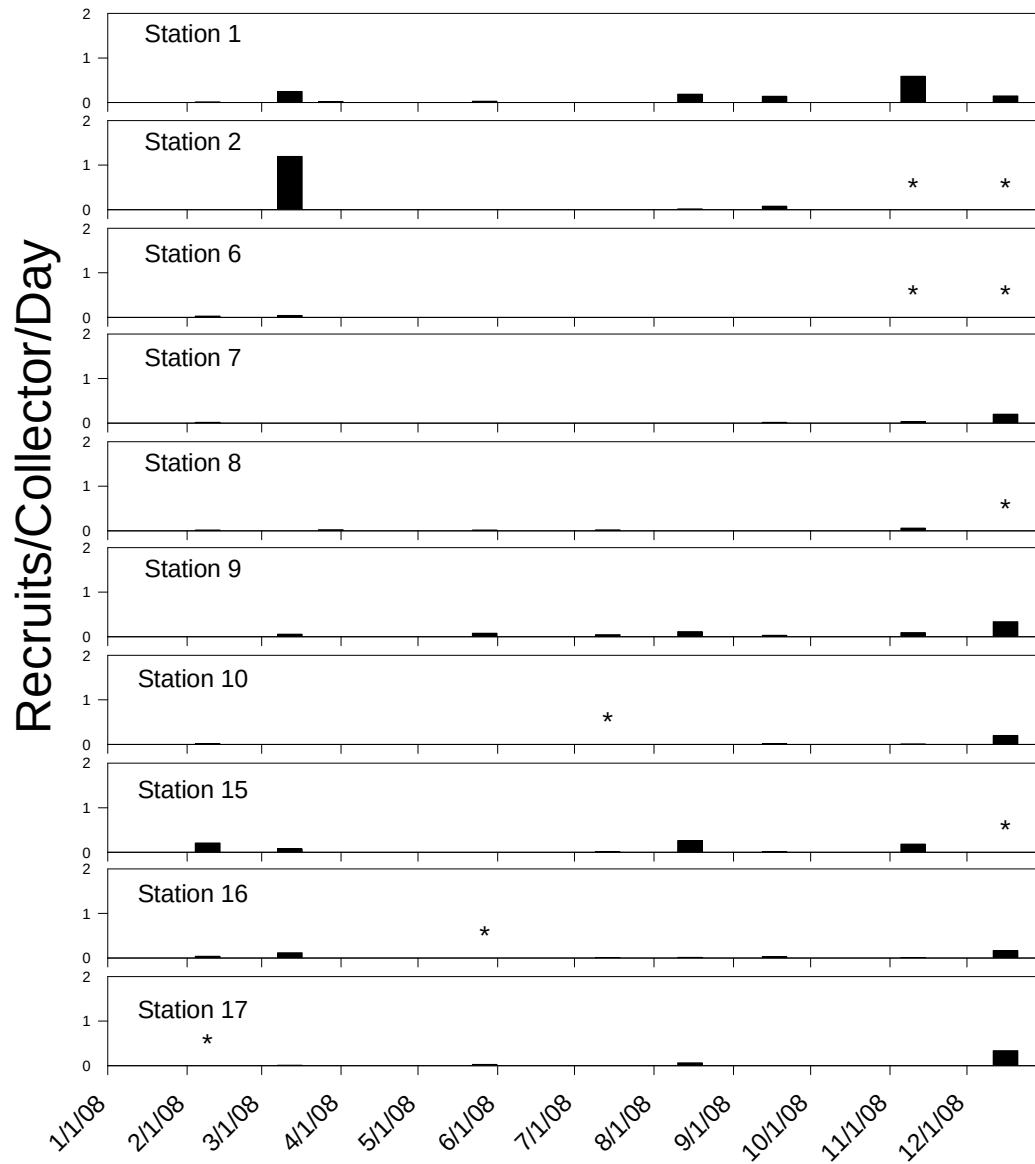


Figure 17. Restoration sites in A) Pine Island Sound, B) Sarasota Bay system, C) Tampa Bay and D) St. Andrew Bay. Black numbers indicate the number of scallops that were released. Numbers > one million represent larval releases, and those less than one million represent juvenile releases.

