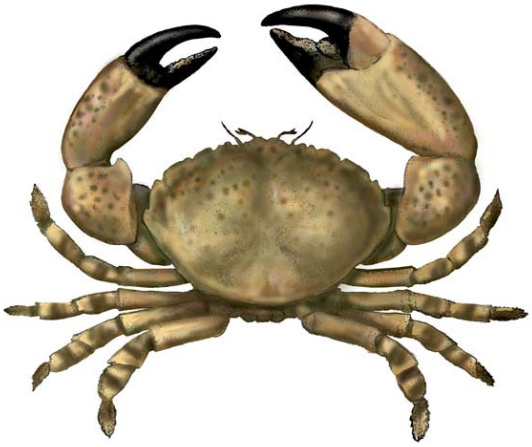
Seafood Watch

Seafood Report

MONTEREY BAY AQUARIUM®

Stone Crab

Menippe mercenaria
Menippe adina



Courtesy of Florida Department of Agriculture

U.S. Atlantic and Gulf of Mexico

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About Seafood Watch® and the Seafood Reports

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as species, whether fished or farmed, that can exist into the long-term by maintaining or increasing stock abundance and conserving the structure, function, biodiversity and productivity of the surrounding ecosystem. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from the web (www.montereybayaquarium.org) or obtained from the program by emailing seafoodwatch@mbayaq.org. The program's goals are to raise awareness of important ocean conservation issues and to shift the buying habits of consumers, restaurateurs and other seafood purveyors to support sustainable fishing and aquaculture practices.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices", "Proceed with Caution" or "Avoid". In producing the Seafood Reports, Seafood Watch seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch Fishery Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch program at Monterey Bay Aquarium by calling 831-647-6873 or sending an email to seafoodwatch@mbayaq.org.

Disclaimer

Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fishery science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Introduction to Series on Crabs:

This is Volume III in a series of seafood reports covering the crabs most frequently found in United States markets and restaurants.

Volume Index:

I Blue Crab *(Callinectes sapidus)*
II Dungeness Crab *(Cancer magister)*
III Stone Crab *(Menippe mercenaria; M. adina)*
IV King Crabs *(Paralithodes camtschaticus; P. platypus; Lithodes aequispinus; L. couesi)*
V Snow Crabs *(Chionoecetes spp.)*
VI Jonah Crab *(Cancer borealis)*

General Crab Biology

Crabs belong to the order Decapoda, a crustacean order which also includes the lobsters, shrimps, and hermit crabs. All decapods possess a full carapace or head shield, and, eponomously, five pairs of walking legs[1]. Their first three pairs of thoracic appendages are modified into maxillipeds, or feeding legs [1]. In crabs and lobsters, the very first pair of these feeding appendages are sizable claws that serve for defense and to grasp and manipulate food [1].

There are more than 4,500 living species of crab worldwide [2]. Many are tiny, or inhabit niches unsuited to mass harvest [2]. The "true" crabs, a group which includes the market species discussed in these reports, are distinguished from other decapods by having a greatly shortened abdomen--the part known as the "tail" in lobsters and hermit crabs. In the true crabs, the abdominal segments are greatly shortened and tucked under the carapace. This characteristic earns the true crabs their sub-order name of Brachyura, or "short-tailed" crabs [2].

As arthropods, all crabs have a chitinous exoskeleton, which must be shed repeatedly as the animal grows. The hormonal control of shell-shedding is one of the most intricate physiological processes known to marine science [2]. Among the true crabs, females can mate only immediately after they have shed their old shell, while their new exoskeleton is still soft [2].

The sexes are separate in crabs. After mating, females store sperm until conditions are right for egg-laying. The female retains the fertilized eggs on her abdomen for weeks or months until they hatch [2]. Females bearing fertilized eggs are called "sponge crabs".

Executive Summary:

Two closely related species, *Menippe mercenaria* and *M. adina*, are harvested as "stone crab". Both are native to the south Atlantic coast of North America and reach their greatest abundance in the Gulf of Mexico off southwest Florida. Approximately 98% of the catch is landed in Florida. The stone crab fishery harvests only the large, meaty claws of the crabs; legal-sized claws are removed from each trapped crab, and the animal is released alive. Stone crabs can regenerate their claws up to four times, and about 10% of crab claws seen in Florida packing houses are regrown. Stone crabs are fecund, spawning up to 13 times per year. Current management regulations (minimum claw size) allow each female one or two breeding seasons before entering the fishery. As a result, stocks are reproducing at a very favorable ratio (70% of their unfished rate). Bycatch is very low in this trap fishery, and habitat damage (small-sized traps on soft substrate) is minimal. The fishery has produces stable landings at or around the approximate BMSY of 3-3.5 million pounds of claws per year since the mid-1980s. NMFS considers the stocks “not overfished” with “no overfishing occurring”. However, the fishery is considered overcapitalized. Catch per unit effort, as measured by number of traps and number of fishing trips, has declined exponentially since the 1960s. Management, which has proven very effective and progressive in maintaining stock abundance, is now tackling the issue of overcaptalization. Managers and fishermen have collaborated to create new licensing and trap limits that will gradually decrease fishing effort over the next 30 years.

