ANNUAL REPORT
OF THE
BAY SCALLOP PROJECT

1999

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INTRODUCTION

This report summarizes bay scallop (*Argopecten irradians*) research conducted by the Florida Marine Research Institute Molluscan Fisheries research group during 1999. We report the results of adult population surveys conducted at a variety of sites along the Florida west coast between Pine Island Sound in the south and St. Andrew Bay in the northwest. The intent of these 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 or restoration efforts instituted by the State of Florida since 1995. In 1995, the Florida Marine Fisheries Commission (now the Florida Fish and Wildlife Conservation Commission) modified bay scallop harvesting regulations to eliminate all commercial fishing for the animal in State waters, to close the recreational fishery south of the Suwannee River, to reduce the length of the recreational fishing season from nine months to three months (later modified to two months and then to two months and ten days), and to reduce the recreational bag limit from five gallons of whole animals to two gallons of whole animals with a boat limit of 10 gallons of whole animals (Arnold et al., 1999). In 1997, the Florida Marine Research Institute initiated a federally funded bay scallop restoration program with the objective of creating concentrated "patches" of spawners and utilizing state-of-the-art genetic techniques to assess the contribution of those spawner patches to future generations. The restoration program is ongoing and will be discussed only briefly in this report. That program is scheduled to conclude in June, 2001, and a final report will be submitted to the federal granting agency and to the Florida Fish and Wildlife Conservation Commission at that time.

In conjunction with our adult monitoring activities, we also monitor various biological and physical factors at a subset of the sites where adult surveys are conducted. We monitor recruitment in the area between Anclote and Crystal River (Figure 1) to determine if recruitment rates are increasing in response to management or restoration efforts (Marelli et al., 1999) and to genetically assess the relative contribution of recruits from naturally occurring versus "planted" scallops. In conjunction with that effort, we monitor water temperature, salinity, water clarity, and phytoplankton abundance to determine what combination of environmental factors may be influencing recruitment success at various areas along the coast. At St. Joseph Bay in the Florida panhandle (Figure 1), we monitor bay scallop recruitment in what we consider to be a relatively healthy population (Arnold et al., 1998) to provide a baseline against which to compare recruitment in the relatively depauperate peninsular populations. These water quality and recruitment monitoring activities are designed to provide a framework within which to assess the success of our management and restoration strategies. The genetic program will allow us to assess the relative contribution of management versus restoration efforts to scallop population abundance.

ADULT POPULATION SURVEYS

Consistent with the 1998 survey (e.g., Arnold et al., 1999), our 1999 adult scallop sampling protocol consisted of diver transect surveys at replicate and randomly-located stations at each of eight study sites (see below). At each station, we deployed one diver on each side of a 300 m transect line and searched the area within 1 m of the line along its length. All scallops within that 2 m x 300 m area were counted and shell height (SH = maximum distance from umbo to ventral margin) determined for a maximum of 30 specimens.

Surveys of adult bay scallop abundance were conducted in Pine Island Sound, Anclote estuary, Hernando, Homosassa Bay, Cedar Keys, Steinhatchee, St. Joseph Bay, and St. Andrew Bay/Sound (Figure 1) during June, with follow-up surveys conducted in Homosassa Bay and St. Joseph Bay during September and October. Twenty stations were sampled at each site (except Cedar Keys) and, with the exception of Pine Island Sound (where the sampling stations were relocated after the 1994 survey), stations were repetitively sampled each year. Each station comprised a 600 m^2 survey area, so we sampled 12,000 m^2 of potential bay scallop habitat at all but the Cedar Keys study sites. At Cedar Keys, we sampled only six stations due to the limited extent of seagrass beds in that area.

Within each study site, the statistical significance of temporal changes in scallop density was determined using the Kruskal-Wallis procedure, a non-parametric equivalent of the one-way analysis of variance (Sokal & Rohlf, 1995). We used the Statistical Analysis System (SAS Institute Inc., 1985) procedure NONPAR1WAY, which provides a Chi-square approximation of the Kruskal-Wallis H statistic that is appropriate when sample size exceeds five per group (Sokal & Rohlf, 1995). This test allows us to evaluate the significance of the overall change in scallop density within each site among years. The Kruskal-Wallis test does not allow for a comparison among means when the overall difference is significant, and most multiple comparison tests are not suited for data such as ours where the median value may be zero.

June Survey

Pine Island Sound: Relative to previous years, scallop abundance remained low but stable in Pine Island Sound during 1999. We found scallops at seven of our 20 survey stations, but only three of those stations (17, 18 and 19; Figure 2) yielded more than five scallops per 600 m^2 transect (Table 1). Mean scallop abundance remains low in Pine Island

Sound and has not changed significantly over the last five years of our study (Figure 3; $\chi^2 = 2.5570$, $p = 0.6345$). During those five years, we have found that scallops are consistently abundant in a very restricted area of the Sound around stations 12, 13, 14, 15, 17, and 18 (Figure 2) and are relatively rare outside of that area. We did not include 1994 survey results in our statistical analyses because of the aforementioned change in survey station location after the 1994 survey (we found no scallops in Pine Island Sound during 1994).

Anclote Estuary: Our survey results suggest that 1999 was not a good year for scallops in the Anclote region. Mean abundance of adult scallops was an order of magnitude less in 1999 than in 1998 or 1997 (Table 2). This is reflective of the almost complete failure of scallop recruitment experienced in the Anclote region during fall 1998 and winter 1999 (Figure 4). Thus, scallop abundance continues to fluctuate substantially and significantly among years at Anclote ($\chi^2 = 50.699$, $p = 0.0001$), and those fluctuations are generally coincident with recruitment during the previous year. As in 1998, scallops were absent from most of our northern and central sampling stations but were relatively abundant at the southern sampling stations during 1999 (Figure 5; Table 2). The essential difference between Anclote scallop abundance in 1998 and 1999 was that the very dense population sampled at stations 16-19 during 1998 was absent during 1999.

Hernando: During the three years we have sampled the Hernando study area, scallop abundance has varied significantly among years (Table 3; $\chi^2 = 14.586$, $p = 0.0007$). Mean scallop abundance increased by an order of magnitude between 1998 and 1999, and most of that increase was concentrated at the north end of the study area around stations 2, 3, and 4 (Figure 6). That is the same area where we recorded large numbers of scallops during 1997, and the lack of scallops in that area during 1998 was largely responsible for the substantial decrease in mean scallop abundance recorded for the Hernando study area during 1998. However, we observed no relationship between recruitment and adult abundance at the Hernando study site. We did detect a low level of recruitment to spat collectors deployed in the Hernando region (Figure 7). However, that recruitment event was recorded almost exclusively from the area around Hudson (Figure 6) and not from the area north of Hernando Beach where we found the relatively dense patch of adult scallops.

Homosassa: We have conducted surveys of adult bay scallop abundance in Homosassa (Figure 8) since 1993, and during that time scallop density has experienced significant inter-annual variability (Table 4; $\chi^2 = 33.614$, $p = 0.0001$). In June 1997, we recorded a substantial increase in mean scallop abundance relative to all previous years (double the previous

[1993] peak), but during 1998 mean scallop abundance was again low in Homosassa. In June 1999, mean scallop abundance again doubled the previous (1997) peak. However, that substantial increase in adult abundance was not reflected in our recruitment data (Figure 9); we recorded essentially no recruitment at the Homosassa study site throughout 1998.

Cedar Keys: Scallop abundance increased slightly between 1998 and 1999 at the Cedar Keys study site (Table 5), but a determination of the significance of that trend will await at least one more year of data collection.

Steinhatchee: Scallop density continues to vary significantly among years at the Steinhatchee (Figure 10) study site (Table 6; $\chi^2 = 34.598$, $p = 0.0001$), but mean density recorded during June 1999 increased substantially relative to the previous two years. Steinhatchee remains one of the two most stable and abundant bay scallop populations in the state despite intense fishing pressure during the July 1-September 10 recreational fishing season. That attests to the ability of a healthy bay scallop population to support a reasonable level of fishing pressure.

St. Joseph Bay: This site (Figure 11) represents the other of the two most stable and abundant scallop populations in Florida. As with Steinhatchee, scallop density varies significantly among years at the St. Joseph Bay study site (Table 7; $\chi^2 = 26.360$, $p = 0.0001$). Mean abundance during 1999 was more than double that observed during 1998 although only about one-tenth that recorded during the peak year of 1996. Citizens in the nearby community of Port St. Joe remain concerned about the status of the bay scallop population in St. Joseph Bay. However, we consider this population to be healthy as defined by three factors: 1) the population is resilient because years of relatively low abundance are typically followed closely by years of relatively high abundance; 2) mean scallop abundance rarely falls below 25 scallops per 600 m^2 transect; and 3) scallops are widely distributed throughout our survey area rather than being concentrated at only a few stations. Nevertheless, scallop recruitment in St. Joseph Bay was sporadic throughout 1999 and almost non-existent during fall, 1999 (Figure 12), so we are concerned about the status of bay scallops in St. Joseph Bay during the upcoming year.

St. Andrew Bay and Sound: Scallop density varies significantly among years at the St. Andrew Bay/Sound study site ($\chi^2 = 39.891$, $p = 0.0001$), but remained low during 1999 (Table 8). Mean scallop abundance has increased in both 1998 and 1999 relative to 1997, but it remains an order of magnitude lower than what was recorded during the peak years of 1994 and 1996. Scallops were more evenly distributed among stations during 1999 relative to 1998 and no single station dominated the catch. We found few scallops at stations located around the inlet into St. Andrew Bay (Figure 13). Most scallops were discovered east of the inlet, especially along the mainland shore of the bay and in the eastern end of St. Andrew (Crooked Island) Sound.

June Population Trend

The Florida bay scallop populations that we study can be divided into two groups based upon their location relative to the Suwannee River closure line. The Pine Island Sound, Anclote, Hernando, Homosassa, and Cedar Keys populations are located within the recreational fishery closed zone ("South") whereas the Steinhatchee, St. Joseph Bay, and St. Andrew Bay/Sound populations are located within the recreational fishery open zone ("North"). Within the North zone, the general trend for population abundance is slightly downward (Figure 14), but this trend is slight and is influenced by the substantial number of scallops collected during 1996. In contrast, the general trend in the South zone is a slight increase in overall population abundance between 1992 and 1999. Again, this trend is slight and is influenced by the substantial number of scallops collected during 1997. When comparing these plots, it is important to note the difference in scale along the y-axis. The decrease in abundance in the northern populations equals about 10% fewer scallops recorded between 1994 and 1999, whereas the increase in abundance in the southern populations equals about 20% more scallops recorded between 1992 and 1999. Interestingly, a substantial increase in scallop abundance in the northern region during 1996 was followed one year later by a similar increase in scallop abundance in the southern region. We are not yet able to determine if this is coincidental or if there is a direct correlation, possibly resulting from increased larval supply in late 1996 from the northern to the southern populations. Possible physical oceanographic forces that might support such larval transport are discussed below, and we are conducting genetic analyses that also may assist in elucidating the relationship between spawner stock abundance in northern populations and recruitment in southern populations.

