

# Monterey Bay Aquarium Seafood Watch®

## Stone Crab

*Menippe mercenaria, Menippe adina*



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## U.S. Atlantic and Gulf of Mexico Trap

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### **Disclaimer**

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## Final Seafood Recommendation

Stock	Fishery	Impacts on the Stock Rank (Score)	Impacts on other Species Lowest scoring species Rank*, Subscore, Score	Management Rank Score	Habitat and Ecosystem Rank Score	Overall Recommendation Score
Stone crab	Trap	Yellow 3.05	No other main species caught Green, 5,5	Yellow 3	Yellow 2.74	<b>BEST CHOICE</b> 3.35

**Scoring note** – Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact. Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

▲ **Best Choice** = Final Score between 3.2 and 5, **and** no Red Criteria, **and** no Critical scores

▬ **Good Alternative** = Final score between 2.2 and 3.199, **and** Management is not Red, **and** no more than one Red Criterion other than Management, **and** no Critical scores

▬ **Avoid** = Final Score between 0 and 2.199, **or** Management is Red, **or** two or more Red Criteria, **or** one or more Critical scores.

## **Executive Summary**

This report discusses the stone crab (*Menippe mercenaria*, *M. adina*, and hybrids of the two species) fishery using crab pots in the U.S. Atlantic and Gulf of Mexico. Although stone crabs occur along the entire southeastern U.S. coast from North Carolina through Texas, over 98% of stone crabs are landed in Florida. Because of the limited fishery outside of Florida and the fact that other states have modeled their fishery regulations on Florida's, this report focuses on the Florida fishery.

Stone crabs are a fast-maturing species with high fecundity, and females enter the fishery after they have reproduced at least once. Fishery landings fluctuate among years but have remained relatively stable over the past several decades, indicating that the stock status is somewhat stable. The unique regulations of the fishery make accurate fishing mortality estimates difficult; crabs are returned to the water alive after having one or both claws removed, and post-declawing mortality estimates range from 19% to 100%, based on a wide range of factors.

The vast majority of incidental catch in the stone crab fishery consists of undersized stone crabs, which are returned alive to the sea. Blue crabs (*Callinectes sapidus*) and spiny lobsters (*Panulirus argus*) are rarely caught as incidental catch, and these species will be landed if the season is open and the individuals are legal-sized. Landings of these species in the stone crab fishery are negligible. Though traps occasionally capture small fishes or benthic invertebrates such as sand dollars or molluscs, all incidental catch is returned alive to the ocean and is expected to survive, so Seafood Watch does not consider this fishery to have any retained or bycatch stocks other than the targeted stone crabs. Additionally, stone crab fishermen use waste products from slaughterhouses (such as pig's feet) or fish houses (such as fish heads) as bait in their traps. A limited number of fishermen use whole gutted mullet purchased from fish houses as bait, but the areas with the most stone crab fishing use primarily pig's feet.

The stone crab fishery has unique regulations that result in the survival of some small fraction of the catch. Stone crabs are caught in traps and returned to the water alive after fishermen remove one or both legal-sized claws. Additional regulations include a prohibition on taking claws from egg-bearing females, a five-month seasonal closure, and an effort reduction program that aims to reduce fishery effort over a 30-year period. The Florida Fish and Wildlife Conservation Commission regulates the resource and conducts population surveys through its research organization, the Fish and Wildlife Research Institute. Management incorporates some scientific advice and there are extensive efforts to include stakeholders in management decision processes, including the formation of an effort reduction advisory board composed exclusively of commercial fishermen.

The stone crab fishery uses traps set on soft substrates such as mud and sand, as well as biogenic sea grass habitats, so the impact on the seafloor is a moderate conservation concern. The fishery has moderate mitigation measures that include a seasonal closure for five months of the year and an effort reduction program, whereby the number of traps in the fishery will be steadily reduced over a period of thirty years. There are currently no efforts underway to

determine the ecosystem-wide impact of the fishery, but stone crabs are not a species of concern and no exceptional species are caught in the fishery.

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## **Introduction**

### **Scope of the analysis and ensuing recommendation**

This report discusses the stone crab (*Menippe mercenaria*, *M. adina*, and hybrids of the two species) fishery using crab pots in the U.S. Atlantic and Gulf of Mexico. Although stone crabs occur along the entire southeastern U.S. coast from North Carolina through Texas, over 98% of stone crabs are landed in Florida (Fluech 2010a). Because of the limited fishery outside of Florida and the fact that other states have modeled their fishery regulations on Florida's (Fishwatch 2012), this report focuses on the Florida fishery.

### **Overview of the species and management bodies**

Stone crabs occur from approximately North Carolina to Panama, including the entire Gulf of Mexico, the Bahamas, and the Greater Antilles (FFWCC 2010). Two species occur in U.S. waters: *Menippe mercenaria* primarily occurs along the Atlantic coast and southwest coast of Florida, while *M. adina* occurs from Florida's west coast through Texas (Fluech 2010b). Both species are caught by the fishery and are fast-maturing crabs with high fecundity.