List of Five Component Ranks	Conservation Concern			
	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks	√			
Bycatch	√			
Habitat Effects	√			
Management Effectiveness	√			

Overall Seafood Rank:
Best Choices

Seafood Watch is indebted to the outside experts who graciously volunteered their time to review the facts presented in this report for completeness and scientific accuracy: Dr. Theresa Bert, Florida Fish and Wildlife Conservation Commission, Dr. Steve Vanderkooy, Florida Fish and Wildlife Conservation Commission; Dr. Virginia Vail, Florida Fish and Wildlife Conservation Commission; and an anonymous reviewer with the Louisiana Department of Wildlife and Fish.

It is important to note that scientific review does not constitute an endorsement of Seafood Watch on the part of the reviewing scientists; the Seafood Watch staff is solely responsible for the conclusions reached in this report.

Distribution and Habitat:
Two closely related species, *Menippe mercenaria* and *M. adina*, are harvested as "stone crabs"; they take their common name from their hard, stony shells. *M. adina* is sometimes called the Gulf stone crab or Western Gulf stone crab [42]. Both species are native to North America's warm Atlantic region and reach their greatest abundance off southwest Florida. *M. mercenaria* is found in south Florida, from approximately Cape Canaveral in the Atlantic to Tampa Bay [27, 32]. *M. adina* ranges from west of Cape San Blas, Florida to northern Mexico [38,39,41]. Between Cape San Blas and Tampa Bay, the ranges of the two species overlap and they hybridize extensively [Bert, 2004]. In that region, both pure-species and many types of hybrids occur [Bert, 2004]. In the Atlantic, north of Cape Canaveral, the population is composed of *M. mercenaria* and hybrids that are predominantly *M. mercenaria* but also carry some *M. adina* genes [Bert, 2004; 28,32]. All stone crabs inhabit relatively sheltered nearshore ecosystems, but the habitats occupied by *M. mercenaria* and *M. adina* differ somewhat. *M. mercenaria* is common in seagrass flats and rocky outcrops in the higher-salinity areas of bays and from nearshore to the shallow continental shelf. *M. adina* can tolerate somewhat lower salinities and is found in coastal and shallow offshore waters and in bays from low-salinity areas to ocean waters [Bert, 2004]. *M. mercenaria* and *M. adina* occupy similar habitats, except that *M. adina* is found in oyster bars, while *M. mercenaria* does not utilize that habitat [Bert, 2004; 22; 23; 28,33]. Juveniles hide under rocks and shell fragments and may live in sponges and on other benthic organisms [23], [31, 32]; adults dig burrows 12-20 inches deep in soft substrates [23], [27]. Stone crab productivity is considered to be dependent on the maintenance of coastal nursery grounds, including seagrass beds and mangrove forests [27,31].

Life History:
Stone crabs begin life as fertilized eggs, carried under the mother's abdomen until they hatch [28,33]. In south Florida, egg-bearing females are found year-round [27;31;Bert, 2004], but in more northerly regions, egg bearing occurs only in the warmer months of the year. As in other crab species, the female must shed her shell before mating; the male does not [Lindberg]. Stone crabs seek shelter for breeding: often a burrow dug in silty or sandy substrate, particularly at the edges of seagrass beds, and sometimes an excavation in a rocky crevice [Lindberg]. Mating takes place in the burrow [Lindberg]. Male stone crabs practice a form of mate guarding [40]. The male escorts the female for up to 12 hours before she sheds, protects the soft-shelled female during the 6-8 hour mating period, and guards the burrow for several days after mating, until the female's shell hardens [Lindberg]. This offers protection to the female, and also helps ensure that no other males will mate with her [Lindberg].

From each mating, the female typically spawns several times---at least three or four egg masses [Lindberg], with the maximum recorded being thirteen [Bert, 2004]. Eggs are extruded onto the female's abdominal flap and carried and aerated by the female [Bert et al, 1986]. Nine to 14 days after fertilization [28,33], the eggs hatch into pelagic larvae that resemble shrimp more closely than adult crabs [2]. Stone crab larvae thrive best at temperatures from 28° to 30° C and at relatively high salinities of >30 parts per thousand [29]. The larvae undergo a series of five molts before manifesting the characteristic short-tailed form of a juvenile crab and settling out of the plankton [29], a process that, in the laboratory, takes place about 30 days after hatching [47]. The time from hatching to settlement can, however, vary considerably based on temperature, salinity and other factors [47].

Adult stone crabs can tolerate a wide range of temperatures and have been caught in waters ranging from 8° (*M. adina* only) to 33° C (both species)[26; Bert, 2004]]. However, they are killed by long exposure to low-salinity water, and are most abundant in water approaching the salinity of seawater [30; Bert, 2004].

Stone crabs play an important role in Gulf ecosystems as both predators and prey. The planktonic larvae are food for filter-feeding fish [30], while juveniles are eaten by grouper, black sea bass, and larger crabs [26, 27, 30]. Adults fall prey only to octopus [Bert, 2004]. The crabs themselves are opportunistic carnivores, hunting and scavenging molluscs, crustaceans, flatworms, and occasional vegetable matter [41]. With their strong claws and heavy shells, stone crabs can crack such tough-shelled prey as clams, hermit crabs and oysters [44]. In some areas, stone crabs (principally *M. adina*) are major predators upon young Atlantic oysters [44, 45; Bert, 2004].

