ANNUAL REPORT
OF THE
BAY SCALLOP PROJECT

2000

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William S. Arnold
Joel Bickford
Keri Ferenc
Lisa Gentile
Melissa M. Harrison
Melanie L. Parker
Sarah C. Peters
Winnie White

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

Phone: (727) 896-8626
Fax: (727) 893-1374
e-mail: bill.arnold@fwc.state.fl.us

INTRODUCTION

This report summarizes bay scallop (*Argopecten irradians*) research conducted by the Florida Marine Research Institute Molluscan Fisheries program during calendar year 2000. We report the results of adult population surveys conducted at a variety of sites along the west coast of Florida between Pine Island Sound in the south and St. Andrew Bay in the northwest. 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 1995.

In 1995, the Florida Marine Fisheries Commission (now the Florida Fish and Wildlife Conservation Commission) modified bay scallop harvesting regulations in response to the perceived collapse of scallop populations throughout most of their historical range in Florida (Arnold et al., 1993). Those modifications included the elimination of all commercial fishing for bay scallops in State waters and closure of the recreational fishery in coastal waters south of the Suwannee River. Additionally, the length of the recreational fishing season was reduced from nine months to three months (later modified to two months and then to two months and ten days) in coastal waters north and west of the Suwannee River. Finally, the recreational bag limit was reduced from five gallons of whole animals to two gallons of whole animals per person per day, and a vessel limit of 10 gallons of whole animals per boat per day was instituted.

In 1997, the Florida Marine Research Institute initiated a federally-funded bay scallop restoration program with the objective of creating concentrated "patches" of spawners, then utilizing intensive field sampling and state-of-the-art genetic techniques to assess the contribution of those spawner patches to future generations. 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. However, it should be noted that an extension of that contract will be requested, and if granted will delay completion and report submission until June 2002. Interim results from the restoration program will be discussed only briefly in the present report.

In conjunction with our adult monitoring activities, we also monitor several biological and physical variables 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. We also monitor water temperature, salinity, water clarity, and phytoplankton abundance at various stations along the coast to ascertain the potential influence of those variables on recruitment, growth, and survival. At St. Joseph Bay in the Florida panhandle (Figure 1), we monitor bay scallop recruitment in what we consider to be a historically healthy population (Arnold et al., 1998) to provide a baseline against which to compare recruitment in the relatively depauperate peninsular populations between Anclote and Crystal River. Those monitoring activities are designed to provide information necessary to assess the success of our management and restoration strategies. To further resolve the success of our efforts, the genetic program is designed to allow us to differentiate the relative contribution of management versus restoration efforts to observed changes in scallop population abundance.

ADULT POPULATION SURVEYS

Consistent with each of the previous surveys (e.g., Arnold et al., 1999), our 2000 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 on each side 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 Key, Steinhatchee, St. Joseph Bay, and St. Andrew Bay/Sound (Figure 1) during June. Follow-up surveys were conducted at the Anclote, Homosassa Bay, Steinhatchee, and St. Joseph Bay study sites during September and October. Twenty stations were sampled each season at each site (except Cedar Key) and, with the exception of Pine Island Sound (where the sampling stations were relocated after the 1994 survey and again after the 1999 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 Key study sites. At Cedar Key, we sampled only six stations due to the limited extent of seagrass beds in that area.

June Survey

Pine Island Sound: Relative to previous years, scallop abundance remained low but stable in Pine Island Sound

during 2000. We found scallops at 11 of our 20 survey stations, and four of those stations (1, 4, 17, and 20; Table 1) yielded more than five scallops per 600 m^2 transect. Mean scallop abundance remains low in Pine Island Sound and has not changed significantly over the last six years (1994 data excluded) of our study (Kruskal-Wallis test, $\chi^2 = 4.90$, $p = 0.43$). During those six 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. However, we moved five stations following the 1999 sampling season because we needed better coverage in the shallow waters surrounding Josslyn Key. Those station, moved from their original location around Patricio Island where scallops were essentially non-existent (Arnold et al., 2000), yielded almost 60% of the scallops that we collected from Pine Island Sound during 2000.

Anclote Estuary: Scallop abundance at the Anclote Estuary study site (Figure 3) increased by an order of magnitude during our June 2000 survey relative to June 1999. As a result, scallop abundance at Anclote was similar to abundance estimates recorded during 1997 and 1998 (Table 2). We failed to discover scallops at only three of our 20 stations, reflecting the broad distribution of scallops in Anclote during 2000. The distribution of adults is consistent with the pattern of scallop recruitment that we recorded in the Anclote area during fall 1999 (Arnold et al., 2000) and winter 2000 (Figure 4). We recorded prolonged and substantial recruitment to our artificial spat collectors beginning in October 1999 and continuing through January 2000. As with the adult distributions, some level of recruitment was recorded at almost all of our monitoring stations. The highest density of recruits was recorded at stations in the northern section of the study area, a pattern that was reflected in adult abundance the following June. Thus, scallop abundance continues to fluctuate substantially and significantly among years at Anclote ($\chi^2 = 54.97$ $p < 0.0001$), and those fluctuations are generally coincident with recruitment during the previous year. During 1998 and 1999, scallops were absent from most of our northern and central sampling stations but were relatively abundant at the southern sampling stations (Arnold et al., 1999; 2000). In contrast, during 2000 both recruits and adults were most abundant at the northern stations.

Hernando: Scallop abundance continues to vary substantially and significantly among years (Table 3; $\chi^2 = 45.21$, $p < 0.0001$) at the Hernando study site (Figure 5). Mean scallop abundance increased by an order of magnitude between 1998 and 1999, and increased by another order of magnitude between 1999 and 2000. However, in contrast to the

spatially limited increase in scallop abundance during 1999, we recorded substantially more scallops at all Hernando stations during 2000 relative to the previous years. As with Anclote, the pattern of recruitment that we recorded during fall 1999 (Arnold et al., 2000) and winter 2000 (Figure 6) are coincident with the pattern of adult abundance recorded during summer 2000.

Homosassa: We have conducted surveys of adult bay scallop abundance in Homosassa (Figure 7) since 1993, and during that time scallop density has experienced significant inter-annual variability (Table 4; $\chi^2 = 65.14$, $p < 0.0001$). In June 1997, we recorded a substantial increase in mean scallop abundance relative to all previous years (double the previous [1993] peak). During 1998, mean scallop abundance decreased by approximately 80% from the 1997 peak, possibly in response to an extended bloom of blue-green algae that was reported in the area during late 1997 and most of 1998. 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. We recorded essentially no recruitment at the Homosassa study site throughout 1998 and 1999 (Arnold et al., 2000) and during winter 2000 (Figure 8). In June 2000, we discovered very high scallop densities (average = 242.8 / 600 m^2, maximum = 850 / 600 m^2) within the Homosassa study area. Thus, mean scallop density was higher at Homosassa during 2000 than at any other study site although a higher density of scallops was recorded from some stations at the Steinhatchee study site. Additionally, during fall 2000 we recorded increased recruitment to our spat collectors relative to previous years (Figure 8). Whether that is indicative of a continuing increase in abundance of adult scallops in the Homosassa area will be determined by our June 2001 survey.

Cedar Keys: Scallop abundance decreased slightly between 1999 and 2000 at the Cedar Keys study site (Table 5), but changes in scallop abundance at the Cedar Key study site since 1998 have been small and not statistically significant ($\chi^2 = 2.97$, $p = 0.23$). Our Cedar Key study site consists of a few small seagrass beds that will probably never support a substantial scallop population. However, this site is important because it provides the first suitable bay scallop habitat north of the Homosassa/Crystal River restoration area. Thus, it provides the first landing site for expatriate larvae from that restoration effort. We will continue to monitor the grass beds around Cedar Key for any evidence of a contribution to that population from our restoration efforts.

Steinhatchee: Scallop density continues to vary significantly among years at the Steinhatchee study site (Figure 9; χ^2

= 36.59, $p < 0.0001$), but mean density recorded during June 2000 increased relative to the previous three years (Table 6). Steinhatchee remains one of the 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: Adult scallop abundance continues to differ significantly among years at the St. Joseph Bay study site (Figure 10; $\chi^2 = 44.48$, $p < 0.0001$), represented during summer 2000 by the lowest abundance we have yet recorded during seven years of monitoring (Table 7). We have considered the bay scallop population in St. Joseph Bay to be one of the two (along with Steinhatchee) most healthy scallop populations in Florida waters. Based upon the results of our June 2000 survey, that may no longer be the case. Scallop abundance at the 20 survey stations in St. Joseph Bay averaged only 3.85 animals per 600 m^2 transect, a precipitous decline from the 247.7 scallops per 600 m^2 average recorded during 1996 and an order of magnitude decrease from the density recorded during 1999. Additionally, we have been monitoring recruitment in St. Joseph Bay since October 1998, and we consistently recorded relatively high levels of recruitment from fall 1998 through spring 1999 (Arnold et al., 2000), consistent with the relatively healthy adult scallop population observed during summer 1999. Since fall 1999, we have detected almost no scallop recruitment within the estuary (Figure 11). Although one bad year does not necessarily indicate a collapse of the bay scallop population in St. Joseph Bay, the almost linear decrease in scallop abundance in St. Joseph Bay since 1996 is a cause for concern.

St. Andrew Bay and Sound: Scallop density varies significantly among years at the St. Andrew Bay/Sound study site ($\chi^2 = 48.08$, $p < 0.0001$), but again remained low during 2000 (Table 8). Mean scallop abundance decreased to a level similar to that observed during 1997 and remains an order of magnitude lower than what was recorded during the peak years of 1994 and 1996. Most stations in St. Andrew Bay had at least some scallops whereas we found only one scallop in Crooked Island Sound (Figure 12).

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 Key populations are located within the recreational fishery closed zone whereas the Steinhatchee, St. Joseph Bay, and St.

Andrew Bay/Crooked Island Sound populations are located within the recreational fishery open zone. However, at least during 2000, those subdivisions do not explain scallop distribution and abundance very well (Figure 13). Instead, sites located within the Steinhatchee Bight (inshore of a line drawn from approximately Clearwater to Cape San Blas), including Hernando, Homosassa, and Steinhatchee, supported significantly more dense scallop populations than did those sites (Pine Island Sound, St. Joseph Bay, St. Andrew Bay) located outside of the Bight (Table 9). Abundance at Anclote differed significantly from the sites within the Bight but also differed significantly from the St. Andrew Bay population. These results provide further support for the potential influence of hydrographic factors on the distribution and abundance of bay scallop populations in Florida (Arnold et al., 2000). Further, our data suggest that the Anclote population may be located in a transition zone between those waters within the Bight and waters outside of the Bight. Those observations are consistent with the hypothesized location of the Big Bend Gyre within the Steinhatchee Bight and with the location of a hydrographic confluence zone in the vicinity of Anclote (Yang & Weisberg, 1999).