The state of Florida has managed stone crabs in its waters since 1929, and a Fishery Management Plan (FMP) for the Gulf of Mexico stock was implemented in 1979 to manage the fishery. Because most commercially caught stone crabs are landed in Florida state waters, however, the FMP was redundant with existing state regulations and was repealed in 2011 (FFWCC 2011a). The Florida Fish and Wildlife Conservation Commission currently manages the stone crab fishery in Florida, including vessels using the limited fishing grounds outside state waters.

### **Production statistics**

Nearly all commercially landed stone crabs are landed in Florida, and almost all of Florida's catch occurs along the Gulf coast (FFWCC2010; Figure 1). Overall landings fluctuate among years (FFWCC 2010; Figure 2), and catch per unit effort has declined dramatically since the 1980s as the number of traps has increased exponentially.

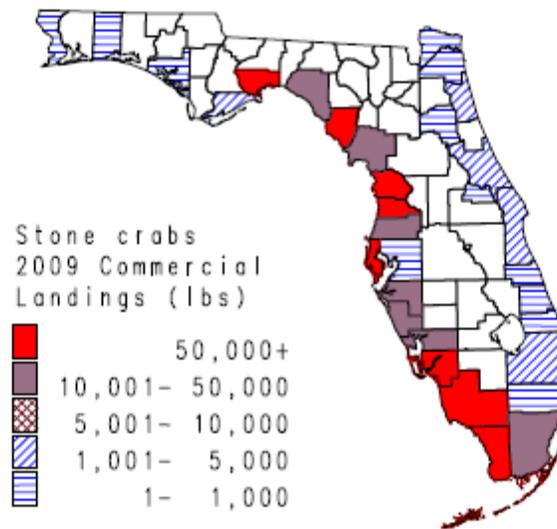


Figure 1: Distribution of commercial stone crab landings by county in Florida in 2009 (Figure from FFWCC 2010).

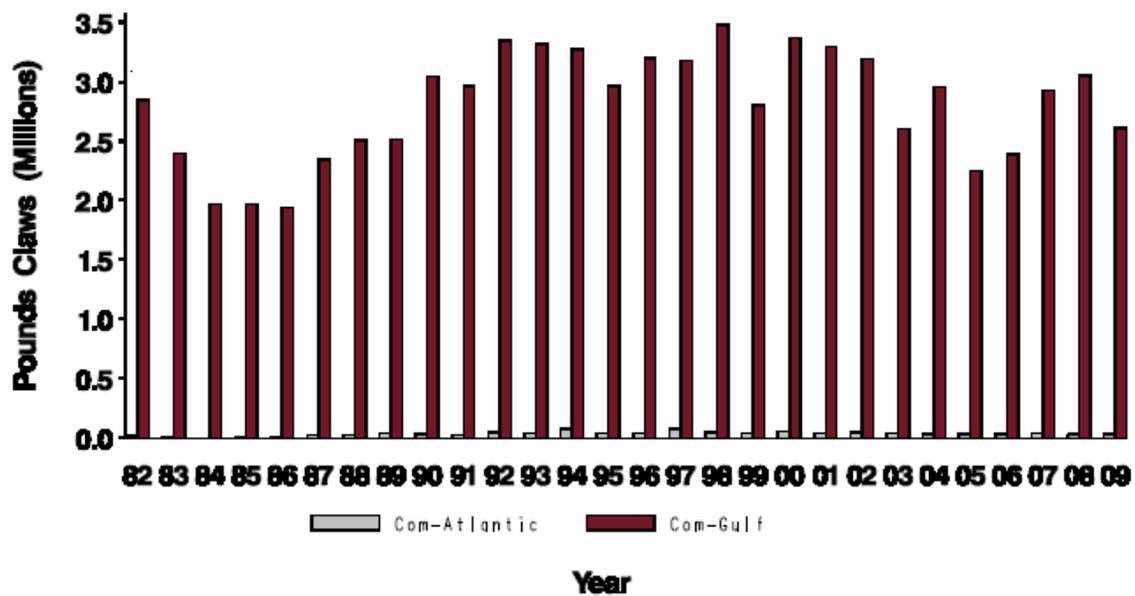


Figure 2: Total annual commercial landings of stone crab claws along the Atlantic and Gulf of Mexico coasts of Florida from 1982-2009 (Figure from FFWCC 2010).

**Importance to the US/North American market**

Stone crab has limited availability outside of the southeastern U.S. and Gulf coast and is considered a minor species in the national crab market. However, it is an important species locally in regions where it is caught, particularly Florida. All stone crab sold in the U.S. is caught here, and there is a negligible export market to Asia for the species.

**Common and market names**

Gulf stone crab, Florida stone crab, kani (cooked crab sushi, although stone crabs are rarely used in this type of sushi, particularly outside of Florida).

**Primary product forms**

Claws, either fresh-cooked or frozen. The fishery is unique in that the only landings are claws removed from live crabs at sea (Fishwatch 2012).

## Analysis

### Scoring guide

- All scores result in a zero to five final score for the criterion and the overall final rank. A zero score indicates poor performance, while a score of five indicates high performance.
- The full Seafood Watch Fisheries Criteria that the following scores relate to are available on our website at [www.seafoodwatch.org](http://www.seafoodwatch.org).