Fall Survey

Using the same stations and methods that we employed during our June surveys, we surveyed Homosassa and St. Joseph Bay for adult scallop abundance during fall (September and October) 1999 after the closure of the recreational fishing season. Results of those post-season surveys, for 1999 and previous years, are presented in Tables 9 and 10. At both sites, post-season scallop density was considerably reduced relative to the June survey. In particular, density at St. Joseph Bay decreased by almost 98% between June and fall. However, such a substantial decrease is not unprecedented; a similar decline (96.4%) was recorded during 1994 but was followed during 1995 by one of the most abundant scallop populations that we have yet recorded in St. Joseph Bay (Table 10). Thus, there is no reason to modify harvesting regulations in St. Joseph Bay although we reiterate that this population is of particular concern and interest during 2000.

Despite a considerable difference in mean scallop abundance between Homosassa and St. Joseph Bay since 1994, it is interesting to note that the average decrease in population abundance within each site between June and fall is approximately 60%. That result suggests that recreational fishing mortality plays a small role in the regulation of bay scallop populations in Florida and that natural mortality, probably in response to stress associated with reproductive development (Barber & Blake, 1993), predominates. However, when bay scallop density is very low, even a small increase in mortality (such as that effected by recreational fishing) may have an important impact on the reproductive success of the population by eliminating those few patches of reproductively viable scallops that could contribute to future generations of this short-lived animal (Marelli et al., 1999).

Physical Oceanographic Processes

The physical oceanography of the nearshore zone along the west coast of Florida remains understudied, but recent work by Weisberg and associates (e.g., Weisberg et al., 1996; Yang & Weisberg, 1999; Yang et al., 1999) has contributed substantially to our understanding of the hydrodynamics of that area. Such information is critical to understanding the ecology of bay scallops and other predominately nearshore species such as seatrout, blue crabs, and stone crabs. For bay scallops, the planktonic larval phase provides the linkage among the discrete scallop populations that are distributed along the coast, and the fate of that larval phase is strongly influenced by the physical processes operating during the planktonic dispersal phase. We cannot understand or restore Florida bay scallop populations without an understanding of those physical processes, and such considerations probably apply equally to numerous other coastal marine species.

Nearshore circulation along the west coast of Florida is largely wind-driven and therefore seasonally modulated. Nearshore currents flow predominately north to south during most of the year, but during fall and early winter that flow pattern is reversed and currents tend to flow south to north (Weisberg et al., 1996). Within the "Big Bend" region of Florida, defined as that area inshore of a line drawn between Cape San Blas and Anclote Key, modeled circulation defines a gyre (the "Big Bend Gyre" [Yang & Weisberg, 1999]) that is distinct from the larger water mass of the west Florida shelf. Results of numerous surface drifter studies suggest that there is little exchange of water between the Big Bend Gyre and the west Florida shelf (Yang et al., 1999). As a result, "passive" particles (including pelagically borne larvae) entrained within the Big Bend Gyre are isolated within that gyre and appear to mix with shelf waters only rarely. As a result, bay scallop larvae generated within the Big Bend at sites such as Anclote, Homosassa, and Steinhatchee remain within the Big Bend. They may act to replenish other populations within the Big Bend, but according to this model they will not supply bay scallop populations outside of the Big Bend. Conversely, larvae generated outside of the Big Bend will not make their way into the Big Bend to resupply those populations. Our own data suggest that larval exchange does occur among bay scallop populations along the Florida west coast (Marelli and Arnold, in press), but that exchange may operate at a scale of decades to centuries rather than on an annual basis.

Within the Big Bend Gyre, the predominant flow of water appears to be from north to south near the coast with the return south to north flow occurring in deeper offshore waters (Yang & Weisberg, 1999). This nearshore southward flow provides an opportunity for transport of bay scallop larvae from the populous beds in the Steinhatchee region to more depauperate populations in areas such as Homosassa and Anclote. In recent years, we have recorded considerable bay scallop recruitment in the Anclote region, a focal point for the convergence of this southward flowing water. However, it remains a mystery as to why we are not recording similar levels of recruitment in the Homosassa region. Clearly, bay scallop abundance in the Homosassa region has increased since 1997, but we are not observing a concomitant increase in recruitment in that area. One possible explanation is that the larvae are setting farther offshore than we place our recruit collectors, and then the resultant juveniles or adults are either actively or passively being transported into the nearshore zone. We would like to more closely study this phenomenon, but working in offshore areas around Homosassa is difficult because of the very active roller-frame shrimp fishery operating in that area. Those trawl operations are tremendously destructive of our sampling gear.

According to the model of Yang and Weisberg (1999), the Big Bend Gyre operates primarily during October through March. Throughout the remainder of the year, nearshore currents in the Big Bend region tend to be unidirectional to the north. Thus, it might be possible for scallops in the Anclote region or in regions to the south of Anclote to resupply Homosassa during those times, but scallops spawn infrequently during April through September so larval availability is limited during that time. Of course, even if the larvae were transported from the south rather than the north, they still may not be supplied to the nearshore zone off Homosassa.

Limited larval supply to the nearshore zone off Homosassa may be a recently developed feature of the west Florida shelf. The Crystal River nuclear power plant is located just north of our Homosassa study area, and a component of that power plant is a jetty that extends several miles into the Gulf of Mexico and considerably seaward of the Homosassa scallop beds. The jetty is a continuous feature that must interrupt alongshore currents moving in either direction along the coast. The model of Yang and Weisberg (1999) needs to be tested in the field, with particular emphasis on the utility of the model in the nearshore zone, and one component of that test could be an analysis of the influence of the Crystal River power plant jetty on coastal flow.

Restoration

Preliminary results of our bay scallop population restoration program suggest that scallops can be cultured in the laboratory with relative ease and that those scallops can be transplanted into the field without much difficulty. One of the major impediments to the success of this program has been our inability to obtain scallops from some of the areas that we have targeted for restoration. For example, in fall 1997 we were unable to locate any adult scallops from the Anclote region, so we did not plant scallops in that area during 1998. Similarly, during fall 1998 we were unable to locate any scallops in Tampa Bay so we did not plant scallops in that area during 1999. We are careful to avoid planting scallops from one region (e.g., Crystal River or Steinhatchee) into another region (e.g., Tampa Bay or Anclote) until we are confident that the genetic ramifications of such transplants are well understood. At present, we do not have the genetic information necessary to ensure that those ramifications are minimal or at least acceptable.

We were able to successfully plant scallops in Tampa Bay, Homosassa, and Crystal River during 1998 and in Anclote, Homosassa, and Crystal River during 1999. We have the juveniles available to plant in Tampa Bay, Anclote, Homosassa, and Crystal River during 2000. In addition, we have enough cultured juveniles available to plant scallops in Sarasota Bay during 2000 as part of a separately funded project. We anticipate that our restoration activities during 2000-2001 will provide an opportunity to thoroughly evaluate our ability to successfully restore scallop populations along the west coast of Florida.

Results from our 1998-1999 and 1999-2000 plantings suggest that scallops planted in predator protection cages during spring do survive through the fall spawning season. Mortality tends to be quite variable among sites and even among stations within sites, but overall the scallops suffer approximately 80% mortality during the summer months. That rate of mortality is approximately 20% higher than the overall average mortality recorded for natural populations between our June and fall adult surveys. Much of that additional mortality may be due to overcrowding in the cages. In the past, we have planted at a density of 300 scallops per cage, but comparative density studies indicate that scallops planted at 150 or 50 per cage have a much higher rate of survival. However, the important consideration is the number of scallops remaining alive and healthy at the time of spawning, and in all density treatments we typically find 60-80 scallops remaining alive during the fall spawning season. In any case, that represents a considerable increase above the natural scallop density that we have measured at our Tampa Bay, Anclote, Homosassa, and Crystal River restoration sites. We are monitoring the reproductive development of the planted scallops but those data remain to be analyzed. Similarly, we are sampling recruits and adults from each population to ascertain a genetic linkage between those animals and the animals that we originally planted at each site. Again, we are in the process of analyzing those data and we will discuss those results in future annual reports.

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Figure 1. Map of Florida, showing sample sites and other locations referenced in the text.