The stone crab fisher depends on the ability of crabs to regenerate a lost limb. In this unique fishery, only the large, meaty claws are landed. Legal-sized claws—usually just one, but occasionally both large front claws [Bert, 2004]--are removed from each trapped crab, and the animal is released alive. If carefully treated, adult stone crabs can regenerate their claws three or four times [23]. Between 20 and 25% of legal-sized crabs are regenerating a claw at any given time [47], and between 3% and 8% of stone crabs regrow a claw large enough to be harvested a second time [24]. About 10% of crab claws seen by fisheries inspectors in Florida processing plants are regenerated [24]. However, regeneration is not a matter of course. It depends partly upon the skill of the fisherman, who must separate the claw from the crab's body at the proper joint. If the joint is pierced or snapped quickly enough, the crab's own defense reflex contracts its muscles and sheds the claw cleanly [16].

Male stone crabs grow bigger than females. Males develop legal-size claws and enter the fishery at a smaller carapace width than females [31, 35]. Since males have larger claws, males enter the fishery earlier, and the majority of claws are taken from males [24]. Females are believed to have spawned at least once before their claws reach legal size (Muller and Bert, 1997, as cited in [24]). Exact age at sexual maturity is difficult to determine, as crab growth and maturity is influenced greatly by temperature, food availability, and claw loss [24]. There are no specific data available on age-related size in stone crabs; males and females appear to have different growth rates both as juveniles and as adults [43]. But a clue comes from the Florida's Tampa Bay juvenile crab monitoring project. There is good correlation between the catch rate of newly-settled juveniles and the catch rate of legal-sized crabs three years later [24]. Some juveniles reach legal size 27 months after settlement; these are presumed to be the faster-growing males [24]. Another wave of juveniles reach legal size 38 months after settlement; these are presumed to be the females [24]. As many egg-bearing females are less than legal size, it is presumed that each female breeds for one or two years before entering the fishery [24]. If females reach legal size at 38 months, and breed for 12 to 24 months before that, then females reach breeding maturity at 14-26 months after settlement (or about 16-28 months after hatching). Males presumably mature earlier. About 50% of male M. *adina* reach sexual maturity at a carapace width of 71 mm [43]. Males are believed to live to about 6 years old and females to 7 years [31, 35].

Where there ranges overlap, including the Big Bend region of Florida, *M. mercenaria* and *M. adina* are known to hybridize [27, 31]. Hybrids are taken in the fishery as readily as the parent species [27,31].

Statement on the Availability of Science:
Most data on stone crabs is fishery-dependent. Florida's Fish and Game Conservation Commission (FFGCC) conduct regular landings surveys and surveys at crab-packing houses [24]. Commercial and recreational effort is monitored via trip tickets and trap tags [24]. Some fishery-independent data are also available, notably an annual survey of juvenile crab abundance in Tampa Bay [24].

Fecundity of stone crabs is relatively high. Female *M. mercenaria* produce 160,000 to 1,000,000 eggs per spawning event [28, 33].

For *M. mercenaria*, both instantaneous and natural mortality rates are thought to be high. The total annual mortality rate *Z* is estimated to be 1.47 for males of greater than 118 mm carapace width and 0.7 for females of greater than 104 mm ([pink]-13,33). Mortality rates for *M. adina* are unquantified, but are considered by some NMFS managers to be too high to sustain the population at maximum yield [37].

Based on landings, which, despite increasing fishing effort, have been relatively steady since the 1980s [24], managers consider the Florida fishery to have a "probable" maximum sustainable yield (MSY) of 3-3.5 million pounds of claws per year. Managers note that the fishery is difficult to quantify, because each crab may supply more than one claw over several years [24]. However, managers consider the stocks very stable, as it is operating at an SPR (spawning potential ratio) of greater than 70% [24], meaning that actual egg production is 70% of what would be expected in an unfished population [8]. This is largely due to the fact that the minimum claw size regulation lets female stone crabs spawn one or two years before their claws are large enough to harvest [24].

Market Information:

Market Names:
Stone crab, Gulf stone crab, Florida stone crab

Product Forms:
Claws only, fresh-cooked or cooked and frozen [16]; [46]. Claws are graded according to size, as jumbo, large, medium and small [24]. Crab claws are cooked at the docks where the crab is landed; the rust-colored raw claws are immersed in boiling water, emerging ten minutes later bright red [16]. The cooked claws are chilled immediately over ice. Stone crab claws are usually served cold, as the flavor is considered better [16].

Seasonal Availability:
Fresh-cooked claws are available October through May [16]. Frozen claws are available year-round [46].

Import and Export Sources and Statistics:
Stone crab is an entirely domestic fishery; stone crab imports are so minor as to be unreported by the U.S. Department of Commerce [19]. In 2002, stone crab claws retail at $12 to $21 per pound, depending upon size and seasonal availability [16].

Consumption Information and Trends:
Originally marketed almost entirely to local consumers in the immediate fishing area, the stone crab market expanded in the 1980s, and today the market has broadened to include seafood restaurants, hotels, coastal supermarkets, and specialty food stores [24]. Although many Gulf fish purveyors now offer shipment [23], availability outside the Southeast and Gulf regions is very limited. Compared to blue, snow, king and Dungeness crabs, stone crab is a minor market species. Snow crab consumption is lumped with other minor species into the 34,361,000 pounds of "other crab" consumed in the U.S. in 2000 [14]. NMFS market statistics for the domestic fishery follow. It may be assumed that all stone crab marketed in the U.S. is consumed in the U.S.