### Criterion 1: Stock for which you want a recommendation

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown. The final Criterion 1 Score is determined by taking the geometric mean of the abundance and fishing mortality scores.*

Stock	Fishery	Inherent Vulnerability Rank	Stock Status Rank (Score)	Fishing Mortality Rank (Score)	Criterion 1 Rank Score
Stone crab	Trap	Low	Low Concern (4)	Moderate Concern (2.33)	Yellow 3.05

Stone crabs are a fast-maturing species with high fecundity, and females enter the fishery after they have reproduced at least once. Fishery landings fluctuate among years but have remained relatively stable over the past several decades, indicating that the stock status is somewhat stable. The unique regulations of the fishery make accurate fishing mortality estimates difficult; crabs are returned to the water alive after having one or both claws removed, and post-declawing mortality estimates range from 19% to 100%, based on a wide range of factors.

### Justification of Ranking

#### Factor 1.1 - Inherent Vulnerability to Fishing

- Low = FishBase vulnerability score for species 0-35 OR species exhibits life history characteristics that make it resilient to fishing, e.g., early maturing (<5 years), short lived (< 10 years), small maximum size, and low on food chain.
- Medium = FishBase vulnerability score for species 36-55 OR life history characteristics that make it neither particularly vulnerable or resilient to fishing, e.g. moderate age at sexual

maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain.

- High = FishBase vulnerability score for species 56-100 OR life history characteristics that make is particularly vulnerable to fishing, e.g. long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator.

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g. schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

**Key relevant information: Low Vulnerability**

Stone crabs have 'low' inherent vulnerability based on the Seafood Watch invertebrate vulnerability rubric (SFW criteria document, pg. 4).

Detailed rationale

**Table 1: Results from Seafood Watch invertebrate vulnerability rubric (SFW criteria document, pg. 4):**

Vulnerability attribute	Category	Score
Average age at maturity	< 5 years	3
Average maximum age	< 10 years	3
Fecundity	N/A	N/A
Reproductive strategy	Demersal egg brooder	2
Density dependence	No depensatory or compensatory dynamics demonstrated or likely	2
	Average score	2.5

Seafood watch deems species with average attribute scores between 2.46 and 3 to have 'low vulnerability.'

**Factor 1.2 - Abundance**

- 5 (Very Low Concern) = Strong evidence that population is above target abundance level (e.g. biomass at maximum sustainable yield, BMSY) or near virgin biomass
- 4 (Low Concern) = Population may be below target abundance level, but it is considered not overfished.

- 3 (Moderate Concern) = Abundance level is unknown and species has a low or medium inherent vulnerability to fishing
- 2 (High Concern) = Population is overfished, depleted, or a species of concern OR Abundance is unknown and species has a high inherent vulnerability to fishing.
- 1 (Very High Concern) = Population is listed as threatened or endangered.

**Key relevant information: Low Concern**

Stone crabs are not classified as overfished (NOAA Fisheries 2012). Stock assessments have been conducted although coverage could be improved and data are limited (Muller et al. 2011). Additionally, there is an absence of biological reference points, leading to uncertainty in the status of the stock.

**Detailed rationale:**

Past assessments of the stone crab fishery have concluded that the resource is not overfished, even in the face of dramatic increases in the number of traps used in the fishery, though there is evidence that the fishery is being recruitment-harvested and fished at a maximum level (Bert 1992, Muller et al. 2006, Muller et al. 2011).

**Factor 1.3 - Fishing Mortality**

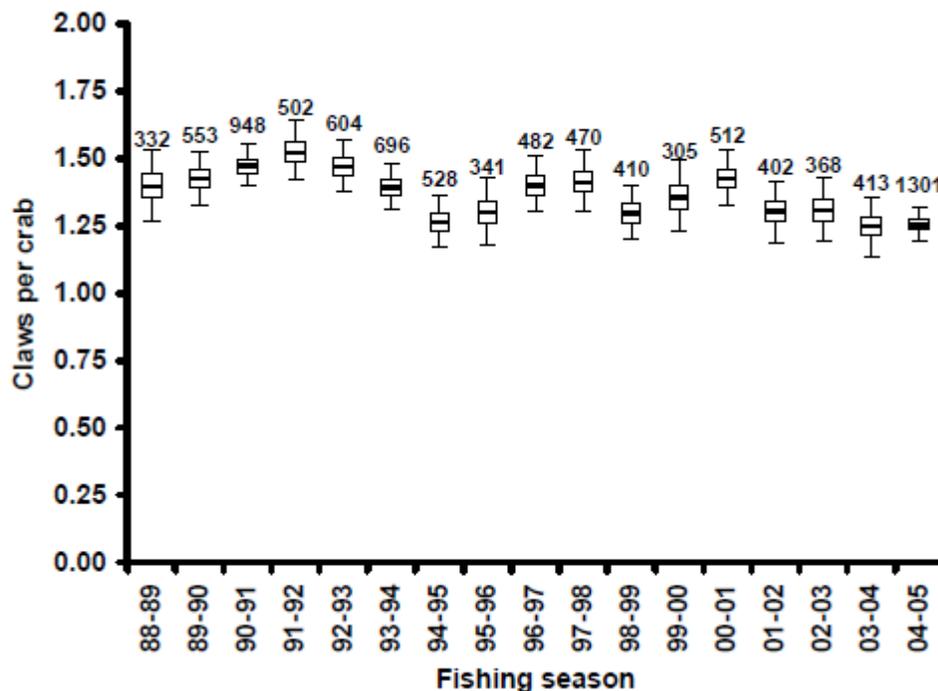
- 5 (Very Low Concern) = Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY) OR fishery does not target species and its contribution to the mortality of species is negligible ( $\leq 5\%$  of a sustainable level of fishing mortality)
- 3.67 (Low Concern) = Probable ( $>50\%$  chance) that fishing mortality is at or below a sustainable level, but some uncertainty OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught)
- 2.33 (Moderate Concern) = Fishing mortality is fluctuating around sustainable levels OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery, and if species is depleted, reasonable management is in place.
- 1 (High Concern) = Overfishing is occurring, but management is in place to curtail overfishing OR fishing mortality is unknown, species is depleted and no management is in place
- 0 (Critical) = Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.