Fall Survey

Using the same stations and methods that we employed during our June surveys, we surveyed Anclote, Homosassa, Steinhatchee, and St. Joseph Bay for adult scallop abundance during fall (September and October) 2000 after the closure of the recreational fishing season. As previously discussed (Arnold et al., 2000), the average decrease in scallop abundance within each of the Homosassa and St. Joseph Bay study sites between June and fall has averaged approximately 60% during the late 1990's. During 2000, scallop abundance decreased by 40-50% at those two sites (Tables 10 and 11), and a similar decrease of 34% was observed at Steinhatchee (Table 12). In contrast, scallop abundance decreased by 90% between June and fall at the Anclote study site (Table 13).

Our estimates of changes in scallop abundance during the recreational fishing season provide no evidence of a significant impact of recreational fishing on scallop abundance. Changes in scallop abundance between June and fall are highly variable both within and among sites, and we have no evidence that the change in overall abundance differs substantially between open and closed harvest areas. But, this evidence is not conclusive. First, it is very difficult to estimate recreational fishing effort for bay scallops in Florida, and no hard data on effort is available. Additionally, recreational fishing effort is targeted and spatially biased within the study areas. As a result,

our large-scale sampling program is not appropriate for estimating the impact of fishing on the scale at which it is occurring. Finally, bay scallop distribution may shift, due to both passive (e.g., currents) and active (swimming) forces, within each site. The effect of that movement, at the scale at which our sampling program operates, is unknown.

It is possible to make a rough estimate of the potential impact of recreational scallop harvest at a particular site. We will choose Steinhatchee as an example. The area that we survey in Steinhatchee is approximately 17850 hectares, although it should be noted that our survey area is representative of the Steinhatchee area but does not include all potential scallop habitat. Instead, we sample 20 stations that have been randomly selected from the area between the 0.61 m (2') and 1.83 m (6') depth contours and from Pepperfish Keys in the south to Sponge Point in the north. During June 2000, we estimated a mean density of 218.3 scallops per 600 m^2 transect, equivalent to 3638 scallops per hectare or approximately 65 million scallops within our study area. Each scallop harvester is allowed to harvest two gallons of whole scallops per day, equivalent to approximately 150 medium sized (mean size approximately 55 mm SH) scallops. Thus, during June 2000 there were enough scallops in the Steinhatchee study area to fill over 400,000 daily limits. To achieve a 10% harvest impact on the population would require the taking of 40,000 limits within the 72-day season, equivalent to over 500 limits per day. Although Steinhatchee remains a very popular area to fish for scallops, average daily scalloping activity during the season is probably less than 100 people, so it is doubtful that harvest contributes more than 1-2% mortality in this robust population of scallops.

In contrast, roughly estimating the area of our study domain in St. Joseph Bay, and using the mean June density of 3.85 scallops per 600m^2, we estimate that there were approximately 2.5 million scallops in St. Joseph Bay during June 2000. That equates to 16,900 limits. If an average of 100 people fish for scallop during each of the 72 days of the season, then 7200 limits or almost 43% of the population would be taken.

The above analyses provide a very rough estimate of total bay scallop abundance in the Steinhatchee and St. Joseph Bay study areas during June 2000. However, those analyses do provide a useful estimate of the fishing effort required to significantly impact a healthy bay scallop population and also provide a contrast between the effect of fishing in a healthy scallop population versus a population exhibiting signs of stress.

Restoration

We were able to successfully plant scallops in Tampa Bay, Anclote, Homosassa, and Crystal River during 2000. Survival has been relatively good at all sites, and we have preliminary evidence that those scallops spawned and that recruitment did occur at each of our target sites. However, we cannot be sure that those recruits are offspring of the scallops that we planted. That determination awaits the results of genetic analyses that are ongoing.

We conducted a preliminary scallop restoration effort in Sarasota Bay during 2000. Only a small number of scallops were planted, but survival was good and we anticipate that we will have good success with the larger effort that will be initiated during May 2000.

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Marelli, D.C., W.S. Arnold and C. Bray (1999). Levels of recruitment and adult abundance in a collapsed population of bay scallops (*Argopecten irradians*) in Florida. J. Shellfish Res. 18: 393-399.

Yang, H. and R.H. Weisberg (1999). Response of the West Florida Shelf circulation to climatological wind stress forcing. J. Geophys. Res. 104: 5301-5320.

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

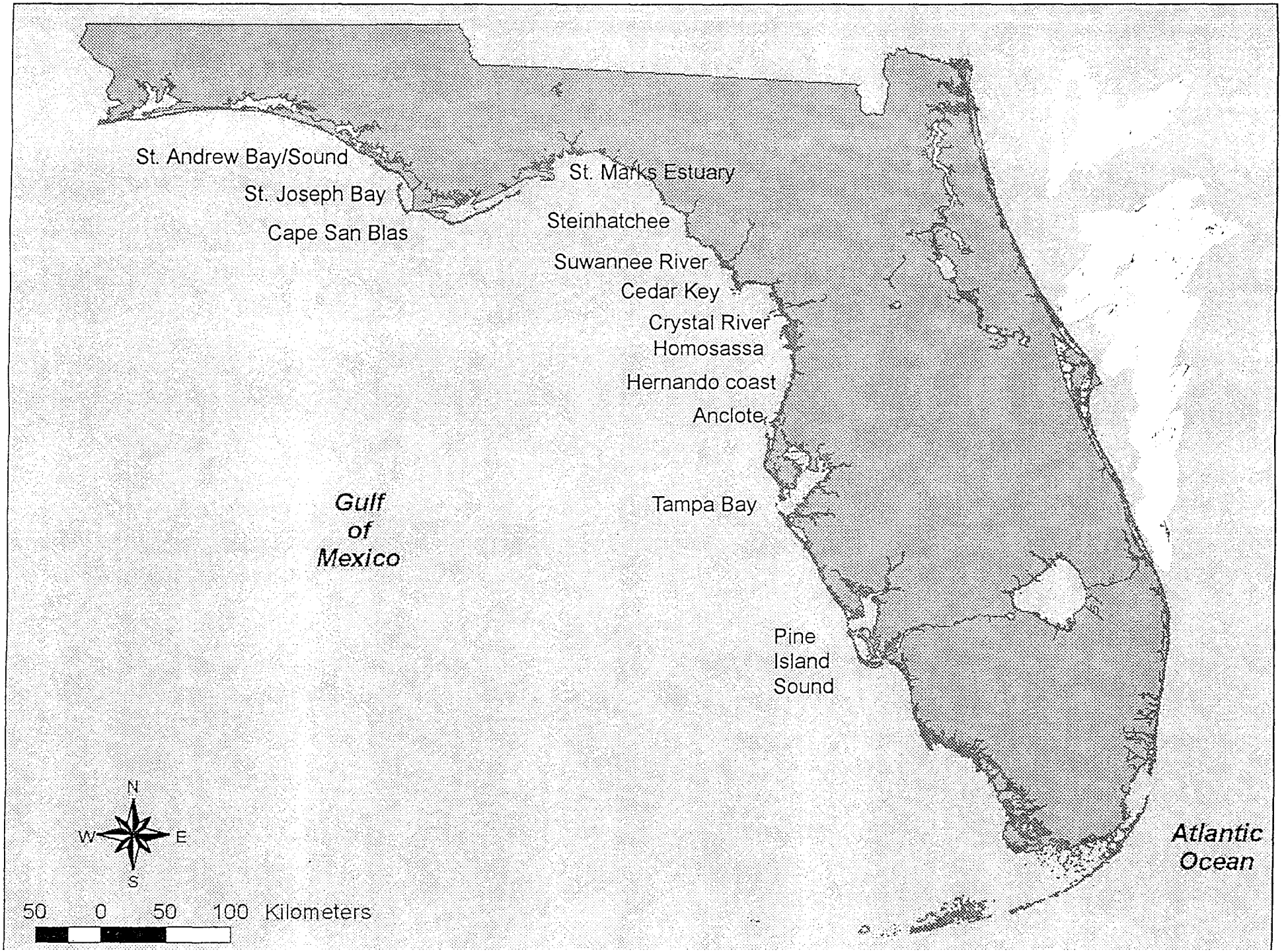
St. Andrew Bay/Sound
St. Joseph Bay
Cape San Blas
St. Marks Estuary
Steinhatchee
Suwannee River
Cedar Key
Crystal River
Homosassa
Hernando coast
Anclote
Tampa Bay
Gulf of Mexico
Pine Island Sound
Atlantic Ocean
N
W
E
S
50 0 50 100 Kilometers

Table 1. Adult bay scallop density at each of 20 stations sampled at the Pine Island Sound, Florida, study site during each June from 1994 through 2000.

JUNE BAY SCALLOP SURVEY
PINE ISLAND SOUND
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	0	0	0	0	0	0	8
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	2
4	0	0	0	0	0	0	22
5	0	0	0	0	0	0	1
6	0	0	1	0	0	0	0
7	0	0	1	1	0	0	1
8	0	0	0	0	2	1	0
9	0	0	0	0	0	0	2
10	0	1	0	3	1	0	0
11	0	1	0	0	0	0	1
12	0	34	1	5	5	1	0
13	0	9	0	4	0	0	0
14	0	0	0	15	0	0	0
15	0	1	0	5	0	0	0
16	0	1	0	2	0	1	2
17	0	0	9	9	22	12	8
18	0	0	3	0	14	25	1
19	0	1	0	2	0	7	0
20	0	1	0	0	3	5	8
MEAN	0.00	2.45	0.75	2.30	2.35	2.60	2.80
S.D.	0.00	7.69	2.07	3.87	5.66	6.12	5.31

Figure 2. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at the Pine Island Sound, Florida, study site.