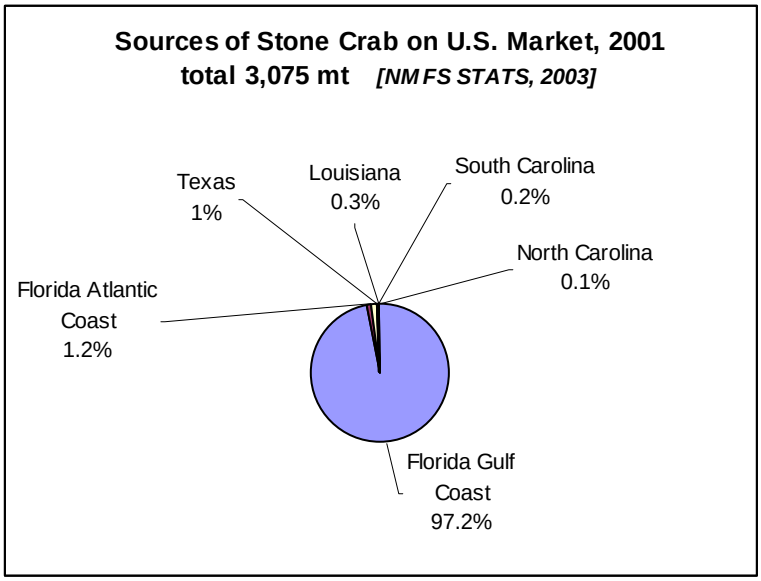
Table 1: Latest available NMFS Market Data for Stone Crab, 1990-2001 (Source: NMFS Stats, 2003)

Year	Metric Tons (mt)	Million Pounds	Market Value, million U.S. dollars
1990	2,905	6.4	$16.3
1991	2,880	6.3	$12.7
1992	3,073	6.8	$16.3
1993	2,994	6.6	$11.8
1994	3,070	6.8	$12.7
1995	2,796	6.1	$19.2
1996	3,029	6.7	$21.6
1997	2,992	6.6	$7.5
1998	3,209	7.1	$23.3
1999	2,511	5.5	$23.5
2000	3,132	6.9	$28.9
2001	3,075	6.8	$20.8

Fishery Information:

Fishery Range and Distribution:
Commercial fisheries for stone crab occur along the Gulf coast from Texas to Florida [22] and, to a very small extent, up the Atlantic coast to North Carolina [18]. Florida's west coast (Gulf coast) supports by far the largest fishery [23]; [21]. Virtually all commercially-harvested stone crab is landed in Florida ports, principally in southwestern Florida [21] but extending up to Wakulla County in the Florida Panhandle [Vail, 2004]. Stone crab was originally taken as bycatch in the Florida Keys spiny lobster fishery [24]. However, markets developed during the 1970s and 1980s, and, since 1992, stone crab has been Florida's third-most-valuable fishery, surpassed in economic importance only by shrimp and spiny lobster [24].

In 2001, the last year for which figures are complete [18], 97.2% (2,991.8 mt) of stone crab was landed along Florida's Gulf coast. In second place, Florida's Atlantic coast supplied just 1.2% (35.0 mt) . Texas landed about 1% (27.7 mt), while Louisiana landed 0.3% (12.0 mt); South Carolina landed about 0.2% (6.3 mt); and North Carolina landed about .1% (2.5 mt) [18].



Florida Fishery
Stone crabs are taken both state-regulated waters (shore to 3 miles) and in federally-controlled waters (3 miles-200 miles). As might be expected with a nearshore species, state waters supply most of the catch. According to statistics from the Florida Fish and Wildlife Conservation Commission (FFWCC), in the years 1994-2000, at least half of the annual catch was taken in state waters (see Figure 1), notably the area bordering Monroe County [24]. The most productive fishery occurs in the Florida Everglades/Florida Bay region ([pink]-3,13). However, with increasing numbers of traps, a greater and greater percentage of the fishery is taken in deeper waters further offshore [24]. Figure 1 shows the growing proportion of stone crab catch taken in federal waters [24].

Fishing Methods:
Stone crabs are captured in traps, traditionally baited with mullet or other small fish [16] but now usually with pigs' feet [24]. Most commercial fishermen string together "lines" of up to several hundred individual traps [16] and re-bait traps every other day [23]. Recreational fishing for stone crabs is

usually conducted with traps [12], but recreational fishers are also permitted to harvest crabs by hand [13].

There has been some concern about bycatch of finfish in stone crab trap fishery [8]. New trap designs introduced in 1999 are intended to minimize this problem [8], and, as traps are checked frequently, managers do not consider bycatch mortality a major problem [24]. Currently, bycatch is not a significant issue, as most of the unintended catch is undersized or egg-bearing crabs, which are released alive (and without being de-clawed) [24]. All stone crab traps must have a biodegradable panel to minimize "ghost fishing" from lost traps [24]. Stone crabs are themselves taken incidentally in Gulf blue crab and spiny lobster trap fisheries; Florida permits lobster and blue-crab fishermen to purchase an endorsement and legally market this stone crab [24]. Traps can damage seafloor habitat, especially live coral and manatee grass beds [24], although stone crab traps are small and do less damage than other kinds of traps used in Gulf fisheries [24].Excessive numbers of buoys and ropes have been know to impede navigation, interfere with shrimp trawling, and increase problems with shoreline debris as lost ropes and buoys wash ashore (particularly after hurricanes) [24].