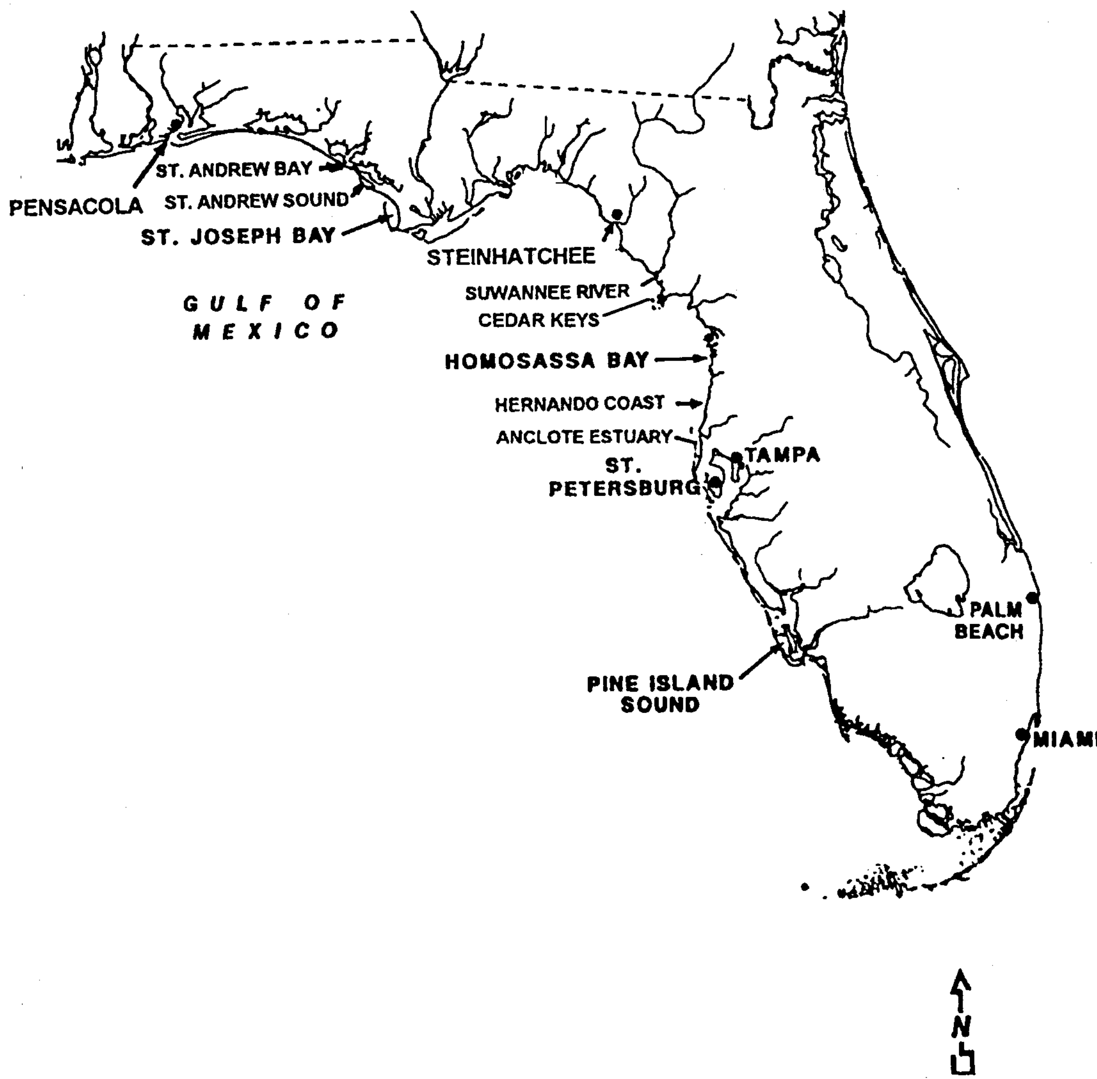
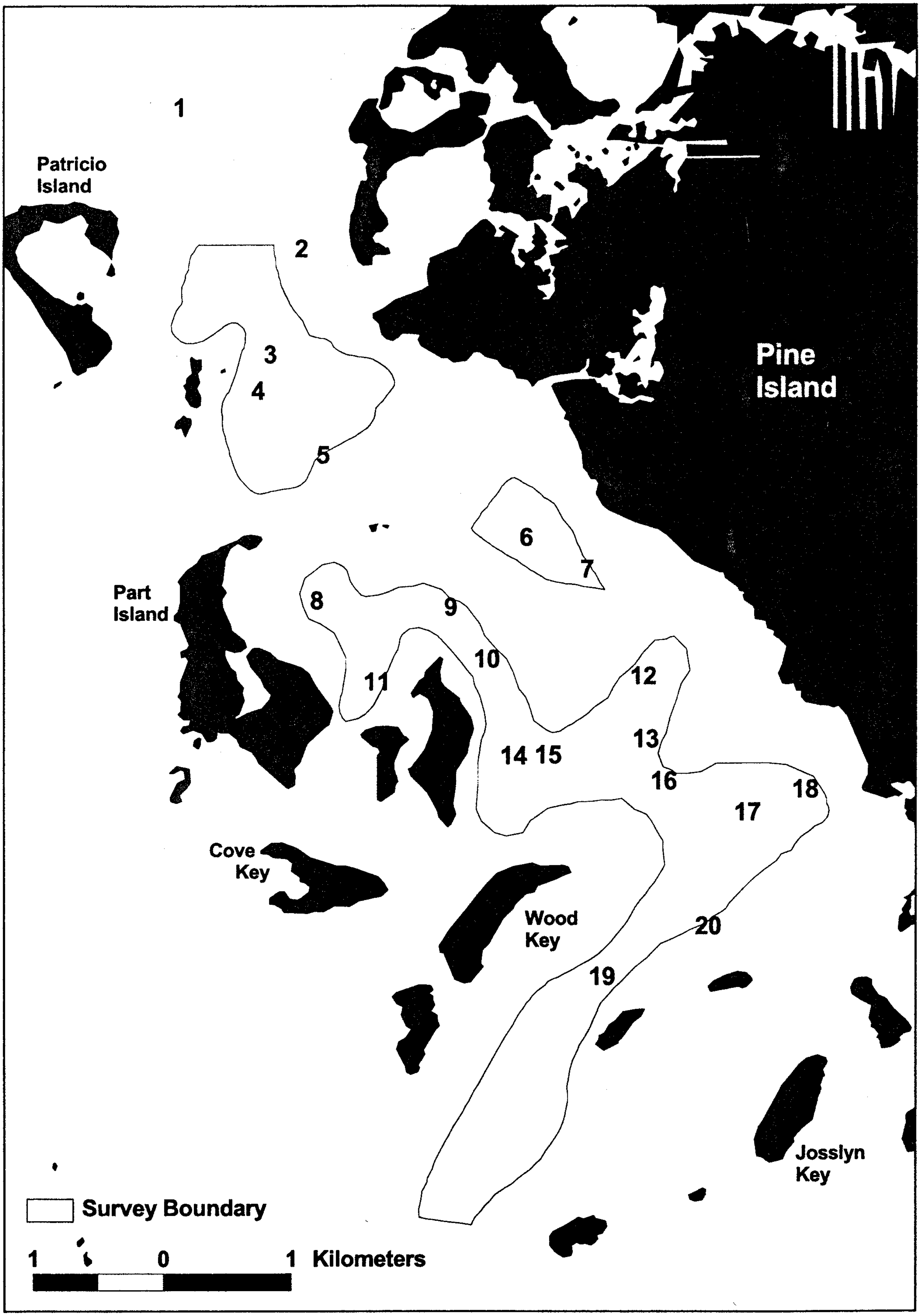

PENSACOLA
ST. ANDREW BAY
ST. ANDREW SOUND
ST. JOSEPH BAY
STEINHATCHEE
SUWANNEE RIVER
CEDAR KEYS
GULF OF MEXICO
HOMOSASSA BAY
HERNANDO COAST
ANCLOTE ESTUARY
TAMPA
ST. PETERSBURG
PINE ISLAND SOUND
PALM BEACH
MIAMI
N

Figure 2. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at the Pine Island Sound, Florida, study site.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Pine Island
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Cove Key
Wood Key
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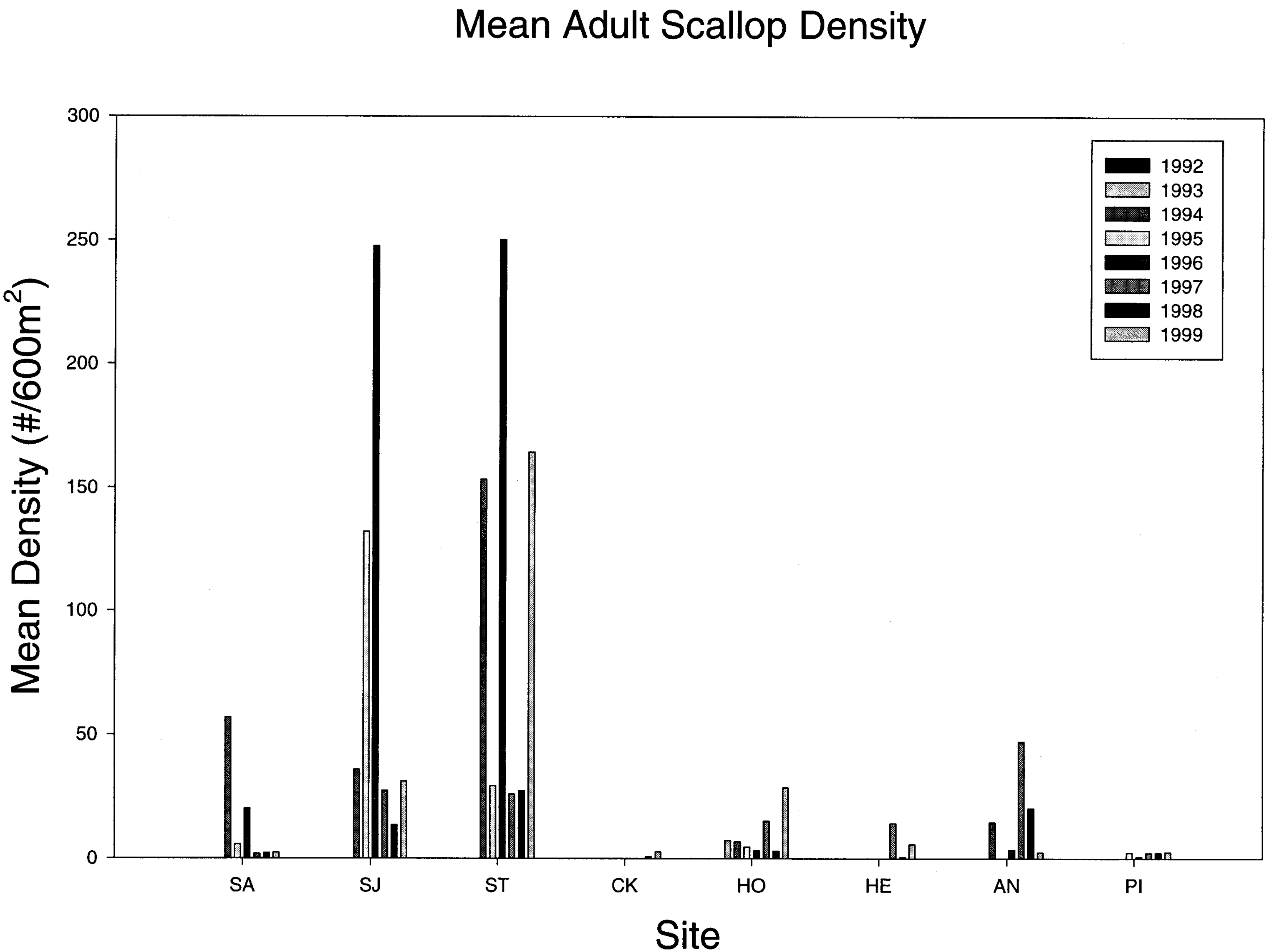
Josslyn Key
Survey Boundary
1 0 1 Kilometers

Figure 3. Mean annual abundance of adult bay scallops (*Argopecten irradians*) at Pine Island Sound (PI), Anclote (AN), Hernando (HE), Homosassa (HO), Cedar Keys (CK), Steinhatchee (ST), St. Joseph Bay (SJ), and St. Andrew Bay and Sound (SA) recorded during June surveys. Years are as listed. Mean density is number per 600 m^2 transect.


Mean Adult Scallop Density
Mean Density (#/600m2)
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1994
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AN
PI
Site

Figure 4. Average daily recruitment of juvenile scallops to spat collectors located at various locations within the Anclote study site. Stations run from north to south with station 1 most northerly and station 12 most southerly. For specific station locations, consult Arnold et al. (1999).

