ANNUAL REPORT
OF THE
BAY SCALLOP PROJECT

2001

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INTRODUCTION

This report summarizes bay scallop (*Argopecten irradians*) research conducted by the Florida Marine Research Institute Molluscan Fisheries program during calendar year 2001. 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 2002, and a final report will be submitted to the federal granting agency and to the Florida Fish and Wildlife Conservation Commission at that time. 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 ABUNDANCE/RECRUITMENT

Consistent with each of the previous surveys (e.g., Arnold et al., 1999), our 2001 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, Hernando, 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 (3,600 m^2) due to the limited extent of seagrass beds in that area.

We estimate recruitment of new individuals to the scallop population using spat collectors. These devices consist of a plastic mesh panel encased within an onion bag that is tied to a polypropylene rope which is anchored to the sediment with a cinder block and which is supported in the water column with a crab trap float (Arnold et al.,

1998). A single trap is deployed at each station and allowed to soak for six weeks prior to retrieval. An additional collector is deployed, at the same station, three weeks later and similarly allowed to soak for six 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 subsequent, overlapping collector. Upon recovery, collectors are returned to the laboratory for visual examination and enumeration of all recruits.

June Survey

Pine Island Sound: Relative to previous years, scallop abundance increased in Pine Island Sound during 2001. We found scallops at nine of our 20 survey stations, and five of those stations (4, 12, 13, 16, and 17; 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 seven years (1994 data excluded) of our study (Kruskal-Wallis test, $\chi^2 = 5.56$, $p = 0.47$). During those seven years, we have found that scallops are consistently abundant in a very restricted area of the Sound around stations 12, 13, 14, 15, 16, 17, and 18 (Figure 2) and are relatively rare outside of that area. The five stations that we moved following the 1999 sampling season (in an effort to obtain better coverage in the shallow waters surrounding Josslyn Key) yielded 25 scallops (23% of total), although all of those scallops were captured at a single station.

Anclote Estuary: Scallop abundance at the Anclote Estuary study site (Figure 3) decreased by approximately 75% during our June 2001 survey relative to June 2000 (Table 2). We failed to discover scallops at eight of our 20 stations, most notably five stations (1, 8, 10, 11, 12) in the central portion of the study area. However, the most substantial change occurred at the northern stations (particularly stations 2 and 3). There, we recorded far fewer scallops during June 2001 relative to June 2000. Such fluctuations appear to be a common feature of the Anclote bay scallop population as reflected in the relatively high and statistically significant ($\chi^2 = 55.44$, $p < 0.0001$) interannual variability in scallop abundance at this site (Table 2). The distribution of adults is consistent with the pattern of scallop recruitment that we recorded in the Anclote area during fall 2000 (Arnold et al., 2001) in that both recruitment and adult distribution were sporadic and patchy. During fall 2001, rates of recruitment have been relatively high and we have recorded some level of recruitment at every sampling station (Figure 4).

Hernando: Scallop abundance continues to vary substantially and significantly among years (Table 3; $\chi^2 = 53.54$, $p <$

0.0001) at the Hernando study site (Figure 5). Mean scallop abundance was similar between 2000 and 2001 following substantial increases between the 1998 and 1999 surveys and between the 1999 and 2000 surveys. During 2001, the vast majority of scallops (92%) were collected from stations 1-7 north of North Point (Figure 5). Similarly, we recorded the highest recruitment rate at our northern Hernando monitoring stations during fall 2000 (Arnold et al., 2001). During fall 2001, we captured scallop recruits at most of our sampling stations (Figure 6), so we anticipate continued abundance of scallops in the Hernando region during 2002.

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; $\chi^2 = 89.04$, $p < 0.0001$). In June 2001, scallops were very abundant throughout the Homosassa study site, and we failed to observe scallops at only one station (station 20) located in shallow water at the southern end of the study area. Despite the abundance and extensive distribution of scallops at the Homosassa study site, we continue to detect only low levels of recruitment during both fall 2000 and fall 2001 (Arnold et al., 2001; Figure 8). The peak recruitment rates recorded during either of those periods did not exceed approximately three scallops per collector per day. That is less (sometimes much less) than rates recorded for areas such as Anclote and St. Joseph Bay that may exceed 5-10 recruits per collector per day, despite the fact that Homosassa supports the most abundant scallop population in Florida. Possible explanations for this discrepancy include failure to detect recruitment due to the loss of collectors to trawling activities on many occasions or the migration of juvenile or adult scallops into the study area following settlement. Scallop populations can be redistributed following settlement as a result of the influence of water currents on scallops during swimming activities, although the extent of such movements would be expected to be relatively limited. Roller-frame trawls are very active in the Homosassa area, and those activities negatively impact our sampling gear and our ability to conduct experiments designed to elucidate factors influencing the observed discrepancy between recruitment and adult abundance.

Cedar Key: Scallop abundance increased substantially between 2000 and 2001 at the Cedar Key study site (Table 5). As a result, the among year difference in scallop abundance at Cedar Key was significant for the first time ($\chi^2 = 9.75$, $p = 0.02$). 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. Additionally, this area will be open for scallop harvest beginning with the 2002 season, and continued monitoring will be necessary to determine if such a small area is capable of sustaining scallop harvest without suffering complete collapse.

Steinhatchee: Scallop density continues to vary significantly among years at the Steinhatchee study site (Figure 9; $\chi^2 = 40.46$, $p < 0.0001$). Although mean density recorded during June 2001 decreased relative to the previous two 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. Although the Steinhatchee scallop population is no longer the most densely populated in the state, this population has exhibitied remarkable stability throughout the eight-year history of our population monitoring efforts and continues to provide the baseline against which all other Florida scallop populations are compared.

St. Joseph Bay: Adult scallop abundance continues to differ significantly among years at the St. Joseph Bay study site (Figure 10; $\chi^2 = 57.21$, $p < 0.0001$). Following a very poor year in 2000, scallop abundance increased slightly in St. Joseph Bay (Table 7) despite very poor recruitment especially during fall 2000 (Arnold et al., 2001). However, recruitment during fall 2001 has been exceptional (Figure 11). Although many factors can intervene to prevent a recruitment year class from translating into increased adult abundance, we are optimistic that scallop abundance will increase considerably in St. Joseph Bay during 2002 relative to at least the previous two years.

St. Andrew Bay and Sound: Scallop density varies significantly among years at the St. Andrew Bay/Sound study site ($\chi^2 = 68.00$, $p < 0.0001$), but overall scallop abundance continues to decline especially relative to 1994 (Table 8). We found only one scallop during our June 2001 survey in St. Andrew Bay and we found no scallops in St. Andrew Sound (Figure 12). We have requested that both of these areas be closed to all scallop harvest in an attempt to facilitate natural rebuilding of the populations.

Fall Survey

Post-season scallop surveys were conducted at the Anclote, Homosassa, Steinhatchee, and St. Joseph Bay study sites. Additionally, for the first time, we resurveyed the Hernando study site following the July 1-September 10 scallop season in anticipation of the opening of this and other areas for recreational harvest during 2002. At the

Anclote, Homosassa, and Steinhatchee sites, scallop density decreased to 28% (Table 9), 27% (Table 11), and 32% (Table 12), respectively, of June density. At the Hernando study site, scallop density decreased to 9% of the June density (Table 10). As we have mentioned in previous reports (e.g., Arnold et al., 2001), the relatively equivalent changes in scallop abundance between June and fall, at both open and closed scallop harvesting areas, indicates that recreational scallop harvest may not be a major source of mortality for these scallop populations. However, other factors that are not measured also need to be considered. Our understanding of latitudinal gradients in the timing of seasonal mortality is poor, but if natural mortality events are seasonally delayed in Steinhatchee relative to more southerly (and closed) scallop populations, then the impact of recreational harvest may be obscured. Additonally, illegal scallop harvest or bycatch of scallops during shallow-water trawling activities may create a source of mortality in some scallop populations that balances recreational harvest mortality in areas north of the Suwannee River. Thus, care must be taken in using our survey results to estimate the relative impact of natural vs. fishing mortality.

At St. Joseph Bay, we recorded a higher mean abundance of scallops (57% increase) in fall relative to June. The anomalous results for St. Joseph Bay probably result from the low number of scallops collected at that site during 2001. With the exception of a few stations (particularly stations 8 and 14), numbers were equal or lower at most stations during fall relative to June, but increased abundance recorded at a few stations resulted in an overall increase in the total number of scallops counted. Alternatively, we have noted during past surveys that many scallops are found in very shallow (< 0.3 m water depth) seagrass beds during early June. Local fishermen have noted that, later in the summer, those scallops tend to move out of the shallow grass beds into deeper water, and that redistribution of scallops may result in an apparent increase in scallop abundance between June and fall surveys.