With any trap fishery, there is concern about “ghost fishing” by lost traps. Florida has a program in place for removal of lost stone crab gear [VanderKooy, 2004].

Fishing Effort and Trends:
The majority of commercial harvest comes from Florida [23];[24], where commercial harvest has been level at something between 3 and 3.5 million pounds of claws per year [24]. In 1999 (the last year for which figures are confirmed), combined landings from state and federal waters totaled about 3.9 million pounds [24]. Based on steady landings, Florida managers consider the fishery to have a “probable” maximum sustainable yield (MSY) of 3-3.5 million pounds per year [24].

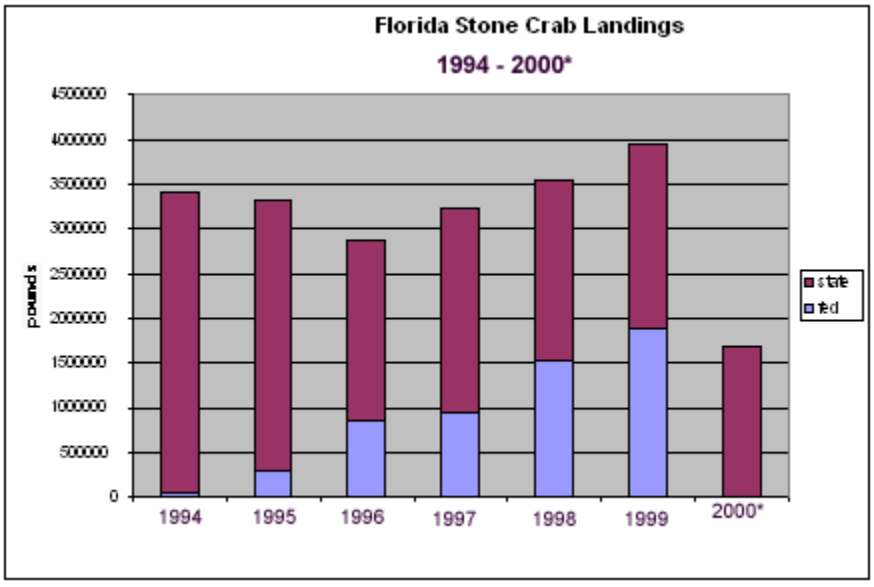


Figure 1. Florida stone crab landings from state and federal waters, 1993 (year 1) to 1999 (year 6). Source: Florida FGCC, as published in Stone Crab FMP Appendix 7. * For 2000 (year 7), federal data were not available at the time of publication.

Since 1962, Florida has kept records on stone crab effort, as measured by the number of traps, number of fishing boats, and number of fishermen involved in the fishery. When these data are paired with stone crab landings, a trend is seen (Figure 1). Effort has increased exponentially, from about 14,000 traps in 1962 to more than 900,000 in 1994 [24]. However, since the early 1980s, catches been level at roughly 3.5 million pounds per year [24]. Average pounds per trap (a measure of catch per unit effort, or CPUE)

show an exponential decline (Figure 2). Managers consider the fishery overcapitalized [24] and are currently taking steps to reduce fishing capacity [24].

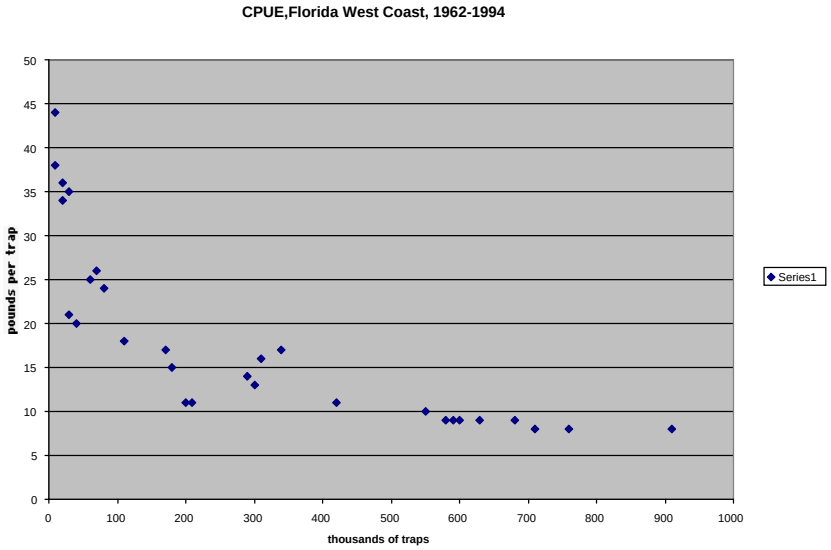


Figure 2: Declining CPUE in Florida's West Coast stone crab fishery, 1962-94. Source: Florida FGCC, as published in Stone Crab FMP Appendix 7.

Interviews with 239 Florida crab fishers found that stone crab fishing is significantly related to blue crab fishing in the upper-west portions of the coast and to spiny lobster fishing along the southern coast [15]. In other words, many trap fishermen take part in more than one fishery. Many trap fishermen target spiny lobster for part of the year, stone crab the rest [24]. Up to 73% of Florida spiny lobster fishermen also fish for stone crabs [24]. Under Florida law, blue crab and spiny lobster fishers can apply for an incidental take endorsement allowing them to market stone crabs taken in their traps [24].

