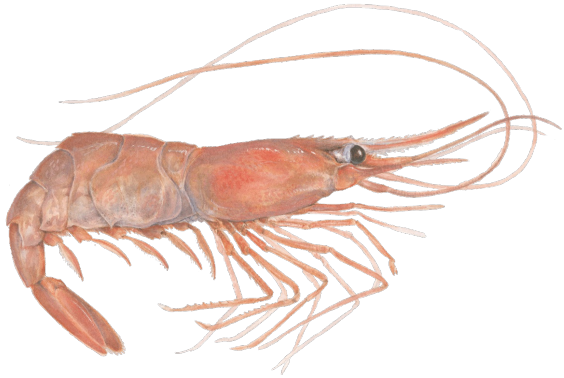
Monterey Bay Aquarium

Seafood Watch®

Warmwater Shrimp: Brown shrimp, Pink Shrimp, Rock Shrimp, Royal Red Shrimp, Seabob Shrimp, White Shrimp

Farfantepenaeus aztecus, Farfantepenaeus duorarum, Sicyonia brevirostris, Hymenopenaeusrobustus, Xiphopenaeus kroyeri, Litopenaeus setiferus



U.S. Gulf of Mexico and Western Central Atlantic Ocean

Bottom trawls, Pushed skimmer nets

October 07, 2013

Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF2

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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. 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[1] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch had developed four sustainability **criteria** for evaluating wildcatch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

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

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This Seafood Watch report update covers wild-caught shrimp species in the Gulf of Mexico and the South Atlantic regions of the United States. Shrimp is overwhelmingly caught by bottom (modified otter) trawl, although other gears such as skimmer trawls are also used to catch shrimp. U.S. wild-caught shrimp species are: brown (*Farfantapenaeus aztecus*), Atlantic white (*Litopenaeus setiferus*), pink (*Farfantepenaeus duorarum*), royal red (*Hymenopenaeus robustus*), brown rock (*Sicyonia brevirostris*), and Atlantic seabob (*Xiphopenaeus kroyeri*). Wild-caught warmwater shrimp from outside of the U.S., and farmed shrimp are covered in separate Seafood Watch reports.

While royal red shrimp can live for several years, peneaid shrimps are generally short-lived (18-24 months), highly prolific species. They are broadcast spawners that mature early (usually within 6-12 months). Brown, pink and white shrimp populations are considered healthy in both the Gulf and South Atlantic regions. The stock status for royal red and rock shrimp is less certain, and seabob is unknown.

Bycatch is a significant concern in the southeastern US shrimp fisheries. At present, incidental take of sea turtles continues to be the primary source of bycatch concern throughout shrimp fisheries. Endangered or threatened sea turtles continue to be caught by many U.S. fishing gears; of all gears in the region, shrimp trawls are responsible for the most turtle mortalities. In the United States, the use of Turtle Excluder Devices (TEDs) has been instrumental in reducing sea turtle bycatch and allowing most sea turtle populations to begin to recover. Despite the reduction in sea turtle mortalities from the use of TEDs, the fishery is still estimated to be responsible for thousands of sea turtle mortalities each year, and all sea turtle populations in the region are still listed as endangered or threatened. While the populations of most species have shown increasing trends, the Northwest Atlantic loggerhead sea turtle population is not increasing. Recent analyses indicate that cumulative fisheries mortality may still be too high for the population to recover. Aside from sea turtles, other bycatch species of particular concern include Gulf and Atlantic sturgeon, smalltooth sawfish, Gulf and Atlantic blacknose shark, and red snapper.

The primary issues for management are shrimp fishery impacts to non-retained species, or bycatch. Over the long term, management agencies have generally addressed bycatch reduction in a progressive manner, although shrimp fishery bycatch still greatly outweighs actual shrimp landings, and includes threatened and endangered sea turtles and other species of concern. Regulations that require the use of TEDs are integral to the effectiveness of bycatch management for the otter trawl fishery.

Management of bycatch in skimmer trawls, outside of the Florida fishery, is currently considered a very high concern. Skimmer trawls also interact with sea turtles, but are not required to use TEDs. A recent proposed federal rule to require TEDs in skimmer trawls was withdrawn in February 2013. Currently, the only mitigation strategy to reduce sea turtle bycatch in skimmer trawls is through limits on tow time; however, scientific review has shown these limits are not sufficient to protect sea turtles, and compliance with the tow time regulation is poor. Florida requires the use of TEDs in skimmer trawls.