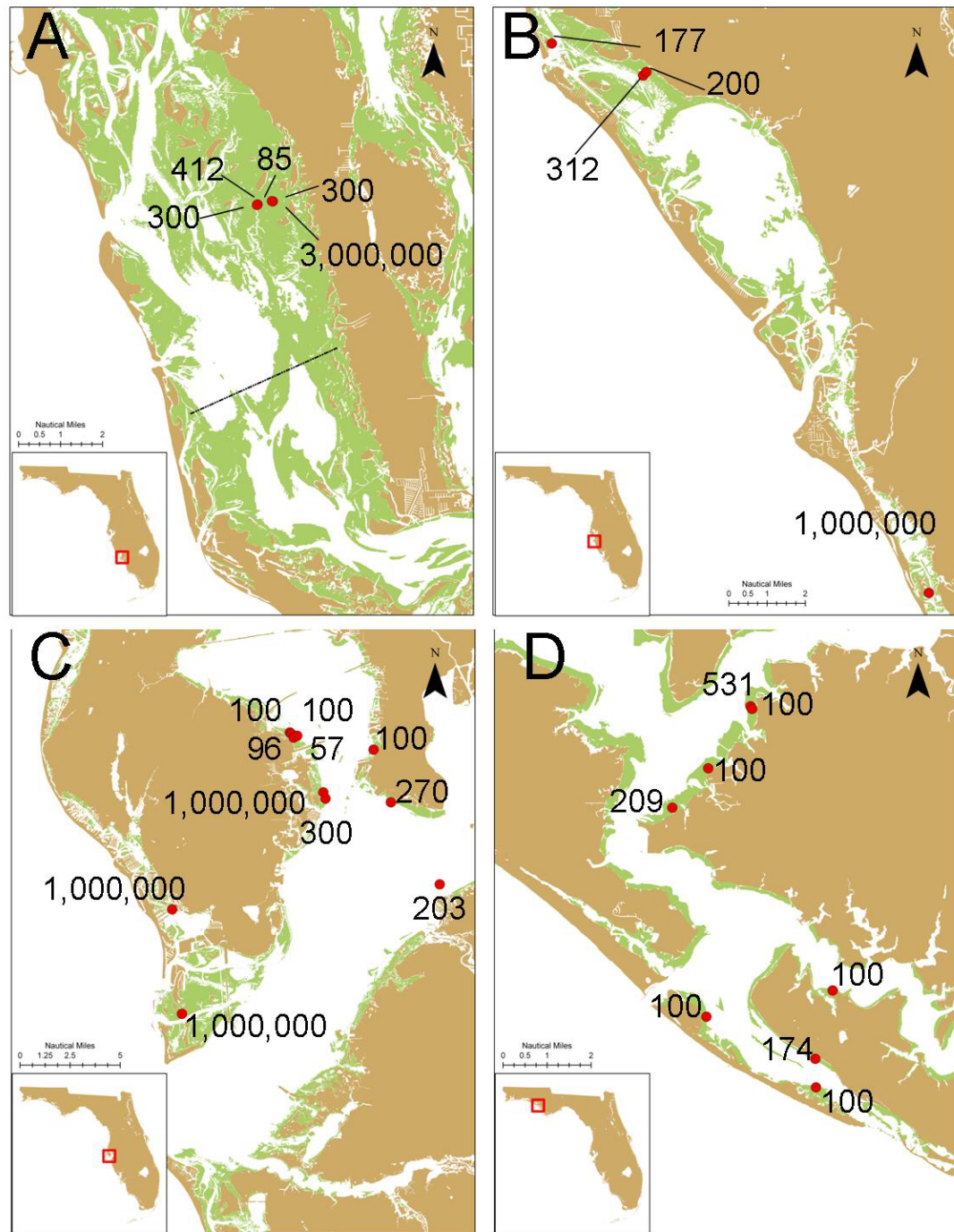


Figure 18. Restoration sites and survey stations in Pensacola Bay. Black numbers indicate the number of juvenile scallops released.