Anclote Region Recruitment-1999

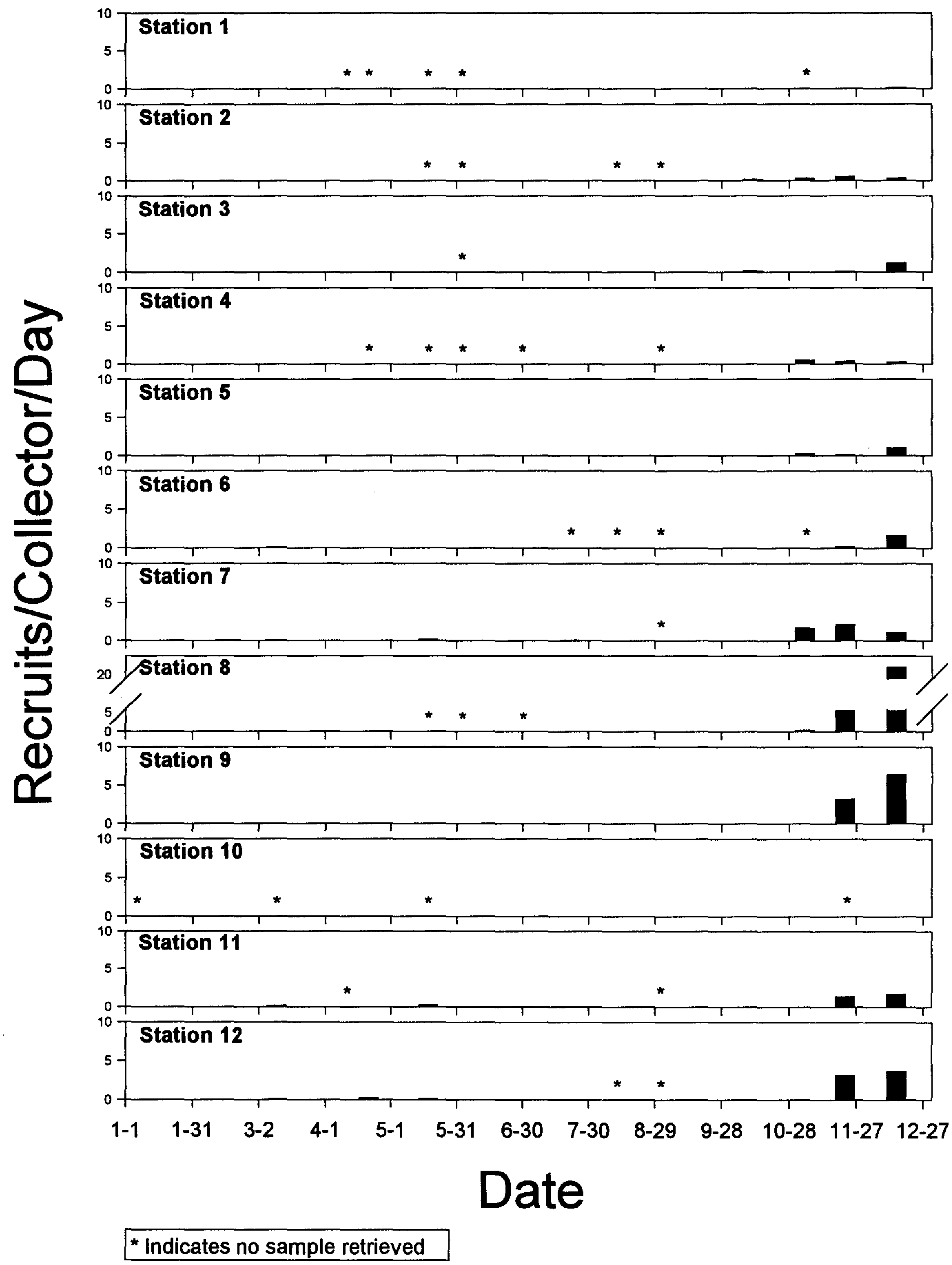
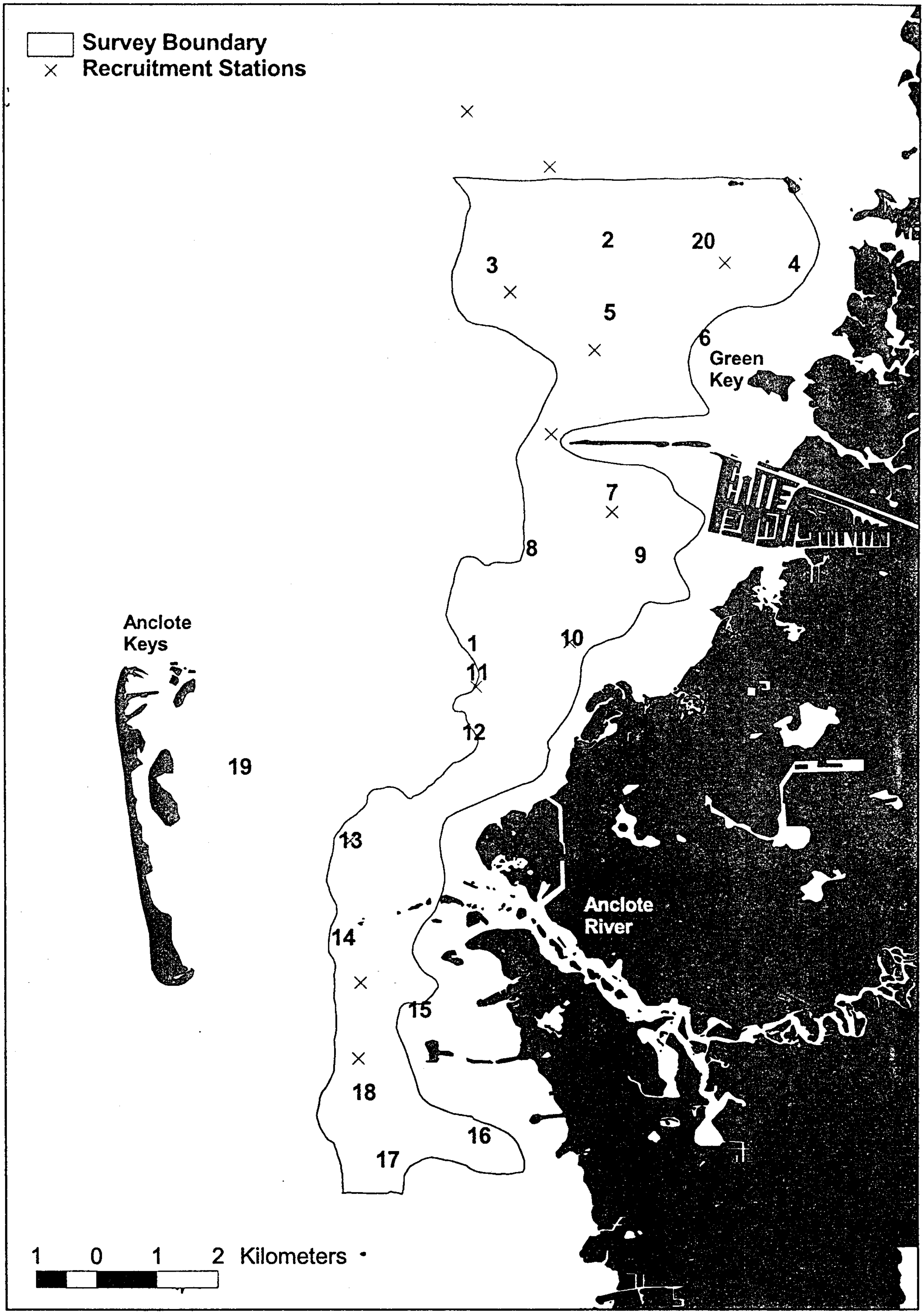


Figure 5. Station locations for sampling juvenile recruitment (X) and adult abundance of bay scallops (*Argopecten irradians*) at the Anclote Estuary, Florida, study site.


Survey Boundary
Recruitment Stations
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Green Key
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Anclote Keys
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Anclote River
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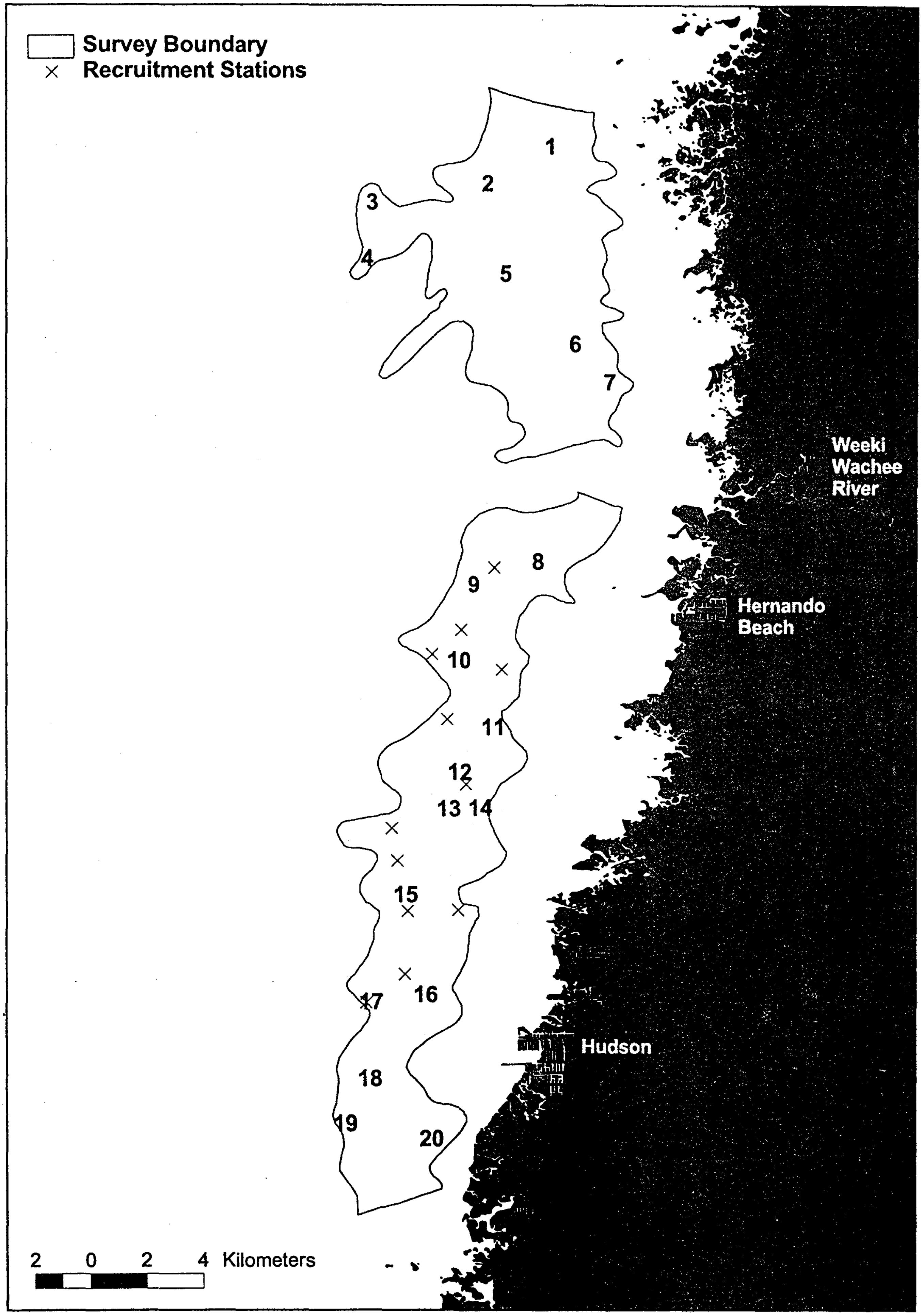
Figure 6. Station locations for sampling juvenile recruitment (X) and adult abundance of bay scallops (*Argopecten irradians*) at the Hernando, Florida, study site.