U.S. shrimping takes place largely over sandy, silt, or mud bottom habitat. Otter trawls generate the vast majority of shrimp landings, especially in federal waters, and have the most bottom contact. Skimmer trawls are also commonly used in the Gulf. Overall, damage to habitat caused by the fishery is a moderate concern.

A portion of the fisheries covered in this report are engaged in a Fishery Improvement Project (FIP). Engagement in a FIP does not affect the Seafood Watch score as we base our assessments on the current situation. Monterey Bay Aquarium is a member organization of the Conservation Alliance for Seafood Solutions. The Alliance has outlined guidelines for credible Fishery Improvement Projects. As such, Seafood Watch will support procurement from fisheries engaged in a FIP provided it can be verified by a third party that the FIP meets the Alliance guidelines. It is not the responsibility of Monterey Bay Aquarium to verify the credibility or

progress of a FIP, or promote the fisheries engaged in improvement projects.

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Royal red shrimp United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**
Atlantic seabob United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**
Atlantic seabob United States of America Gulf of Mexico, Pushed skimmer nets, United States of America	Green (3.87)	Red (0.75)	Yellow (2.24)	Yellow (2.60)	**Avoid (2.03)**
Pink shrimp United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (5.00)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.36)**
Pink shrimp United States of America Gulf of Mexico, Pushed skimmer nets, United States of America	Green (5.00)	Red (0.75)	Yellow (2.24)	Yellow (2.60)	**Avoid (2.16)**
White shrimp United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (5.00)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.36)**
White shrimp United States of America Gulf of Mexico, Pushed skimmer nets, United States of America	Green (5.00)	Red (0.75)	Yellow (2.24)	Yellow (2.60)	**Avoid (2.16)**
Brown rock shrimp United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**

Royal red shrimp United States of America Atlantic, Bottom trawls, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**
Pink shrimp United States of America Atlantic, Bottom trawls, United States of America	Green (4.47)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.29)**
White shrimp United States of America Atlantic, Bottom trawls, United States of America	Green (4.47)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.29)**
Brown rock shrimp United States of America Atlantic, Bottom trawls, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**
White shrimp Florida Western Central Atlantic, Pushed skimmer nets, United States of America	Green (4.47)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.29)**
Pink shrimp Florida Western Central Atlantic, Pushed skimmer nets, United States of America	Green (4.47)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.29)**
Atlantic seabob Florida Western Central Atlantic, Pushed skimmer nets, United States of America	Green (3.87)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.21)**
Brown shrimp United States of America Atlantic, Bottom trawls, United States of America	Green (4.47)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.29)**
Brown shrimp United States of America Gulf of Mexico, Bottom trawls, United States of America	Green (5.00)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.36)**

Brown shrimp United States of America Gulf of Mexico, Pushed skimmer nets, United States of America	Green (5.00)	Red (0.75)	Yellow (2.24)	Yellow (2.60)	**Avoid (2.16)**
Brown shrimp Florida Western Central Atlantic, Pushed skimmer nets, United States of America	Green (5.00)	Red (0.75)	Yellow (3.16)	Yellow (2.60)	**Good Alternative (2.36)**

Scoring Guide

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/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern[2], and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This Seafood Watch report update covers wild-caught, warmwater shrimp species from the Gulf of Mexico or the South Atlantic regions of the United States. Shrimp is overwhelmingly caught by bottom (modified otter) trawl, although other gears such as skimmer trawls are fished for certain shrimp species in certain areas. U.S. wild-caught shrimp species are: brown (*Farfantapenaeus aztecus*), Atlantic white (*Litopenaeus setiferus*), pink (*Farfantepenaeus duorarum*), royal red (*Hymenopenaeus robustus*), rock (*Sicyonia brevirostris*), and seabob (*Xiphopenaeus kroyeri*). Wild-caught warmwater shrimp from outside of the U.S. are covered in separate reports.

Species Overview

All U.S. Gulf Coast and South Atlantic states have warmwater shrimp fisheries, with brown, white, and pink shrimp composing most of the landed volume and value in both regions. Gulf shrimp fisheries, as well as those in the Carolinas and Georgia, are centered on brown and white shrimp (NMFS 2012a). Rock shrimp is incidental catch in most of the Gulf, but a significant portion of the catch on both coasts of Florida, as is pink shrimp. Royal red shrimp is the target of small deepwater trawl fisheries in the Gulf and South Atlantic (GMFMC 1997)(Oceana 2007)(SAFMC 2009). Seabob is caught incidentally in the Gulf of Mexico, particularly in Louisiana (NMFS 2012a). More extensive fisheries for seabob exist in Honduras, Nicaragua, Costa Rica, Colombia, Brazil, and Venezuela (FAO 2003).