**Key relevant information: Moderate Concern**

The stone crab fishery releases crabs back to the water alive, so in theory there is no actual fishing mortality. In practice, however, there is likely some mortality when correctly removing one claw (19-28% mortality; Davis et al. 1978, Simonson and Hochberg 1986), and higher mortality if both claws are removed, if claws are removed incorrectly, or if crabs are exposed to air for long periods (up to 100% mortality under the most extreme situations; Davis et al. 1978, Simonson and Hochberg 1986). Additionally, these mortality estimates represent controlled studies where crabs were fed and free from predation risk, so actual mortality in the field is likely higher. The maintenance of landings over the past decades (FFWCC 2010, Figure 2), even in the face of increasing numbers of traps, does give some indication that fishing mortality is not having a strong effect on population recruitment. However, the considerable uncertainty surrounding the survival of declawed crabs after they are released to the water leads Seafood Watch to deem fishing mortality as a ‘moderate concern.’

**Detailed rationale:**

The number of claws per crab found in fishery-independent population surveys find the average number of legal-sized claws per crab to be around 1.5 (Muller et al. 2006; Figure 3). This indicates that around half of the current population of stone crabs has either never been fished or has been fished and fully regenerated its claws, while the other half has survived being declawed but has not yet regenerated the fished claws.



**Figure 3: Average number of claws per crab in fishery-independent surveys in Tampa Bay (1988-2005) and Florida Keys (2005 only). The number above the plot is the number of traps surveyed (Figure from Muller et al. 2006).**

## **Criterion 2: Impacts on other retained and bycatch stocks**

All retained and primary bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch.

Stock	Inherent Vulnerability Rank	Stock Status Rank (Score)	Fishing Mortality Rank (Score)	Subscore	Score (subscore* discard modifier)	Rank (based on subscore)
Stone crab	Low	Low Concern (4)	Moderate Concern (2.33)	3.05	3.05	Yellow
No other main species caught	#N/A	#N/A	#N/A	5.00	5.00	Green

The vast majority of incidental catch in the stone crab fishery consists of undersized stone crabs, which are returned alive to the sea (Theresa Bert, pers. comm.). Blue crabs (*Callinectes sapidus*) and spiny lobsters (*Panulirus argus*) are rarely caught as incidental catch, and these species will be landed if the season is open and the individuals are legal-sized. Landings of these species in the stone crab fishery are negligible (Theresa Bert, pers. comm.). Though traps occasionally capture small fishes or benthic invertebrates such as sand dollars or molluscs, all incidental catch is returned alive to the ocean and is expected to survive, so Seafood Watch does not consider this fishery to have any retained or bycatch stocks other than the targeted stone crabs. Additionally, stone crab fishermen use waste products from slaughterhouses (such as pig's feet) or fish houses (such as fish heads) as bait in their traps (Theresa Bert, pers. comm.). A limited number of fishermen use whole gutted mullet purchased from fish houses as bait, but the areas with the most stone crab fishing use primarily pig's feet.

### **Justification of Ranking**

Only species that scored 'red' are included here. All other species evaluations are in Appendix 1. See criterion 1 for scoring definitions.

### **Criterion 3: Management effectiveness**

*Management is separated into management of retained species and management of non-retained species/bycatch. The final score for this criterion is the geometric mean of the two scores.*

<b>Fishery</b>	<b>Management: Harvest Strategy</b> Rank (Score)	<b>Management: Bycatch</b> Rank (Score)	<b>Criterion 3</b> Rank Score
Trap	Moderate Concern (3)	All species retained (N/A)	Yellow 3

The stone crab fishery has unique regulations that result in the survival of some small fraction of the catch. Stone crabs are caught in traps and returned to the water alive after fishermen remove one or both legal-sized claws. Additional regulations include a prohibition on taking claws from egg-bearing females, a five-month seasonal closure, and an effort reduction program that aims to reduce fishery effort over a 30-year period. The Florida Fish and Wildlife Conservation Commission regulates the resource and conducts population surveys through its research organization, the Fish and Wildlife Research Institute. Management incorporates some scientific advice and there are extensive efforts to include stakeholders in management decision processes, including the formation of an effort reduction advisory board composed exclusively of commercial fishermen.