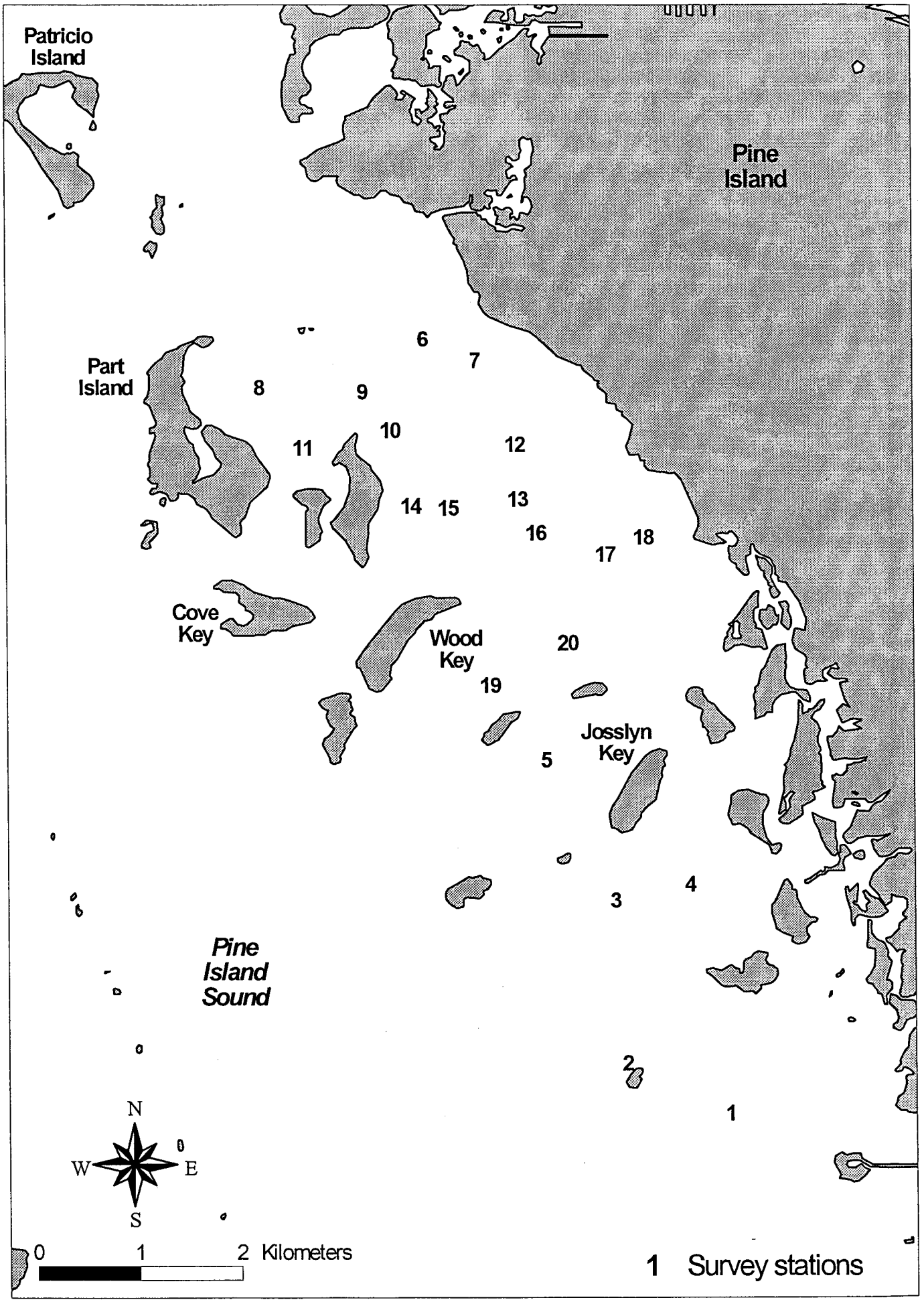
Patricio Island
Pine Island
Part Island
6
7
8
9
10
11
12
13
14
15
16
17
18
Cove Key
Wood Key
20
19
Josslyn Key
5
4
3
Pine Island Sound
2
1
N
W
E
S
0
1
2 Kilometers
1 Survey stations

Figure 3. Station locations for sampling juvenile recruitment (small numbers) and adult abundance (large bold numbers) of bay scallops (*Argopecten irradians*) at the Anclote Estuary, Florida, study site.

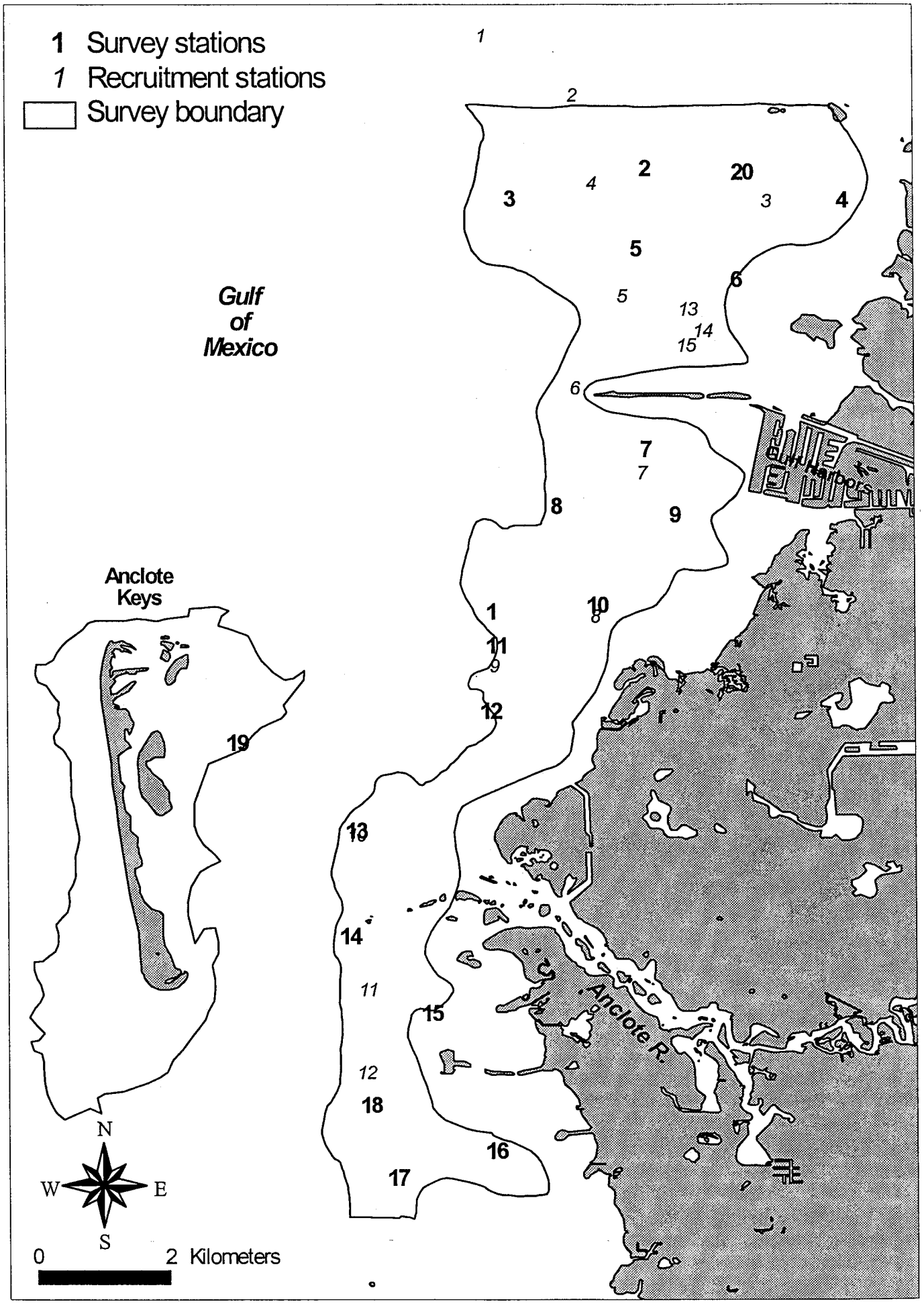
1 Survey stations
1 Recruitment stations
Survey boundary
Gulf of Mexico
Anclote Keys
Anclote R.
N
W
E
S
0
2 Kilometers

Table 2. Adult bay scallop density at each of 20 stations sampled at the Anclote, Florida, study site during each June from 1994 through 2000.

JUNE BAY SCALLOP SURVEY
ANCLOTE
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	1	0	4	43	0	0	1
2	72	0	3	49	0	1	171
3	15	0	2	307	0	8	177
4	0	0	0	1	0	1	1
5	106	0	0	20	0	0	7
6	3	0	0	4	0	0	6
7	21	0	0	1	0	1	3
8	14	0	12	136	0	2	8
9	2	3	0	4	0	0	0
10	1	0	1	30	0	0	2
11	1	0	2	27	0	0	3
12	14	0	0	1	0	0	0
13	12	0	0	8	0	0	0
14	0	0	11	14	1	4	12
15	1	0	1	141	17	13	4
16	5	0	23	87	46	9	4
17	9	0	6	20	313	8	27
18	1	0	3	42	17	0	7
19	1	0	0	8	12	2	9
20	14	0	0	4	0	1	2
MEAN	14.65	0.15	3.40	47.35	20.30	2.50	22.2
S.D.	26.80	0.67	5.82	74.05	69.80	3.85	52.28

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. See Figure 3 for specific station locations.