Brown shrimp have reddish-brown shells with dark green and red tail-fan appendages, with grooves along the upper midline of the head and the upper midline of the lower region of the abdomen (SCDNR 2007). They grow to about 9 inches in length (NCDMF 2001), and favor muddy or peaty bottoms, often with clay, sand or broken shells (FAO 2003). They concentrate in depths around 30-50 meters, although they have been found as deep as 160 meters (FAO 2003). The white shrimp is a white to greenish-gray color and distinguished by its long antennae—typically longer than its body (FAO 2003)(SCDNR 2001). It is also fairly large for a shrimp, sometimes growing to 10 inches in length (SCDNR 2001). White shrimp are most abundant in areas with extensive estuarine marshes, such as along the South Carolina coast; they reach their greatest abundance in the Mississippi River Delta of Louisiana (SCDNR 2001). Compared to brown and pink shrimps, the white shrimp is often found higher in the water column (Barnette 2003). The pink shrimp has a pink-to-lemon-yellow shell with a prominent spot on each side and a bluish tail-fan (SCDNR 2001). Pink shrimp are most abundant at depths of 11-26 meters, in estuaries and shallow marine waters (SAFMC 2009a). Pink shrimp are relatively uncommon in the Gulf of Mexico, with their greatest densities in the Tortugas and Sanibel areas off Florida (GMFMC 2002).

Rock shrimp are a mid-shelf shrimp species, distinguished by their thick stony exoskeletons (SAFMC 2002). They are active at night, and favor shell or sandy bottom habitat (SAFMC 1993). Rock shrimp has been commercially exploited only since the 1960s (FAO 2003), when technology that could split the hard shell and de-vein the shrimp was invented (Oceana 2007). A subsequent improvement to shrimp peeling technology in the 1980s further aided fishery expansion (Oceana 2007). U.S. landings grew exponentially from the early 1990s to the late 1990s (FAO 2003), and rock shrimp was added to the federal South Atlantic shrimp fishery management plan in 2002 (SAFMC 2002). Royal red shrimp is also a deepwater shrimp species which, unlike the other shrimp covered in this report, lives for several years (Oceana 2007). Royal red shrimp are found mostly between 256-547 meters on muddy or sandy seafloor (SAFMC 1993). Finally, seabob are relatively small shrimp at 7-14 centimeters, and are found mainly around depths less than 27 meters with mud or sand bottoms. Adults can tolerate fresher water than most penaeid shrimps, and are most plentiful in areas near river estuaries (FAO 2003).

The majority of U.S. commercial shrimp catch is taken by otter trawls--bottom otter trawls generate about 77% of total shrimp landings in the Gulf, and about 81% of total shrimp landings in the South Atlantic (Barnette 2001} (Barnette 2012)(Novak 2012)(NMFS 2013). Shrimp trawls may be single-, double-, or quad-rigged. Smaller shrimp vessels and/or those fishing inshore tend to use a single trawl (80-100 feet net width), or a double-rig design with a 40-50 foot width trawl net suspended from an outrigger on both port and starboard sides of the vessel (SERO 2011). A "quad-rig" consists of twin trawls (40-50 feet each) on each outrigger (SERO 2011). The quad rig has become the primary shrimp trawl gear used by large vessels in federal waters, owing largely to its higher fuel efficiency and lower drag (SAFMC 2007)(SERO 2011)(NMFS 2012a). In addition to otter trawls, a variety of gears can be used in inshore shrimp fisheries, including but not limited to cast nets, haul seines, beam trawls, skimmer trawls and "butterfly" or wing nets (SERO 2011). Skimmer trawls are important gears in the Gulf of Mexico, particularly in Louisiana state waters--in 2008, over 2,000 vessels using these gears reported landings (NMFS 2012a). Shrimp landings by skimmer trawl averaged 22% of total Gulf shrimp landings from 2006–2011; and during this time period 98% of skimmer trawl shrimp catch was landed in Louisiana (NMFS 2013). Recent work to better quantify inshore shrimp effort in the Gulf indicated that there are around 3,700 shrimp vessels active in Gulf inshore waters, more than half from Louisiana (NMFS 2012a), but inshore fishing effort characterization from the South Atlantic is not available.

