To date there has been no attempt at a comprehensive stock assessment for wahoo. Therefore, the status of the stocks is unknown at this time. Proxy MSY estimates were provided by the NMFS SEFSC and were used to specify the status determination criteria in the Dolphin Wahoo FMP.

4.1.9 Calico Scallops

Description and Distribution

Calico scallops, *Argopecten gibbus* (Linnaeus 1758), are part of the bivalve mollusc family Pectinidae that contains all commercial species of scallops (Waller 1991). They are unified by series of minute denticles formed in the notch of the right valve, most visible in early juvenile stages. Waller (2006) indicates there are four major groupings or subfamilies, three of which are monophyletic (Camptonectinae, Palliolinae and Pectininae) and one of which is paraphyletic (Chlamydinae). At least six species in the subfamily Pectininae are commercially exploited: *Aequipecten operularis* (queen scallop), *Argopecten irradians* (bay scallops) and *A. gibbus* in the North Atlantic, *Aequipecten tehuelchus* (Tehuleche scallop) in the South Atlantic, and *Argopecten purpuratus* (Chilean scallop) and *A. ventricosus* (Catarina scallop) in the eastern Pacific.

Identification of calico scallops can be made from shell color and morphology. The upper (left) valve has red or maroon calico markings over a white or yellow base; the lower (right valve) is more lightly pigmented. The calico markings on the shell distinguish this scallop from the solid gray or brown upper valve of the bay scallop, which resembles the calico scallop in size. Calico scallop shell morphology varies with locality (Krause et al. 1994), but generally the species reaches 40 to 60 mm (1.6-2.4 in) in shell height (a straight line measurement of the greatest distance between the umbo and the ventral margin), with a maximum size reported to be about 80 mm (3.2 in) in shell diameter (a straight line measurement of the greatest distance between the anterior and posterior margin) (Roe et al. 1971). The shells are almost equally convex, deeply ridged, with 17 to 23 ribs on the right valve (Waller 1969).

The calico scallop occurs most often at moderate depths of 18-73 m (59-240 ft) and restricted generally to the continental shelf of the western North Atlantic and Gulf of Mexico between about 35° N and 20° N latitude (Broom 1976). The range includes the northern side of the Greater Antilles, throughout the Gulf of Mexico, to Bermuda and slightly north of Cape Hatteras (possibly Delaware Bay) in waters varying from 2 m (6.6 ft) at Bermuda to 370 m (1,214 ft) on the northern side of the Greater Antilles (Allen and Costello 1972). Off the Florida east coast, depth of occurrence was 9 to 74 m (30-243 ft) while off North Carolina, south of Cape Hatteras, calico scallops were reported at depths of 13 to 94 m (43-308 ft) (Allen and Costello 1972). Adults are generally restricted to open marine waters but juveniles do recruit to estuarine areas (Waller 1969). The closely related species *Argopecten irradians* and *A. nucleus* have overlapping ranges but are more common in estuarine waters, especially seagrass beds.

Calico scallop beds are generally distributed on the continental shelf parallel to the coastline. These beds are most abundant off Cape Lookout, North Carolina; Cape Canaveral, Florida; and Cape San Blas, Florida, in the northeastern Gulf of Mexico (Allen and Costello 1972). Scallop abundance fluctuates at each area, with good years followed by years when none are available.

On the Cape Canaveral grounds, scallops occur in long narrow bands, or beds, more than 800 m (2,625 ft) long and several hundred meters wide. A calico scallop bed near Cape Lookout, North Carolina, was elliptical and 15 km (9.3 mi) long. Off Cape San Blas, in 1957, a bed 16 km (9.9 mi) long by 8-16 km (5.0-9.9 mi) wide was located (Bullis and Ingle 1959). The greatest concentrations of these scallops appeared to be near coastal prominences (Allen and Costello 1972). A population of calico scallops was located in 1977 offshore of the South Carolina/Georgia border in 37-45 m (121-148 ft) (Anderson and Lacey 1979). The scallop bed was also elliptically shaped and oriented perpendicular to the coast. Concentrations have also been reported from the eastern Gulf of Mexico between Sanibel Island and Dry Tortugas.

The Cape Canaveral scallop grounds are among the largest in the world, extending over 321.8 km (200 mi) from St. Augustine to near Stuart, Florida. Depths of the heaviest concentrations of calico scallops off Cape Canaveral from 1960-1967 ranged from 26-49 m (85-161 ft), as recorded by exploratory fishing cruises (Miller and Richards 1980). Roe et al. (1971) reported depth distributional differences off Florida, noting scallops south of Cape Canaveral were generally found in shallower water than north of the Cape. However, Sutherland (unpublished report) reported that scallop beds located north of Cape Canaveral were not always found in deeper water than beds south of the Cape. Estimates of the calico stock distribution and abundance from data obtained with RUFAS (Remote Underwater Fishery Assessment System) were used to visually capture the scallop resource (c.f. May et al., 1971). Tumbler dredges were used to obtain ground-truth samples to enable comparison with historic survey and fishery data (Figure 4.1-22). They found the bed width was highly variable and ranged from 6.7 to 2,633.5 m (22 to 8,640 feet). Juvenile calico scallop beds in 1970 surveys accounted for almost 4 percent of scallop distribution. Scallop occurrence was uniformly less than 4 percent of completed transect miles.