RESTORATION

The substantial increase in scallop abundance that we have observed since 1999, particularly at the Homosassa and Hernando study sites, has occurred contemporaneous with our scallop restoration program. Three alternative explanations are possible. First, this resurgence is completely coincidental and would have occurred even if we had not modified the scallop management plan or conducted a restoration program. It is difficult to refute this alternative because we have no control system available with which to make comparisons. However, such a

coincidence would be remarkable, and it is noteworthy that a similar resurgence has not been recorded in other areas of the scallop range in Florida such as Sarasota Bay and Pine Island Sound. Second, the resurgence could be a result of changes in the scallop management plan. Closing the Homosassa and Hernando areas to all scallop fishing would allow for increased survival of scallops until the fall spawning season, thereby increasing recruitment success. Such a process may be gradual at first, but recruitment and adult abundance may increase rapidly once a threshold scallop density is achieved. That would explain why, although the fishery was formally closed in 1995, the resurgence was not detected until 1999. Third, the resurgence could be the result of our restoration efforts. As noted above, our restoration efforts and the scallop resurgence were essentially contemporaneous, but as yet we have no direct evidence that they were related. We are hopeful that the results of our genetic program will allow us to distinguish between the second and third alternatives.

REFERENCES

Arnold, W.S., D.C. Marelli and C. Bray (1993). Annual report of the bay scallop project 1991-1992. Report to the Florida Marine Fisheries Commission, 19 pp. + appendix.

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Arnold, W.S., D.C. Marelli, K.G. Hagner, M.M. Harrison, P.L. Hoffman, M. Humphrey, M.L. Parker and M.W. White (1999). Annual report of the bay scallop project, 1998. Report to the Florida Marine Fisheries Commission, 71 pp.

Arnold, W.S., J. Bickford, K. Ferenc, L. Gentile, M.M. Harrison, M.L.Parker, S.C. Peters and M.White (2001). Annual report of the bay scallop project, 2000. Report to the Florida Fish and Wildlife Conservation Commission, 61 pp.

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.

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

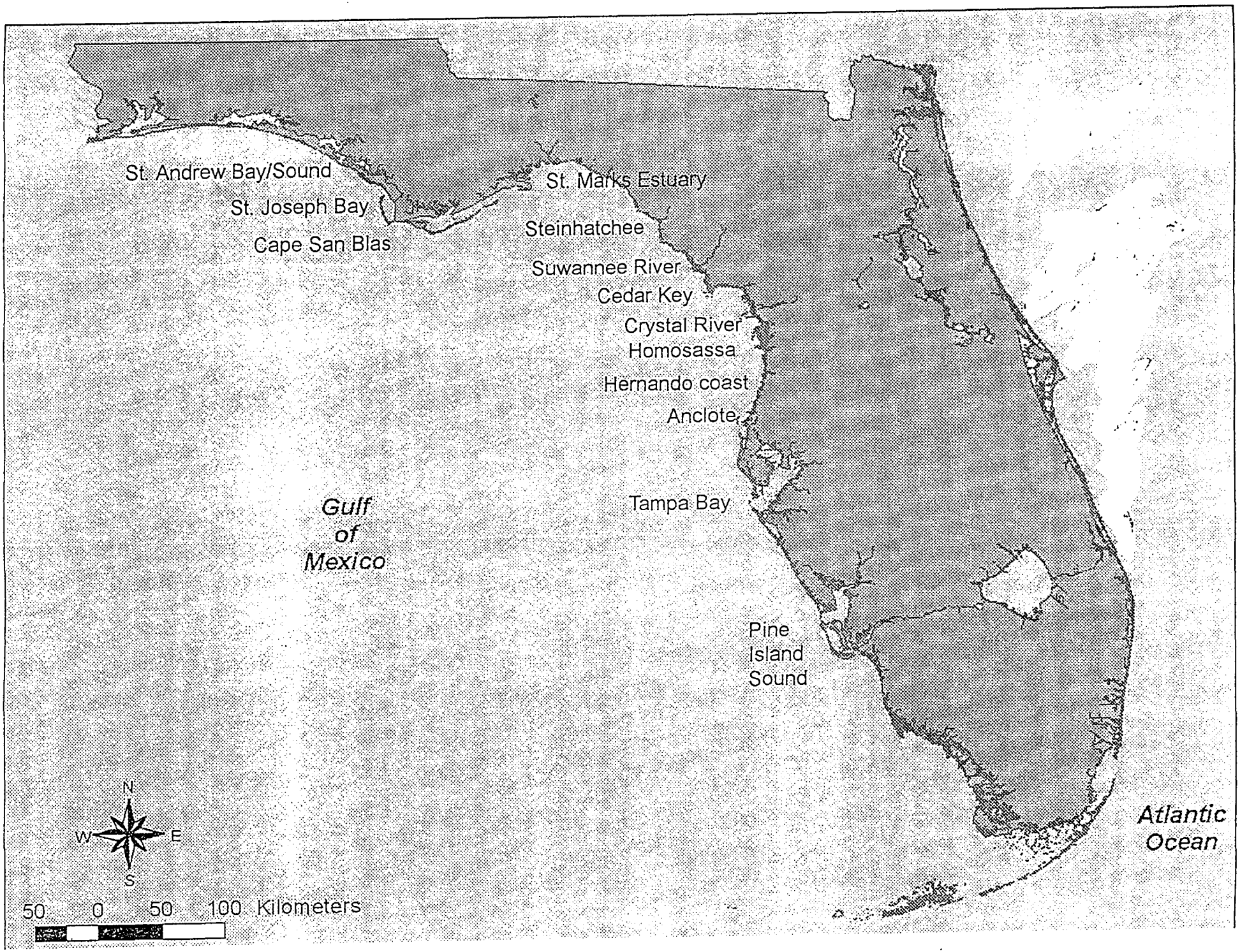
St. Andrew Bay/Sound
St. Joseph Bay
Cape San Blas
St. Marks Estuary
Steinhatchee
Suwannee River
Cedar Key
Crystal River
Homosassa
Hernando coast
Anclote
Tampa Bay
Gulf of Mexico
Pine Island Sound
Atlantic Ocean
N
W
E
S
50 0 50 100 Kilometers

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 2001.

JUNE BAY SCALLOP SURVEY
PINE ISLAND SOUND
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	0	0	0	0	0	0	8	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	2	0
4	0	0	0	0	0	0	22	25
5	0	0	0	0	0	0	1	0
6	0	0	1	0	0	0	0	0
7	0	0	1	1	0	0	1	0
8	0	0	0	0	2	1	0	0
9	0	0	0	0	0	0	2	0
10	0	1	0	3	1	0	0	0
11	0	1	0	0	0	0	1	1
12	0	34	1	5	5	1	0	22
13	0	9	0	4	0	0	0	37
14	0	0	0	15	0	0	0	2
15	0	1	0	5	0	0	0	1
16	0	1	0	2	0	1	2	7
17	0	0	9	9	22	12	8	12
18	0	0	3	0	14	25	1	3
19	0	1	0	2	0	7	0	0
20	0	1	0	0	3	5	8	0
MEAN	0.00	2.45	0.75	2.30	2.35	2.60	2.80	5.50
S.D.	0.00	7.69	2.07	3.87	5.66	6.12	5.31	10.47

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

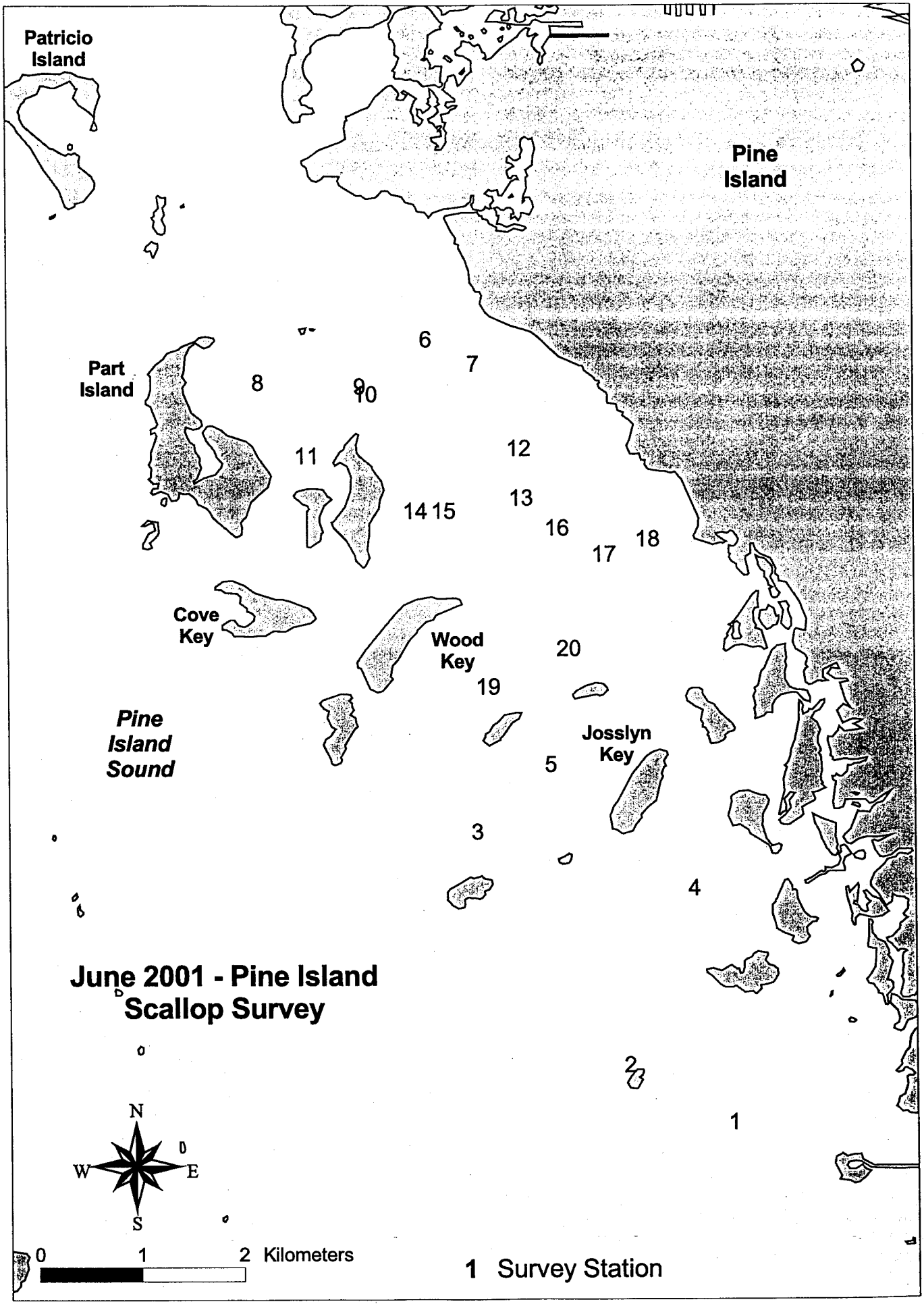
Patricio Island
Pine Island
Part Island
Cove Key
Wood Key
Josslyn Key
Pine Island Sound
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
June 2001 - Pine Island Scallop Survey
N
W
E
S
0
1
2 Kilometers
1 Survey Station

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.

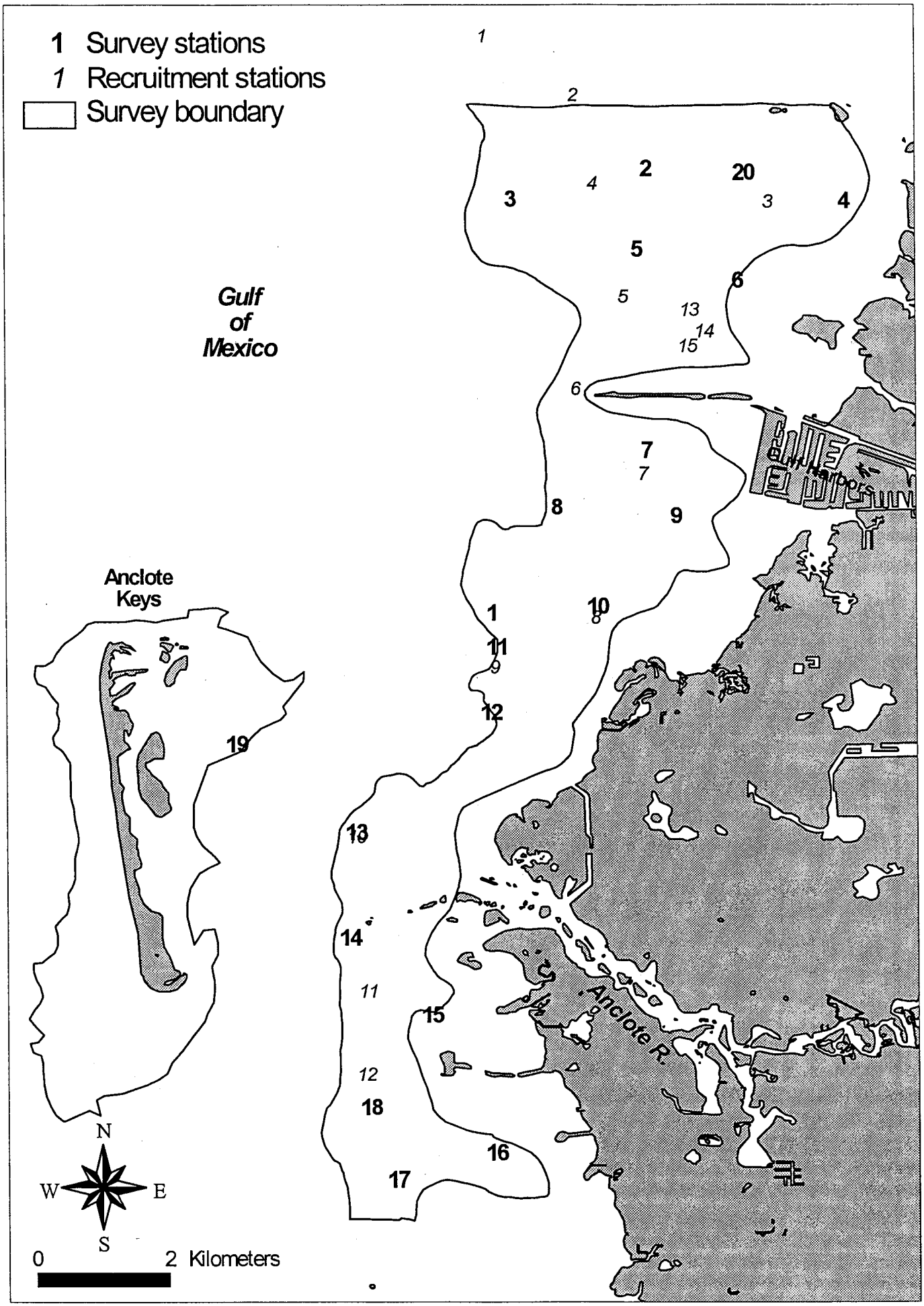
1 Survey stations
1 Recruitment stations
Survey boundary
Gulf of Mexico
Anclote Keys
Anclote R.
N
W
E
S
0
2 Kilometers

Table 2. Adult bay scallop density at each of 20 stations sampled at the Anclote, Florida, study site during each June from 1994 through 2001.

JUNE BAY SCALLOP SURVEY
ANCLOTE
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	1	0	4	43	0	0	1	0
2	72	0	3	49	0	1	171	8
3	15	0	2	307	0	8	177	8
4	0	0	0	1	0	1	1	0
5	106	0	0	20	0	0	7	14
6	3	0	0	4	0	0	6	2
7	21	0	0	1	0	1	3	26
8	14	0	12	136	0	2	8	0
9	2	3	0	4	0	0	0	12
10	1	0	1	30	0	0	2	0
11	1	0	2	27	0	0	3	0
12	14	0	0	1	0	0	0	0
13	12	0	0	8	0	0	0	1
14	0	0	11	14	1	4	12	12
15	1	0	1	141	17	13	4	0
16	5	0	23	87	46	9	4	7
17	9	0	6	20	313	8	27	24
18	1	0	3	42	17	0	7	3
19	1	0	0	8	12	2	9	1
20	14	0	0	4	0	1	2	0
MEAN	14.65	0.15	3.40	47.35	20.30	2.50	22.2	5.90
S.D.	26.80	0.67	5.82	74.05	69.80	3.85	52.28	8.05

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 - 2001

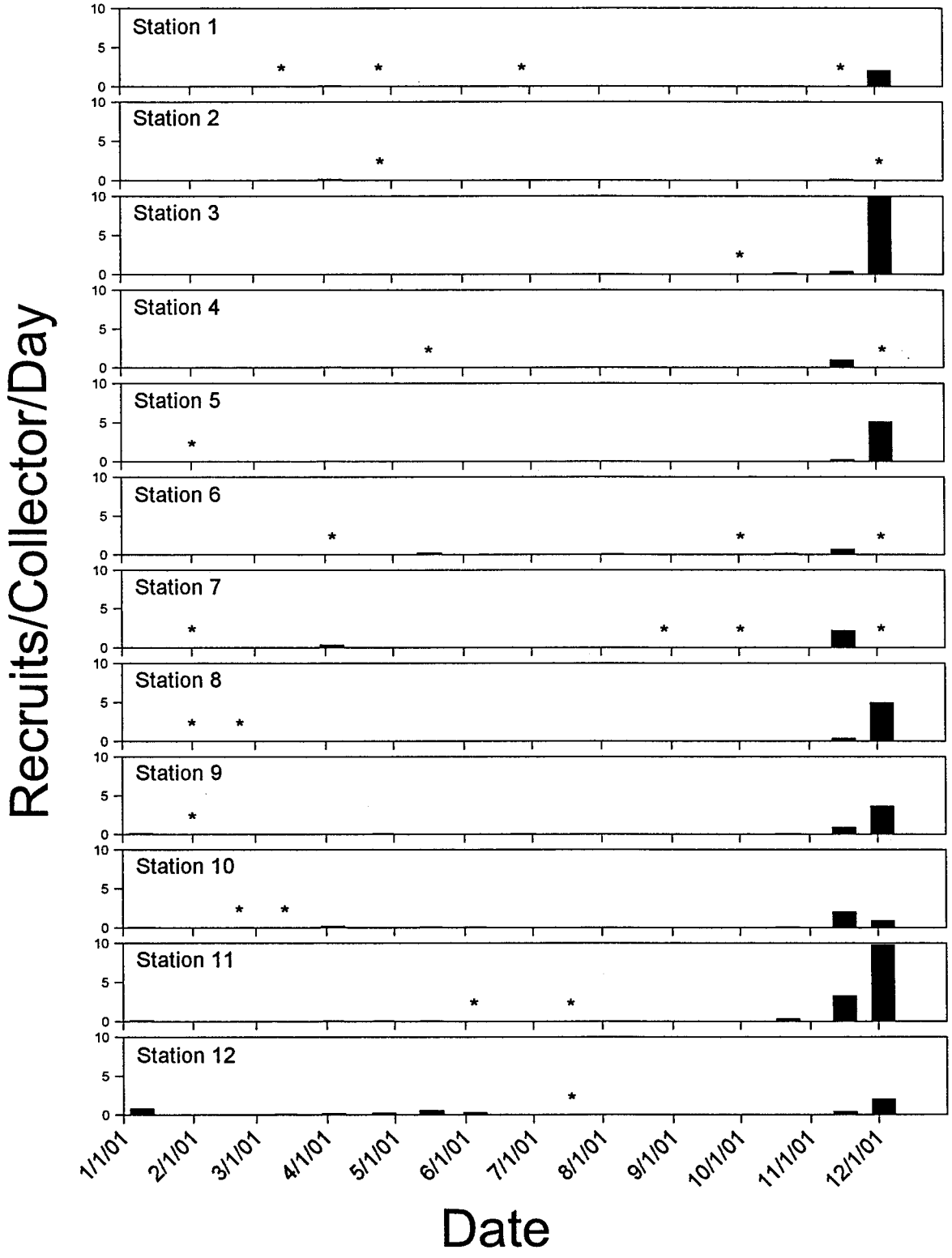

Table 3. Adult bay scallop density at each of 20 stations sampled at the Hernando, Florida, study site during each June from 1997 through 2001.

JUNE BAY SCALLOP SURVEY
HERNANDO
1997-2001
#/600M^2

STATION	1997	1998	1999	2000	2001
1	3	0	0	13	13
2	11	0	33	76	110
3	134	3	17	213	555
4	80	6	43	48	105
5	9	0	1	29	61
6	1	0	2	31	2
7	0	0	0	10	0
8	0	0	0	14	2
9	1	0	1	66	6
10	3	0	1	43	6
11	0	0	5	17	5
12	0	0	1	61	2
13	10	0	4	18	7
14	1	0	0	15	6
15	10	1	2	54	14
16	2	1	1	7	5
17	8	0	3	27	7
18	6	0	0	28	10
19	6	0	0	25	5
20	0	0	0	49	1
MEAN	14.25	0.55	5.70	42.2	46.10
S.D.	33.13	1.47	11.79	44.94	124.21

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.

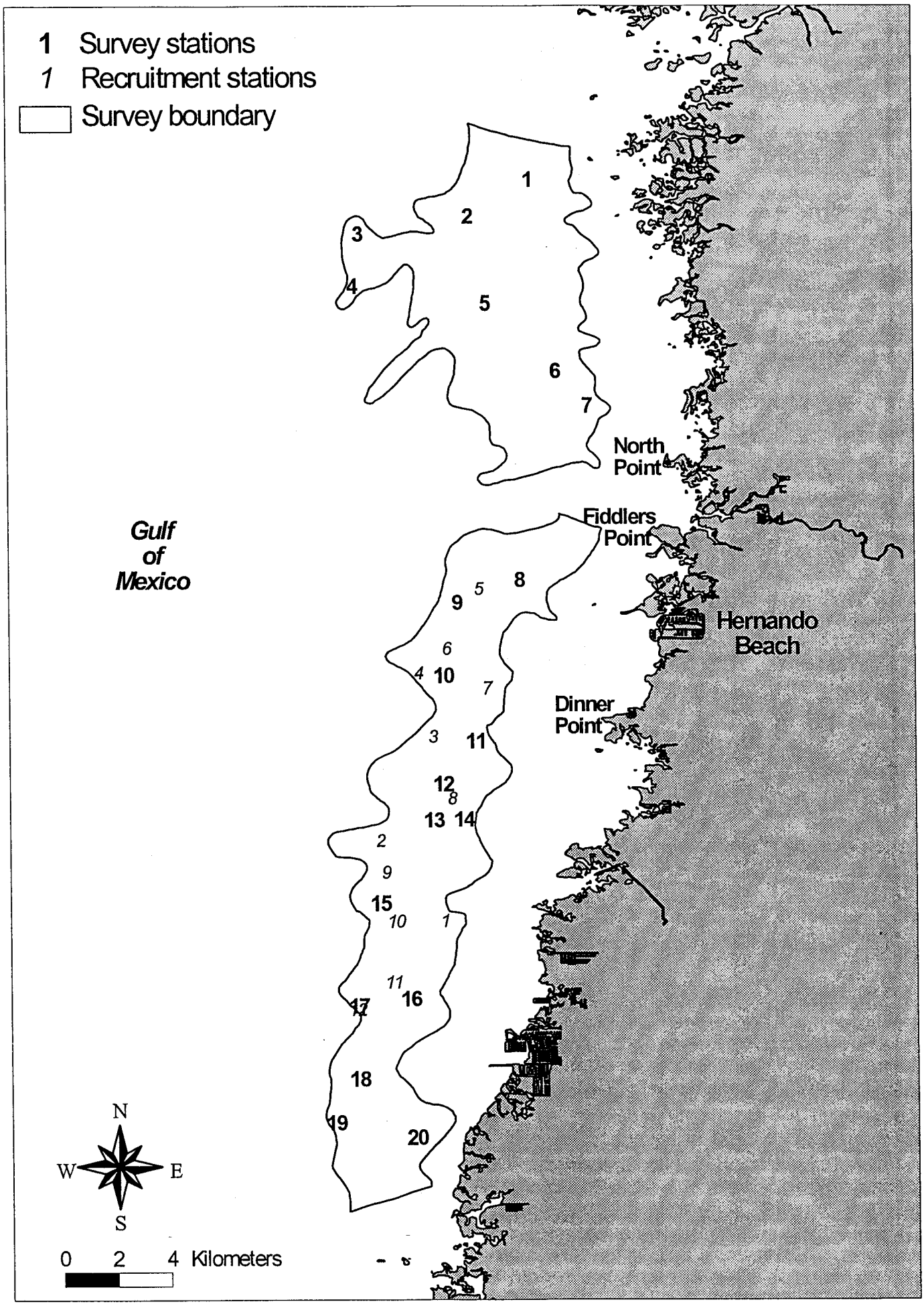
1 Survey stations
1 Recruitment stations
Survey boundary
1
2
3
4
5
6
7
North Point
Fiddlers Point
Gulf of Mexico
8
5
9
6
4
10
7
Hernando Beach
Dinner Point
3
11
12
8
13
14
2
9
15
10
1
11
16
17
18
19
20
N
W
E
S
0 2 4 Kilometers

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 - 2001

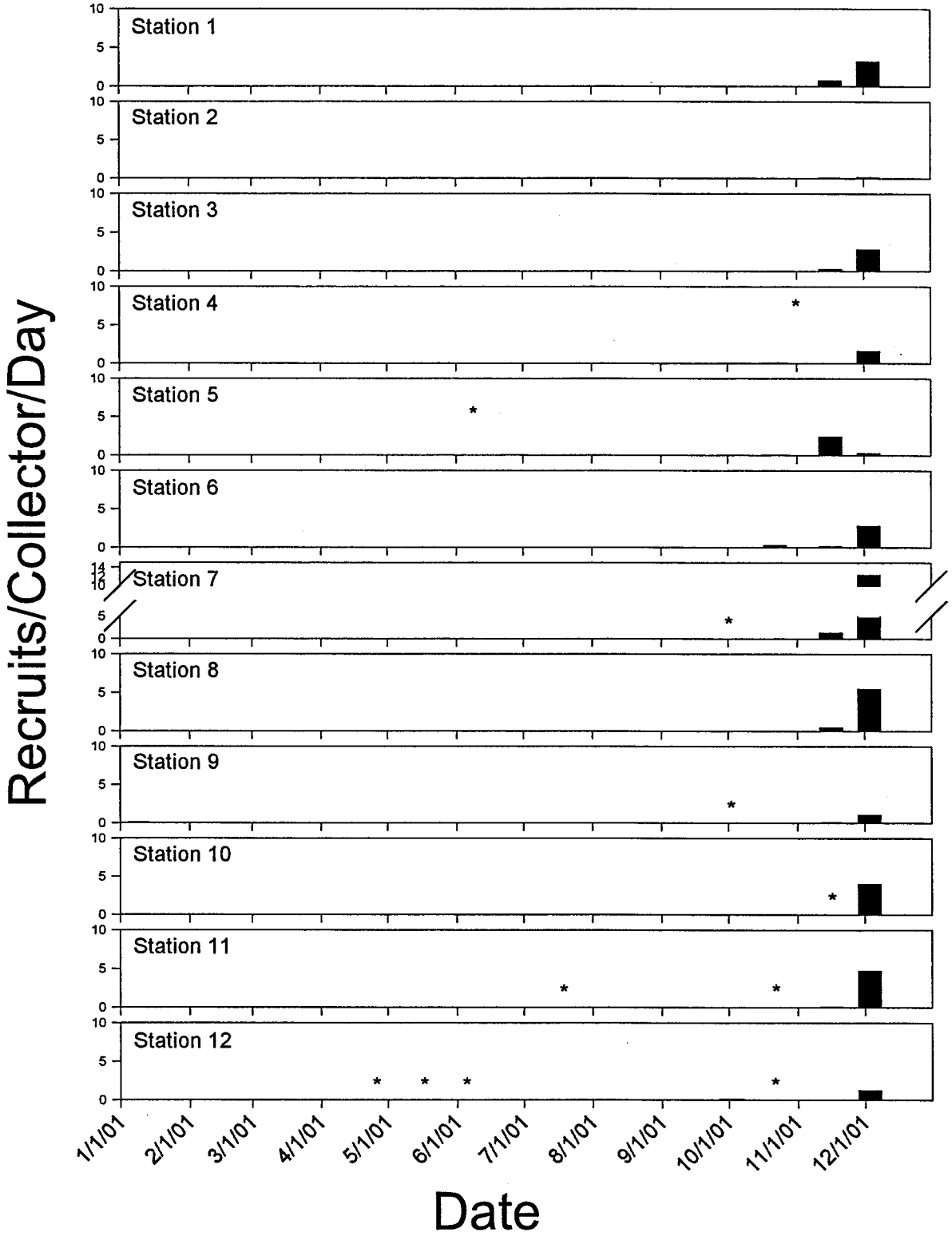

Figure 7. Station locations for sampling juvenile recruitment (small numbers) and adult abundance (large bold numbers) of bay scallops (*Argopecten irradians*) at the Homosassa Bay, Florida, study site.

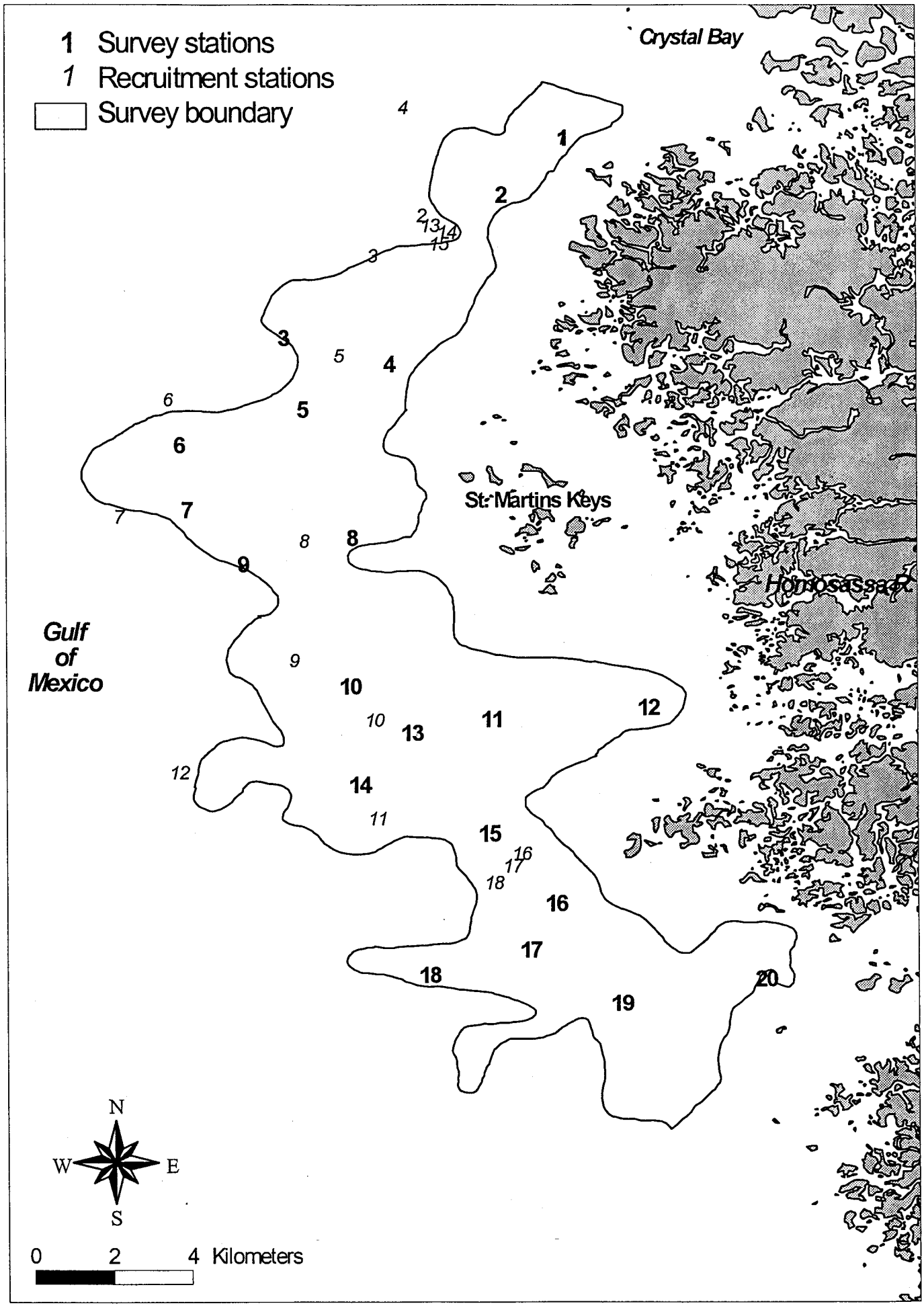
1 Survey stations
1 Recruitment stations
Survey boundary
Crystal Bay
St. Martins Keys
Homosassa R.
Gulf of Mexico
N
W
E
S
0 2 4 Kilometers

Table 4. Adult bay scallop density at each of 20 stations sampled at the Homosassa, Florida, study site during each June from 1993 through 2001.

JUNE BAY SCALLOP SURVEY
HOMOSASSA
1994-2001
#/600M^2

STATION	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	4	3	0	0	9	0	3	23	74
2	13	38	9	2	17	0	3	87	209
3	4	5	9	5	18	2	7	29	185
4	9	1	4	0	19	0	36	323	735
5	5	0	14	5	15	0	33	395	489
6	4	0	1	9	7	0	70	724	121
7	4	1	2	5	5	34	47	817	174
8	8	5	27	4	27	3	13	850	663
9	3	3	7	4	13	13	54	614	391
10	3	19	3	2	58	6	9	165	1237
11	10	0	1	0	5	1	2	23	39
12	0	0	1	3	0	0	0	12	5
13	8	23	6	2	12	0	13	231	380
14	4	15	0	9	23	2	48	352	339
15	24	4	1	2	7	0	3	45	173
16	13	3	3	1	6	0	5	28	197
17	20	3	1	6	0	0	13	25	133
18	8	9	3	3	55	0	212	88	431
19	2	5	2	1	8	0	2	25	11
20	0	0	0	0	0	0	0	1	0
MEAN	7.30	6.85	4.70	3.15	15.20	3.05	28.65	242.85	299.3
S.D.	6.28	9.82	6.43	2.74	16.01	7.92	48.10	290.00	305.38

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 - 2001

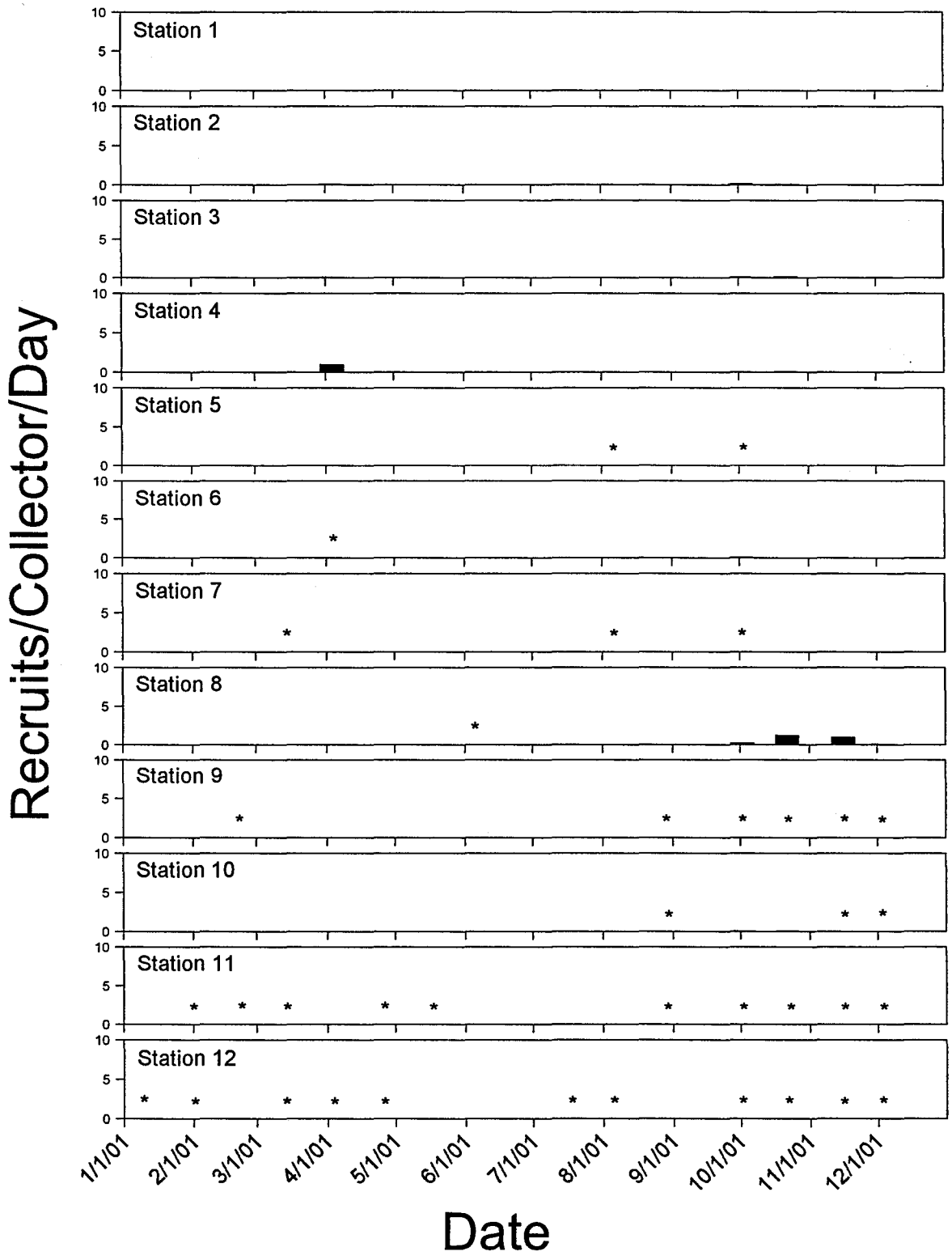

Table 5. Adult bay scallop density at each of six stations sampled at the Cedar Key, Florida, study site during each June from 1998 through 2001.

JUNE BAY SCALLOP SURVEY
CEDAR KEY
1998-2001
#/600M^2

STATION	1998	1999	2000	2001
1	0	1	1	5
2	0	0	0	8
3	1	4	0	26
4	0	4	0	1
5	1	0	1	5
6	3	7	0	1
MEAN	0.83	2.67	0.33	7.67
S.D.	1.17	2.80	0.52	9.37

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

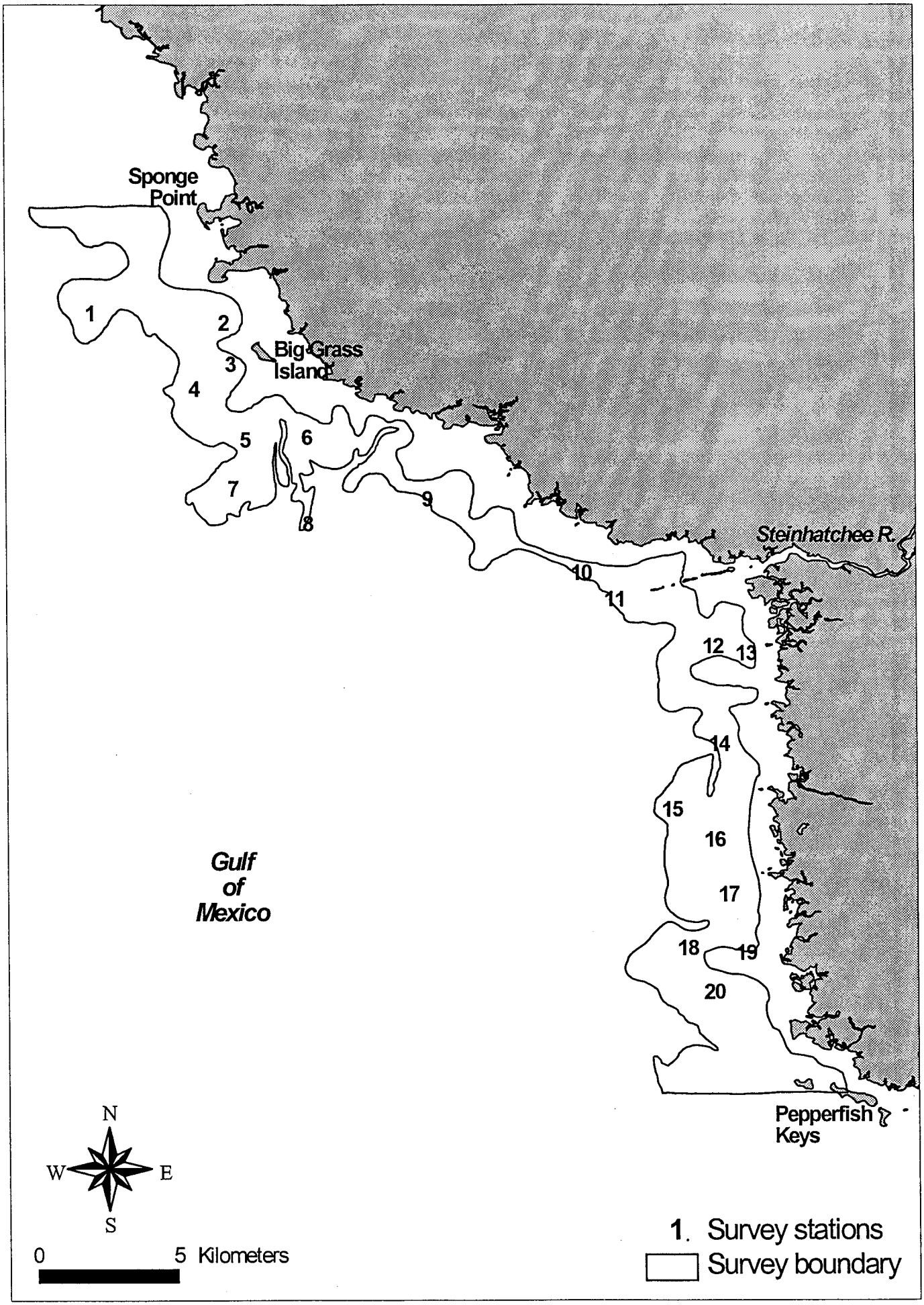
Sponge Point
Big Grass Island
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Steinhatchee R.
Gulf of Mexico
Pepperfish Keys
N
W
E
S
0
5 Kilometers
1. Survey stations
Survey boundary

Table 6. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee, Florida, study site during each June from 1994 through 2001.

JUNE BAY SCALLOP SURVEY
STEINHATCHEE
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	189	13	528	1	9	43	946	19
2	284	48	36	5	100	97	17	41
3	89	16	128	103	90	97	24	70
4	338	14	269	13	18	34	196	93
5	650	14	1879	25	16	105	99	430
6	234	22	210	37	0	137	75	48
7	81	4	73	3	4	29	115	47
8	0	1	0	3	0	2	5	8
9	169	44	498	23	39	158	84	57
10	10	0	76	1	3	10	0	33
11	1	0	0	0	0	0	0	0
12	281	0	415	30	0	638	1603	804
13	10	8	41	6	0	46	124	214
14	259	4	119	7	7	129	9	7
15	120	1	65	6	0	52	8	21
16	1	30	71	30	20	545	49	48
17	13	23	118	42	35	789	208	150
18	133	3	44	14	3	19	313	44
19	121	313	284	135	111	332	278	101
20	85	27	151	34	91	27	213	220
MEAN	153.40	29.25	250.25	25.90	27.30	164.45	218.30	122.75
S.D.	159.05	68.31	414.65	34.95	38.17	227.34	388.54	190.03

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

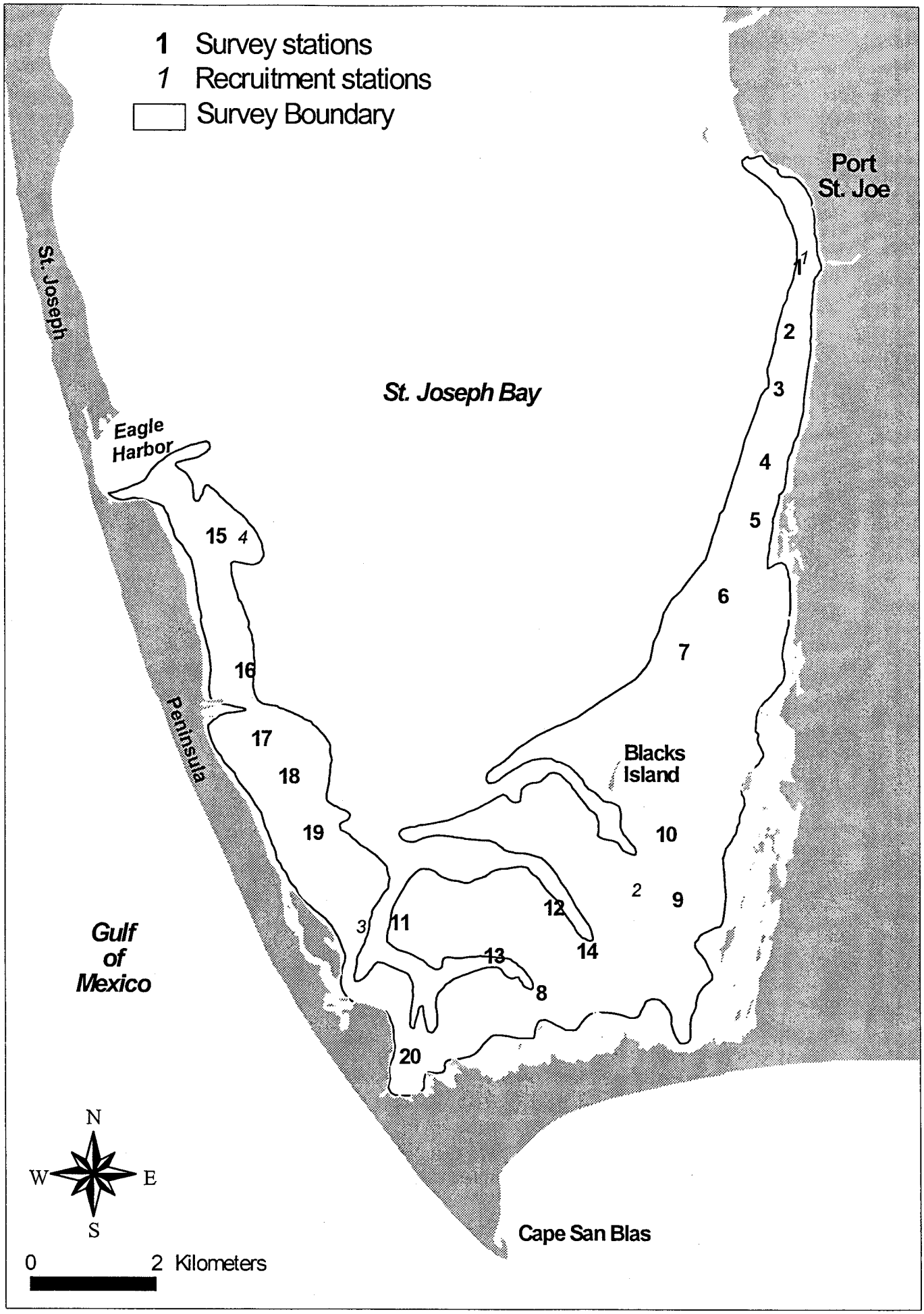
1 Survey stations
1 Recruitment stations
Survey Boundary
Port St. Joe
St. Joseph
St. Joseph Bay
Eagle Harbor
Peninsula
Blacks Island
Gulf of Mexico
Cape San Blas
N
W
E
S
0
2 Kilometers

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 2001.

JUNE BAY SCALLOP SURVEY
ST. JOE BAY
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	16	1	4	2	0	1	0	0
2	2	1	64	10	0	35	9	0
3	12	6	2	3	0	10	22	0
4	1	2	0	0	12	11	18	0
5	8	67	2	2	0	29	5	0
6	15	205	114	19	3	43	3	0
7	5	114	55	7	4	30	0	0
8	265	348	140	93	90	105	4	41
9	61	118	43	11	7	29	0	4
10	7	711	363	111	18	53	3	3
11	0	5	759	10	25	31	1	1
12	5	233	1143	40	26	13	1	167
13	3	195	369	62	45	9	0	4
14	19	270	820	10	2	4	0	10
15	5	11	44	1	9	22	0	0
16	9	14	228	14	10	5	0	0
17	2	44	282	2	7	7	0	1
18	1	25	240	0	4	7	1	0
19	2	17	179	7	5	14	0	1
20	279	257	103	142	2	164	10	10
MEAN	35.85	132.20	247.70	27.30	13.45	31.10	3.85	12.10
S.D.	81.87	175.47	312.22	41.53	21.31	48.25	6.30	37.62

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 - 2001

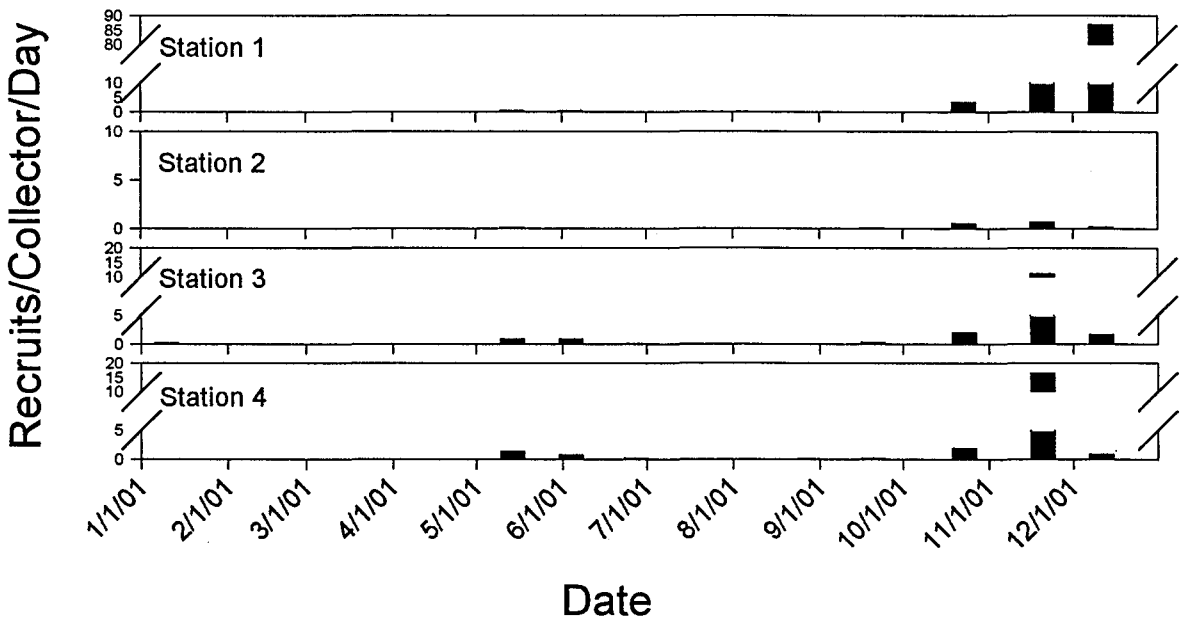

Table 8. Adult bay scallop density at each of 20 stations sampled at the St. Andrew Bay/Sound, Florida, study site during each June from 1994 through 2001.

JUNE BAY SCALLOP SURVEY
ST. ANDREW BAY
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	1	4	12	1	1	0	0	0
2	5	13	6	5	0	0	2	0
3	70	16	155	9	0	1	2	0
4	244	8	23	0	0	1	1	0
5	50	1	20	2	2	0	0	0
6	96	20	13	0	0	1	0	0
7	144	6	2	0	2	4	0	0
8	173	13	11	0	31	3	1	0
9	149	8	39	1	0	0	1	1
10	68	0	26	1	0	5	1	0
11	69	5	5	0	1	9	12	0
12	6	2	6	4	0	1	1	0
13	6	2	56	8	1	2	2	0
14	24	2	2	0	0	0	0	0
15	0	9	7	0	0	8	0	0
16	0	1	0	0	0	0	0	0
17	2	0	0	0	0	0	0	0
18	5	3	1	0	1	0	0	0
19	24	1	13	3	0	8	1	0
20	0	1	5	3	4	4	0	0
MEAN	56.80	5.75	20.10	1.85	2.15	2.35	1.20	0.05
S.D.	70.77	5.82	34.78	2.74	6.87	3.01	2.65	0.22

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.

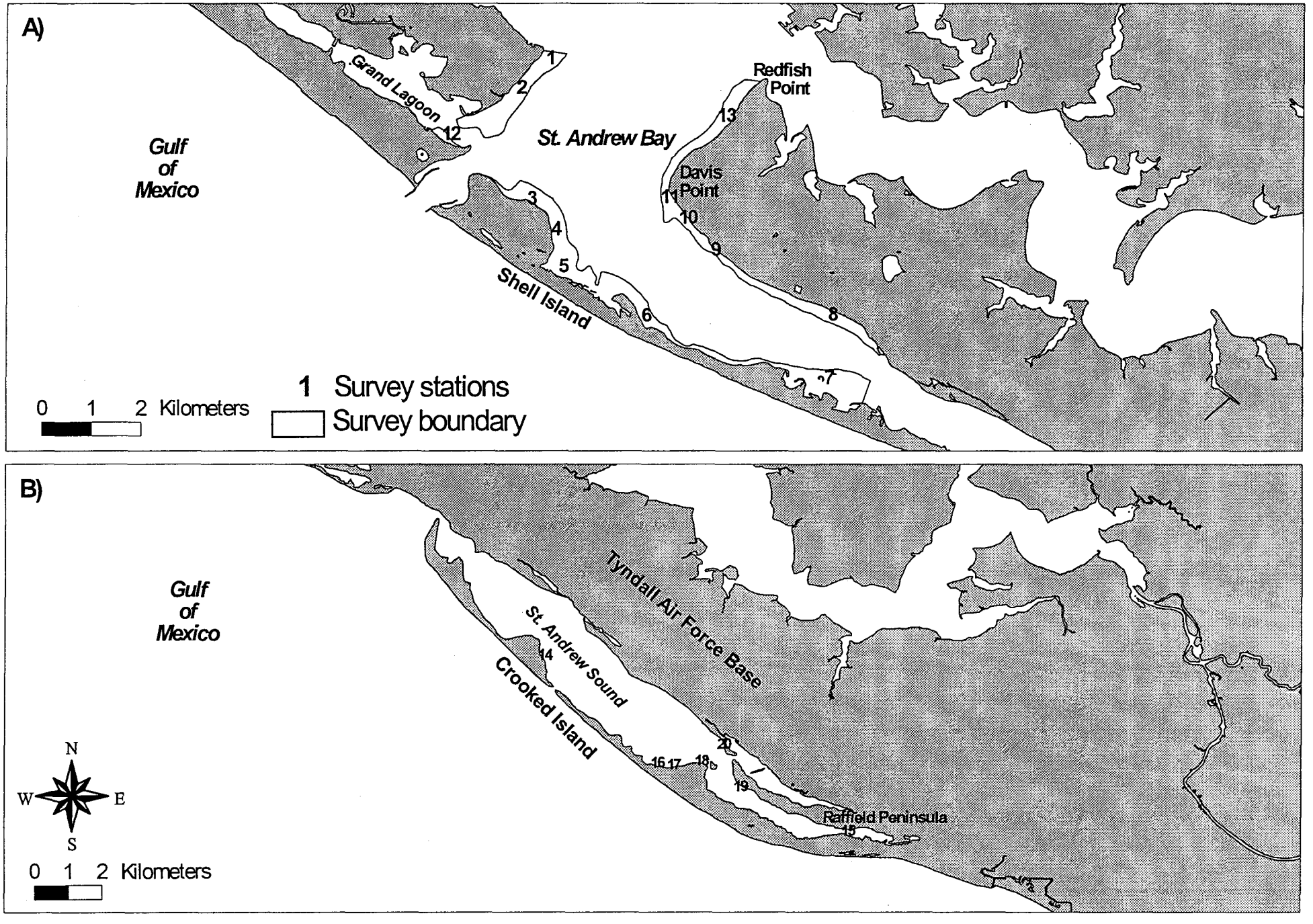
A)
Grand Lagoon
Gulf
of
Mexico
St. Andrew Bay
Redfish
Point
Davis
Point
Shell Island
1
2
3
4
5
6
7
8
9
10
11
12
13
0 1 2 Kilometers
1 Survey stations
Survey boundary
B)
Gulf
of
Mexico
St. Andrew Sound
Tyndall Air Force Base
Crooked Island
Raffield Peninsula
14
15
16
17
18
19
20
N
W
E
S
0 1 2 Kilometers

Table 9. Adult bay scallop density at each of 20 stations sampled at the Anclote, Florida, study site during fall of 1994, 1997, 1998, 2000, and 2001.

FALL BAY SCALLOP SURVEY
ANCLOTE
1994-2001
#/600M^2

STATION	1994	1997	1998	2000	2001
1	3	33	0	6	0
2	36	4	0	7	8
3	22	292	0	12	2
4	0	1	0	0	0
5	44	22	0	1	1
6	0	3	0	1	0
7	13	29	0	3	0
8	0	88	0	3	0
9	0	0	0	0	1
10	2	42	0	1	0
11	2	41	0	0	0
12	0	4	0	0	0
13	0	7	0	0	2
14	1	9	1	0	1
15	9	182	1	0	0
16	0	607	23	1	2
17	3	47	12	3	8
18	5	40	2	0	1
19	0	0	1	5	1
20	3	5	0	1	1
MEAN	7.15	72.80	2.00	2.20	1.40
S.D.	12.58	144.81	5.62	3.16	2.37

Table 10. Adult bay scallop density at each of 20 stations sampled at the Hernando, Florida, study site during fall, 2001.

FALL BAY SCALLOP SURVEY
HERNANDO
2001
#/600M^2

STATION	2001
1	2
2	6
3	6
4	4
5	2
6	2
7	2
8	3
9	10
10	2
11	1
12	3
13	0
14	0
15	4
16	6
17	4
18	14
19	11
20	0
MEAN	4.10
S.D.	3.81

Table 11. Adult bay scallop density at each of 20 stations sampled at the Homosassa, Florida, study site during each fall from 1995 through 2001.

FALL BAY SCALLOP SURVEY
HOMOSASSA
1995-2001
#/600M^2

STATION	1995	1996	1997	1998	1999	2000	2001
1	0	0	0	0	2	5	0
2	0	0	9	0	1	39	36
3	0	6	8	3	6	40	115
4	0	0	50	0	12	542	598
5	0	1	38	0	5	412	211
6	2	1	9	5	29	654	73
7	0	0	4	8	58	570	62
8	0	1	28	1	4	399	299
9	1	0	13	4	24	111	43
10	4	1	35	0	2	5	115
11	0	0	2	0	0	4	0
12	0	3	1	0	0	2	2
13	0	0	9	0	0	3	0
14	0	1	29	0	24	57	46
15	3	1	1	0	2	5	13
16	0	1	21	0	1	14	4
17	0	4	4	0	1	4	0
18	0	7	43	0	53	12	0
19	0	0	11	0	0	16	2
20	0	0	1	0	0	0	0
MEAN	0.50	1.35	15.80	1.05	11.20	144.70	80.95
S.D.	1.15	2.06	15.77	2.21	17.61	226.64	145.38

Table 12. Adult bay scallop density at each of 20 stations sampled at the Steinhatchee, Florida, study site during each fall from 1994 through 2001 (fall survey not conducted in 1999).

FALL BAY SCALLOP SURVEY
STEINHATCHEE
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	2000	2001
1	1	6	439	4	5	1066	9
2	48	105	60	87	7	7	21
3	100	25	65	79	13	13	7
4	61	18	139	5	18	190	50
5	45	25	767	5	9	147	288
6	25	12	48	27	0	31	45
7	61	3	183	9	0	216	57
8	0	0	0	6	0	3	0
9	0	11	3	130	0	218	87
10	0	6	29	0	0	0	1
11	0	0	0	1	0	0	1
12	1	30	62	1	0	57	4
13	0	7	31	6	0	20	10
14	0	25	39	0	2	13	6
15	0	1	46	17	0	43	24
16	0	58	69	136	1	75	12
17	0	47	33	148	3	131	11
18	26	0	35	70	5	352	34
19	18	112	176	163	10	143	21
20	77	5	197	42	10	169	95
MEAN	23.15	24.80	121.05	46.80	4.50	144.70	39.15
S.D.	31.3	32.74	183.11	57.02	5.29	237.54	64.82

Table 13. 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
1994-2001
#/600M^2

STATION	1994	1995	1996	1997	1998	1999	2000	2001
1	0	1	0	0	0	0	3	0
2	0	0	1	0	0	0	10	0
3	0	1	94	24	0	0	0	0
4	0	0	86	0	1	0	0	0
5	0	1	30	0	7	0	1	0
6	0	0	51	32	6	0	7	3
7	1	1	8	18	1	0	2	3
8	7	150	11	70	25	3	3	89
9	5	2	1	25	0	9	0	13
10	11	21	28	35	0	2	0	8
11	0	3	190	2	26	0	0	6
12	0	37	1534	59	16	0	2	126
13	0	55	1324	61	42	0	6	20
14	1	37	439	44	13	0	1	89
15	0	0	0	5	0	0	0	0
16	0	0	12	6	3	0	2	5
17	1	16	137	4	3	0	3	0
18	0	4	238	4	2	0	1	3
19	0	31	187	4	1	0	0	9
20	0	10	171	0	3	1	0	7
MEAN	1.30	18.50	227.10	19.65	7.45	0.75	2.05	19.05
S.D.	2.94	34.95	426.98	23.17	11.47	2.10	2.74	36.50

EXECUTIVE SUMMARY
Bay Scallops
William S. Arnold
March, 2002

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 2001, the results of our monitoring efforts suggest that areas south of the Suwannee River between Crystal River and Tarpon Springs continue to experience 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 2001 mean density in the Crystal River region was almost 300 scallops per 600 m^2 transect.

In contrast, bay scallop abundance at the popular harvesting area in St. Joseph Bay has 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 2001, abundance in St. Joseph Bay averaged approximately 12 scallops per transect. However, that is an increase from 2000 and recruitment patterns suggest that this resurgence may continue into 2002.

Overall, the status of bay scallops in Florida waters has improved considerably since harvest modifications were implemented in 1995. Although problems persist along the southwest coast of the state and throughout the western panhandle, overall abundance is up especially in the area between Tampa Bay and Cape San Blas. The recent closure of the western panhandle to all scallop harvest may allow for the natural rebuilding of those populations. The continued closure of southwest Florida should facilitate the rebuilding of scallop populations in coastal waters south of Tampa Bay, although frequent red tide events in that area increase the difficulty of that task.