#### **Justification of Ranking**

##### **Factor 3.1: Management of Fishing Impacts on Retained Species**

*Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective', 'moderately effective', or 'highly effective'.*

- 5 (Very Low Concern) = Rated as 'highly effective' for all seven subfactors considered
- 4 (Low Concern) = Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective'.
- 3 (Moderate Concern) = All subfactors rated at least 'moderately effective'.

- 2 (High Concern) = At minimum meets standards for ‘moderately effective’ for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated ‘ineffective’.
- 1 (Very High Concern) = Management exists, but Management Strategy and/or Recovery of Species of Concern rated ‘ineffective’
- 0 (Critical) = No management exists when a clear need for management exists (i.e., fishery catches threatened, endangered, or high concern species) OR there is a high level of Illegal, Unregulated, and Unreported Fishing occurring.

Key relevant information:

Overall, the stone crab fishery is a moderately well-managed fishery and is ranked as ‘Highly Effective’ or “Moderately Effective” in all management categories. The fishery could complete more extensive and regular population surveys, increase its adherence to scientific advice, particularly regarding the effects of removing both claws from a crab, and have a more active trap reduction program.

**Subfactor 3.1.1 - Management Strategy and Implementation**

*Considerations: What type of management measures are in place, are there appropriate management goals, and is there evidence that management goals are being met. To achieve a highly effective rating, there must be appropriate management goals and evidence that the measures in place have been successful at maintaining/rebuilding species.*

*Management Strategy and Implementation: Moderately Effective*

Stone crabs are managed by the Florida Fish and Wildlife Conservation Commission (FFWCC) in state waters and in federal waters adjacent to state waters where stone crab fishing takes place (FFWCC 2011a). A federal Fishery Management Plan for stone crabs was repealed effective July 1, 2011 due to redundancies in the management of the resource between state and federal agencies (FFWCC 2011b).

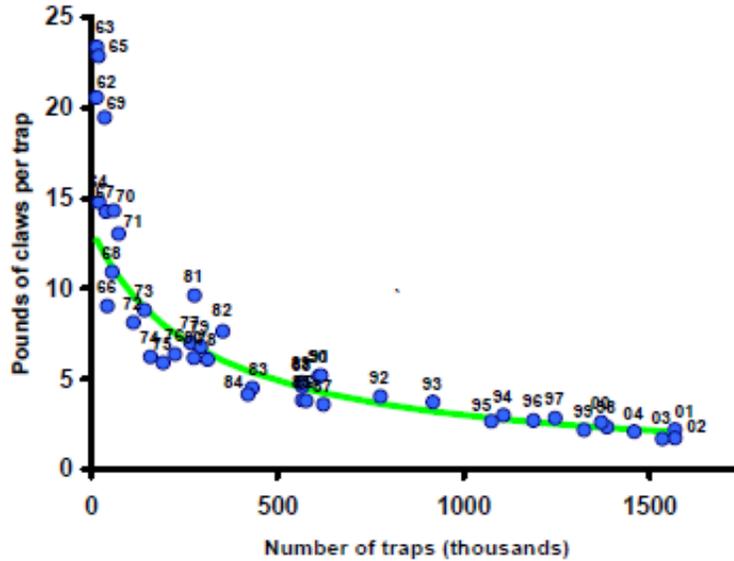
The stone crab fishery is unique in that only the claws are harvested (claw legal size: 2  $\frac{3}{4}$  inches), and the crab is returned to the water alive (FFWCC 2012a). If fishermen accurately detach a claw, the crab can regenerate the claw and thus be harvested again in the future (Savage and Sullivan 1978). However, some percentage of claws are pulled from the body with muscle tissue attached, thus permanently disfiguring the crab, eliminating its ability to regenerate the claw, and leading to higher mortality (Davis et al. 1978, Simonson and Hochberg 1986).

Fishermen are allowed to remove both claws from a crab if they are of legal size, but the FFWCC discourages the practice because clawless crabs take longer to regenerate their claws and likely experience higher mortality after release (Simonson and Hochberg 1986, FFWCC

2012a). Though few fully declawed crabs are found in fishery-independent sampling programs (Muller et al. 2006), this does not necessarily indicate that fishermen do not remove both claws. Instead, this could be the result of high mortality of crabs that have had both claws harvested, or the result of many crabs having only one claw large enough to harvest (T. Bert, pers. comm.). Claw regeneration in stone crabs can be accurately assessed due to differences in ridge patterns between original claws and regenerated claws, and researchers have found that from 1-19% of claws landed are regenerated claws (Savage et al. 1975, Erhardt and Restrepo 1989, Muller and Bert 2001). It is estimated that females will have reproduced at least once before entering the fishery, though males likely do not reproduce until after entering the fishery (Gerhart and Bert 2008). There are concerns that the removal of claws could affect the reproductive potential of stone crabs due to reduced ability to compete for females, and diversion of energy away from reproductive capacity in order to re-grow claws (Bert, pers comms 2013).