Calico scallops occur off North Carolina at water depths of 13-94 m (Schwartz and Porter 1977). In April of 1949, a survey cruise by the Institute of Fisheries Research located calico scallops off New River Inlet (Chestnut 1951). Other beds located by the U.S. Bureau of Commercial Fisheries (now National Marine Fisheries Service) have existed intermittently since 1959. Cummins et al. (1962) reported that the principal calico scallop grounds located near Cape Lookout were described as elliptical in shape and were approximately 16 km long. Other lesser beds were located in 19-37 m depths northeast and southeast of the Cape. Schwartz and Porter (1977) reported that the fishery concentrated in an area located southeast of Cape Lookout in 1971. A bed located 16 to 24 km south of Beaufort, NC in depths of 20-25 m and inside the 28 m contour produced approximately 1 million pounds of meats in 1972 (Schwartz and Porter 1977). The R/V *Dan Moore*, a North Carolina Division of Marine Fisheries (NCDMF) exploratory research vessel, surveyed beds southwest of New River and northeast of Cape Lookout but failed to locate commercial quantities of calico scallops. Exploration by the R/V *Dan Moore* in February and April 1975 in an area 20 nautical miles south of Bogue Inlet produced no scallops. This area only had shell material, sponge, coral and starfish (Powell et al. 1975a; Powell et al. 1975b). In 1978, the R/V *Dan Moore* surveyed a calico scallop bed off the coast of South Carolina. This trip was arranged after South Carolina biologists captured small sub-adult scallops incidental to rock shrimp during May of 1977. Trawlers taking rock shrimp were also catching large quantities of small scallops. In January of 1978, scallops were landed in Mount Pleasant, SC. This bed was located 77 km (48 mi) south of Charleston Sea Buoy and was

determined to be 11.3 km (7 mi) in width and 8 km (5 mi) in length running perpendicular to the shore (Holland et al. 1978).

Government sponsored surveys in the South Atlantic Bight have been describing calico scallop distribution, along with other important benthic resources like the many species of shrimps, since at least the late 1950s (Bullis and Ingle 1959; Bullis and Cummins 1961). This program used a variety of trawls and dredges because of the large variety of targeted species, and often calico scallops were collected as by-catch of another targeted species. The program continued through at least the mid 1960s (Figure 4.1-22). Additional cruises in the 1970s utilized both dredge and video survey methods (May et al. 1971). During the peak of the fishery in the 1980s, there was some survey activity in Florida (Blake and Moyer 1989; Figure 4.1-23). Much more information was probably gathered by fishermen themselves (Figures 4.1-24 and 4.1-25).

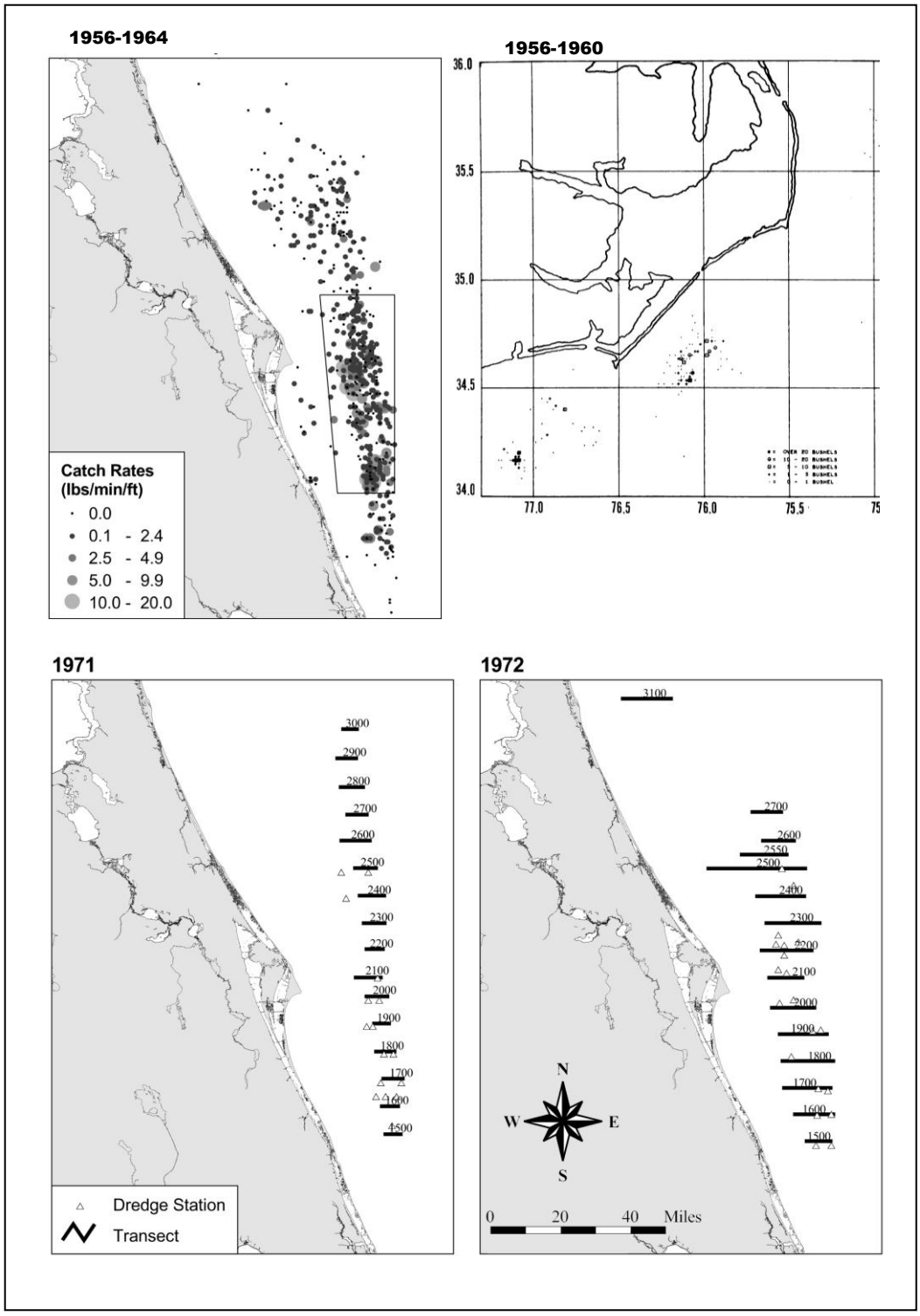

Figure 4.1-22. Historic NOAA calico scallop surveys. Top left, data compiled from the R/V *Silver Bay*. Top right, North Carolina surveys. Bottom, two "RUFAS" cruises.