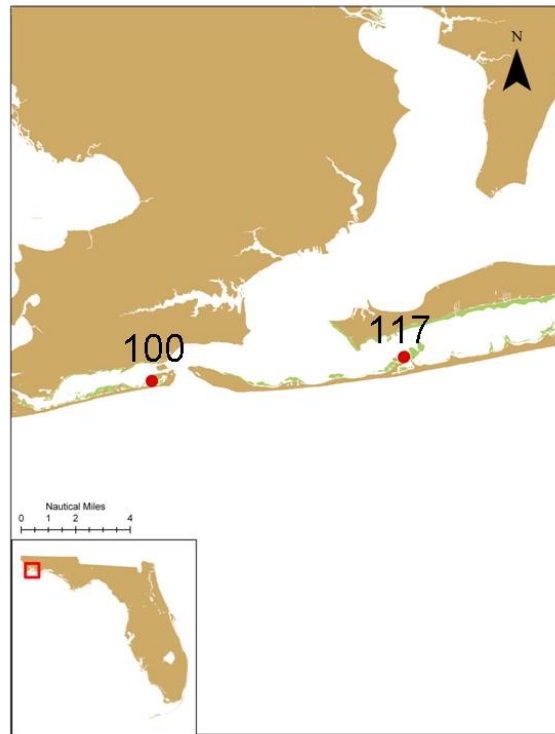


Figure 19. Growth (A) and mortality (B) plots for Sarasota County volunteer-based scallop restoration cages.