Additional fishery regulations include a seasonal closure from May 16 to October 14 each year, a ban on harvesting claws from egg-bearing females, restrictions regarding the types of traps that can be used to capture the crabs, and requirements concerning how crabs are held on vessels before declawing (FFWCC 2008, 2012a). Traps may be constructed from wood, plastic, or wire, and must have a volume of eight cubic feet or less. To reduce the capture of undersized crabs and to prevent lost traps from ghost fishing, wire traps must have escape rings and plastic traps must have biodegradable panels (FFWCC 2008). There are no bag limits, but incidental stone crab landings in other fisheries are limited to five gallons (FFWCC 2012a).

Anyone fishing for stone crabs commercially must have a Saltwater Products License, a Restricted Species Endorsement, and a Stone Crab Endorsement (FFWCC 2012a). There is a recreational fishery for stone crabs, where anyone is allowed to have five traps without a permit. Thus the magnitude of the recreational fishery is unknown. Fishing commercially, each trap must have a trap tag that corresponds to a trap certificate issued by the FFWCC. The issuance of trap certificates is part of an effort management program established in 2000 that aims to reduce the total effort in the stone crab fishery (FFWCC 2011b). By 2000, the rapidly expanding stone crab fishery had led to a declining catch per unit effort, and the high number of crab traps had created hazards to navigation and spatial conflicts with shrimp trawlers (Overbey 1992, Muller et al. 2006; Figure 4).



**Figure 4: Historical landings of stone crab claws per trap and the number of traps by fishing season. The fitted line shows the declining catch per unit effort with increasing number of traps (Figure from Muller et al. 2006).**

To control the number of traps in the fishery, the FFWCC now annually allocates certificates to commercial stone crab fishermen (Matthews and Larkin 2002). Fishermen can then either use their certificates to place traps or may sell them to another commercial fisherman. To reduce the number of traps in the fishery, each sale of certificates between fishermen involves a mandatory reduction in the number of certificates being transferred, based on how many certificates exist in the fishery. For example, if more than 1.5 million certificates exist throughout the state, then 25% of the sold certificates will be eliminated from the fishery, though only 10% of sold certificates will be eliminated from the fishery if there are between 750,000 and 600,000 certificates available in the state (FFWCC 2011b). Once the number of trap certificates declines below 600,000, no reductions will occur during sales, and the number of certificates will remain constant. However, because the trap reduction program is passive (traps are only removed when a fisherman sells his or her permits), there are still over one million traps in the fishery (T. Bert., pers. comm.), and researchers believe the fishery is still over-capitalized (Muller et al. 2011).

### **Subfactor 3.1.2 - Recovery of Species of Concern**

*Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success. To achieve a rating of highly effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.*

*Recovery of stocks of concern: N/A*

Stone crabs are not a stock of concern and the fishery does not interact with other stocks of concern, so the fishery scores an 'N/A' for this category.

### **Subfactor 3.1.3 - Scientific Research and Monitoring**

*Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species. To receive a highly effective score, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.*

#### *Scientific Research and Monitoring: Moderately Effective*

The FFWCC conducts fishery-independent monitoring through its Fish and Wildlife Research Institute (FWRI). FWRI scientists survey stone crab populations every two weeks at multiple locations in Tampa Bay (since 1988), southwest Florida (since 2005), and the Big Bend region of Florida (since 2006; FFWCC 2012b). A wide number of variables, including molt condition, size, and regeneration state of claws are recorded for each crab, and the fouled traps are surveyed for juveniles monthly. FWRI also conducts other research on stone crabs, including comparisons of the genetics and biology of the two stone crab species and their hybrids, mortality rates of declawed crabs, and effects of trap soak time on crabs (Muller et al. 2011; FFWCC 2012b). Funding for these projects has come from stone crab endorsement fees since 2004 (Muller et al. 2011).

These population surveys provide information about stone crab stock status and the future viability of the resource, and are incorporated into stock assessment reports drafted every five years (FFWCC 2012b). The most recent overall assessment of the stone crab fishery was completed in 2011 (Muller et al. 2011) and recommends a number of future research topics. The assessment authors note that there is currently no mechanism for monitoring recreational landings of stone crabs, which is a major limitation to gaining a complete picture of the stock status (Muller et al. 2011). Additional uncertainties around the stock assessments could come from the relatively small proportion of the annual catch that is sampled in surveys, and the fact that the spatial scope of the surveys could be increased. Therefore, Seafood Watch deems scientific research and monitoring for this fishery to be 'Moderately Effective.'

### **Subfactor 3.1.4 - Management Record of Following Scientific Advice**

*Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels). A highly effective rating is given if managers nearly always follow scientific advice.*

#### *Scientific Advice: Moderately Effective*

Relatively little research is conducted on stone crabs, particularly when compared to the body of work conducted on other commercially important crustaceans, such as the blue crab, *Callinectes sapidus*. The FFWCC has a direct link to stone crab research through its FWRI, which conducts some research on stone crabs and performs stock assessment surveys (FFWCC 2012b). Management generally adheres to scientific advice, such as with its trap reduction

program, but there is evidence that removing both claws from a crab decreases its survival (Davis et al. 1978), and management only suggests the removal of a single claw instead of mandating it. Therefore, Seafood Watch deems this factor to be ‘Moderately Effective.’