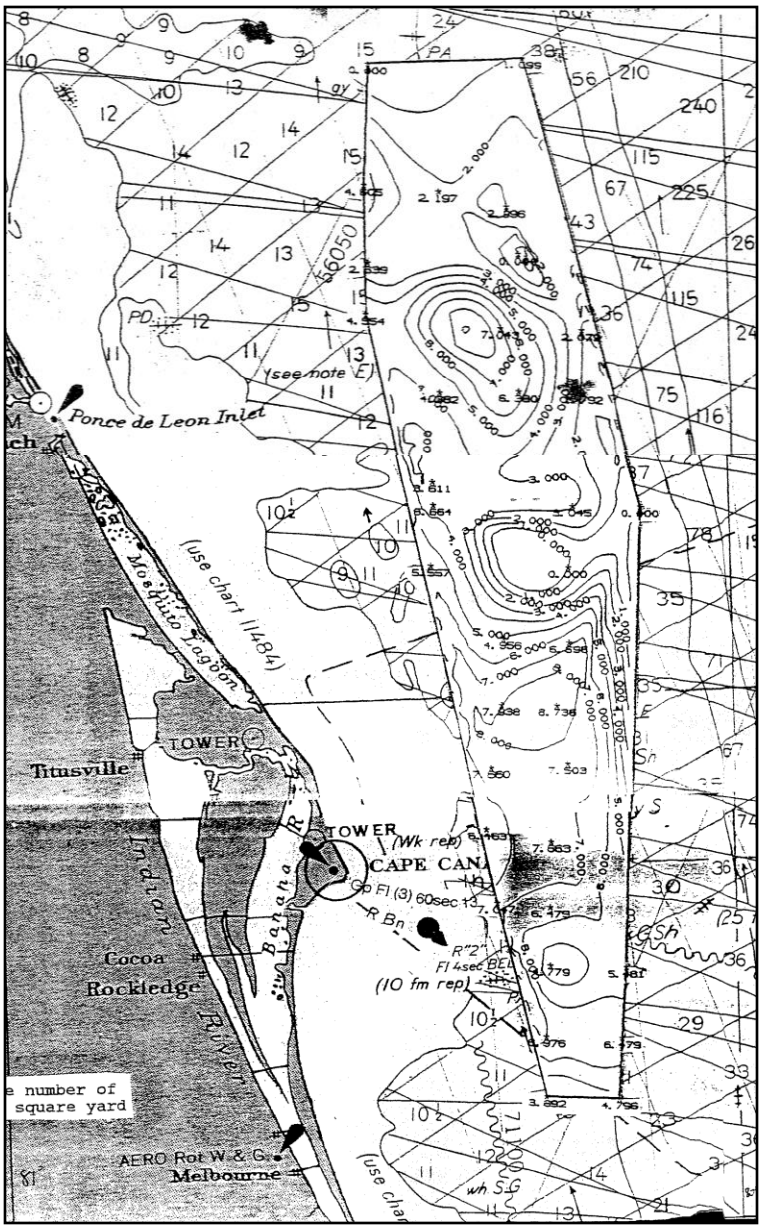

Figure 4.1-23. 1980s survey by Blake and Moyer, contours of estimated scallops per square yard.

Recent Florida surveys are being conducted under NOAA's MARFIN program (Figure 4.1-26). Figures 4.1-24 and 4.1-25 were provided by representatives of the calico scallop industry during scoping meetings and public hearings on calico scallop management and present recent calico scallop harvest areas/distribution, spawning locations, and shell distribution off southeast Florida.

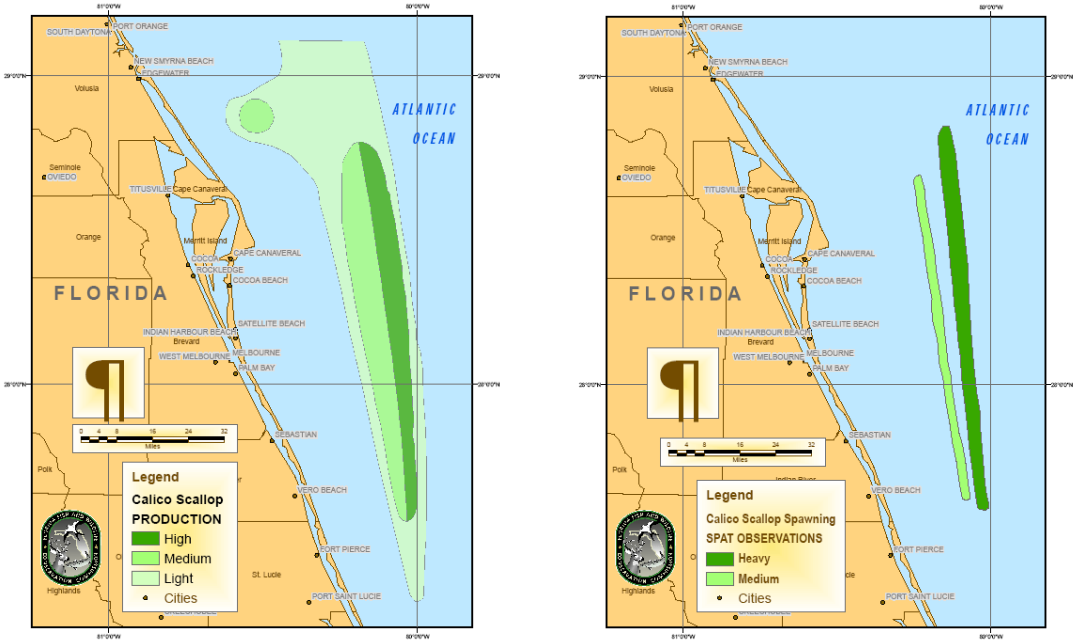

Figure 4.1-24. Calico scallop spawning areas and fishing grounds (Source: William Burkhardt, Calico Scallop Advisory Panel). Reproduced from SAFMC 1998 (Draft Calico Scallop FMP).