Anclote Region Recruitment - 2000

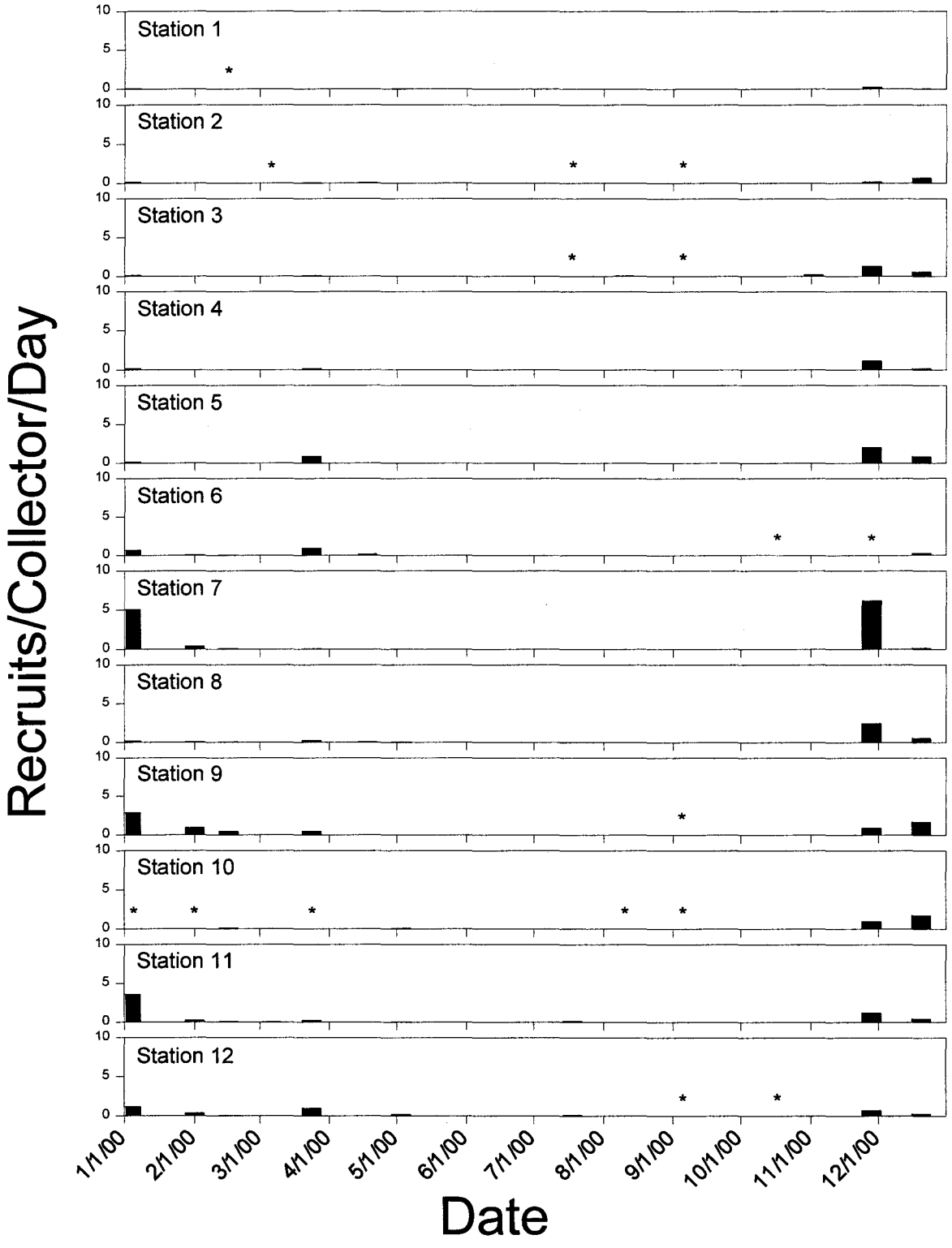

Table 3. Adult bay scallop density at each of 20 stations sampled at the Hernando, Florida, study site during each June from 1997 through 2000.

JUNE BAY SCALLOP SURVEY
HERNANDO
1997-2000
#/600M^2

STATION	1997	1998	1999	2000
1	3	0	0	13
2	11	0	33	76
3	134	3	17	213
4	80	6	43	48
5	9	0	1	29
6	1	0	2	31
7	0	0	0	10
8	0	0	0	14
9	1	0	1	66
10	3	0	1	43
11	0	0	5	17
12	0	0	1	61
13	10	0	4	18
14	1	0	0	15
15	10	1	2	54
16	2	1	1	7
17	8	0	3	27
18	6	0	0	28
19	6	0	0	25
20	0	0	0	49
MEAN	14.25	0.55	5.70	42.2
S.D.	33.13	1.47	11.79	44.94

Figure 5. Station locations for sampling juvenile recruitment (small numbers) and adult abundance (large bold numbers) of bay scallops (*Argopecten irradians*) at the Hernando, Florida, study site.

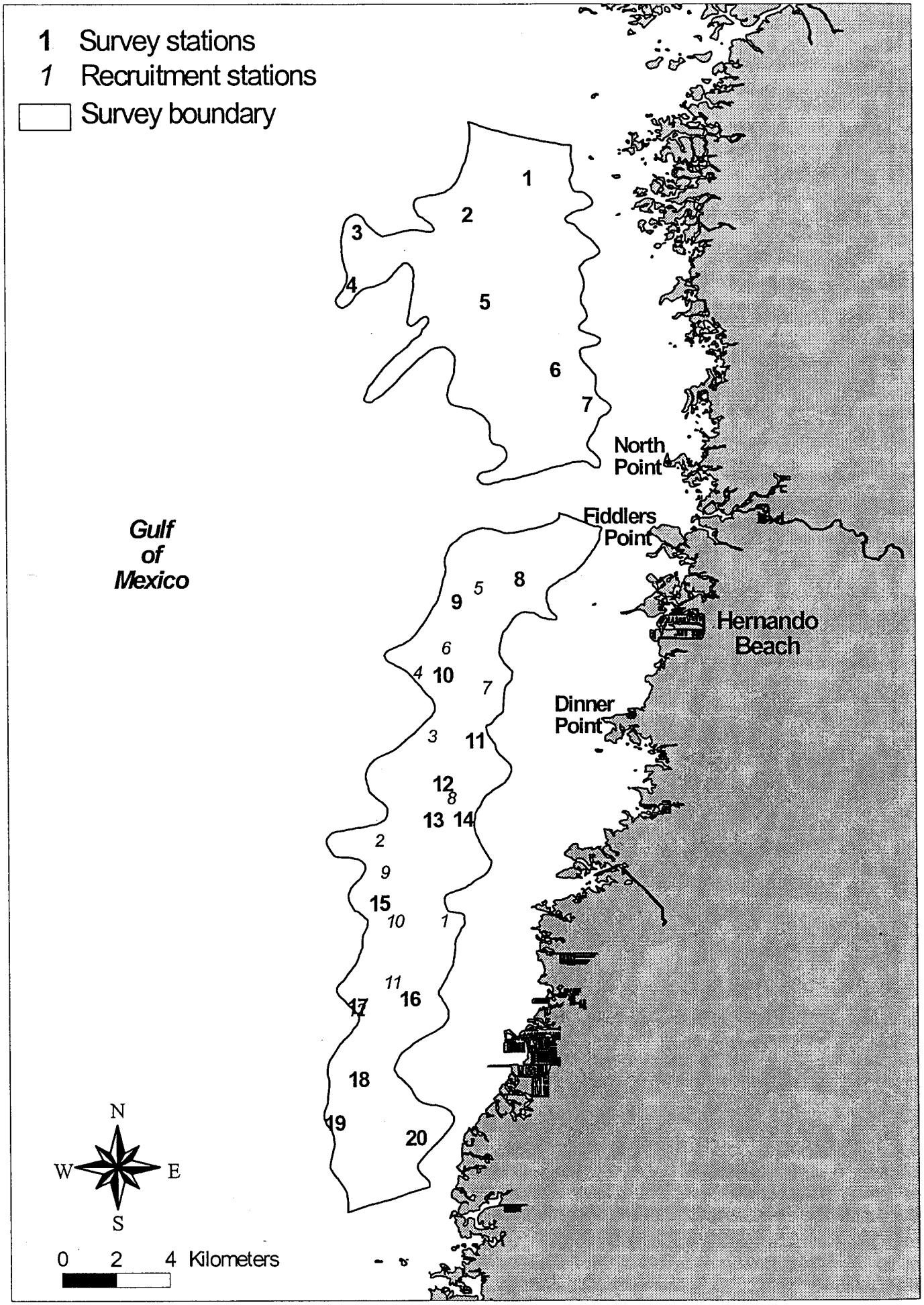
1 Survey stations
1 Recruitment stations
Survey boundary
Gulf of Mexico
North Point
Fiddlers Point
Hernando Beach
Dinner Point
N
W
E
S
0 2 4 Kilometers

Figure 6. 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. See Figure 5 for specific station locations.

Hernando Region Recruitment - 2000

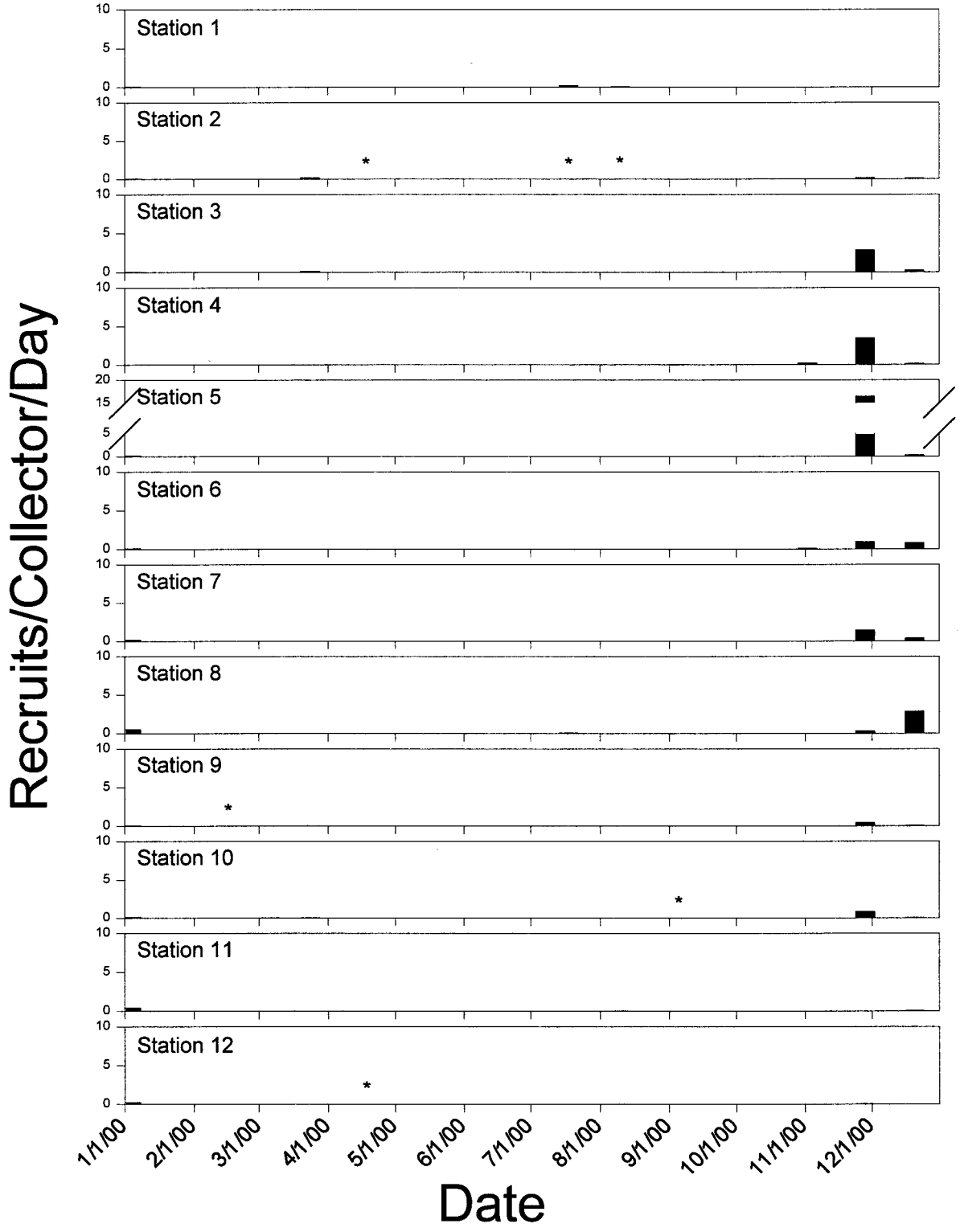

Figure 7. Station locations for sampling juvenile recruitment (small numbers) and adult abundance (large bold numbers) of bay scallops (*Argopecten irradians*) at the Homosassa Bay, Florida, study site.