### **Subfactor 3.1.5 - Enforcement of Management Regulations**

*Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen’s compliance with regulations. To achieve a highly effective rating, there must be regular enforcement of regulations and verification of compliance.*

*Enforcement: Moderately Effective*

Each trap and trap float must be clearly marked with information identifying the owner, and each trap must have an associated trap certificate (FFWCC 2012a). The FFWCC operates a division of law enforcement to enforce regulations, which includes both uniformed and plainclothes investigators (FFWCC 2012c). There is no onboard observer system, but fishery-independent surveys monitor average trap landings and bycatch data (Muller et al. 2011).

### **Subfactor 3.1.6 – Management Track Record**

*Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels. A highly effective rating will be given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.*

*Track Record: Moderately Effective*

Fluctuating landings and the possibility that the resource is fished at a maximum level create some uncertainty around the effectiveness of past management strategy (FFWCC 2010, Muller et al. 2011; Figure 2). However, the FFWCC has taken some proactive steps, such as the passive trap reduction program (FFWCC 2011b), to manage the fishery in a way that limits the environmental and habitat impacts of the fishery. For this reason, Seafood Watch deems the track record ‘Moderately Effective.’

### **Subfactor 3.1.7 - Stakeholder Inclusion**

*Considerations: Are stakeholders involved/included in the decision-making process. Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g. fishermen, conservation groups, etc.). A highly effective will be given if the management process is transparent and includes stakeholder input.*

*Stakeholder inclusion: Highly Effective*

The FFWCC has an excellent record of stakeholder inclusion, with public meetings held throughout the state and posted to their website (FFWCC 2012d). Stakeholders have been particularly involved in the stone crab fishery; the July 2000 effort management program established a stone crab advisory board composed of stone crab fishermen to guide the program and make recommendations concerning its implementation (FFWCC 2011b). The

eight-member board had a series of requirements regarding its composition to ensure even representation based on geography, size of fishing operation, and communities served (at least one member was required to be of Hispanic origin and fluent in Spanish). This advisory board was dissolved on July 1, 2011 due to the fulfillment of its duties (FFWCC 2011b).

### **Factor 3.2: Management of Fishing Impacts on Bycatch Species**

*Four subfactors are evaluated: Management Strategy, Scientific Research/Monitoring, Following of Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective', 'moderately effective', or 'highly effective'. Unless reason exists to rank Scientific Research/Monitoring, Following of Scientific Advice, and Enforcement of Regulations differently, these ranks are the same as in 3.1.*

- 5 (Very Low Concern) = Rated as 'highly effective' for all four subfactors considered
- 4 (Low Concern) = Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective'.
- 3 (Moderate Concern) = All subfactors rates at least 'moderately effective'.
- 2 (High Concern) = At minimum meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective'.
- 1 (Very High Concern) = Management exists, but Management Strategy rated 'ineffective'
- 0 (Critical) = No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substantially impacted by the fishery.

#### Key relevant information:

Bycatch in stone crab pots is very low, and consists primarily of undersized stone crabs, along with some other benthic invertebrates (Theresa Bert, pers. comm.; Fishwatch 2012). Two commercially fished species (blue crabs, *Callinectes sapidus*, and spiny lobsters, *Panulirus argus*) are occasionally captured in stone crab pots and landed if their fishing seasons are open and the individuals are legal-sized, though the take of these species is negligible (Theresa Bert, pers. comm.). All other incidental catch is returned to the sea and expected to survive, so Seafood Watch deems this fishery to have insignificant bycatch.

## **Criterion 4: Impacts on the habitat and ecosystem**

*This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of Ecosystem Based Fisheries Management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the EBFM score.*

<b>Fishery</b>	<b>Impact of gear on the substrate</b> Rank (Score)	<b>Mitigation of gear impacts</b> Rank (Score)	<b>EBFM</b> Rank (Score)	<b>Criterion 4</b> Rank Score
Trap	Moderate Concern (2)	Moderate mitigation (0.5)	Moderate Concern (3)	Yellow 2.74

The stone crab fishery uses traps set on soft substrates such as mud and sand, as well as biogenic sea grass habitats, so the impact on the seafloor is a moderate conservation concern. The fishery has moderate mitigation measures that include a seasonal closure for five months of the year and an effort reduction program, whereby the number of traps in the fishery will be steadily reduced over a period of thirty years. There are currently no efforts underway to determine the ecosystem-wide impact of the fishery, but stone crabs are not a species of concern and no exceptional species are caught in the fishery.

### **Factor 4.1 – Impact of Fishing Gear on the Habitat/Substrate**

- 5 (None) = Fishing gear does not contact the bottom
- 4 (Very Low) = Vertical Line Gear
- 3 (Low) = Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom *occasionally* (<25% of the time) or purse seine known to commonly contact bottom
- 2 (Moderate) = Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand;

- 1 (High) = Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g. cobble or boulder).
- 0 (Very High) = Dredge or trawl fished on biogenic habitat, e.g. deep-sea corals, eelgrass and maerl.

*Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive plausible habitat type*

**Key relevant information: Moderate Concern**

Traps targeting stone crabs are set on soft substrates such as mud and sand, and they are also set on seagrass meadows, which are biogenic habitat. Therefore, Seafood Watch considers them to have a 'moderate' impact on the substrate (SFW Criteria Document p.21).