Survey Boundary
Recruitment Stations
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Weeki Wachee River
Hernando Beach
Hudson
2 0 2 4 Kilometers

Figure 7. Average daily recruitment of juvenile scallops to spat collectors located at various locations within the Hernando study site. Stations run from north to south with station 1 most northerly and station 12 most southerly. For specific station locations, consult Arnold et al. (1999).

Hernando Region Recruitment-1999

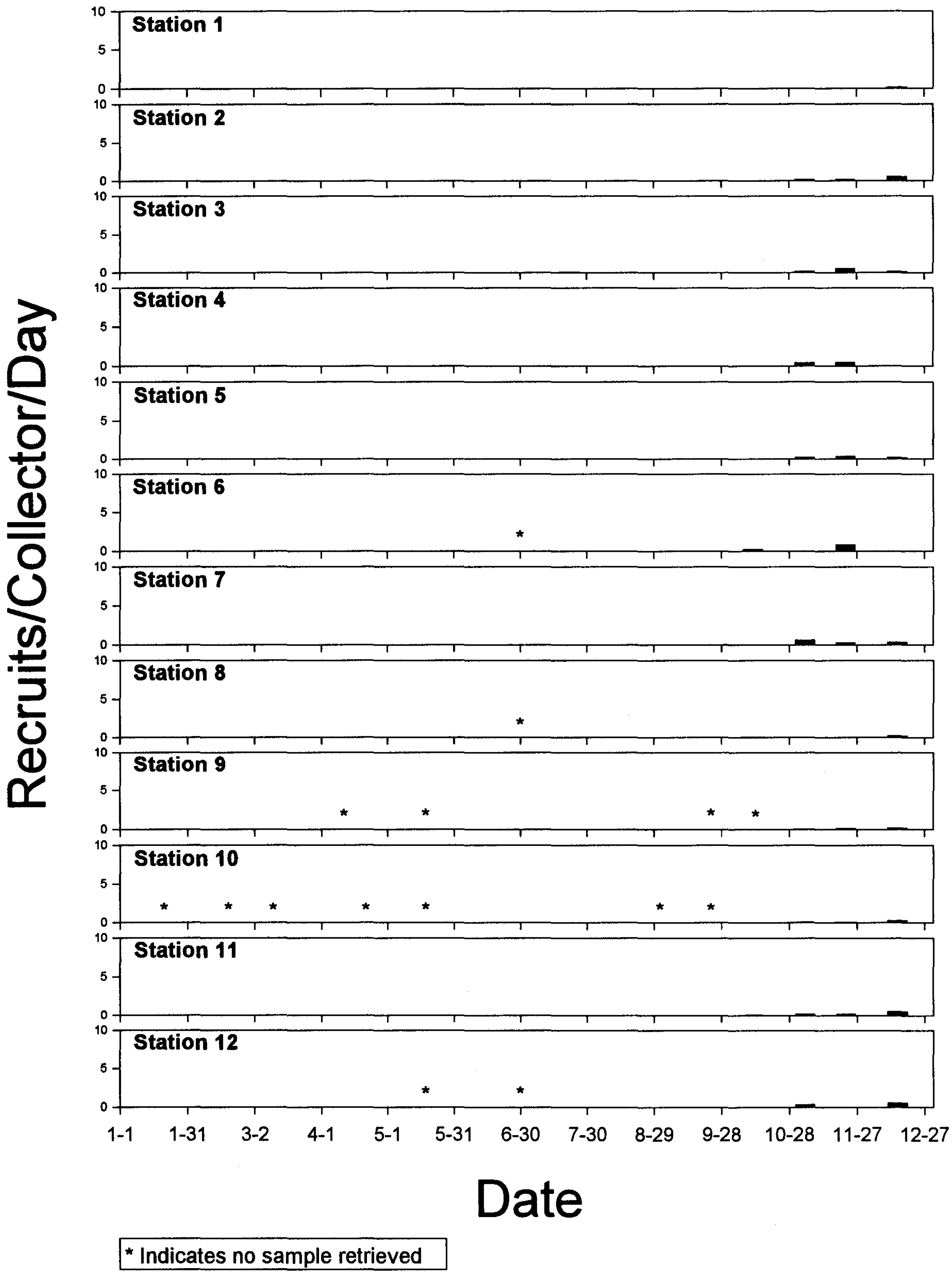

Figure 8. Station locations for sampling juvenile recruitment (X) and adult abundance of bay scallops (*Argopecten irradians*) at the Homosassa Bay, Florida, study site.

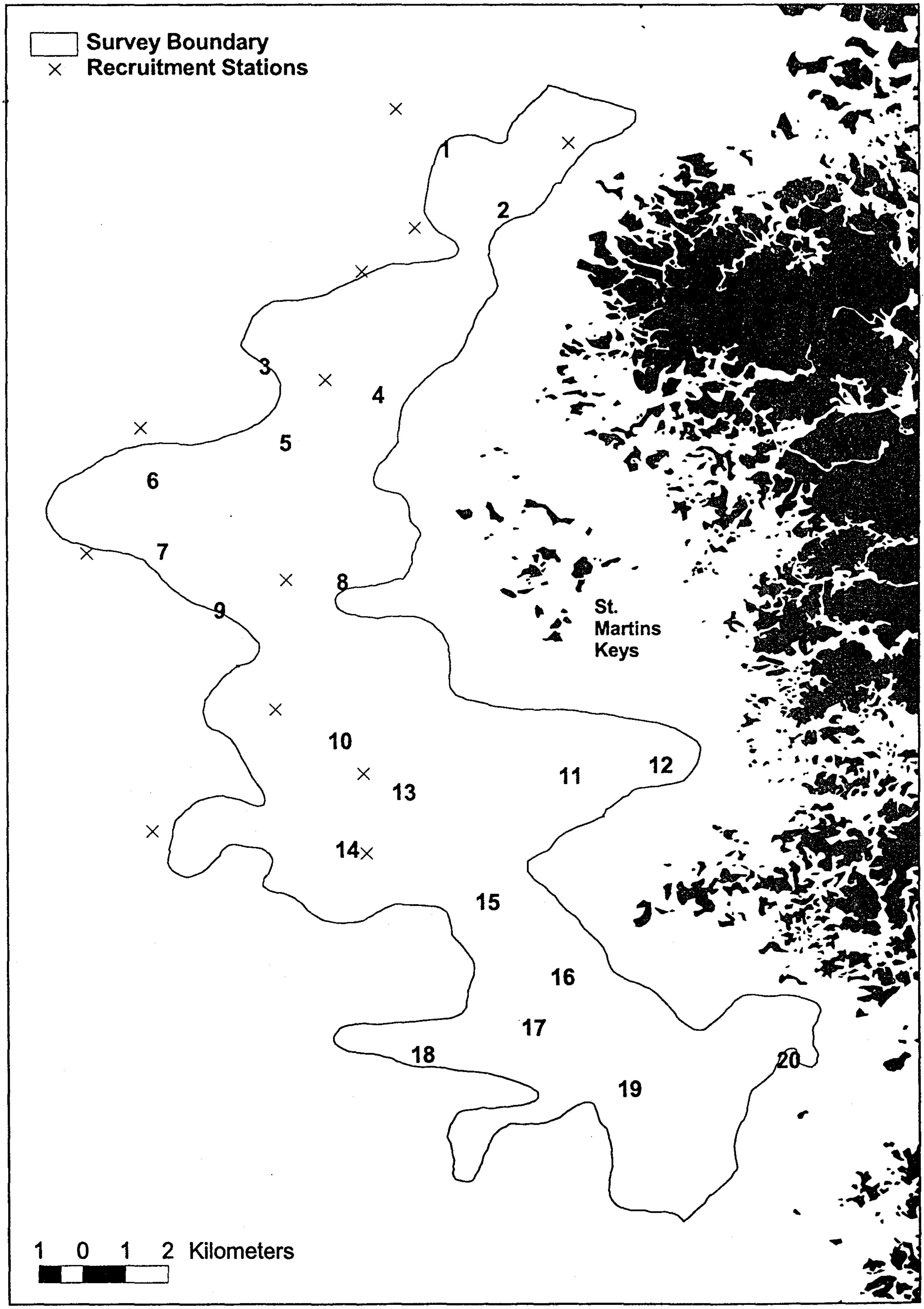
Survey Boundary
Recruitment Stations
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Figure 9. Average daily recruitment of juvenile scallops to spat collectors located at various locations within the Homosassa study site. Stations run from north to south with station 1 most northerly and station 12 most southerly. For specific station locations, consult Arnold et al. (1999).