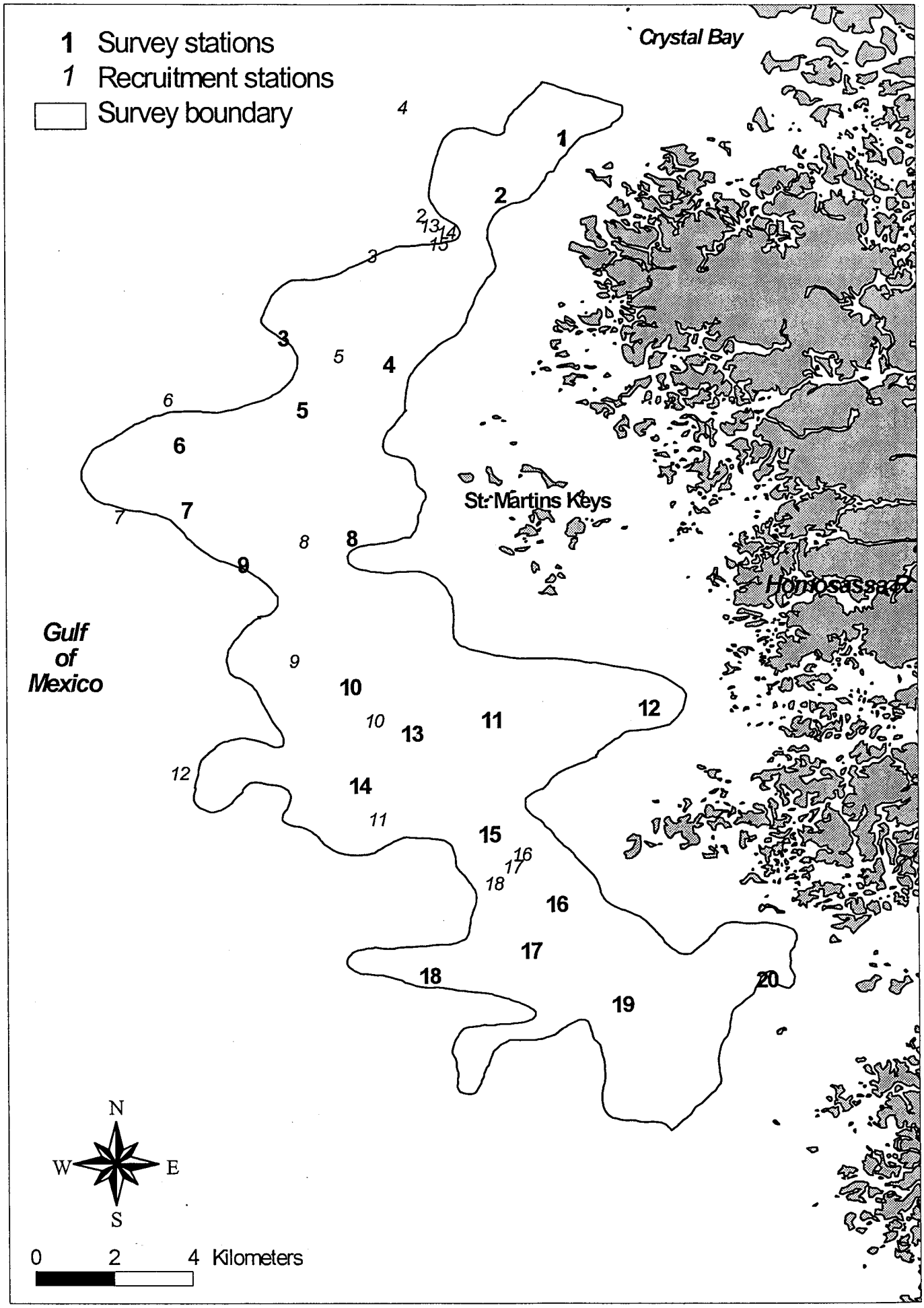
1 Survey stations
1 Recruitment stations
Survey boundary
Crystal Bay
St. Martins Keys
Homosassa R.
Gulf of Mexico
N
W
E
S
0 2 4 Kilometers

Table 4. Adult bay scallop density at each of 20 stations sampled at the Homosassa, Florida, study site during each June from 1993 through 2000.

JUNE BAY SCALLOP SURVEY
HOMOSASSA
1994-2000
#/600M^2

STATION	1993	1994	1995	1996	1997	1998	1999	2000
1	4	3	0	0	9	0	3	23
2	13	38	9	2	17	0	3	87
3	4	5	9	5	18	2	7	29
4	9	1	4	0	19	0	36	323
5	5	0	14	5	15	0	33	395
6	4	0	1	9	7	0	70	724
7	4	1	2	5	5	34	47	817
8	8	5	27	4	27	3	13	850
9	3	3	7	4	13	13	54	614
10	3	19	3	2	58	6	9	165
11	10	0	1	0	5	1	2	23
12	0	0	1	3	0	0	0	12
13	8	23	6	2	12	0	13	231
14	4	15	0	9	23	2	48	352
15	24	4	1	2	7	0	3	45
16	13	3	3	1	6	0	5	28
17	20	3	1	6	0	0	13	25
18	8	9	3	3	55	0	212	88
19	2	5	2	1	8	0	2	25
20	0	0	0	0	0	0	0	1
MEAN	7.30	6.85	4.70	3.15	15.20	3.05	28.65	242.85
S.D.	6.28	9.82	6.43	2.74	16.01	7.92	48.10	290.00

Figure 8. 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. See Figure 7 for specific station locations.

Homosassa Region Recruitment - 2000

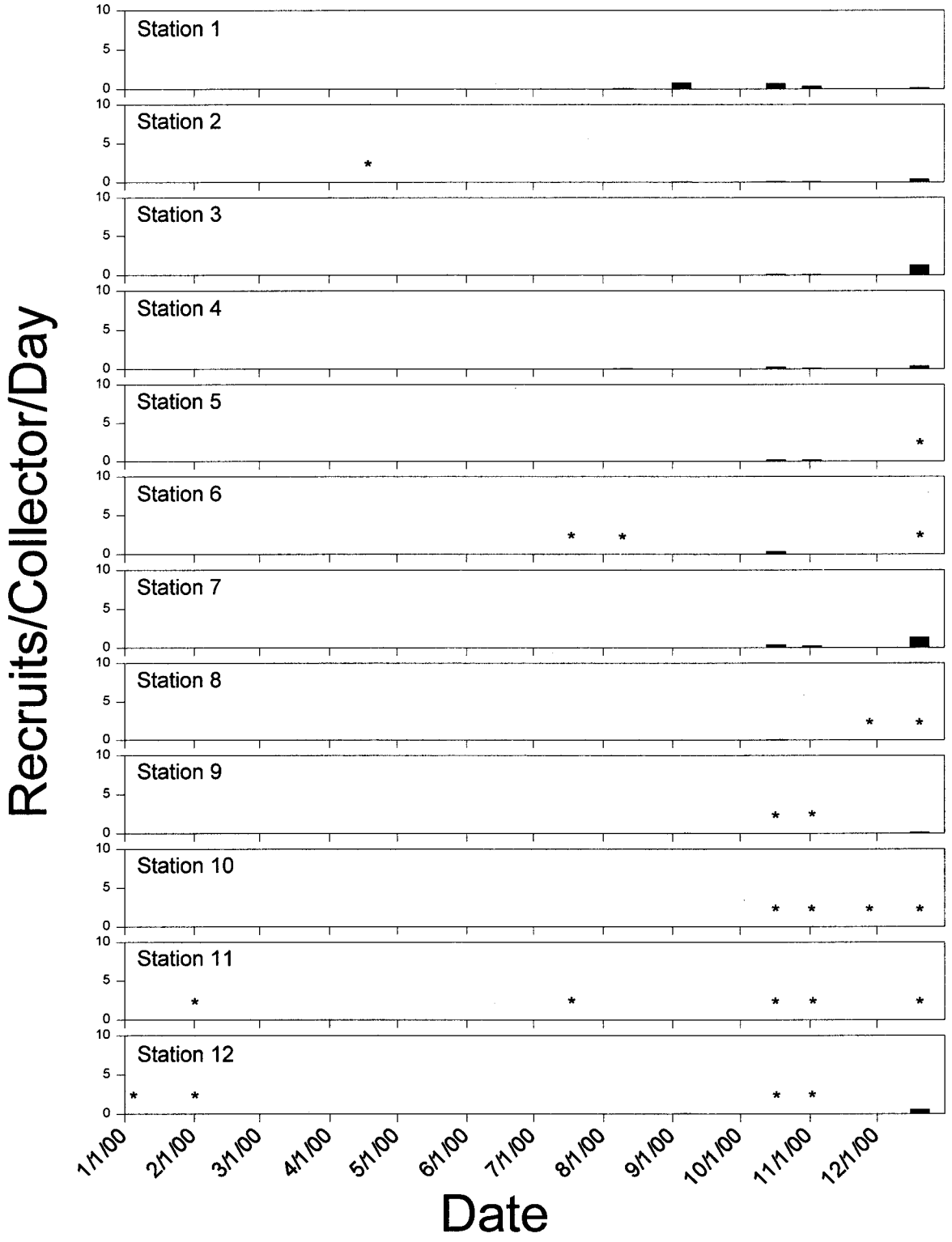

Table 5. Adult bay scallop density at each of six stations sampled at the Cedar Key, Florida, study site during each June from 1998 through 2000.