Shrimp fisheries are managed federally under Shrimp Fishery Management Plans by the Gulf of Mexico Fishery Management Council (GMFMC), and the South Atlantic Fishery Management Council (SAFMC). The GMFMC regulates shrimp fishing in federal waters off the coasts of Texas, Louisiana, Mississippi, Alabama, and the west (Gulf) coast of Florida. The SAFMC regulates shrimp fishing in federal waters off the coasts of North Carolina, South Carolina, Georgia, and the east (Atlantic) coast of Florida. Corresponding management regulations vary among the states in the region. Allowable gear configurations vary throughout the states – for instance, Texas does not allow the use of skimmer trawls, but all other Gulf states do (NMFS 2012b). Regulations to mitigate bycatch vary by state, with some states more pro-active than others. To minimize incidental takes of sea turtles, Florida requires TEDs on skimmer trawls (NMFS 2012a)(NMFS 2012b). Federal TED regulations for otter trawl fisheries apply in all state waters as well (sea turtles are listed under the Endangered Species Act, which does not distinguish between federal and state waters). With regards to bycatch of finfish, BRDs are required in the state waters of Texas, Florida, Georgia, North Carolina and South Carolina, but not Louisiana, Mississippi and Alabama (LA Sea Grant 2009).

Both bycatch and habitat effects have been exacerbated by historical overcapitalization of the fishery, but overall fishing effort has dropped considerably in recent years. However, a variety of factors – overcapitalization itself, hurricane damage to fishing infrastructure (especially in 2005 from Hurricanes Katrina and Rita), rising fuel costs, declining prices due to the influx of cheap imported farmed shrimp, and the 2010 Deepwater Horizon oil spill – have all combined to make shrimping a very difficult way to profit economically. As a result, effort has dropped precipitously in recent years (Andrews 2008)(Griffin et al. 2008); there is more detailed information about this decline throughout the Gulf (NMFS DEIS). As of April 2012, there were 1,465 limited-access-permitted shrimpers in the Gulf, a decline from over 2300 federal Gulf open access permits which expired in 2007 (NMFS 2012b). Approximately 1,225 of those federal permits are active (NMFS 2012). Shrimping otter trawl effort in the South Atlantic declined by an estimated 38% from 2002 to 2009, and there are no data to suggest that effort will increase in either region (NMFS 2012b). Skimmer trawl fisheries have also declined in number of active vessels and amount of shrimp landed (NMFS 2012b). Ultimately, reductions in effort due to economic hardship may have saved the fishery from over-exploitation (Caillouet et al. 2008)(Nance et al. 2008). Due to the lower effort in recent years, CPUE has improved, and reduced effort is also credited with increased size of shrimp in landings, because shrimp have more time to reach maturity before harvest (GMFMC 2009).

Production Statistics

The majority of shrimp consumed in the U.S. is imported: in 2010, 558,602 metric tons of shrimp were

imported, whereas U.S. commercial landings of shrimp totaled 117,469 metric tons of shrimp, with the majority being warmwater shrimp from the Gulf and South Atlantic (NMFS 2011). In 2011, just under 574 thousand metric tons of shrimp were imported, which represents a 3% increase in shrimp imports from 2010 (NMFS 2011c). Most shrimp imported to the U.S. – the Fisheries and Agriculture Organization of the United Nations (FAO) indicates 80% of it – is farmed (Gillett 2008). Farmed shrimp are covered in a separate report.

In both the Gulf and the South Atlantic, shrimp fisheries are considered the region's largest and most valuable commercial fishery (GMFMC 2002)(SAFMC 1999). As Table 1 summarizes, white and brown shrimp are still the major species in volume and value in both regions. Gulf shrimp fisheries accounted for almost 90% of southeastern shrimp landings a decade ago (SAFMC 1999); Gulf shrimp fisheries still dominate South Atlantic landings at present (NMFS 2013).

Table 1. Shrimp landings (lbs) by region for 2011; and average landings (lbs) and value ($) by region from 2000- 2011. Data from NMFS (2013).

	2011Landings (lbs)	**Average Landings (lbs), 2000-2011**	**Average Landed Value ($), 2000-2011**
Gulf of Mexico	**219,838,809**	235,504,708	396,281,353
White shrimp	90,235,175	100,854,549	180,610,028
Brown shrimp	117,802,384	118,174,343	188,118,785
Pink shrimp	8,146,976	11,198,709	23,125,042
Rock shrimp	2,989,318	1,486,783	2,013,150
Royal red shrimp	351,636	411,468	992,802
Seabob	313,320	3,378,857	1,421,545
South Atlantic	**21,615,853**	22,807,982	45,011,746
White shrimp	11,801,839	12,087,373	27,215,160
Brown shrimp	7,589,012	6,821,081	12,563,350
Pink shrimp	371,182	818,247	1,234,757
Rock shrimp	1,260,309	2,786,267	3,468,460
Royal red shrimp	593,511	295,014	530,020
Total (both regions)	241,454,662		

Importance to the US/North American market.