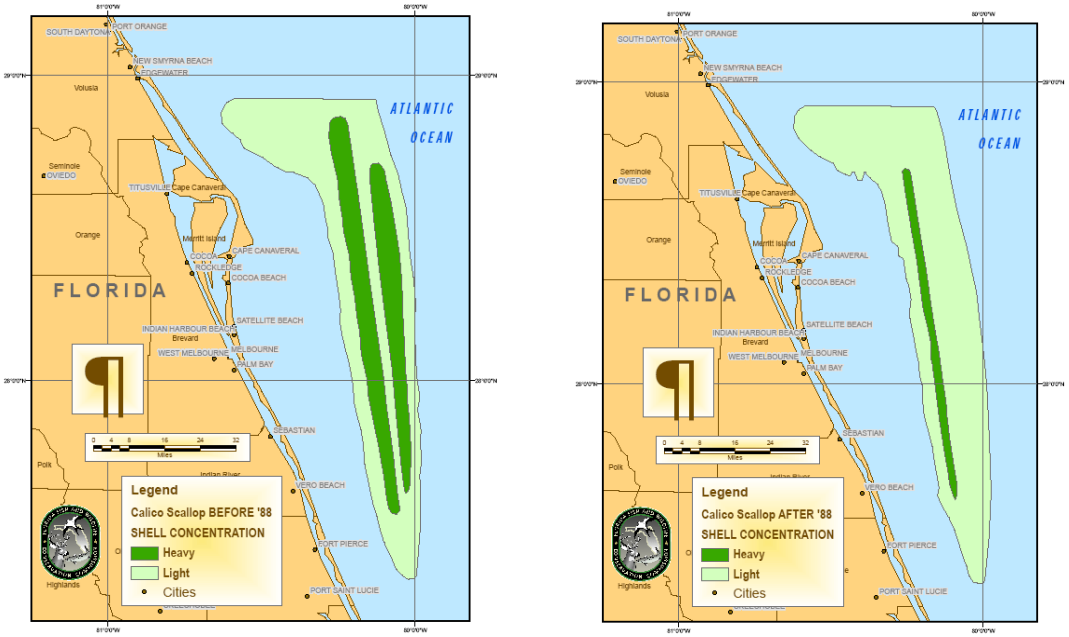

Figure 4.1-25. Calico Scallop shell distribution (Source: William Burkhardt, Calico Scallop Advisory Panel). Reproduced from SAFMC 1998 (Draft Calico Scallop FMP).

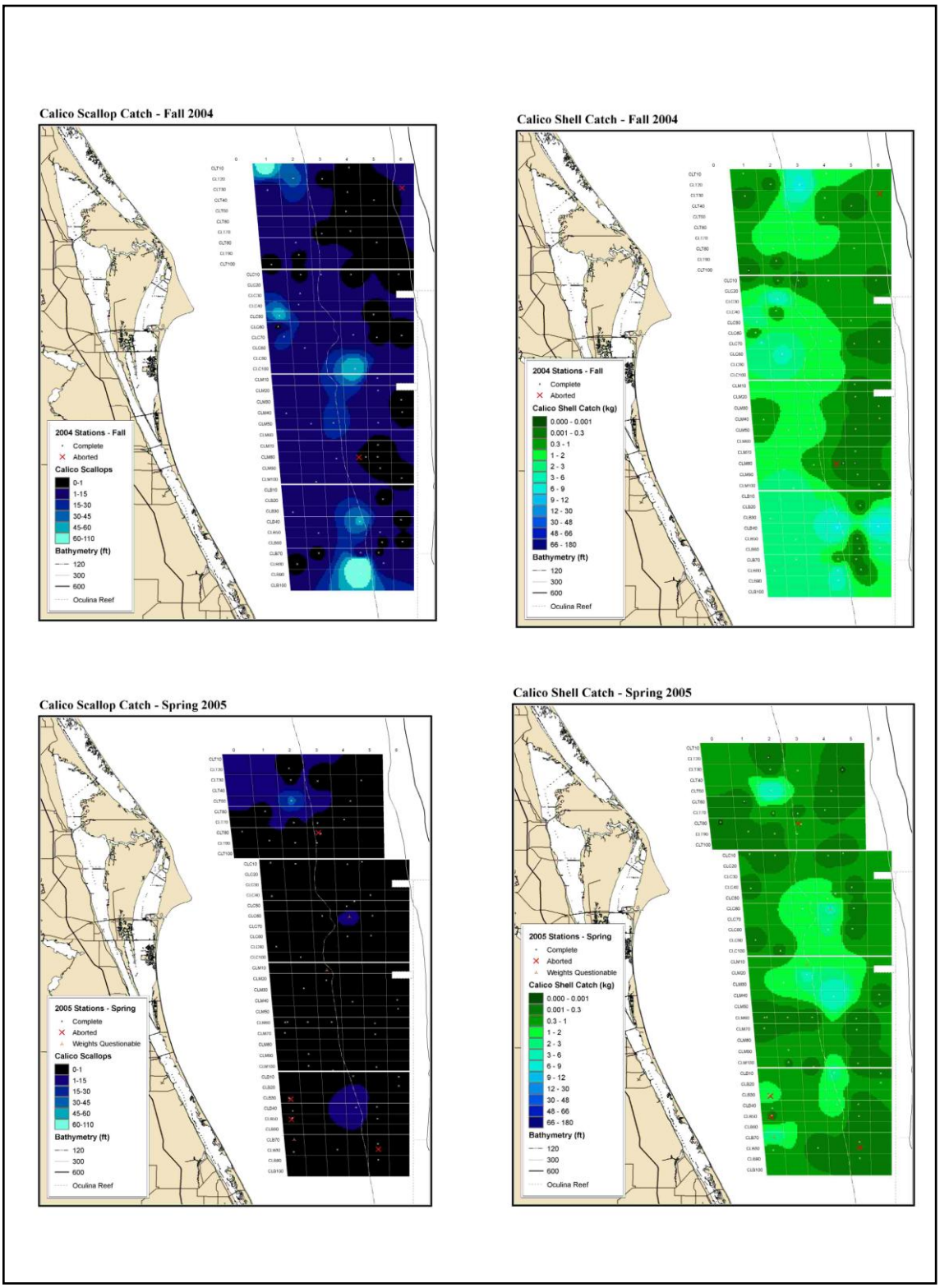

Figure 4.1-26. Current calico scallop distribution (left) and calico scallop shell distribution (right) for two seasons of sampling (FWRI) in the vicinity of Cape Canaveral, FL.

Reproduction

Maturity in Atlantic calico scallops is correlated with age rather than size (Roe et al. 1971). Change in ovarian color was found to correlate with reproductive stage (Miller et al. 1979). Scallops as small as 23.0 mm have been observed with developed gonads, and scallops as small as 20 mm, estimated to be as young as 71 days old, can probably begin spawning (Miller et al. 1979). Atlantic calico scallops are hermaphroditic, ejecting first sperm and then eggs into the water where fertilization occurs. Laboratory spawned calico scallops produced eggs with a diameter of 60 microns (Costello et al. 1973).

Changes in water temperature may stimulate spawning. Peak spawning is thought to occur at temperatures around 18°C (Allen 1979) in both spring and fall but scallops may spawn intermittently many times during the spawning season, and spat have been observed throughout the year. The fall peak is secondary to the spring peak, and does not occur in all years. No data on fecundity of Atlantic calico scallops was located. The closely related bay scallop (*Argopecten irradians*) can produce 12.6 to 18.6 million eggs at age 1 year, and some individuals will produce a second, smaller spawn at an age of 18 months (Bricelj et al. 1987). Based on an age at first reproduction of about 6 months, and a maximum age of 24 months, the oldest calico scallops may survive for up to four spawning seasons. It is difficult to determine if any individual scallop actually spawns more than once, because scallops often suffer increased mortality after a spawn, but multiple, smaller batches of eggs seems likely for this species.

Development, growth and movement patterns

In the laboratory at 23°C and 35 ppt, trochophore larvae were observed at 24 hr and larvae settled at 235-270 micron on day 16 (Costello et al. 1973). Larvae settle as spat in 14 to 16 days and attach to substrates with byssal threads from the foot. Juveniles can reach 10 mm by an age of two months, and thereafter grow at about 0.65 mm per week. Calico scallops reach commercial shell height of 4 to 4.5 cm (1.6 to 1.8 in) in 6 to 8 months, and have a life span averaging only 18 to 20 months, with a maximum age of 24 months (Allen and Costello 1972). The maximum shell height attained is at least 68.9 mm (Waller 1991).

Part of the North Carolina stock may result from larvae transported northward from the Cape Canaveral grounds by the Gulf Stream. Krause et al. (1994) found that the North Carolina stock and Cape Canaveral stocks were more similar morphometrically and genetically than two stocks within Florida waters. However, oceanographic data suggest that most larvae would be retained at Cape Canaveral (Leming 1979). Cyclic movement of bottom waters on and off the continental shelf ranged in period from 2-23 days during the summer (mean around 11.5 days) to 3-6 days in winter. Both were related to fluctuations in wind stress. The results also suggest that the net transport of most larvae would result in displacement from the spawning ground of only 7 - 40 km over the two week larval phase. The author also said that the predicted pattern of dispersal could explain the long, oval shaped beds which have been observed; elongate elipses roughly parallel to the bathymetry. These same patterns of water movement probably generate a high flux of both nutrient rich and food rich water across the shelf edge at depths around 40 m, which are optimal for the rich benthic abundance and diversity present.

Ecological relationships

Most scallops are primarily filter feeders on phytoplankton, benthic microalgae, and to varying degrees suspended particulate organic matter and detritus (Bricelj and Shumway 1991). Although no studies are available for calico scallops, the genus *Argopecten* has been studied extensively. Clearance rates vary from less than 1 liter/hr/g dry tissue weight at very high algal concentrations to over 10 liters/hr/g dry tissue weight at low algal concentrations (MacDonald et al. 2006). Using our rough estimates of 1 billion individuals, with an average dry tissue weight of 2 mg, the calico scallop population could then be estimated to clear 10 billion liter/hr (1 million m^3/hr) or 8.8 billion m^3/yr. In terms of biomass, these rates translate to about 8 mg/hr/g dry tissue weight or 140 million kg of phytoplankton per yr removed from the east Florida shelf waters.

Calico scallops can be among the most abundant members of the benthic community near the shelf edge and thus a large potential prey source for other species. Predators on juvenile and adult scallops include seastars, gastropods, squid, octopus, crabs, sharks, rays, and bony fishes. Schwartz and Porter (1977) found that at least 24 of the 33 most common fishes examined in North Carolina preyed on scallops. Nine species did so commonly: *Spheroides maculatus, Stenotomus aculeatus, Diplectrum formosum, Orthopristes chrysopterus, Monacanthus hispidus, Balistes capriscus, Centropristis striata, Mustelus canis*, and *Synodus foetens*. Two invertebrates, *Luidia clathrata* and *Astropecten articulatus*, were found to be common predators and at least 19 other invertebrates were implicated in scallop predation. One fear is that at-sea shucking of scallops may result in increased abundance of these predators on the scallop beds by attracting them to the discarded viscera. An additional survey in North Carolina waters in the 1980s found a similar collection of incidental species (Table 4-1-24). Economically important species include *Paralichthys albigutta, P. lethostigma*, and *P. dentatus*, as well as the penaeid shrimp *Farfantepenaeus duorarum* (Stephan 1989).

Wells et al. (1964) identified 112 species of benthic invertebrates from the North Carolina scallop beds, most of which were found as fouling organ isms on scallops shells. The most abundant was *Balanus amphitrite* (up to 200 per shell) and the polycheates *Pomatoceros caeruleus* (up to 65 per shell) and *Sabellaria floridensis* (up to 28 per shell). All three species were present on essentially every scallop. The dry weight of the associated epifauna weighed 40-50 percent of the dry weight of the shell itself. A similar amount of fouling occurred on the inside surface of the shells of dead scallops.

Table 4.1-24. List of incidental species captured from scallop trawl November 1988 (From Stephan 1989).

Species	Common Name
Finfish	
Bellator militaris	Horned searobin
Centropristis ocyurus	Bank sea bass
C. philadelphica	Rock sea bass
Citharichthyes macrops	Spotted whiff
C. spilopterus	Bay whiff
Diplectrum formosum	Sand perch
Etropus crossotus	Fringed flounder
Gymnachirus melas	Naked sole
Hippocampus erectus	Lined sea horse
Lagodon rhomboides	Pinfish
Monacanthus hispidus	Planehead filefish
Orthopristis chrysoptera	Pigfish
Paralichthys albigutta	Gulf flounder
P. dentatus	Summer flounder
P. lethostigma	Southern flounder
Prionotus evolans	Striped searobin
P. roseus	Bluespotted searobin
P. salmonicolor	Blackwing searobin
P. scitulus	Leopard searobin
Scophthalmus aquosus	Windowpane
Scorpaena sp.	Scorpionfish
Sphoeroides maculates	Northern puffer
Stenotomus chrysops	Scup
Syacium papillosum	Dusky flounder
Symphurus plagiusa	Blackcheek tonguefish
Synotus foetens	Lizardfish
Trachinocephalus myops	Snakefish
Invertebrates	
Aequipecten muscosus	Rough scallop
Arbacia punctulata	Purple urchin
Arcinella cornuta	Florida spiny jewelbox
Astropecten articulatus	Margined sea star
Calappa flamea	Shame-fase crab
Chione latilirata	Imperial venus
Cnidaria	Sea nettles
Glatheidea	Hermit crab
Hepatus epheliticus	Dolly Varden crab
Laevicardium laevigatum	Egg cockle
Ludia clathrata	Slender sea star
Lytechinus variegatus	Short-spined sea urchin
Murex sp.	Murex
Ophiothricidae	Short spined brittle star
Pecten raveneli	Ravenel’s scallop
Farfantepenaeus duorarum	Pink shrimp
Portunus gibbessi	Portunid crab
P. spiymanus	Spiny-handed crab
Scyllaridae	Slipper lobster
Sicyonia sp.	Rock shrimp
Xenophora conchyliophora	Atlantic carrier shell

A protistan parasite of the genus *Marteilia* was first recorded from the east Florida calico scallop beds in samples collected during 1991 (Moyer et al. 1993). There is no direct evidence that this parasite caused mortality in the scallop population, but the samples from which the parasite was identified were collected during a major scallop mortality event that occurred in February 1991. Moreover, species of *Marteilia* have been implicated in mass mortalities of oysters in Europe and Asia (Moyer et al. 1993), so this organism certainly has the capability of instigating a mass mortality event in calico scallops. The history of *Marteilia* on the east Florida shelf, and its occurrence in calico scallop populations in the Gulf of Mexico or off North Carolina, is presently unknown.

Several other parasites have been linked to calico scallops but no mortalities have been directly attributed to them: *Echeneibothrium* (cestode) (Singhas et al. 1993), *Pontonia margarita* and *Pinnotheres maculatus* (decapod crustaceans), *Boonea seminude* (gastropod), *Ceratoneries tridentate* and *Polydora websteri* (polychaetes), and *Pinnotheres maculates* (crab) (Wells et al. 1964). The decapod crustaceans which inhabit the mantle cavity are likely commensal, causing little impact on host scallops. Worms that cause blisters (*Polydora* sp., *Pontonia* sp. and *Pinnotheres* sp.) weaken the shell and may increase the incidence of predation or at least cause the host to spend resources repairing injuries to the shell (Wells et al. 1964). *Odostomia seminuda* (ectoparasitic gastropod) will similarly drain resources by attaching to the shell and draining body fluids from the mantle edge (Wells et al. 1964). Eggs and developing larvae of the nematode *Sulcascaris sulcata*, the loggerhead stomach worm, may be found in muscles of calico scallops. This nematode in scallops has also been incorrectly identified as *Paranisakis pectinis* and possibly as a species of *Porrocaecum* (Cheng 1978). Eggs released in turtle feces can be ingested by scallops, and developed larvae can later re-infect turtles that consume scallops (Berry and Cannon 1981). The encysted larvae appear as a 2 - 2.5 mm blemish on the meat. They do not pose any threat to humans because it will be killed during freezing, cooking or even human body temperatures (Otwell and Koburger 1985). Another parasite, the encysted nematode larvae, *Echeneibothrium* sp., has been found in calico scallop gonads. Alteration of intestinal epithelium is the most serious tissue damage observed, but, failure of a local population in North Carolina coincided with the appearance of this parasite (Singhas et al. 1993).

Abundance and status of stocks

Most individuals of this species are probably located in the Cape Canaveral population. The maximum harvest, 42.7 million pounds in 1984, would equate to about 8.54 billion adult scallops, based on an average of 200 meats per pound (assuming 1 pint = 1 pound), assuming all of the scallops present were harvested. Other populations would add significantly to the potential overall abundance. The Florida Gulf of Mexico populations may reach abundances of around 1 billion or more, based on a harvest approaching 5 million pounds of meat 1993, and the North Carolina population might achieve abundances of 0.5 billion based on catches approaching 2 million pounds of meat in 1978. It is unknown if any of the populations are present at those levels today. Based on a 30 year average harvest of 5 million pounds per year, the Florida population would average around 1 billion individuals. The abundance in local populations can change by 50 fold between successive years (Anonymous 1981).

Disappearance of Atlantic calico scallops from a particular area commonly occurs, and the size of the stock shows considerable annual fluctuations. Monthly mortality on the Cape Canaveral

bed was estimated at 12% during recruitment periods and 23 % during post-spawn periods, and ranged from 1-31% (Roe et al. 1971). Declines and mass mortalities have occurred on the grounds off North Carolina and Florida. Possible causes include migration, poor larval transport from elsewhere, and increased fishing pressure following introduction of shucking and eviscerating machines. Spawning stock is maintained because (1) not all beds are harvested each year; (2) the spawning stock includes scallops too small to market; and (3) individuals at densities too low to harvest.

The oceanography of the east Florida shelf is highly variable and strongly influenced by the Gulf Stream. Gulf Stream meanders and other topographic and meteorological events can induce upwelling of cold, nutrient rich water onto the continental shelf (Leming 1979). This water may have positive effects on scallop biology by increasing food supply (Atkinson et al. 1984). Negative impacts also are possible, particularly the dispersal of larvae away from the natal habitat as the upwelled water mass is swept northward off the shelf (Leming 1979). The implications of upwelling to calico scallops inhabiting the east Florida shelf are not well known, but such upwelling events are an historic feature of the continental shelf in this area and in other areas where abundant calico scallop populations have been recorded (e.g., Atkinson et al. 1984; Muller-Karger 2000). To the degree that upwelling events on the east Florida shelf reflect larger scale oceanographic events such as the El Niño Southern Oscillation (ENSO) or the North Atlantic Oscillation (NAO), which may cycle on a decadal or even longer time scale, these upwelling events may induce relatively long-term cycles in calico scallop abundance.

Reliable information on the geographic extent of current fishable stocks, if any, is unavailable. The most reliable data comes from fishery dependant monitoring in Florida and North Carolina (Table 4.1-25; Figure 4.1-27). These sources show that the fishery in NC peaked in 1972 and in Florida in 1984. Despite having annual harvests in Florida averaging 9.6 million pounds of meat per year for over a decade, and harvests that exceeded one million pounds in North Carolina there are no current harvests. Concentrations of scallops have been observed in the Cape Canaveral beds and off Cape San Blas in recent years, but not harvested.

The NCDMF has managed the calico scallop fishery by proclamation since 1974. North Carolina Fisheries Rules state that it is unlawful to land or possess aboard a vessel, calico scallops except at such times as designated by the Fisheries Director by proclamation (15A NCAC 3K .0504). The seasons varied through time based on the availability of calico scallops. Generally, calico scallop season opened in early spring and closed when catches became low. The last opening in North Carolina was in February of 2001 because of some scattered reports of available calicos. However, no landings were made in 2001. Presently, trawlers heading north out of Beaufort Inlet to participate in the summer flounder fishery will sometimes make a tow over the traditional beds to ascertain if commercial quantities of calico scallops exist (David Taylor, NCDMF, personal communication).

Table 4.1-25. Commercial landings and ex-vessel value from North Carolina (NCDMF Trip Ticket Program) and Florida calico scallop fishery.

YEAR	Pounds of Meat	Value $	Pounds of Meat	Value $
1952			275	
1953			3,742	861

1954			184	
1958			248,000	
1959	6,572	$2,629	15,400	
1960	111,726	$44,691		
1961	22,427	$8,971	3,648	1,459
1962			16,453	5,169
1963			176	39
1965	871,100	$244,709		
1966	1,856,760	$368,685		
1967	1,388,606	$308,843	20,736	7,672
1968			29,916	12.787
1969			196,724	179,473
1970	1,574,087	$498,570	195,764	195,764
1971	1,285,304	$432,025	288,575	370,299
1972	1,050,320	$492,899	302,767	407,030
1973	556,315	$353,757	1,624	2,055
1974			1,074,354	587,799
1975			1,882,239	1,249,510
1976			2,268,802	1,621,977
1977			113,244	837,170
1978			477,813	751,912
1979	43,301	$80,973	1,257,292	1,710,469
1980			2,582,471	3,619,497
1981	244,324	$307,215	15,170,881	14,277,460
1982			10,841,988	11,276,834
1983	101,977	$178,476	9,351,781	11,666,133
1984	1,184	$888	42,700,000	23,485,000
1985			11,500,000	18,170,000
1986			1,565,784	2,974,990
1987			10,936,384	21,982,131
1988	668,064	$702,134	12,410,456	22,338,820
1989	335,521	$469,164	6,981,704	11,938,713
1990	384,783	$530,590	874,376	820,165
1991			39,000	38,220
1992			205,111	174,906
1993	2,912	$3,640	5,306,545	4,439,34
1994			6,879,061	3,898,733
1995			949,805	625,912
1997			1,714,849	1,749,365
1998			2,396,511	2,065,041
1999			3,593,596	3,448,072
2000			1,740,000	482,069
2001			314,372	387,802
2002			42,232	63,020
2003			61,704	80,215
2004			0	0
2005			0	0

The intermittent fishery for calico scallops results from the unpredictable nature of scallop stocks. Naturally occurring fluctuations in stocks are attributed to natural mortality, migration, and poor larval recruitment. In addition, stocks may have been depleted by overfishing which

stemmed from the introduction of the scallop shucking and eviscerating machines (Schwartz and Porter 1977; NCDMF 1989)