**Factor 4.2 - Mitigation of Gear Impacts**

- +1 (Strong Mitigation) = Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.
- +0.5 (Moderate Mitigation) = 20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.
- +0.25 (Low Mitigation) = A few measures in place, e.g., vulnerable habitats protected but other habitats not protected; some limits on fishing effort/intensity, but not actively being reduced.
- 0 (No Mitigation) = No effective measures are in place to limit gear impacts on habitats.

**Key relevant information: Moderate Mitigation**

Two measures mitigate the effect of stone crab traps on the habitat: a 5-month seasonal closure during which no traps may be placed and a trap reduction program initiated by the FFWCC. Due to the effectiveness of this program to reduce fishing intensity, Seafood Watch deems the fishery to have 'Moderate Mitigation.'

**Detailed rationale:**

The trap reduction program was initiated by the FFWCC in 2000 to reduce the total effort in the stone crab fishery, in response to a rapidly expanding fishery and declining catch per unit effort (FFWCC 2011b). Each commercial fisherman now receives an allotment of trap certificates that correspond to trap tags that must be placed on each stone crab trap. Fishermen can then either use their certificates to place traps or may sell them to another commercial fisherman. To reduce the number of traps in the fishery, each sale of certificates between fishermen involves

a mandatory reduction in the number of certificates being transferred, based on how many certificates exist in the fishery. For example, if more than 1.5 million certificates exist throughout the state, then 25% of the sold certificates will be eliminated from the fishery. If there are between 750,000 and 600,000 certificates available in the state, though, only 10% of sold certificates will be eliminated from the fishery (FFWCC 2011b). Once the number of trap certificates declines below 600,000, no reductions will occur during sales, and the number of certificates will remain constant (FFWCC 2011b). Because this program is passive, however, there are still over one million traps in the fishery and it will likely take many years to reach the reduction target (T. Bert, pers. comm.). The implementation of this program has been overseen by a special board composed of commercial fishermen.

#### **Factor 4.3 – Ecosystem-Based Fisheries Management**

- 5 (Very Low Concern) = Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g. large proportion of fishery area protected with marine reserves, abundance is maintained at sufficient levels to provide food to predators).
- 4 (Low Concern) = Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. If hatchery supplementation or fish aggregating devices (FADs) are used, measures are in place to minimize potential negative ecological effects.
- 3 (Moderate Concern) = Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species. OR negative ecological effects from hatchery supplementation or FADs are possible and management is not in place to mitigate these impacts.
- 2 (High Concern) = The fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.
- 1 (Very High Concern) = The use of hatchery supplementation or Fish Aggregating Devices (FADs) in the fishery is having serious negative ecological or genetic consequences. OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.

#### **Key relevant information: Moderate Concern**

No exceptional species are caught in the fishery. There are no efforts to fully assess the ecological impacts in the fishery. For these reasons, management of the ecosystem and food web impacts of the fishery is deemed 'Moderate.'

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## **Acknowledgements**

*Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.*

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## **Appendix A: Review Schedule**

Stock assessments for this species appear to occur every five years, and the last one was conducted in 2011. Therefore, it is likely that a new stock assessment will take place in 2016. There are currently no plans to alter the management of the fishery.

## **About Seafood Watch**

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 originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from [www.seafoodwatch.org](http://www.seafoodwatch.org). The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

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", "Good Alternatives" or "Avoid". The detailed evaluation methodology is available upon request. 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 Research 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 1-877-229-9990.

## Guiding Principles

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished<sup>1</sup> or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following **guiding principles** illustrate the qualities that capture fisheries must possess to be considered sustainable by the Seafood Watch program:

- *Stocks are healthy and abundant.*
- *Fishing mortality does not threaten populations or impede the ecological role of any marine life.*
- *The fishery minimizes bycatch.*
- *The fishery is managed to sustain long-term productivity of all impacted species.*
- *The fishery is conducted such that impacts on the seafloor are minimized and the ecological and functional roles of seafloor habitats are maintained.*
- *Fishing activities should not seriously reduce ecosystem services provided by any fished species or result in harmful changes such as trophic cascades, phase shifts, or reduction of genetic diversity.*

Based on these guiding principles, Seafood Watch has developed a set of four sustainability **criteria** to evaluate capture fisheries for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Impacts on the species/stock for which you want a recommendation
2. Impacts on other species
3. Effectiveness of management
4. Habitat and ecosystem impacts

Each criterion includes:

- Factors to evaluate and rank
- Evaluation guidelines to synthesize these factors and to produce a numerical score
- A resulting numerical score and **rank** for that criterion

Once a score and rank has been assigned to each criterion, an overall seafood recommendation is developed on additional evaluation guidelines. Criteria ranks and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide:

**Best Choices/Green:** Are well managed and caught or farmed in environmentally friendly ways.

**Good Alternatives/Yellow:** Buy, but be aware there are concerns with how they're caught or farmed.

**Avoid/Red:** Take a pass on these. These items are overfished or caught or farmed in ways that harm other marine life or the environment.

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<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates.