The Bay Scallop, *Argopecten irradians*, in Florida Coastal Waters

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Introduction

The bay scallop, *Argopecten irradians*, supports one of the most popular and family-oriented fisheries currently pursued in Florida coastal waters. Harvesting bay scallops has a long history in both peninsular (Marelli and Arnold, 2001) and panhandle (Mikell, 1992; 1994; Thomas and Campbell, 1993) Florida dating to at least A.D. 900, but in recent years the popularity of the scallops as a target for recreational and commercial fishermen appears to have contributed to local declines and the implementation of more stringent management measures (Arnold et al., 1998).

Those declines also have instigated many efforts to rebuild scallop populations by transplantation of field-collected specimens or by rearing scallops in a hatchery setting and then planting them at sites targeted for restoration (Arnold et al., 2005). Regardless of the methods used to restore scallop populations in Florida, the species remains imperiled in the face of continued human population growth and concomitant loss of suitable bay scallop habitat.

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ABSTRACT—The bay scallop, Argopecten irradians*, supported a small commercial fishery in Florida from the late 1920's through the 1940's; peak landings were in 1946 (214,366 lbs of meats), but it currently supports one of the most popular and family-oriented fisheries along the west coast of Florida. The primary habitat of the short-lived (18 months) bay scallop is seagrass beds. Peak spawning occurs in the fall. Human population growth and coastal development that caused habitat changes and reduced water quality probably are the main causes of a large decline in the scallop's abundance. Bay scallop restoration efforts in bays where they have become scarce have centered on releasing pediveligers and juveniles into grass beds and holding scallops in cages where they would spawn.*

Life History

Bay scallops are short-lived, and in Florida their life span rarely exceeds 18 months (Barber and Blake, 1985). Their primary habitat is seagrass beds, particularly *Thallassia* and *Syringodium*, but it is not uncommon for scallops to be found in open sand areas or lying on algal mats among the seagrass beds. Bay scallops may or may not have the physiological apparatus to support gregarious behavior, but they are commonly found in patches that are densely populated relative to background abundance. The patchy distribution pattern may facilitate successful reproduction. Scallops are broadcast spawners, so the likelihood of successful fertilization is enhanced by proximity (Levitan, 1995).

Peak spawning activity appears to occur in the fall season in Florida, in contrast to the situation with bay scallops in New York to Massachusetts where spawning is a summer or even spring event. However, ongoing studies by the author show that spring spawning occurs in some years, and recruitment has been recorded in almost every month of the year. Fertilized larvae spend about two weeks in the pelagos, after which they settle and attach to seagrass blades. At a shell height of about 15–20 mm, the scallops drop off the grass blades and assume a benthic existence. They achieve a shell height of 50–55 mm by June of the following year, at which time growth slows considerably and energy is devoted to reproductive development and spawning (Barber and Blake, 1983).

Species Distribution and Status

Three species of *Argopecten* occur in Florida including the calico scallop, *Argopecten gibbus*; the nucleus scallop, *Argopecten nucleus;* and the bay scallop, *Argopecten irradians* (Abbott, 1974). The calico scallop inhabits deeper offshore waters and has been the target of an occasionally lucrative commercial fishery (Moyer and Blake, 1986; Blake and Moyer, 1991). In contrast, the bay scallop and the nucleus scallop inhabit shallow inshore waters. Their range appears to overlap in south Florida and particularly Biscayne Bay (Waller, 1969), but otherwise the range of the nucleus scallop is more southerly than that of the bay scallop.

Nucleus scallops occur throughout the Caribbean and northern South America (Waller, 1969) whereas the most southerly record of the bay scallop is from Tuxpan in the Veracruz region of Mexico (Wakida-Kusunoki, 2009). There are published reports of calico scallops occurring in Biscayne Bay (Coleman et al., 1994), thus creating a situation where all three species co-occur, and the author has many records of calico scallop recruits collected from inshore bays on both the east and west coast of Florida.

Within the species *Argopecten irradians*, three extant subspecies are recognized including *A. i. irradians* from the northeastern United States, *A. i. concentricus* from the Mid-Atlantic region and eastern Gulf of Mexico, and *A. i. amplicostatus* from the western Gulf of Mexico including Mexico. A fourth subspecies (*A. i. taylorae*) occupying Florida and the eastern Gulf of Mexico has been suggested but not codified (Marelli et al., 1997a). If that subspecific designation is accepted, then the *A. i. concentricus* designation would be dropped and bay scallops from North Carolina north would be lumped into the *A. i. irradians* group (Marelli et al., 1997b).

The three subspecies are in many respects similar in appearance although they can be distinguished by morphological details such as hinge width and the number of ribs on the shell surface (Waller, 1969). They also share a dependence on marine seagrass as a habitat (Thayer and Stuart, 1974), although the particular species of seagrass upon which the scallop depends differs from site to site according to seagrass distribution patterns. That dependence upon seagrass has contributed to the decline of bay scallops in Florida and throughout the range of the species, because the seagrasses are becoming scarcer.

Museum collections indicate that the distribution of bay scallops in Florida once extended from Palm Beach on the southwest coast of the state to Pensacola and westward to the Chandeleur Islands in Louisiana (Waller, 1969). Although no definitive information is available, it is likely that the scallops were not continuously distributed within this range. Instead, the population was composed of many discretely distributed subpopulations that inhabited the bays and estuaries that characterize the Florida coast. In recent years, many of those local populations have disappeared in response to a variety of factors including habitat loss, deteriorating water quality, and overfishing.

According to Arnold et al. (1998), by the mid 1990's only two consistently productive local populations remained in Florida, one located in the coastal waters near Steinhatchee and the other located within St. Joseph Bay (Fig. 1). The loss of these local populations appears to have occurred from south to north, somewhat consistent with human development patterns in the state. Bay scallops appear to have disappeared first from the southeast coast of the state, then from Pine Island Sound in southwest Florida, followed by loss of populations in Sarasota Bay and Tampa Bay, then Anclote, and finally Homosassa and Crystal River (Fig. 1). However, bay scallops also have disappeared from western panhandle Florida, suggesting a more complex pattern of loss.

Anecdotal information gleaned from telephone and personal interviews with fishermen, owners of marine-dependent businesses (dive shops, bait shops, marinas), and coastal managers conducted during 1991, 1992, and 1993 supports the pattern of disappearance described above (Arnold and Marelli[1]). Responses were divided into three geographically representative areas including southwest Florida (from Tampa Bay south), the central west coast of Florida (i.e. the Big Bend, from Tampa Bay north to approximately Apalachicola Bay), and northwest Florida (from Apalachicola Bay to the Florida–Alabama state line).

In the southwest region, scallops were reported only from Pine Island Sound, where they were scarce and their interannual abundance was inconsistent. In the central region, scallops were rare from Tampa Bay north to the Pepperfish Keys area, but from Pepperfish Keys north to Keaton Beach (i.e. the Steinhatchee area) scallops were abundant, although abundance varied from year to year. Respondents reported that scallops "used to be" abundant in areas such as Anclote and Homosassa and suggested that declines in these populations were relatively recent.

In the northwest region, scallops remained abundant in St. Joseph Bay and occasionally could be found in St. Andrew Bay, but otherwise they had largely disappeared from the area. Various explanations were offered by the respondents for any observed declines, including increased turbidity, overfishing, and wet weather during the spring, but no definitive correlations could be discerned.

[1]Arnold, W. S., and D. C. Marelli. 1991. Assessment of bay scallop populations on the west coast of Florida. Internal Report IHR1991-001, Fla. Mar. Res. Inst., 19 p.

Bay scallop population density surveys were initiated at several sites along the Gulf of Mexico coast of Florida beginning in 1993 and have continued to the present. Survey sites were selected based upon the historical and anecdotal information described above and have been continued (and expanded) since their initiation at Homosassa in 1993.

At each survey site, 20 stations were randomly selected from within the 2 ft to 6 ft (0.61 m to 1.83 m) depth contours (Arnold et al., 1998). At each station, two scuba divers swam the length of a 984 ft (300 m) transect line and counted all scallops within 1.1 yds (1 m) on either side of the line, thus surveying an area of 718 yds^2 (600 m^2) at each station or 14,352 yds^2 (12,000 m^2) at each site. At the Cedar Key site, where the extent of seagrass beds is relatively small, only 6 rather than 20 stations were surveyed each year.

Initial survey results supported the historical and anecdotal information reported above. Scallops have been essentially nonexistent in Pine Island Sound (Table 1) in southwest Florida and in Pensacola Bay and St. Andrew Bay in northwest Florida. In the central region, scallops were rare in the Homosassa/Crystal River area through 1998 but abundance has been highly variable in Anclote. In contrast, although interannual fluctuations are apparent at both the St. Joseph Bay and Steinhatchee study sites, at least through 1998 scallop abundance at those sites has been an order of magnitude greater than at most other sites during most years. Since 1998, some increases in scallop abundance at several sites have occurred. Events that may have contributed to the increases are discussed in the "Population Restoration Efforts" section below.

Causes of Population Loss

There appears to be no single explanation or event that led to the depletion of bay scallops in coastal Florida. The available explanations are based largely upon anecdotal information rather than hard data. In southeast Florida, where

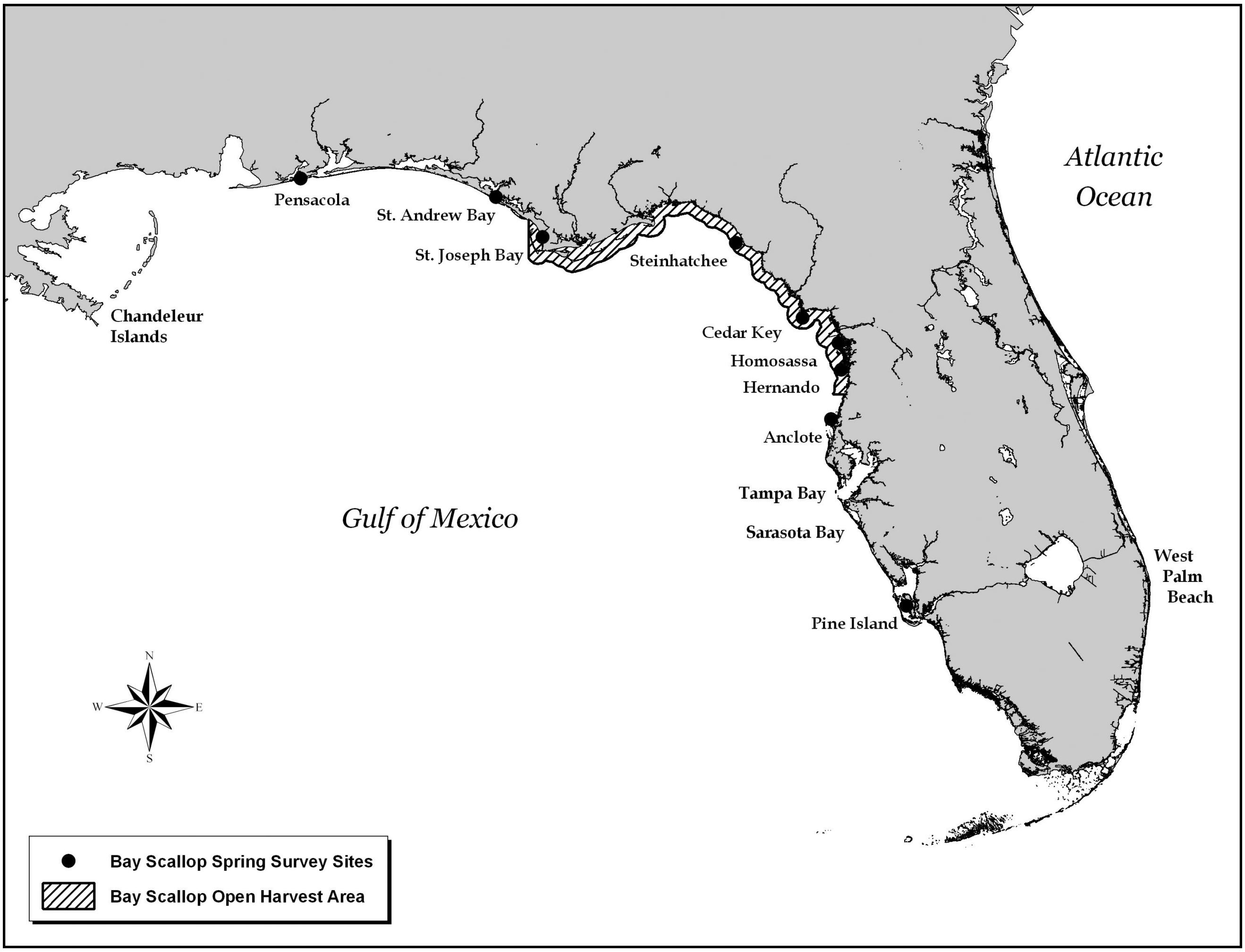

Figure 1.—Bay scallops, *Argopecten irradians,* in Florida, including their historic range from West Palm Beach to the Chandeleur Islands in Louisiana, the location of summer adult abundance survey sites, and the present (2009) open recreational harvest area along the west coast.

Table 1.—Mean abundance of adult bay scallops, *Argopecten irradians,* at various sites along the Florida west coast. Sample locations are depicted in Figure 1. Adult abundance (SD) is calculated as the mean of the abundance at each of twenty 718 yd^2 (600 m^2) survey transects determined by scuba divers, except at Cedar Key where only six stations were surveyed each year.

Site	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Pine Island		0	2.4	0.8	2.3	2.4	2.6	2.8	5.5	0.6	0.6	1.0	93.4	8.2
		(0)	(7.7)	(2.1)	(3.9)	(5.7)	(6.1)	(5.3)	(10.5)	(1.6)	(1.1)	(1.8)	(131.9)	(9.0)
Anclote		14.6	0.2	3.4	47.4	20.3	2.5	22.2	5.9	37.2	35.8	2.8	26.4	11.8
		(26.8)	(0.7)	(5.8)	(74.0)	(69.8)	(3.8)	(52.3)	(8.0)	(63.7)	(49.8)	(7.4)	(34.9)	(16.3)
Hernando					14.2	0.6	5.7	42.2	46.1	7.2	8.0	3.3	17.4	6.6
					(33.1)	(1.5)	(11.8)	(44.9)	(124.2)	(3.9)	(16.8)	(6.0)	(51.7)	(14.3)
Homosassa	7.3	6.8	4.7	3.2	15.2	3.0	28.6	242.8	299.3	51.8	125.6	5.7	72.3	21.9
	(6.3)	(9.8)	(6.4)	(2.7)	(16.0)	(7.9)	(48.1)	(290)	(305.4)	(38.9)	(149.8)	(13.2)	(90.9)	(21.3)
Cedar Key						0.8	2.7	0.3	7.7	2.3	6.0	0.0	4.7	3.8
						(1.2)	(2.8)	(0.5)	(9.4)	(2.6)	(4.2)	(0.0)	(7.7)	(6.0)
Steinhatchee		153.4	29.2	250.2	25.9	27.3	164.4	218.3	122.8	138.7	61.3	18.2	22.7	11.2
		(159.0)	(68.3)	(414.6)	(35.0)	(38.2)	(227.3)	(388.5)	(190.0)	(136.9)	(62.1)	(42.1)	(23.4)	(14.5)
St. Joseph Bay		35.8	132.2	247.7	27.3	13.4	31.1	3.8	12.1	37.5	28.7	2.4	59.3	35.6
		(81.9)	(175.5)	(312.2)	(41.5)	(21.3)	(48.2)	(6.3)	(37.6)	(55.2)	(48.2)	(5.6)	(118.3)	(43.0)
St. Andrew Bay		56.8	5.8	20.1	1.8	2.2	2.4	1.2	0.1	7.8	6.6	1.4	9.4	0.4
		(70.8)	(5.8)	(34.8)	(2.7)	(6.9)	(3.0)	(2.6)	(0.2)	(11.5)	(18.3)	(3.1)	(11.8)	(1.0)
Pensacola Bay			0.0							0.2	0.6	0.0	0.0	
			(0.0)							(0.4)	(1.3)	(0.0)	(0.0)	

bay scallops occurred at least during the early part of the century (see "Fishery and Harvest Regulations" section below), intensive human population growth and concomitant development have led to obvious and substantial changes to habitat and water quality that certainly contributed to the scallop's decline.

In southwest Florida, construction of a causeway from the mainland to Sanibel Island is popularly considered to be the causative agent of decline of the Pine Island Sound scallop population. However, Dr. Peter Sheng[2] at the University of Florida suggests that, based upon his hydrodynamic modeling of Pine Island Sound, dredging the Intracoastal Waterway through Pine Island Sound led to increased transport of fresh water north from the Caloosahatchee River into the sound rather than south into the Gulf of Mexico.

Since the Sanibel Causeway lies just south of the mouth of the Caloosahatchee River and likely contributes to blocking the exit of fresh water from the river into the Gulf of Mexico, it is possible that channelization and causeway construction acted synergistically to increase freshwater inputs into Pine Island Sound. The increase in fresh water would lower the sound's salinity and thereby reduce the suitable bay scallop habitat, because scallops require salinities above 20‰ for proper embryological and larval development (Castagna, 1975).

In Tampa Bay, it is likely that dredge-and-fill operations, causeway construction, and human population growth indirectly contributed to the depletion of scallops in that estuary. Those activities led to a loss of about 80% of the seagrass beds in Tampa Bay (Lewis et al., 1985). Such a loss of essential scallop habitat (Thayer and Stuart, 1974) would probably result in an equivalent or greater loss of scallops. The loss of the Tampa Bay scallop population may have imperiled other populations along the west coast of Florida, because that estuary may have acted as a source of larvae for periodic resupply of populations both north and south of Tampa Bay.

The depletion of scallop populations in the Anclote and Homosassa/Crystal River area may be the result of indirect effects that contributed to a lack of larval supply to these areas. Scallops are an annual species in Florida, so extreme population fluctuations occur. It is therefore not the collapse in abundance that is of concern but rather the lack of recovery. When bay scallop populations fall below a certain level of abundance, they appear to be no longer capable of producing enough larvae to support self-seeding (Arnold et al., 1998).

At that point, allochthonous larval inputs are necessary to rebuild the population, but as the external sources of such larvae are lost (e.g. as scallop populations in Tampa Bay and other areas become depleted) the likelihood of larval supply is lessened. A "domino effect" comes into play; as more populations are lost the remaining populations become increasingly imperiled. This concept of population collapse, based upon the theory of metapopulation ecology (Levins, 1969; Hanski, 1991) has formed the basis of bay scallop population restoration efforts in Florida.

Population Restoration Efforts

Efforts to rebuild bay scallop populations in Florida have been ongoing on a sporadic basis since at least the 1970's, but a more concerted effort was initiated by Dr. Norman J. Blake at the University of South Florida beginning in the early 1990's (Blake, 1996; 1998; Lu and Blake, 1997). Those efforts involved culturing locally collected scallops in a hatchery setting (Lu and Blake, 1997), then either releasing the resulting juveniles into grass beds or planting them into cages deployed throughout Tampa Bay (Blake, 1996; 1998).

Bay scallop population restoration efforts in Florida were expanded in 1997 to include several additional locations including Anclote, Homosassa, and Crystal River (Arnold et al., 2005). For the latter effort, ten stations were established within each of the Tampa Bay, Anclote, Homosassa, and Crystal River study areas and from 50–300 scallops were planted in each of five cages at each of those stations. Scallops planted in spring at a shell height of about 20 mm grew slowly and did not achieve full adult shell height until the following spring, but they did appear to develop and spawn normally.

Plantings were conducted in 1998, 1999, and 2000, and contemporaneous sampling (Table 1) suggests that at least at the Homosassa and Crystal River sites an increase in abundance of wild scallops resulted from the restoration efforts. However, a genetic study designed to detect contributions from the planted scallops to subsequent generations of wild scallops failed to detect any significant contribution (Seyoum et al., 2003; Wilbur et al., 2005). Given the extreme fluctuations in scallop abundance observed from long-term fisheries landings (Fig. 2) and from the adult scallop monitoring program (Table 1), natural fluctuations as an explanation of the sudden resurgence cannot be ruled out.

A novel approach to rebuilding scallop populations has recently been developed and was applied in Pine Island Sound during November 2003 (Leverone et al., 2004; Arnold, 2008). For this effort, adult scallops were collected from Pine Island Sound and induced to spawn in a hatchery. Resultant larvae were raised to the pediveliger stage, at which time they are anticipated to set within approximately 24 hours. The larvae were then transported to the field and released into three pre-established enclosures constructed from sediment containment booms (Fig. 3). Larvae were allowed 72 hours to settle, after which the containment booms were removed and the scallops were allowed to grow to adult size and to spawn in a natural setting.

This approach is designed to emulate the caging approach, with each enclosure serving the same purpose as a set of five cages at each of the stations mentioned above. In both cases, the idea is to establish a concentration of spawning individuals and ultimately to maximize the fertilization success of the scallops that do successfully survive to spawning. However, the larval release approach

[2]Sheng, P. Physical oceanographer, Coastal Eng. Dep., Univ. Fla. Gainesville. Personal commun.

achieves that goal with considerably less cost and effort and with the scallops proceeding through their growth and development in a natural manner.

The larval release approach appears to have been successful. Recruit collectors deployed within the enclosures captured an average of 1.5 scallop recruits, whereas no recruits could be found on collectors deployed outside of the enclosures or within a control enclosure that received no larvae. Moreover, during June 2004 we found an average of 20 scallops within the footprint of the three treatment enclosures versus only three scallops within the footprint of the control enclosure.

Finally, surveys conducted in Pine Island Sound during June 2005, when offspring from the June 2004 adults would be expected to have achieved adult size themselves, revealed that scallop density in Pine Island Sound increased by two orders of magnitude relative to the previous 11 years of monitoring (Table 1). Scallop density in Pine Island Sound decreased by an order of magnitude in 2006 relative to 2005, suggesting that restoration outcomes may be short-lived and may need to be continuous to be successful.

As with the previous restoration efforts, despite apparent success we have no absolute evidence of a connection between our restoration efforts and the resultant resurgence of scallops in Pine Island Sound. Given the vagaries of population abundance characteristic of this short-lived animal, it is possible that the increase in scallop abundance observed during 2005 simply reflected natural variation. The 2003–05 effort in Pine Island Sound was designed to be low-cost so no genetic assessment was included, but we are refining and applying genetic assessment in our ongoing restoration program. Genetic assessments are a costly but necessary component of population rebuilding programs as they provide the best assurance that perceived success is a reality.

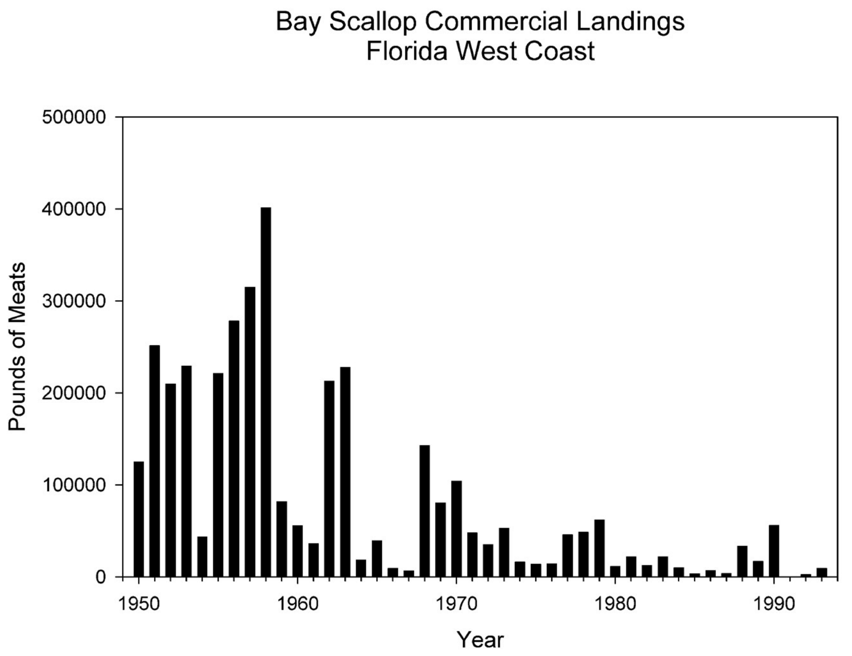

Figure 2.—Bay scallop, *Argopecten irradians,* commercial fishery landings from the west coast of Florida during 1950–93. The commercial fishery was closed by regulation beginning in 1994. Data are courtesy of the Florida FWCC Fish and Wildlife Conservation Commission's Fisheries Dependent Monitoring group.

Figure 3.—Sediment containment booms formed into enclosures for receipt of bay scallop, *Argopecten irradians,* larvae in Pine Island Sound, Fla. For the study described in the text, one of the four enclosures served as a control and received no larvae. Photo from the author's archives.

Fishery and Harvest Regulations

Apparently beginning in the late 1920's (Murdock, 1955), an occasionally substantial commercial fishery was once active along both coasts of Florida. Most production came from Pine Island Sound and St. Joseph Bay (Table 2), but landings were recorded from several other counties including Brevard, Volusia, Flagler, and St. Johns. All four of those counties are located along the east central coast of Florida, well north of reported northernmost distribution of the species on the east coast of Florida (Waller, 1969). This fishery was sometimes substantial; in 1936 over 332,000

Table 2.—Statewide Florida commercial landings of bay scallops, *Argopecten irradians,* from 1928 through 1950. Data are from Murdock (1955) who provides additional information on the various sources of these data. * indicates missing data or no production.

Year	Pounds of meats	Value (dollars)	Dollars/ Pound
1928	14,100	5,000	0.35
1929	*	*	*
1930	21,867	2,139	0.10
1931	13,526	924	0.07
1932	61,965	6,885	0.11
1933	*	*	*
1934	74,100	6,596	0.11
1935	*	*	*
1936	332,100	32,523	0.10
1937	118,600	9,499	0.08
1938	137,400	10,593	0.08
1939	119,100	10,948	0.09
1940	128,400	17,497	13.6
1941	105,508	*	*
1942	42,965	*	*
1943	849	*	*
1944	21,499	*	*
1945	108,000	21,600	0.20
1946	214,366	*	*
1947	*	*	*
1948	*	*	*
1949	135,900	27,180	0.20

lbs of meats were landed and in 1951 over 250,000 lbs of meats were landed. However, the fishery was also very sporadic, and Murdock (1955) suggests that at least some of this variance was due to red tide, *Karenia brevis,* events that still severely affect bay scallop populations in Florida.

Vessels involved in this fishery were typically 15–20 ft (4.5–6 m) long, they had shallow drafts suitable for running in shallow water, and each was manned by one fisherman (Murdock, 1955). Their engines were centrally located, and a culling board was attached to the stern gunwhale. Dredges, constructed from a triangular iron frame of maximum dimensions 28 in (70 cm) wide × 24 in (60 cm) high, with a 2 2/3 in (7 cm) stretch mesh net attached to the distal end of the frame, were the harvest gear of choice. The dredges could hold about one bushel; two dredges were towed from each vessel. In Pine Island Sound, a maximum of perhaps 40 fishermen moved in and out of this fishery depending upon scallop abundance and the abundance of other harvestable species such as blue crabs, *Callinectes sapidus*. No information was provided regarding the number of fishermen engaged in the fishery in other Florida areas (Murdock, 1955).

Scallops were shucked by hand, and the women and high school girls and boys employed could shuck a bushel in less than an hour (Murdock, 1955). The resultant meats were washed to remove any shell and visceral fragments and placed in metal bins with fresh water and ice for an initial chilling. The meats absorbed some water, which increased their volumes and also improved their appearance by whitening them. The meats then were packed in 1-gallon tins which were subsequently packed on ice in barrels or boxes for shipment to local or out-of-state markets.

There were no regulations regarding this fishery (Murdock, 1955), with the predictable result that by the 1960's landings were decreasing. By the 1970's, the fishery was artisanal at best. The first substantial regulations regarding commercial or recreational bay scallop harvests in Florida were implemented in 1985, when a statewide closed season from 1 April through 30 June of each year was instituted. A recreational bag limit of five gallons of whole scallops also was put into effect and allowable dimensions for commercial harvest gear were defined.

As scallop populations continued to decline statewide, more stringent harvest regulations were instituted beginning in 1994. That year the commercial fishery was closed and commercial sale of bay scallops harvested from Florida waters was prohibited. In addition, the recreational harvest was limited to the area north of the Suwannee River and only during the period 1 July–30 Sept. of each year. In 1995 the recreational harvest season was further limited to the period 1 July–30 Aug., and the bag limit was reduced to 2 gallons of whole scallops or 1 pint of meats/person. A boat limit of 10 gallons of whole scallops (1/2 gallon of meats) was included, the prohibition on commercial sale was continued, and the use of any mechanical gear for harvest was outlawed.

In 1997 the recreational season was extended to 10 Sept. to include the Labor Day holiday, but all other regulations were left intact. Finally, in 2002, the area from the Suwannee River south to the Weeki Wachee River was reopened to harvest and the area from the mouth of St. Joseph Bay west to the Florida–Alabama line was closed to harvest due to low scallop abundance in the estuaries of that area. As of 2009, those regulations remain in effect.

As noted, considerable effort has been expended on restoring bay scallop populations in various Florida estuaries, but no definitive evidence can be offered regarding the success of those efforts. One reason for advising caution in the interpretation of the possible outcomes of those efforts relates to the changes that have occurred in harvesting regulations contemporaneous with those restoration efforts. Possibly, changes in management strategies, the restoration efforts, or a combination of the two will be adequate to maintain functional bay scallop populations in Florida coastal waters in the face of continued human population growth. The loss of bay scallops from Florida waters would be a disappointment because the species supports an enjoyable and family-oriented recreation, and that loss would signal that serious environmental problems within the seagrass community are occurring.

Acknowledgments

Many people have contributed to our understanding of the history and ecology of bay scallops in Florida waters, including numerous citizens who contributed their memories and knowledge of scallop distribution and abundance. Specific acknowledgment goes to Alcee Taylor from Cortez, Florida, for the time he spent discussing the history of scallops and to Dr. Norm Blake and his students for establishing research baselines for bay scallops in Florida. Florida FWCC staff who have been instrumental in developing our knowledge of this important and charismatic species include Dan Marelli, Catherine Bray, Melissa Harrison, Kate Hagner, Melanie Parker, Sarah Stephenson, Steve Geiger, Janessa Cobb, Mark Gambordella, Bill Teehan, and others too numerous to mention.

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