Homosassa Region Recruitment-1999

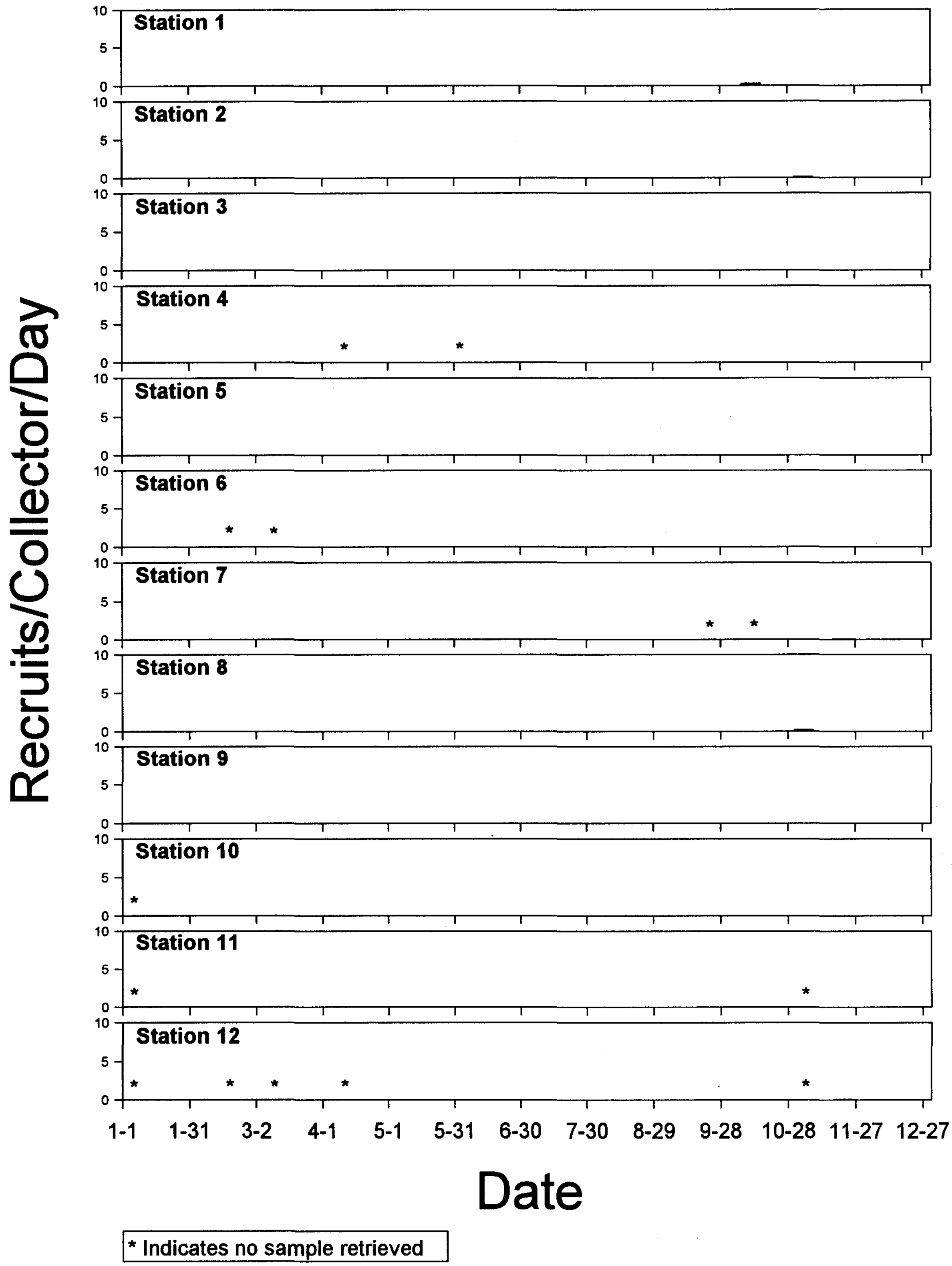
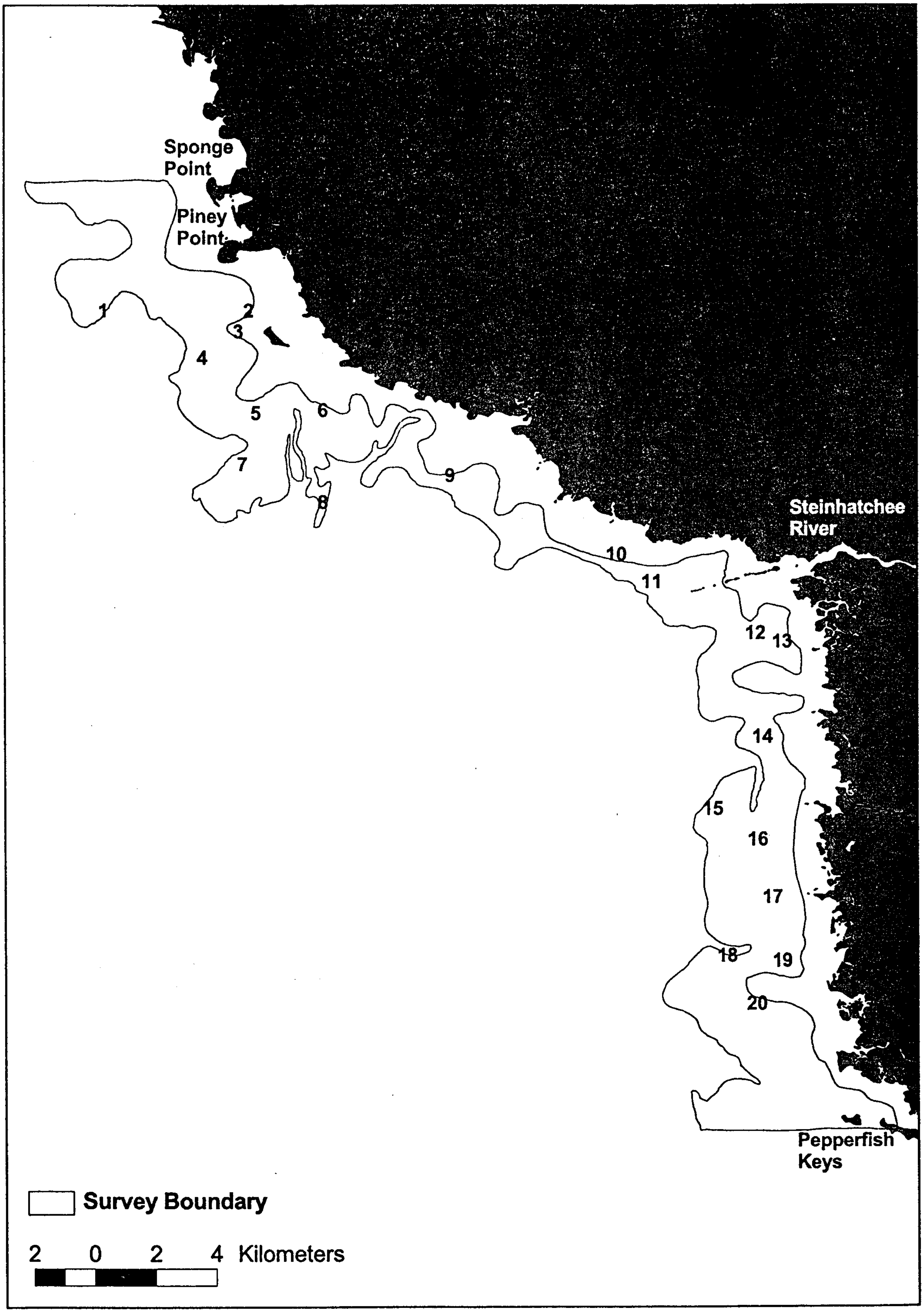


Figure 10. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at the Steinhatchee, Florida, study site.



Sponge Point
Piney Point
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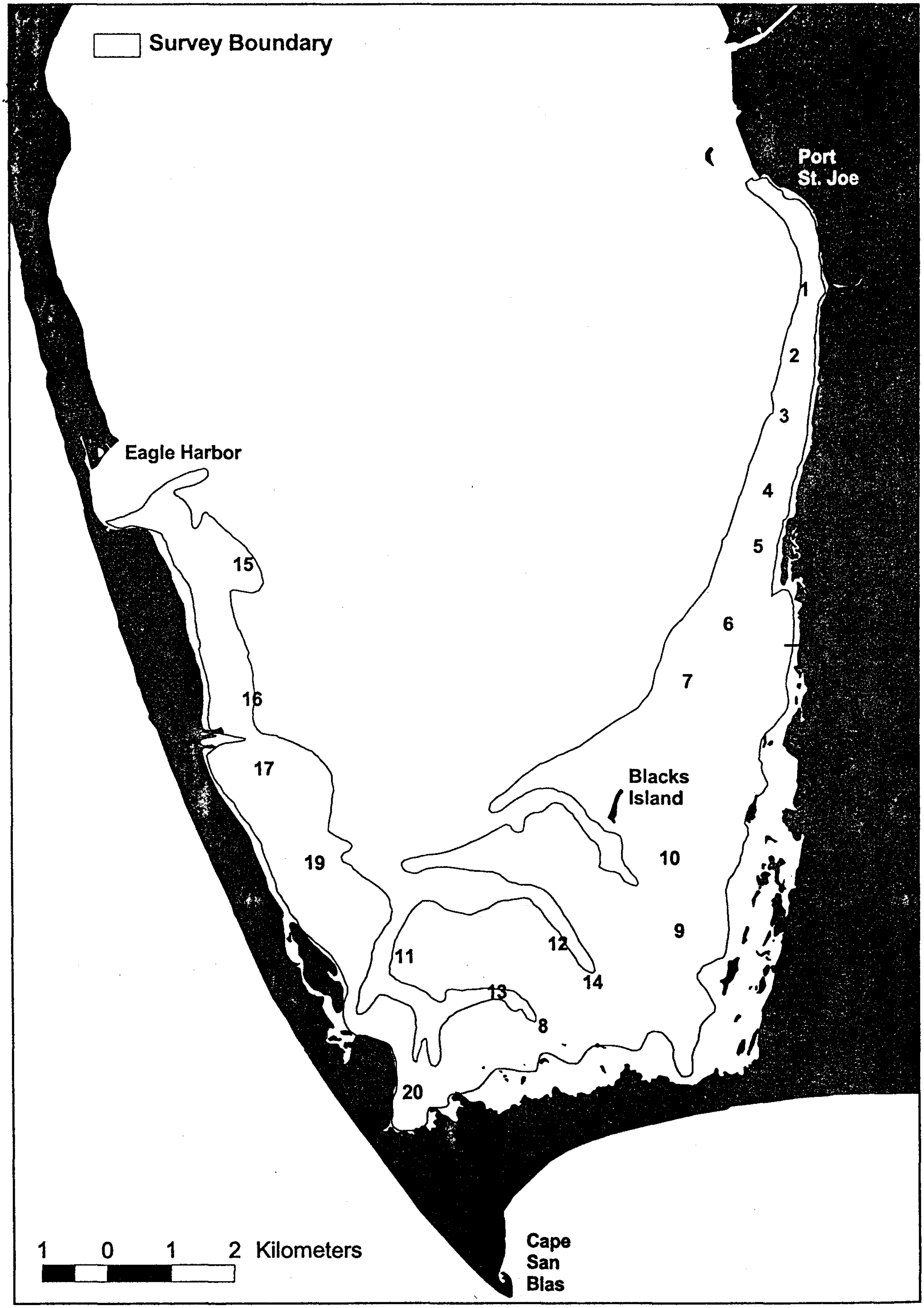
Steinhatchee River
Pepperfish Keys
Survey Boundary
2 0 2 4 Kilometers

Figure 11. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at the St. Joseph Bay, Florida, study site.