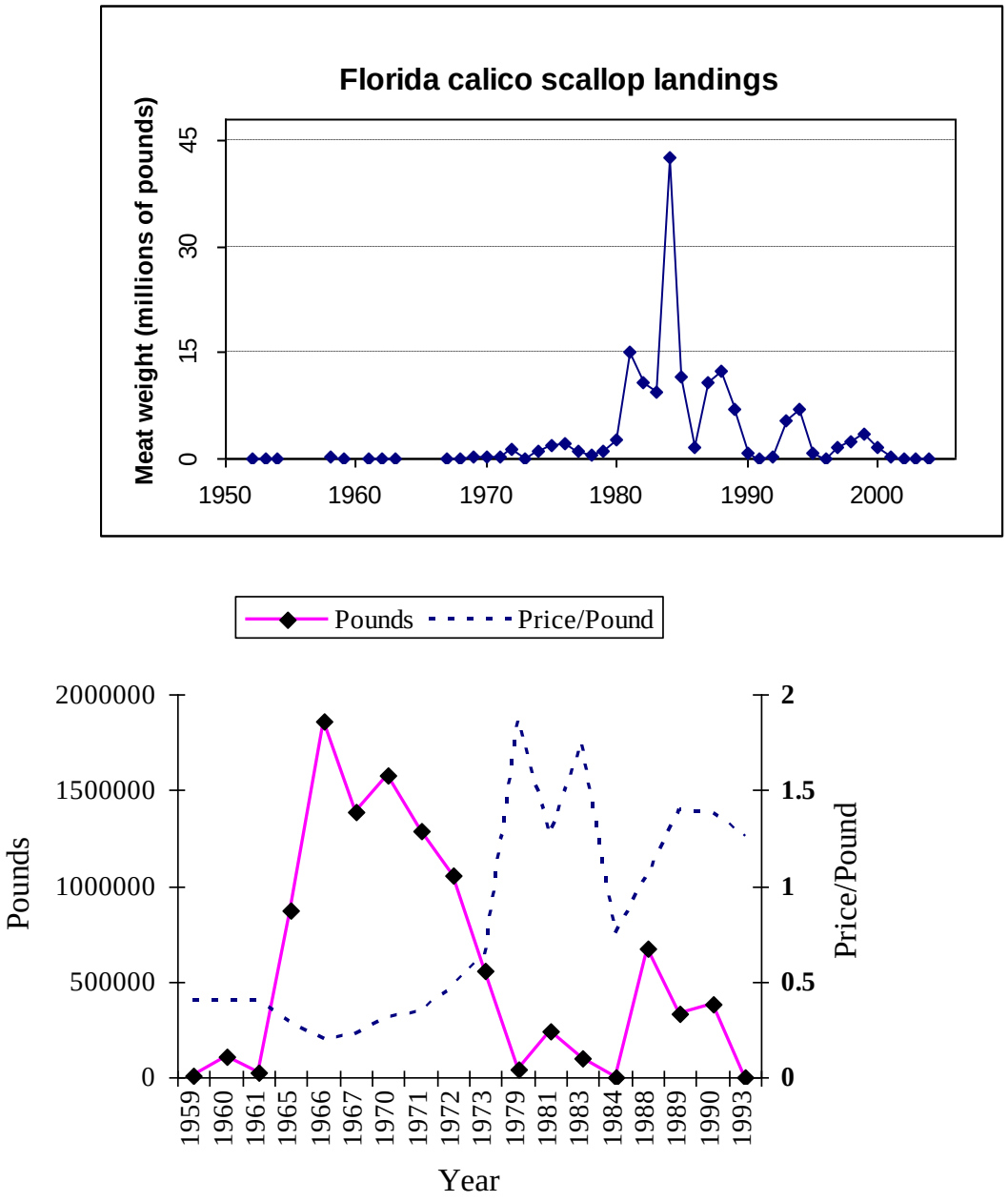

Figure 4.1-27. Ex-vessel value and price per pound for calico scallops (Schwartz and Porter 1977; NCDMF Trip Ticket Program).

The NCDMF has been involved in calico scallop monitoring since 1968 when monitoring was carried out on the R/V *Dan Moore* from 1968-1981. The last survey made by NCDMF was in November of 1988 on the scallop grounds east and west of Cape Lookout Shoals using a 3.7 m

scallop trawl (Stephan 1989). Scallops consisting of two cohorts were found on the eastern side of the Cape only. The smaller size cohort consisted of shell heights of less than 46 mm and made up 43% of the total number of scallops. The larger cohort consisted of scallops whose shell height ranged from 48 mm to 64 mm (Figure 7).

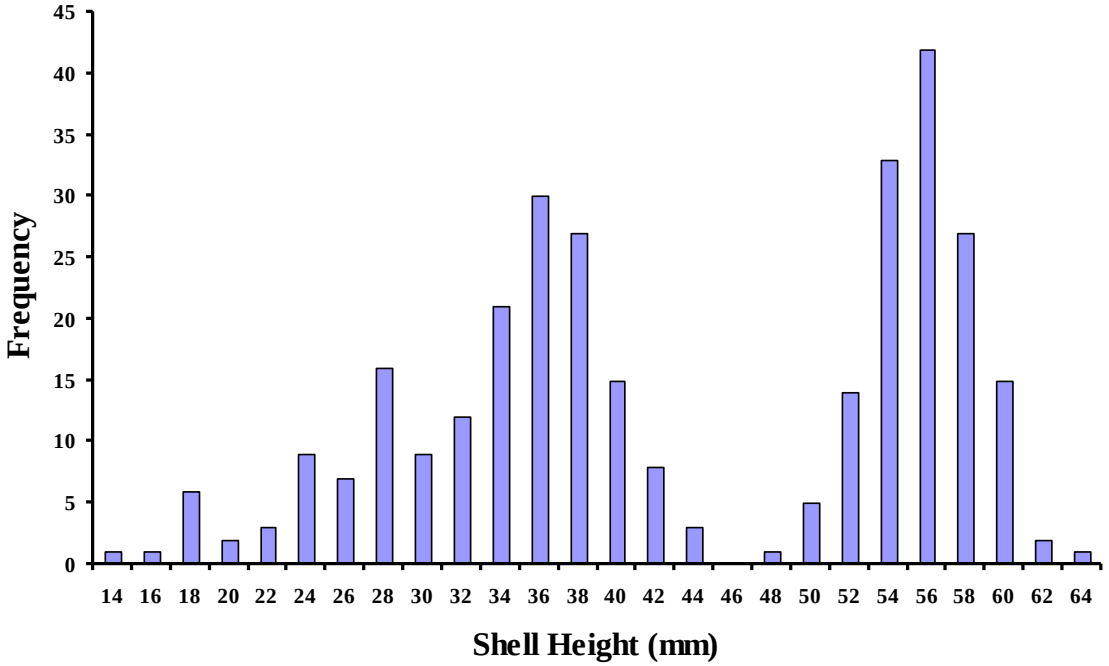

Figure 4.1-28. Shell height frequency for calico scallops collected November 1988 (From Stephan 1989).