Management:

Stone crabs are managed by NMFS' Tampa-based Gulf of Mexico Fishery Management Council (GMFMC), which covers the fisheries of Texas, Louisiana, Mississippi, Alabama and the west coast of Florida [20]. Fisheries in federal waters are regulated under the Fishery Management Plan for the Stone Crab Fishery of the Gulf of Mexico (commonly referred to as the Stone Crab FMP). First approved in 1979 ([pink]-5), the seventh iteration of this FMP was published in February 2001 [24] and was submitted to NMFS for final approval in April 2002 [6]. This plan was up for public comment until June 17, 2002 [6].

General management measures in place for all Gulf stone crab fisheries include:
- Limited entry (state waters)
- Permit requirement (federal waters)
- Claw size limits
- Protections for egg-bearing females
- Fishing seasons
- Gear restrictions

Management of the Florida commercial fishery

Management measures in place for Florida's commercial stone crab fishery include [24]:
Limited entry
Minimum claw size of 2 3/4 inches [23]
No claws taken from egg-bearing females (since 1986)

Crabs to be returned to sea immediately after claw removal, or kept wet and cool until release (since 1986)
Illegal to land whole stone crabs alive or dead [16]
Fishing season (October 15-May 15)
Gear restrictions
Trip tickets required for each load of crab claws sold

As noted above, managers consider the fishery seriously overcapitalized [24]. Under the Stone Crab FMP, there has been a moratorium on new federal stone crab licenses since 1995 [9]. Since 1995, commercial stone crab licenses have been limited to individuals making $5000 (or 25% of their income) from fishing. This limited-entry program was developed with the support of two major fishing-industry groups, Organized Fishermen of Florida [15];[24] and Monroe County Commercial Fishermen, Inc. [24]. Commercial fishermen may set traps ten days before the fishing season opens [16]. No more than 400 traps are permitted on a single line [16]. Since 1991, the FMP has included provisions relating to the Magnuson-Stevens Fisheries Conservation Act; these include adding a scientifically measurable definition of overfishing, designating critical habitat, and having an action plan to halt overfishing if it should occur [24].

The Florida Fish and Wildlife Conservation Commission regulates stone crab fisheries in state waters, out to three miles offshore. Commercial crab fishers are required to hold a state “endorsement”, or license [10]. To reduce overcapitalization, a moratorium on new endorsements has been repeatedly re-authorized since 1995 [24]. The latest version of the endorsement moratorium expires July 1, 2002 [11]. A three-phase trap limitation program is also now in place [5]. Designed to gradually reduce overcapitalization over the next 30 years, this trap limitation program was developed in cooperation with Florida fishermen; it purpose is to reduce fishing effort without putting existing professional fishermen out of business. The first phase, approved in 2000, limited 2001/2002 stone crab endorsements to individuals landing at least 300 pounds of crab claws in the qualifying years 1994/95, 1995/96, 1996/97 or 1997/98. The second phase, in place for the 2001/2002 season, allowed fishermen with a valid endorsement to fish as many traps as they requested; requested traps were issued tags at a cost of 50 cents each [5]. The third and final phase of the trap limitation program will begin with the 2002/2003 fishing season. From then on, fishermen will be allowed to fish only the number of traps for which they have tags [5].

In order to coordinate management and take an ecosystem approach to reducing overcapacity, NMFS now proposes to extend Florida’s trap-limitation program into federal waters. This would be accomplished by an amendment to the federal Stone Crab FMP [3]. In 2000, this proposed amendment was reviewed and approved by the Gulf of Mexico Fisheries Management Council’s Stone Crab Advisory Panel [3] and its Standing and Special Stone Crab Scientific and Statistical Committees [4]. This amendment would allow holders of a Florida endorsement to fish in federal waters without any additional federal permits [7,6]. NMFS is currently reviewing the amendment; public comment is being accepted until August 9, 2002 [7].

Regulations for Florida recreational fishers are similar to commercial regulations, except that there is a five-trap maximum for recreational fishers and a bag limit of 1 gallon of claws per person or 2 gallons per vessel. Recreational fishers must pull their traps by hand; any vessel using a mechanical trap puller is considered a commercial fishing boat [12].

The stone crab fishery practices a unique form of harvest. Claws are removed from each trapped crab, and the animal is released alive. Usually, one claw is taken from each crab, but if both claws are legal

sized, both may be removed [24]. This method was conceived by fishermen in the 1960s and 70s as a way to sustain the breeding population. However, in 1979, Davis et al. reported high mortality among declawed crabs [24]. Experiments showed a mortality rate of 28% among crabs which had had one claw removed and 46.5% among those which lost both claws [47]. Fisheries regulations were subsequently changed to enhance survival by forbidding the harvest of egg-bearing females and requiring that crabs be kept cool and moist if held on board before claw removal [24]. Fishing seasons were established to close the fishery during summer, the peak spawning season [24]. Currently, fishing is only allowed October 15-May 15 [24].

With any trap fishery, there is concern about "ghost fishing" by lost traps. Florida has a program in place for removal of lost stone crab gear [VanderKooy, 2004].