JUNE BAY SCALLOP SURVEY
CEDAR KEY
1998-2000
#/600M^2

STATION	1998	1999	2000
1	0	1	1
2	0	0	0
3	1	4	0
4	0	4	0
5	1	0	1
6	3	7	0
MEAN	0.83	2.67	0.33
S.D.	1.17	2.80	0.52

Figure 9. Station locations for sampling adult abundance of bay scallops (*Argopecten irradians*) at the Steinhatchee, Florida, study site.

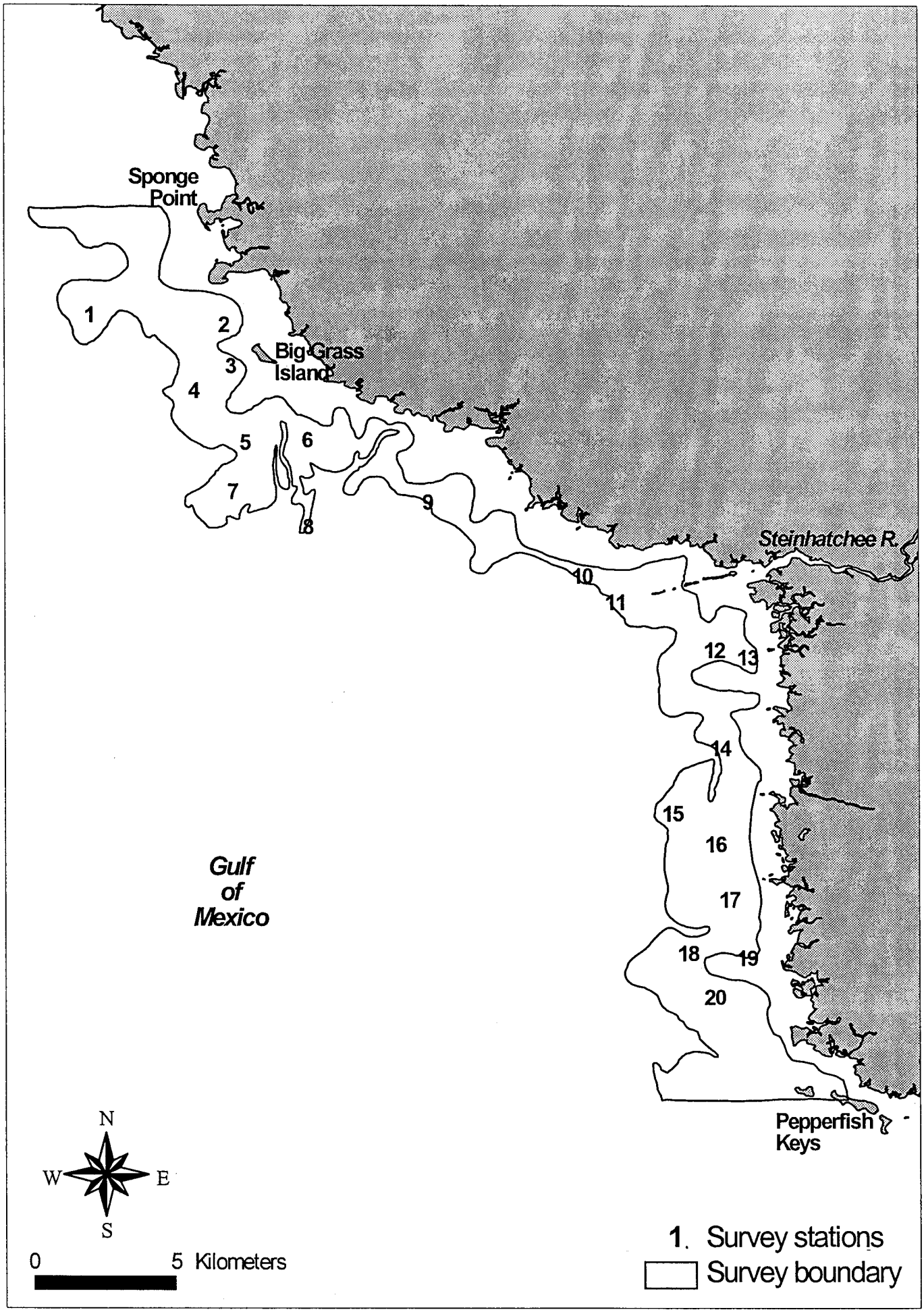
Sponge Point
Big Grass Island
Steinhatchee R.
Gulf of Mexico
Pepperfish Keys
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
N
W
E
S
0
5 Kilometers
1. Survey stations
Survey boundary

Table 6. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee, Florida, study site during each June from 1994 through 2000.

JUNE BAY SCALLOP SURVEY
STEINHATCHEE
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	189	13	528	1	9	43	946
2	284	48	36	5	100	97	17
3	89	16	128	103	90	97	24
4	338	14	269	13	18	34	196
5	650	14	1879	25	16	105	99
6	234	22	210	37	0	137	75
7	81	4	73	3	4	29	115
8	0	1	0	3	0	2	5
9	169	44	498	23	39	158	84
10	10	0	76	1	3	10	0
11	1	0	0	0	0	0	0
12	281	0	415	30	0	638	1603
13	10	8	41	6	0	46	124
14	259	4	119	7	7	129	9
15	120	1	65	6	0	52	8
16	1	30	71	30	20	545	49
17	13	23	118	42	35	789	208
18	133	3	44	14	3	19	313
19	121	313	284	135	111	332	278
20	85	27	151	34	91	27	213
MEAN	153.40	29.25	250.25	25.90	27.30	164.45	218.30
S.D.	159.05	68.31	414.65	34.95	38.17	227.34	388.54

Figure 10. Station locations for sampling juvenile recruitment (small numbers) adult abundance (large bold numbers) of bay scallops (*Argopecten irradians*) at the St. Joseph Bay, Florida, study site.

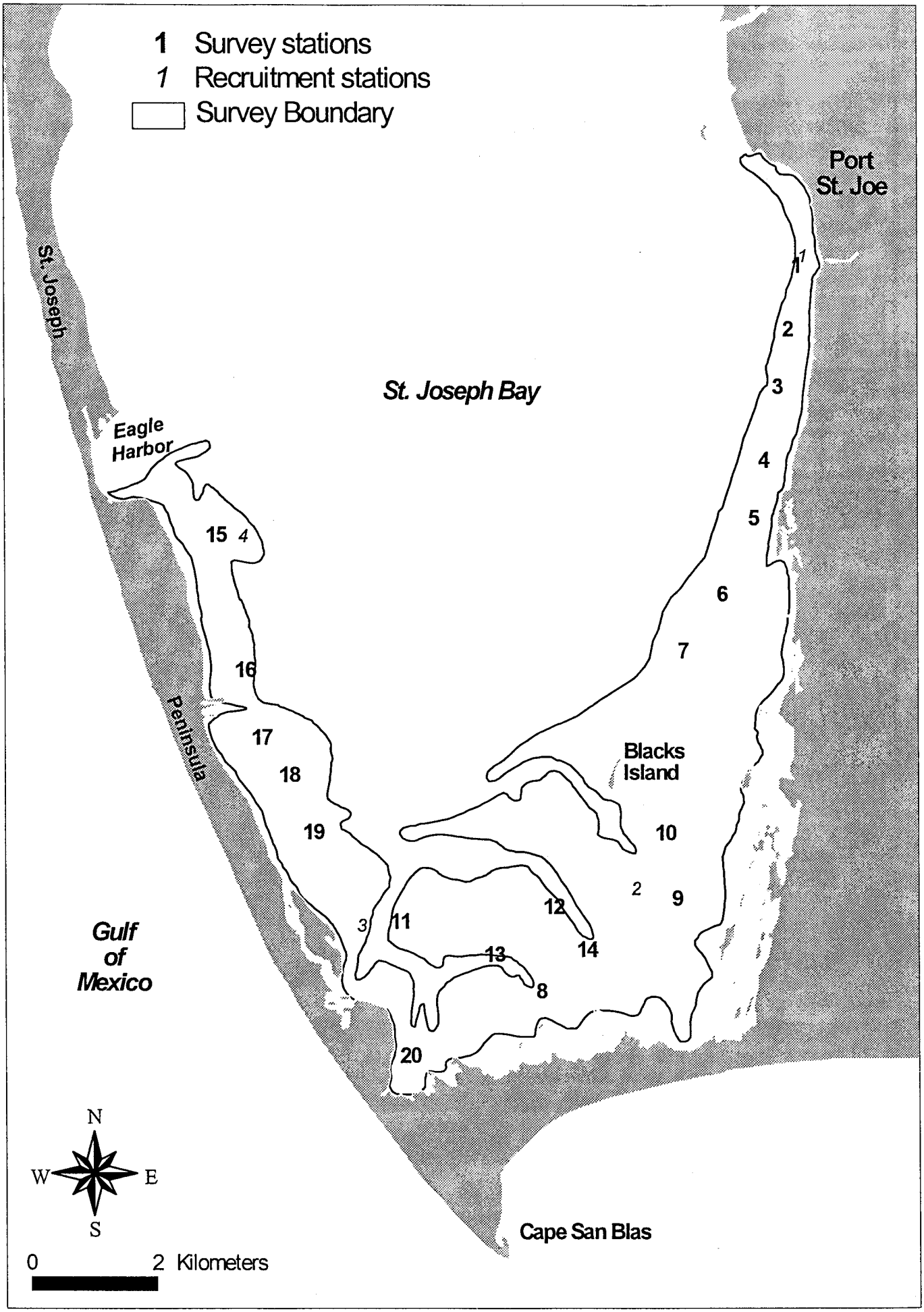
1 Survey stations
1 Recruitment stations
Survey Boundary
Port St. Joe
St. Joseph
St. Joseph Bay
Eagle Harbor
Peninsula
Blacks Island
Gulf of Mexico
Cape San Blas
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
N
W
E
S
0
2 Kilometers

Table 7. Adult bay scallop density at each of 20 stations sampled at the St. Joseph Bay, Florida, study site during each June from 1994 through 2000.

JUNE BAY SCALLOP SURVEY
ST. JOE BAY
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	16	1	4	2	0	1	0
2	2	1	64	10	0	35	9
3	12	6	2	3	0	10	22
4	1	2	0	0	12	11	18
5	8	67	2	2	0	29	5
6	15	205	114	19	3	43	3
7	5	114	55	7	4	30	0
8	265	348	140	93	90	105	4
9	61	118	43	11	7	29	0
10	7	711	363	111	18	53	3
11	0	5	759	10	25	31	1
12	5	233	1143	40	26	13	1
13	3	195	369	62	45	9	0
14	19	270	820	10	2	4	0
15	5	11	44	1	9	22	0
16	9	14	228	14	10	5	0
17	2	44	282	2	7	7	0
18	1	25	240	0	4	7	1
19	2	17	179	7	5	14	0
20	279	257	103	142	2	164	10
MEAN	35.85	132.20	247.70	27.30	13.45	31.10	3.85
S.D.	81.87	175.47	312.22	41.53	21.31	48.25	6.30

Figure 11. Average daily recruitment of juvenile scallops to spat collectors located at various locations within the St. Joseph Bay study site. See Figure 10 for specific station locations.

St. Joe Bay Recruitment - 2000

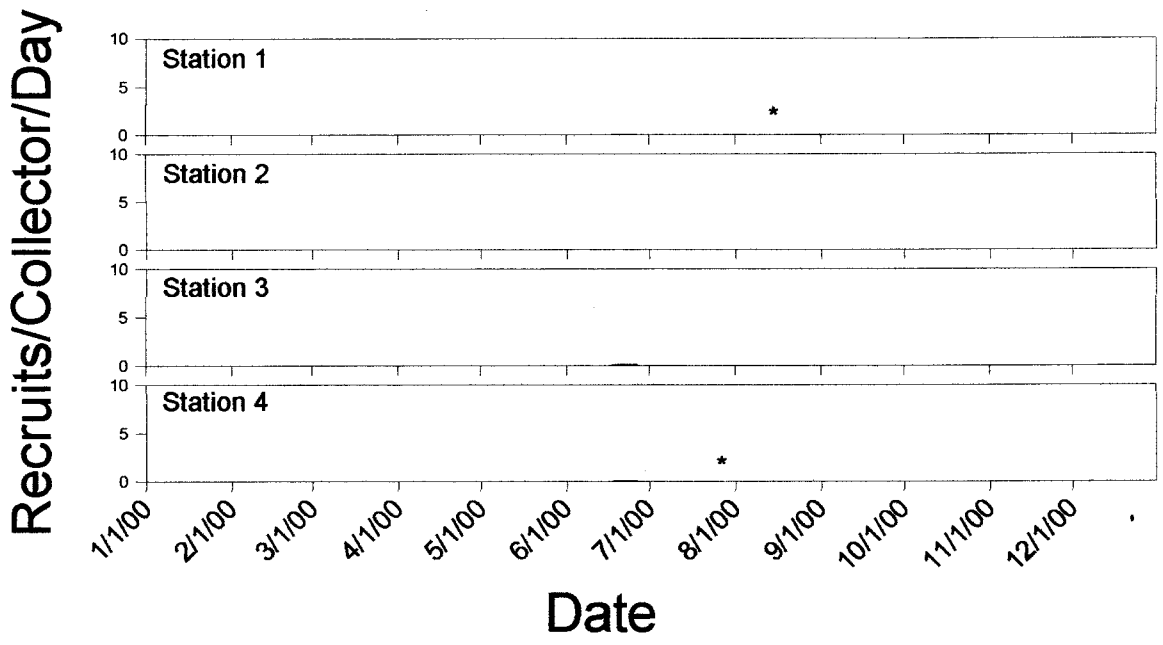

Table 8. Adult bay scallop density at each of 20 stations sampled at the St. Andrew Bay/Sound, Florida, study site during each June from 1994 through 2000.

JUNE BAY SCALLOP SURVEY
ST. ANDREW BAY
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	1	4	12	1	1	0	0
2	5	13	6	5	0	0	2
3	70	16	155	9	0	1	2
4	244	8	23	0	0	1	1
5	50	1	20	2	2	0	0
6	96	20	13	0	0	1	0
7	144	6	2	0	2	4	0
8	173	13	11	0	31	3	1
9	149	8	39	1	0	0	1
10	68	0	26	1	0	5	1
11	69	5	5	0	1	9	12
12	6	2	6	4	0	1	1
13	6	2	56	8	1	2	2
14	24	2	2	0	0	0	0
15	0	9	7	0	0	8	0
16	0	1	0	0	0	0	0
17	2	0	0	0	0	0	0
18	5	3	1	0	1	0	0
19	24	1	13	3	0	8	1
20	0	1	5	3	4	4	0
MEAN	56.80	5.75	20.10	1.85	2.15	2.35	1.20
S.D.	70.77	5.82	34.78	2.74	6.87	3.01	2.65

Figure 12. 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.

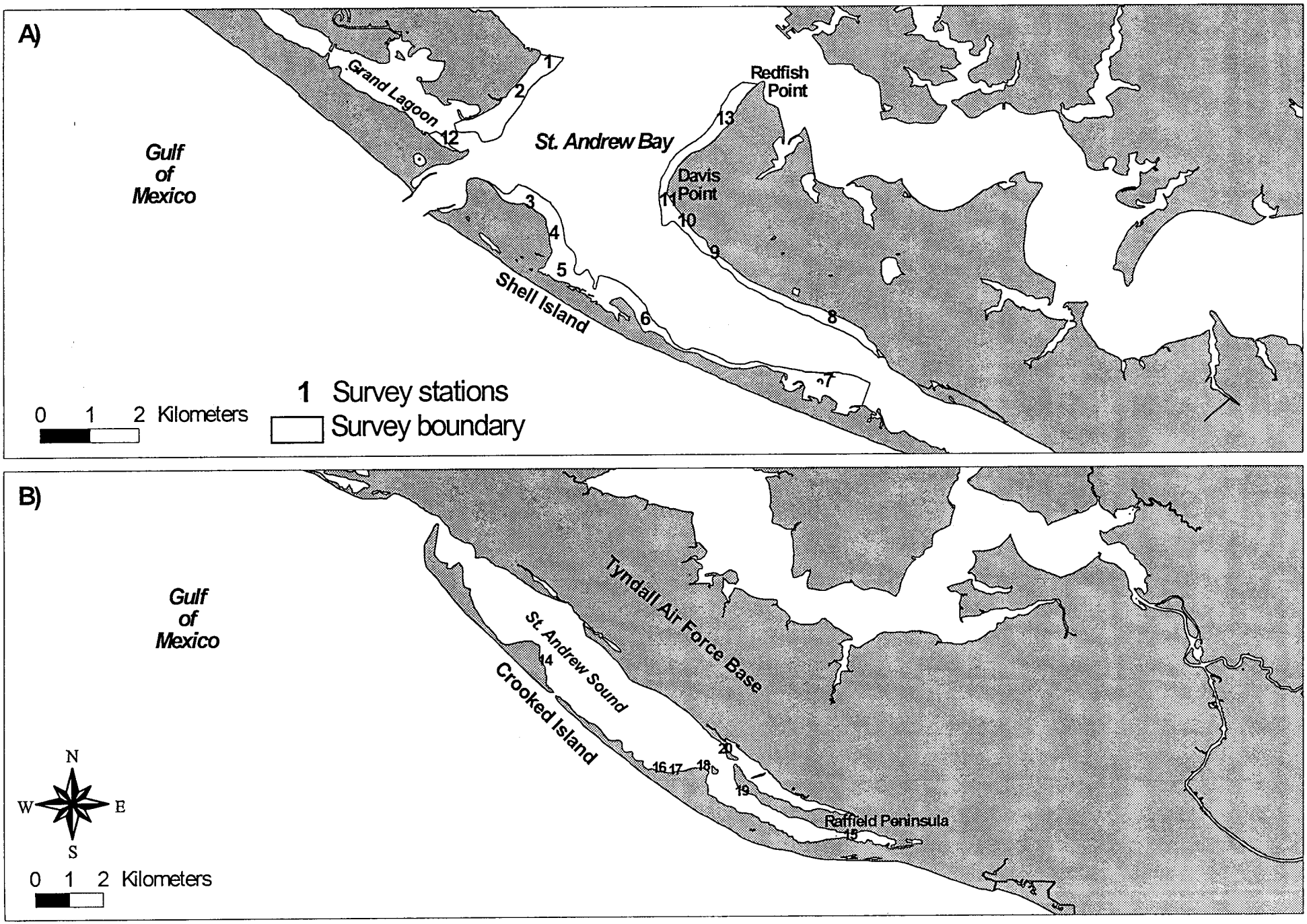
A)
Grand Lagoon
Gulf of Mexico
St. Andrew Bay
Redfish Point
Davis Point
Shell Island
1
2
3
4
5
6
7
8
9
10
11
12
13
0 1 2 Kilometers
1 Survey stations
Survey boundary
B)
Gulf of Mexico
Tyndall Air Force Base
St. Andrew Sound
Crooked Island
Raffield Peninsula
15
16
17
18
19
20
N
W
E
S
0 1 2 Kilometers

Figure 13. Comparison of adult scallop density at various sites along the Florida Gulf of Mexico coast during June of each year beginning in 1994. Note that sampling was not initiated until 1997 at the Hernando site and until 1998 at the Cedar Key site.

Mean Adult Scallop Density

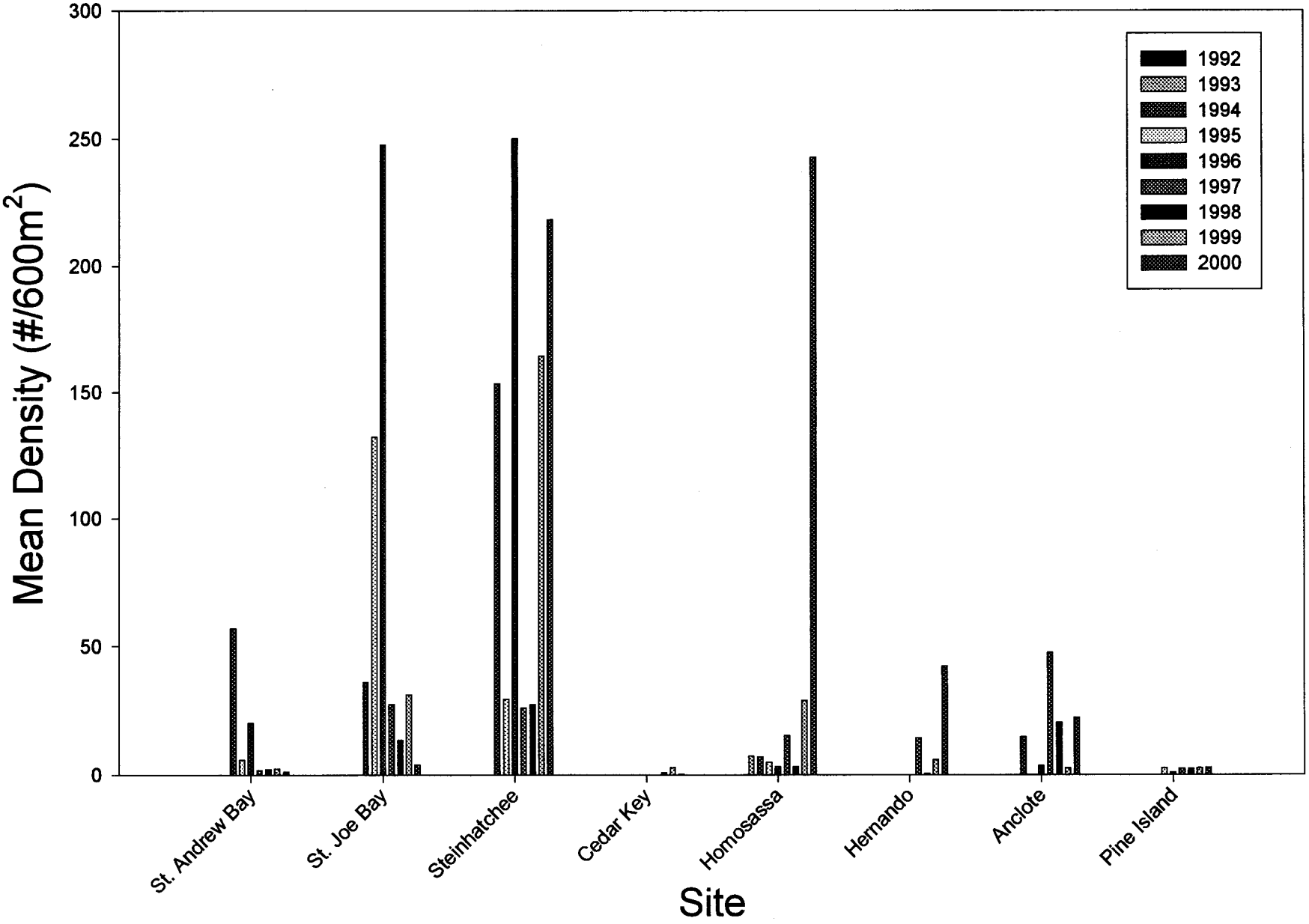

Table 9. Results of Simultaneous Test Procedure (STP; Sokal & Rohlf, 1995) analysis of pairwise differences between various sites sampled for bay scallop adult abundance during June, 2000. Asterisks denote a significant difference between two populations at $p = 0.05$, ns indicates no significant difference, and N/A indicates that a comparison was not appropriate.

Site	Pine Island Sound	Anclote	Hernando	Homosassa	Steinhatchee	St. Joseph Bay	St. Andrew Bay
Pine Island Sound	N/A						
Anclote	ns	N/A					
Hernando	*	*	N/A				
Homosassa	*	*	ns	N/A			
Steinhatchee	*	*	ns	ns	N/A		
St. Joseph Bay	ns	ns	*	*	*	N/A	
St. Andrew Bay	ns	*	*	*	*	ns	N/A

Table 10. Adult bay scallop density at each of 20 stations sampled at the Homosassa, Florida, study site during each fall from 1995 through 2000.

FALL BAY SCALLOP SURVEY
HOMOSASSA
1994-2000
#/600M^2

STATION	1995	1996	1997	1998	1999	2000
1	0	0	0	0	2	5
2	0	0	9	0	1	39
3	0	6	8	3	6	40
4	0	0	50	0	12	542
5	0	1	38	0	5	412
6	2	1	9	5	29	654
7	0	0	4	8	58	570
8	0	1	28	1	4	399
9	1	0	13	4	24	111
10	4	1	35	0	2	5
11	0	0	2	0	0	4
12	0	3	1	0	0	2
13	0	0	9	0	0	3
14	0	1	29	0	24	57
15	3	1	1	0	2	5
16	0	1	21	0	1	14
17	0	4	4	0	1	4
18	0	7	43	0	53	12
19	0	0	11	0	0	16
20	0	0	1	0	0	0
MEAN	0.50	1.35	15.80	1.05	11.20	144.70
S.D.	1.15	2.06	15.77	2.21	17.61	226.64

Table 11. Adult bay scallop density at each of 20 stations sampled at the St. Joseph Bay, Florida, study site during each fall from 1994 through 2000.

FALL BAY SCALLOP SURVEY
ST. JOE BAY
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000
1	0	1	0	0	0	0	3
2	0	0	1	0	0	0	10
3	0	1	94	24	0	0	0
4	0	0	86	0	1	0	0
5	0	1	30	0	7	0	1
6	0	0	51	32	6	0	7
7	1	1	8	18	1	0	2
8	7	150	11	70	25	3	3
9	5	2	1	25	0	9	0
10	11	21	28	35	0	2	0
11	0	3	190	2	26	0	0
12	0	37	1534	59	16	0	2
13	0	55	1324	61	42	0	6
14	1	37	439	44	13	0	1
15	0	0	0	5	0	0	0
16	0	0	12	6	3	0	2
17	1	16	137	4	3	0	3
18	0	4	238	4	2	0	1
19	0	31	187	4	1	0	0
20	0	10	171	0	3	1	0
MEAN	1.30	18.50	227.10	19.65	7.45	0.75	2.05
S.D.	2.94	34.95	426.98	23.17	11.47	2.10	2.74

Table 12. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee, Florida, study site during each fall from 1995 through 2000. Note that a fall survey was not conducted during 1999 due to logistical constraints.

FALL BAY SCALLOP SURVEY
STEINHATCHEE
1994-2000
#/600M^2

STATION	1994	1995	1996	1997	1998	2000
1	1	6	439	4	5	1066
2	48	105	60	87	7	7
3	100	25	65	79	13	13
4	61	18	139	5	18	190
5	45	25	767	5	9	147
6	25	12	48	27	0	31
7	61	3	183	9	0	216
8	0	0	0	6	0	3
9	0	11	3	130	0	218
10	0	6	29	0	0	0
11	0	0	0	1	0	0
12	1	30	62	1	0	57
13	0	7	31	6	0	20
14	0	25	39	0	2	13
15	0	1	46	17	0	43
16	0	58	69	136	1	75
17	0	47	33	148	3	131
18	26	0	35	70	5	352
19	18	112	176	163	10	143
20	77	5	197	42	10	169
MEAN	23.15	24.80	121.05	46.80	4.50	144.70
S.D.	31.3	32.74	183.11	57.02	5.29	237.54

Table 13. Adult bay scallop density at each of 20 stations sampled at the Anclote, Florida, study site during fall 1994, 1997, 1998, and 2000.

FALL BAY SCALLOP SURVEY
ANCLOTE
1994-2000
#/600M^2

STATION	1994	1997	1998	2000
1	3	33	0	6
2	36	4	0	7
3	22	292	0	12
4	0	1	0	0
5	44	22	0	1
6	0	3	0	1
7	13	29	0	3
8	0	88	0	3
9	0	0	0	0
10	2	42	0	1
11	2	41	0	0
12	0	4	0	0
13	0	7	0	0
14	1	9	1	0
15	9	182	1	0
16	0	607	23	1
17	3	47	12	3
18	5	40	2	0
19	0	0	1	5
20	3	5	0	1
MEAN	7.15	72.80	2.00	2.20
S.D.	12.58	144.81	5.62	3.16

EXECUTIVE SUMMARY
Bay Scallops
William S. Arnold
April, 2001

Bay scallops (*Argopecten irradians*) were once abundant throughout Florida coastal waters in the area between Palm Beach and Pensacola. In recent decades, many of those populations have collapsed due to a combination of factors including development, habitat loss, and overfishing of stressed populations. In 1995 the Marine Fisheries Commission (now the Florida Fish and Wildlife Conservation Commission) revised bay scallop harvesting regulations to eliminate all commercial fishing, eliminate recreational fishing south of the Suwannee River, and reduce the season length and bag limits. The Molluscan Fisheries research group at the FWC Florida Marine Research Institute is responsible for monitoring bay scallop populations to determine the effects of those revised regulations.

During 2000, the results of our monitoring efforts suggest that areas south of the Suwannee River between Crystal River and Tarpon Springs have experiences a substantial increase in scallop numbers. For example, density in the Crystal River region averaged less than 8 scallops per 600 m^2 during 1993 through 1996. Since then, scallop abundance has increased in that region, and in 2000 mean density in the Crystal River region exceeded 240 scallop per 600 m^2 transect.

In contrast, bay scallop abundance at the popular harvesting area in St. Joseph Bay have suffered a substantial decline. During 1994 through 1999, mean abundance in St. Joseph bay exceeded 25 scallops per 600 m^2 transect in all years but 1998 when abundance averaged 13 scallops per transect. In 2000, abundance in St. Joseph Bay averaged less than 4 scallops per transect.

Bay scallops only live one year, so population fluctuations (sometimes drastic) are to be expected. Nevertheless, there is a clear trend of increasing scallop abundance in the Crystal River-Anclote area, and if that trend continues it may be possible to reopen that area to some level of recreational fishing effort. Alternatively, the population in St. Joseph Bay requires close monitoring and careful consideration. One bad year does not necessarily constitute a population collapse, but we also recorded little recruitment to the St. Joseph Bay scallop population during fall 2000 and that does not bode well for the abundance of scallops in 2001. Additional surveys will be conducted at all sites during June 2001, and the results of those and previous surveys should be used when considering possible modifications to bay scallop harvesting regulations.