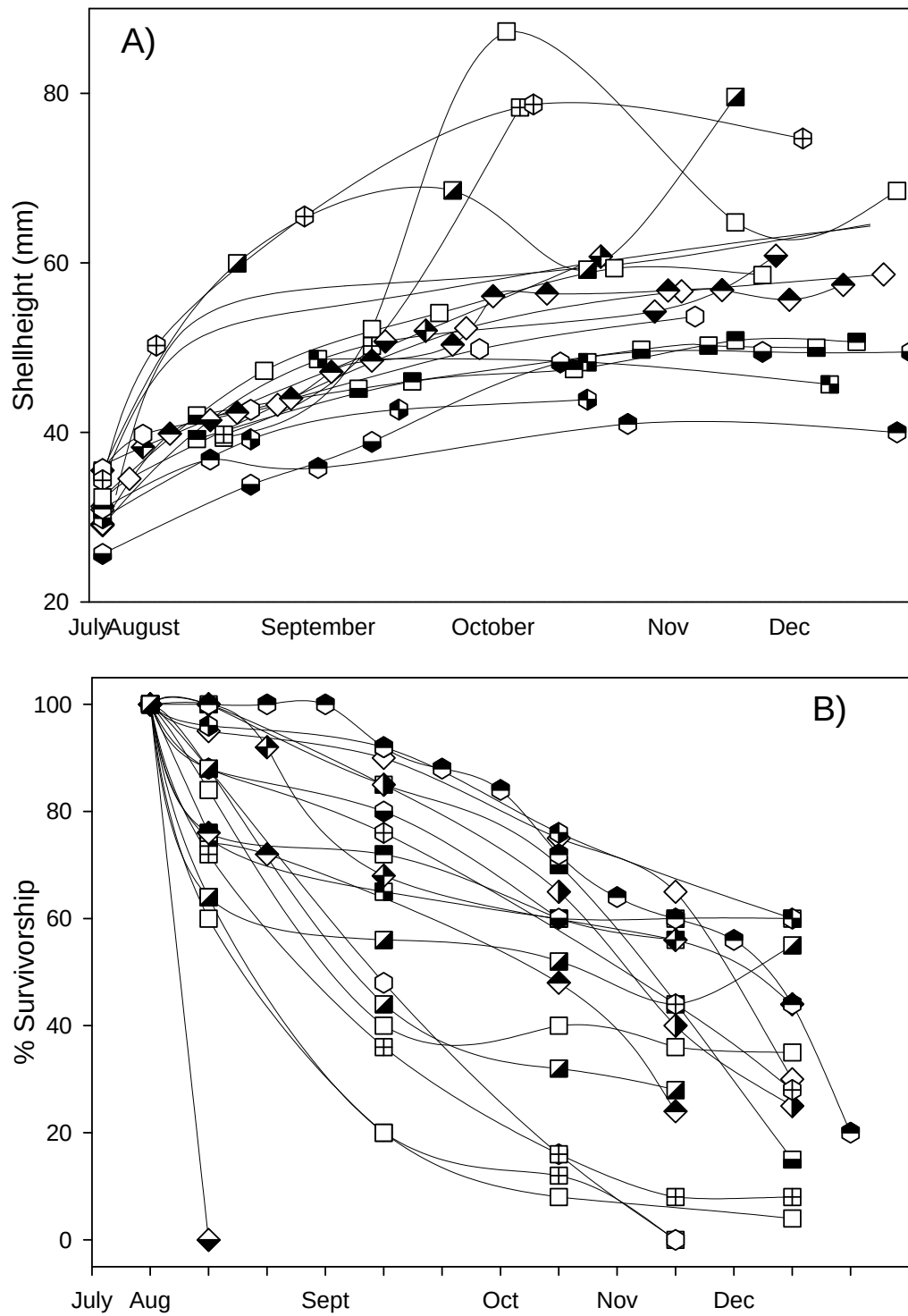


Figure 20. Scallop mortality plot for Tampa Bay volunteer-based scallop restoration cages monitored by Tampa Bay Watch staff.

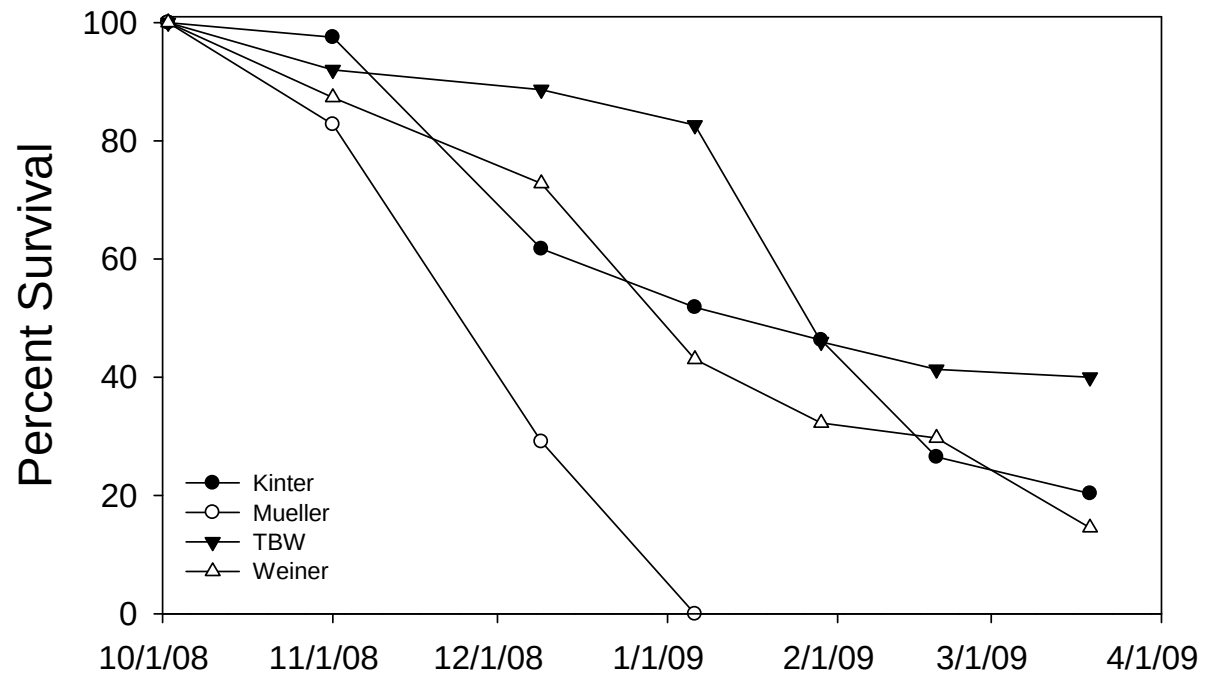


Figure 21. Shell height (A), weekly growth rate (B), and mortality rate (C) comparisons between bay scallop and calico scallop species grown in Bayboro Harbor.