Monitoring/Enforcement:

State authorities monitor the stone crab fishery via dockside inspections, at-sea checks of traps and buoys, and collection of trip tickets from wholesale fish dealers [24]. There is little trouble reported with enforcement in recent years [24]. At once time, however, there was serious conflict between the stone crab fishery and the Gulf shrimp trawl fishery operating in federal waters off southwest Florida. In the 1970s, as the stone crab fishery expanded, trawlers were becoming entangled in crab trap lines. The situation escalated to armed conflict [24]. The first Stone Crab FMP, implemented in 1979, was created to address these gear conflicts [24]; [21], and the first two amendments to this plan specified fishing zones for crabbers and shrimpers (1982) and extended the gear-conflict resolution process to central-west Florida (1984) [24].

In 2000, Florida's FWC took action to strengthen penalties for crab-trap theft and to establish rules for identification tags on all crab traps [10]. However, fishermen will not be required to tag their traps until October, 2002 [11].

Status of the Stocks:

NMFs identifies U.S. stone crab stocks as "not overfished" with "no overfishing occurring" [NMFS 2002 Report to Congress, 2003]. As with other crustacean stocks, stone crab abundance is highly variable and appears to fluctuate cyclically, with years of peak abundance followed by years of declining abundance before the trend reverses [24]. However, allowing for this, managers consider the Gulf stone crab population to be relatively stable, neither increasing nor substantially decreasing [24]. Based on steady landings, managers consider the Florida fishery to have a "probable" maximum sustainable yield (MSY) of 3-3.5 million pounds of claws per year. Managers note that the fishery is difficult to quantify, because each crab may supply more than one claw over several years [24]. However, managers consider the stocks very stable, as it is operating at an SPR (spawning potential ratio) of greater than 70% [24], meaning that actual egg production is 70% of what would be expected in an unfished population [8]. This is largely due to the fact that the minimum claw size regulation lets female stone crabs spawn one or two years before their claws are large enough to harvest [24].

However, based on declining catch per unit effort, NMFS and state managers agree that the Florida fishery is overcapitalized. Fishing effort is measured either by number of traps or number of commercial trips. Catch per trip has been declining since 1993, while the number of traps has increased [24]. Based on these measures of effort, managers conclude that the fishery is either operating at its maximum (traps) or slightly past its maximum (trips) [24]. The stocks are not yet considered overfished [17], but state and federal managers are engaged in ongoing, cooperative projects to reduce fishing effort [24]. The latest (2001) iteration of the Stone Crab FMP outlines trap limits and new-license moratoria designed to gradually reduce fishing capacity over the next 30 years [24].

Analysis of Criteria: Stone Crabs

Criterion 1: Inherent Vulnerability to Fishing Pressure

Primary Factors to evaluate
Low-- Probably 16-28 months after hatching.

Maximum age
Low (6 to 7 years)

Is maximum age validated?
Yes, from lab studies

Reproductive potential (fecundity)
High (e.g. prolific egg layer or broadcast spawner)

Additional Factors to evaluate
Species range
Limited (e. g. species exists in one ocean basin—Gulf of Mexico)

Evidence of special behaviors that increase ease, or population consequences, of capture (e.g. spawning aggregations, site fidelity, segregation by sex, unusual attraction to gear, etc.)No

Evidence of high population variability driven by physical environmental change (e.g. El Nino, Decadal Oscillations)
Yes
Like other crustaceans, larval survival is highly dependent on oceanographic conditions.

Synthesis, analysis and evaluation of relevant factors

Inherent Vulnerability Rank
Conservation Concern Low

Criterion 2: Status of Wild Stocks

NMFs identifies U.S. stone crab stocks as "not overfished" with "no overfishing occurring" [NMFS 2002 Report to Congress, 2003]. In this claws-only fishery, crabs are released alive. While claw harvest causes injury to the crab and depresses its subsequent growth and reproduction, minimum claw size regulations allow females at least one or two spawning seasons before their claws are legal to harvest. Stocks are hard for managers to quantify, but are thought to be at about 70% of unfished biomass. Landings have been stable since the 1980s, at an annual level close to the MSY of 3-3.5 million pounds of claws per year. However, the fishery is considered overcapitalized: effort has increased significantly since the 1980s, but total catches have stayed level, and, therefore, CPUE has decreased significantly.

Primary Factors to evaluate

Classification status

Fully fished

Current population abundance relative to BMSY

BMSY is not defined but estimated at 3.0-3.5 million pounds of claws per year. Landings have been at the level of 3.0-3.5 million pounds of claws per year since the mid-1980s. Stocks are at 70% of unfished biomass

Long term (greater than 10 years) trend in population abundance as measured by fishery independent means (i.e. stock assessment)

Short term (less than 5 – 10 years) trend in population abundance as measured by fishery independent means (i.e. stock assessment)

Stocks have been stable for more than 20 years around relatively high abundance

Long term (greater than 10 years) trend in population abundance as estimated from catch per unit effort (CPUE)

Short term (less than 5 – 10 years) trend in population abundance as estimated from catch per unit effort (CPUE)

Both long and short-term trends in CPUE are down. However, catches have remained stable, and the decline in CPUE is due to an increase in effort---far more traps in the fishery . Trap reduction programs are now in place.