Survey Boundary
Port St. Joe
Eagle Harbor
Blacks Island
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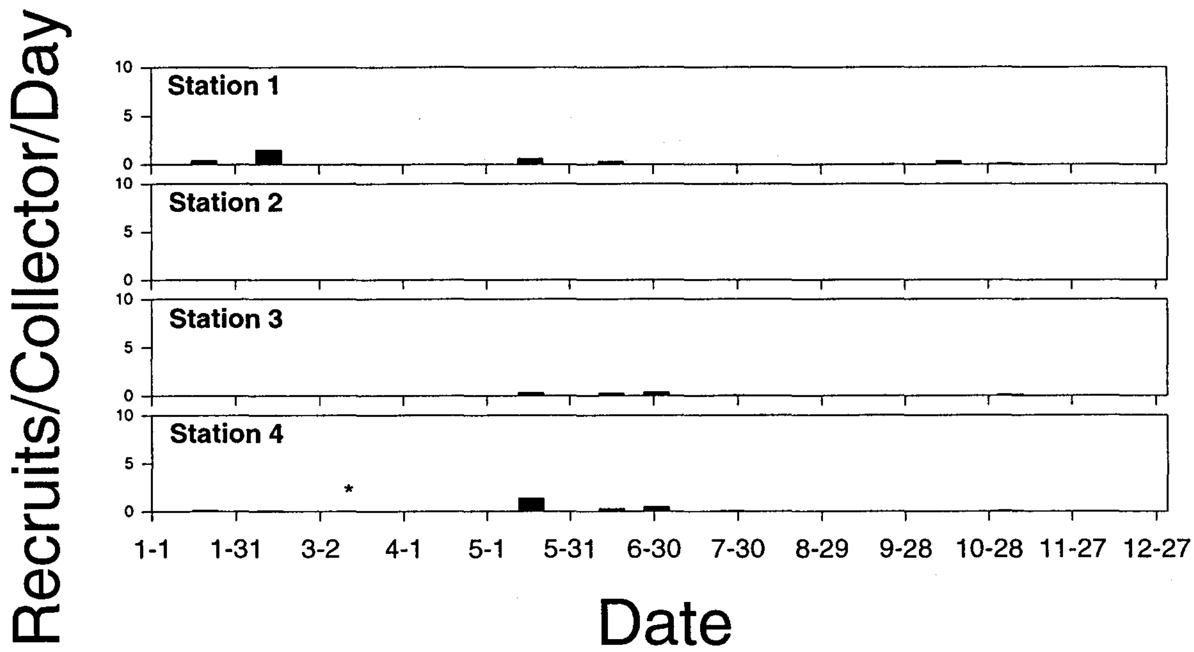
Cape San Blas
1 0 1 2 Kilometers

Figure 12. Average daily recruitment of juvenile scallops to spat collectors located at various locations within the St. Joseph Bay study site. For specific station locations, consult Arnold et al. (1999).

St. Joe Bay Recruitment - 1999



* Indicates no sample retrieved

Figure 13. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at (A) the St. Andrew Bay and (B) the St. Andrew Sound, Florida, study sites.

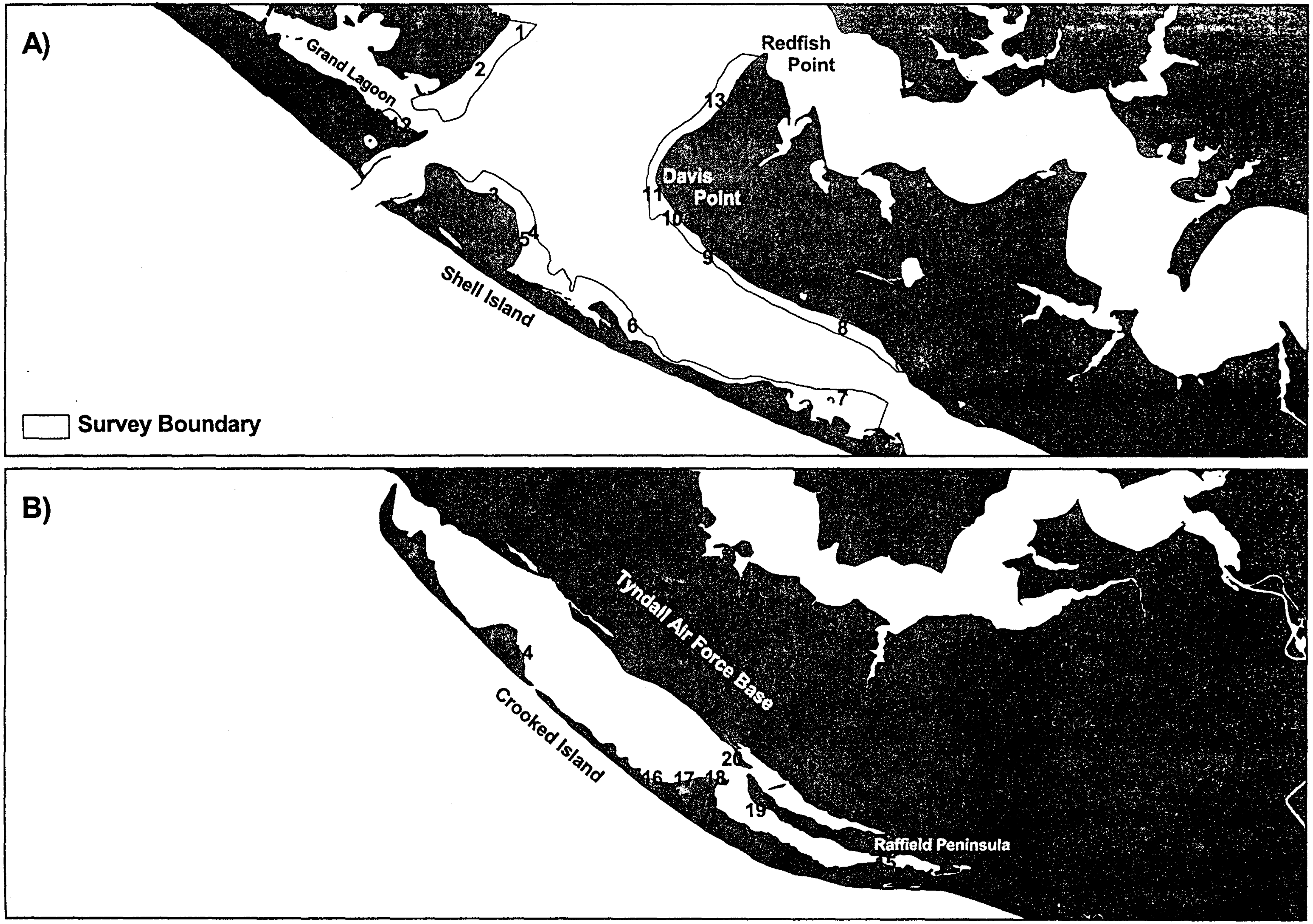
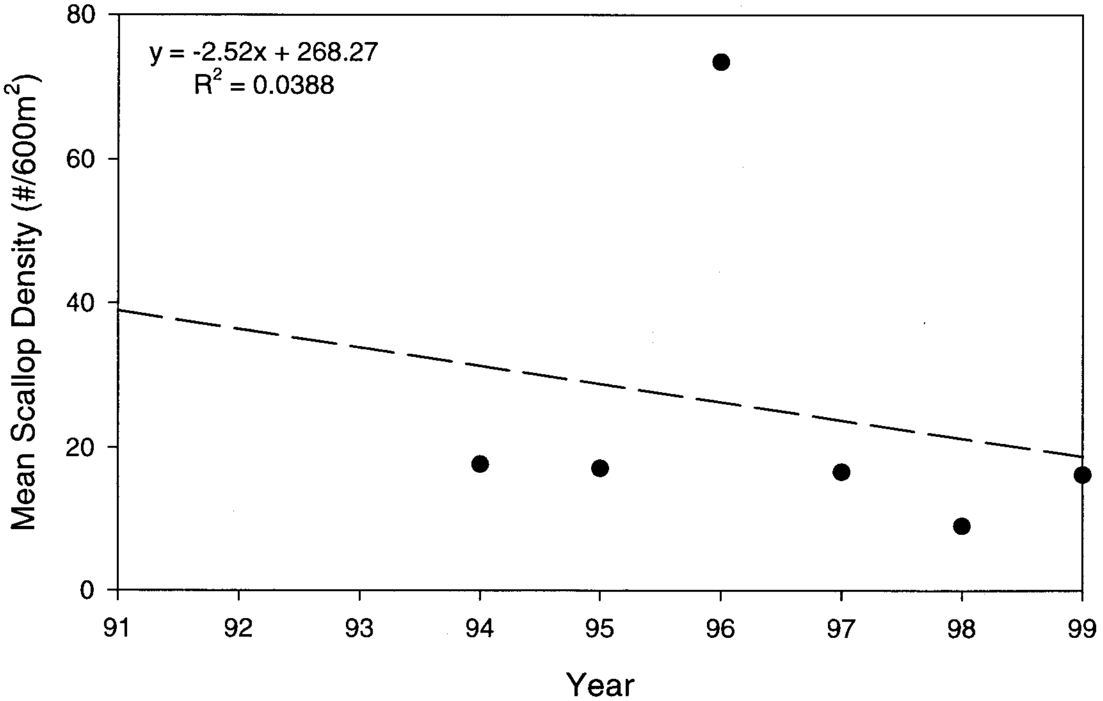

A)
Grand Lagoon
Redfish Point
Davis Point
Shell Island
Survey Boundary
B)
Tyndall Air Force Base
Crooked Island
Raffield Peninsula

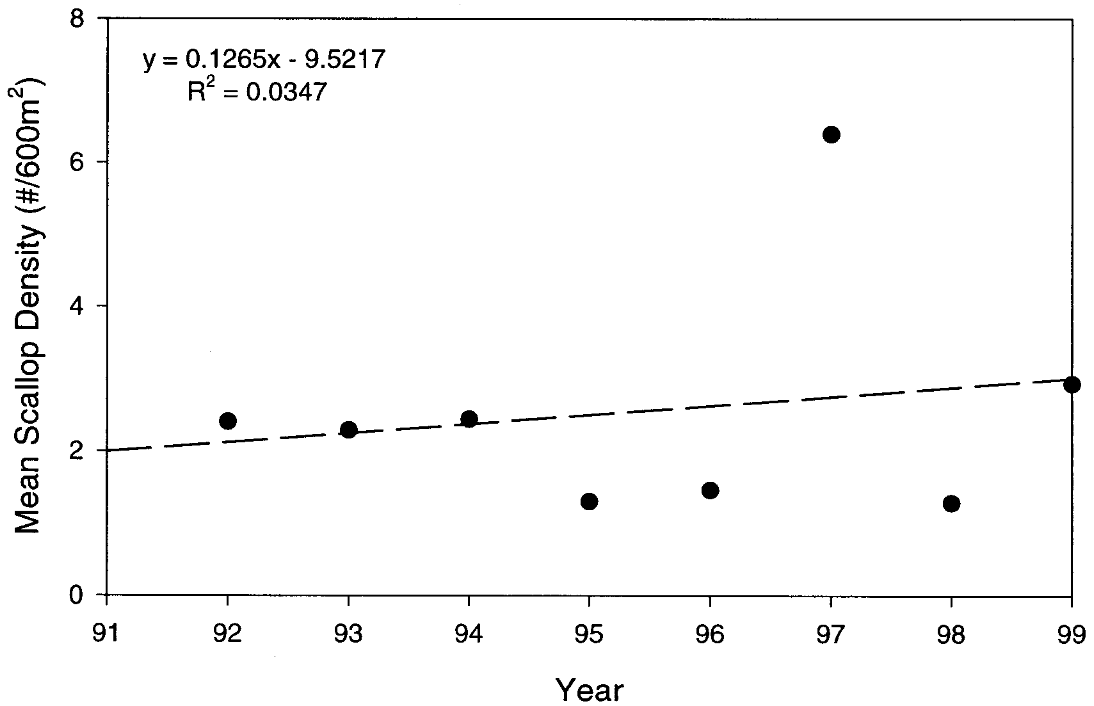
Figure 14. Regression of mean scallop abundance among sites within each of the North (Steinhatchee, St. Joseph Bay, St. Andrew Bay/Sound) and South (Pine Island Sound, Anclote, Hernando, Homosassa, Cedar Keys) during 1992-1999. Included in each plot is the equation for the line and the correlation coefficient, with the regression equation plotted as the dashed line in each plot.

North



y = -2.52x + 268.27
R2 = 0.0388
Mean Scallop Density (#/600m2)
0
20
40
60
80
91
92
93
94
95
96
97
98
99
Year

South



y = 0.1265x - 9.5217
R2 = 0.0347
Mean Scallop Density (#/600m2)
0
2
4
6
8
91
92
93
94
95
96
97
98
99
Year

Table 1. Adult bay scallop density at each of 20 stations sampled at the Pine Island Sound, Florida, study site during June surveys of 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
PINE ISLAND SOUND
1994-1999
#/600M^2

STATION	1994	1995	1996	1997	1998	1999
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	1	0	0	0
7	0	0	1	1	0	0
8	0	0	0	0	2	1
9	0	0	0	0	0	0
10	0	1	0	3	1	0
11	0	1	0	0	0	0
12	0	34	1	5	5	1
13	0	9	0	4	0	0
14	0	0	0	15	0	0
15	0	1	0	5	0	0
16	0	1	0	2	0	1
17	0	0	9	9	22	12
18	0	0	3	0	14	25
19	0	1	0	2	0	7
20	0	1	0	0	3	5
MEAN	0.00	2.45	0.75	2.30	2.35	2.60
S.D.	0.00	7.69	2.07	3.87	5.66	6.12

Table 2. Adult bay scallop density at each of 20 stations sampled at the Anclote, Florida, study site during June of 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
ANCLOTE
1994-1999
$\#/600M^2$

STATION	1994	1995	1996	1997	1998	1999
1	1	0	4	43	0	0
2	72	0	3	49	0	1
3	15	0	2	307	0	8
4	0	0	0	1	0	1
5	106	0	0	20	0	0
6	3	0	0	4	0	0
7	21	0	0	1	0	1
8	14	0	12	136	0	2
9	2	3	0	4	0	0
10	1	0	1	30	0	0
11	1	0	2	27	0	0
12	14	0	0	1	0	0
13	12	0	0	8	0	0
14	0	0	11	14	1	4
15	1	0	1	141	17	13
16	5	0	23	87	46	9
17	9	0	6	20	313	8
18	1	0	3	42	17	0
19	1	0	0	8	12	2
20	14	0	0	4	0	1
MEAN	14.65	0.15	3.40	47.35	20.30	2.50
S.D.	26.80	0.67	5.82	74.05	69.80	3.85

Table 3. Adult bay scallop density at each of 20 stations sampled at the Hernando, Florida, study site during June of 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
HERNANDO
1997-1999
#/600M^2

STATION	1997	1998	1999
1	3	0	0
2	11	0	33
3	134	3	17
4	80	6	43
5	9	0	1
6	1	0	2
7	0	0	0
8	0	0	0
9	1	0	1
10	3	0	1
11	0	0	5
12	0	0	1
13	10	0	4
14	1	0	0
15	10	1	2
16	2	1	1
17	8	0	3
18	6	0	0
19	6	0	0
20	0	0	0
MEAN	14.25	0.55	5.70
S.D.	33.13	1.47	11.79

Table 4. Adult bay scallop density at each of 20 stations sampled at the Homosassa Bay, Florida, study site during June of 1993, 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
HOMOSASSA
1993-1999
#/600M^2

STATION	1993	1994	1995	1996	1997	1998	1999
1	4	3	0	0	9	0	3
2	13	38	9	2	17	0	3
3	4	5	9	5	18	2	7
4	9	1	4	0	19	0	36
5	5	0	14	5	15	0	33
6	4	0	1	9	7	0	70
7	4	1	2	5	5	34	47
8	8	5	27	4	27	3	13
9	3	3	7	4	13	13	54
10	3	19	3	2	58	6	9
11	10	0	1	0	5	1	2
12	0	0	1	3	0	0	0
13	8	23	6	2	12	0	13
14	4	15	0	9	23	2	48
15	24	4	1	2	7	0	3
16	13	3	3	1	6	0	5
17	20	3	1	6	0	0	13
18	8	9	3	3	55	0	212
19	2	5	2	1	8	0	2
20	0	0	0	0	0	0	0
MEAN	7.30	6.85	4.70	3.15	15.20	3.05	28.65
S.D.	6.28	9.82	6.43	2.74	16.01	7.92	48.10

Table 5. Adult bay scallop density at each of 6 stations sampled at the Cedar Keys, Florida, study site during June of 1998 and 1999.

JUNE BAY SCALLOP SURVEY
CEDAR KEY
1998-1999
#/600M^2

STATION	1998	1999
1	0	1
2	0	0
3	1	4
4	0	4
5	1	0
6	3	7
MEAN	0.83	2.67
S.D.	1.17	2.80

Table 6. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee, Florida, study site during June of 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
STEINHATCHEE
1994-1999
#/600M^2

STATION	1994	1995	1996	1997	1998	1999
1	189	13	528	1	9	43
2	284	48	36	5	100	97
3	89	16	128	103	90	97
4	338	14	269	13	18	34
5	650	14	1879	25	16	105
6	234	22	210	37	0	137
7	81	4	73	3	4	29
8	0	1	0	3	0	2
9	169	44	498	23	39	158
10	10	0	76	1	3	10
11	1	0	0	0	0	0
12	281	0	415	30	0	638
13	10	8	41	6	0	46
14	259	4	119	7	7	129
15	120	1	65	6	0	52
16	1	30	71	30	20	545
17	13	23	118	42	35	789
18	133	3	44	14	3	19
19	121	313	284	135	111	332
20	85	27	151	34	91	27
MEAN	153.40	29.25	250.25	25.90	27.30	164.45
S.D.	159.05	68.31	414.65	34.95	38.17	227.34

Table 7. Adult bay scallop density at each of 20 stations sampled at the St. Joseph Bay, Florida, study site during June of 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
ST. JOE BAY
1994-1999
#/600M^2

STATION	1994	1995	1996	1997	1998	1999
1	16	1	4	2	0	1
2	2	1	64	10	0	35
3	12	6	2	3	0	10
4	1	2	0	0	12	11
5	8	67	2	2	0	29
6	15	205	114	19	3	43
7	5	114	55	7	4	30
8	265	348	140	93	90	105
9	61	118	43	11	7	29
10	7	711	363	111	18	53
11	0	5	759	10	25	31
12	5	233	1143	40	26	13
13	3	195	369	62	45	9
14	19	270	820	10	2	4
15	5	11	44	1	9	22
16	9	14	228	14	10	5
17	2	44	282	2	7	7
18	1	25	240	0	4	7
19	2	17	179	7	5	14
20	279	257	103	142	2	164
MEAN	35.85	132.20	247.70	27.30	13.45	31.10
S.D.	81.87	175.47	312.22	41.53	21.31	48.25

Table 8. Adult bay scallop density at each of 20 stations sampled at the St. Andrew Bay/Sound, Florida, study site during June of 1994, 1995, 1996, 1997, 1998 and 1999.

JUNE BAY SCALLOP SURVEY
ST. ANDREW BAY
1994-1999
#/600M^2

STATION	1994	1995	1996	1997	1998	1999
1	1	4	12	1	1	0
2	5	13	6	5	0	0
3	70	16	155	9	0	1
4	244	8	23	0	0	1
5	50	1	20	2	2	0
6	96	20	13	0	0	1
7	144	6	2	0	2	4
8	173	13	11	0	31	3
9	149	8	39	1	0	0
10	68	0	26	1	0	5
11	69	5	5	0	1	9
12	6	2	6	4	0	1
13	6	2	56	8	1	2
14	24	2	2	0	0	0
15	0	9	7	0	0	8
16	0	1	0	0	0	0
17	2	0	0	0	0	0
18	5	3	1	0	1	0
19	24	1	13	3	0	8
20	0	1	5	3	4	4
MEAN	56.80	5.75	20.10	1.85	2.15	2.35
S.D.	70.77	5.82	34.78	2.74	6.87	3.01

Table 9. Adult bay scallop density at each of 20 stations sampled at the Homosassa Bay, Florida, study site during fall of 1993, 1995, 1996, 1997, 1998, and 1999.

FALL BAY SCALLOP SURVEY
HOMOSASSA
1993-1999
#/600M^2

STATION	1993	1995	1996	1997	1998	1999
1	0	0	0	0	0	2
2	0	0	0	9	0	1
3	0	0	6	8	3	6
4	1	0	0	50	0	12
5	3	0	1	38	0	5
6	1	2	1	9	5	29
7	2	0	0	4	8	58
8	1	0	1	28	1	4
9	1	1	0	13	4	24
10	0	4	1	35	0	2
11	2	0	0	2	0	0
12	1	0	3	1	0	0
13	2	0	0	9	0	0
14	0	0	1	29	0	24
15	6	3	1	1	0	2
16	1	0	1	21	0	1
17	2	0	4	4	0	1
18	3	0	7	43	0	53
19	0	0	0	11	0	0
20	1	0	0	1	0	0
MEAN	1.35	0.50	1.35	15.80	1.05	11.20
S.D.	1.46	1.15	2.06	15.77	2.21	17.61

Table 10. Adult bay scallop density at each of 20 stations sampled at the St. Joseph Bay, Florida, study site during fall of 1994, 1995, 1996, 1997, 1998, and 1999.

FALL BAY SCALLOP SURVEY
ST. JOE BAY
1994-1999
#/600M^2

STATION	1994	1995	1996	1997	1998	1999
1	0	1	0	0	0	0
2	0	0	1	0	0	0
3	0	1	94	24	0	0
4	0	0	86	0	1	0
5	0	1	30	0	7	0
6	0	0	51	32	6	0
7	1	1	8	18	1	0
8	7	150	11	70	25	3
9	5	2	1	25	0	9
10	11	21	28	35	0	2
11	0	3	190	2	26	0
12	0	37	1534	59	16	0
13	0	55	1334	61	42	0
14	1	37	439	44	13	0
15	0	0	0	5	0	0
16	0	0	12	6	3	0
17	1	16	137	4	3	0
18	0	4	238	4	2	0
19	0	31	187	4	1	0
20	0	10	171	0	3	1
MEAN	1.30	18.50	227.60	19.65	7.45	0.75
S.D.	2.94	34.95	428.34	23.17	11.47	2.10