Occurrence of overfishing (current level of fishing mortality relative to overfishing threshold)

Overfishing not occurring (mortality is substantially below threshold)

Current age, size or sex distribution of the stock relative to natural condition

Distribution(s) is(are) functionally normal

Overall degree of uncertainty in status of stock

Low (e.g. Current stock assessment and other fishery independent data are robust OR reliable long-term fishery dependent data available)

Synthesis, analysis and evaluation of relevant factors

Status of the Stocks Rank

Conservation Concern Low

Criterion 3: Nature and Extent of Bycatch

Bycatch is very low in this trap-only fishery. (Even the stone crabs are released alive!)

Primary Factors to evaluate:
Composition of the bycatch, including any species of "special concern" (i.e. those identified as "endangered", "threatened" or "protected" under state, federal or international law)
Bycatch includes a low diversity of organisms (e.g. a single or only a few species), none of which are of "special concern"

Population consequences of bycatch
Low: Quantity of bycatch is thought to have little or no impact on population levels

For bycatch species of similar or lower trophic level (relative to the targeted species): Quantity of bycatch relative to the quantity of targeted landings

Not Applicable

Short and long-term trend in quantity and composition of bycatch as a result of management decisions (including gear innovations):
not applicable because bycatch is low

Additional Factor to evaluate
No evidence to date

Synthesis, analysis and evaluation of relevant factors

Nature and Extent of Bycatch Rank
Conservation Concern Low

Criterion 4: **Effect of Fishing Practices on Habitats and Ecosystems**

Habitat impact is low to moderate in this trap fishery. Stone crab traps are smaller—and therefore do less habitat damage---than other kinds of traps used in Gulf fisheries [24].

Primary habitat factors to evaluate:
Areal extent of cumulative fishing gear effects:
Medium area (e.g. footprint of dredge, gill nets or pots)

Effect of fishing gear on physical and biogenic habitats (known for specific fishery or inferred from other studies)
Minimal damage

Resilience of physical and biogenic habitats to disturbance by fishing method:
Moderate (e.g. mud and sand bottoms)

Primary ecosystem factors to evaluate:
Evidence that the removal of targeted species has or will likely substantially disrupt the food web
No evidence to date

Evidence that the fishing method has caused or is likely to cause ecosystem state changes, including alternate stable states or regime shifts.
No evidence to date

Synthesis, analysis and evaluation of relevant factors

Effect of Fishing Practices Rank

Conservation Concern Low

Criterion 5: Effectiveness of the Management Regime

Management has been proactive and effective. Stocks have been kept steady at a high level of abundance since the mid-1980s. Current management action is focused on reducing overcapitalization in the fishery through trap limitation programs.

Primary Factors to evaluate

Stock Status: Management implements a stock assessment that seeks scientific knowledge related to the short and long-term status of the stock

Stock assessment complete

Scientific Monitoring: Management regularly collects data and analyzes it with respect to stock abundance

Regular collection and assessment of both fishery dependent and independent data

Scientific Advice: Does management ignore advice from its scientific advisors?

Rarely or never

Bycatch: Management implements an effective bycatch reduction plan

Bycatch plan in place and reaching its conservation goals (deemed effective) OR no bycatch plan needed because bycatch is "low"

Fishing practices: Management addresses the effect of the fishing method(s) on habitats and ecosystems:

no measures needed because fishing method is deemed to be "benign"

Enforcement: Management and appropriate government bodies enforce fishery regulations

Regulations regularly enforced by independent bodies, including logbook reports, sufficient observer coverage and dockside monitoring

Management Track Record: Conservation measures enacted by management have resulted in the long-term maintenance of stock abundance and ecosystem integrity

Management has maintained stock productivity and limited ecosystem change

Synthesis, analysis and evaluation of relevant factors

Effectiveness of Management Rank

Conservation Concern Low

Overall Evaluation and Seafood Ranking

Stone Crabs

Two closely related species, *Menippe mercenaria* and *M. adina*, are harvested as "stone crab". Both are native to the south Atlantic coast of North America and reach their greatest abundance in the Gulf of Mexico off southwest Florida. Approximately 98% of the catch is landed in Florida. The stone crab fishery harvests only the large, meaty claws of the crabs; legal-sized claws are removed from each trapped crab, and the animal is released alive. Stone crabs can regenerate their claws up to four times, and about 10% of crab claws seen in Florida packing houses are regrown. Stone crabs are fecund, spawning up to 13 times per year. Current management regulations (minimum claw size) allow each female one or two breeding seasons before entering the fishery. As a result, stocks are reproducing at a very favorable ratio (70% of their unfished rate). Bycatch is very low in this trap fishery, and habitat damage (small-sized traps on soft substrate) is minimal. The fishery has produces stable landings at or around the approximate BMSY of 3-3.5 million pounds of claws per year since the mid-1980s. NMFS considers the stocks “not overfished” with “no overfishing occurring”. However, the fishery is considered overcapitalized. Catch per unit effort, as measured by number of traps and number of fishing trips, has declined exponentially since the 1960s. Management, which has proven very effective and progressive in maintaining stock abundance, is now tackling the issue of overcaptalization. Managers and fishermen have collaborated to create new licensing and trap limits that will gradually decrease fishing effort over the next 30 years.

List of Five Component Ranks	Conservation Concern			
	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks	√			
Bycatch	√			
Habitat Effects	√			
Management Effectiveness	√			

Overall Seafood Rank:
Best Choices

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