The United States is the largest market for shrimp globally (Johnson 2007) and more than 85% of shrimp consumed here is imported. Over the past decade, U.S. imports of shrimp have generally increased while landings have remained stable. Currently, shrimp is the nation's fifth most valuable domestic fishery species (including cold-water shrimp) and ninth largest fishery by volume, landing approximately $414 million dollars and 259 million pounds (NMFS 2011). The leading importer of shrimp to the U.S. is Thailand, followed by Indonesia, Ecuador, India, Vietnam, China and Mexico (Urner Barry 2012). Imported wild-caught shrimp is most likely to come from Ecuador, China or Mexico (NMFS 2011b).

Common and market names.

The various shrimp go by different common names. White shrimp are also called common, southern, grey, lake, green, green- or blue-tailed, rainbow or Daytona shrimp (SAFMC 2009a). Brown shrimp may go by brownie; "summer shrimp" in North Carolina; or red, redtail, green lake, golden, or native shrimp (SAFMC 2009a). Pink shrimp are also referred to as hopper, skipper, or pink spotted, brown spotted, grooved, green, red, pink night, spotted, or pushed, shrimp (SAFMC 2009a). When used for sushi or sashimi, warmwater shrimp are commonly sold as ebi.

Primary product forms

Shrimp product forms include fresh, frozen, head-on, shell-on, peeled, cooked, or breaded (UrnerBarry 2012).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

Criterion 1: Impacts on the species under assessment

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. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Criterion 1 Summary

ATLANTIC SEABOB				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)
United States of America/Gulf of Mexico Pushed skimmer nets | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)
Florida/Western Central Atlantic Pushed skimmer nets | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)

BROWN ROCK SHRIMP				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)

United States of America/Atlantic Bottom trawls | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)

BROWN SHRIMP				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Atlantic Bottom trawls | United States of America	3.00: Low	4.00: Low Concern	5.00: Very Low Concern	Green (4.47)
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
United States of America/Gulf of Mexico Pushed skimmer nets | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
Florida/Western Central Atlantic Pushed skimmer nets | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)

PINK SHRIMP				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
United States of America/Gulf of Mexico Pushed skimmer nets | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
United States of America/Atlantic Bottom trawls | United States of America	3.00: Low	4.00: Low Concern	5.00: Very Low Concern	Green (4.47)

Florida/Western Central Atlantic Pushed skimmer nets | United States of America	3.00: Low	4.00: Low Concern	5.00: Very Low Concern	Green (4.47)

ROYAL RED SHRIMP				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)
United States of America/Atlantic Bottom trawls | United States of America	3.00: Low	3.00: Moderate Concern	5.00: Very Low Concern	Green (3.87)

WHITE SHRIMP				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
United States of America/Gulf of Mexico Bottom trawls | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
United States of America/Gulf of Mexico Pushed skimmer nets | United States of America	3.00: Low	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.00)
United States of America/Atlantic Bottom trawls | United States of America	3.00: Low	4.00: Low Concern	5.00: Very Low Concern	Green (4.47)
Florida/Western Central Atlantic Pushed skimmer nets | United States of America	3.00: Low	4.00: Low Concern	5.00: Very Low Concern	Green (4.47)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor 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—The FishBase vulnerability score for species is 56-100, OR species exhibits 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.*

Factor 1.2 - Abundance

- *5 (Very Low Concern)—Strong evidence exists that the 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 the 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 the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

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 (≤ 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 exists, 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.*

ATLANTIC SEABOB

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score
Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Moderate Concern

Seabob shrimp stock status in the Gulf is unknown, and is therefore scored as moderate concern.

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table 2. The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8
White shrimp	below the threshold of 110,000 metric tons total annual spawning biomass	6.5	14.5 million pounds/year	5.1
Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low concern is given.

BROWN ROCK SHRIMP

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp

vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score
Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Moderate Concern

Rock shrimp is also less-studied, but catch is incidental in the Gulf, and in the South Atlantic the 'MSY' proxy of an overfishing limit has not been reached since being defined in Amendment 6 of the SAFMC Shrimp FMP. Rock shrimp in the Gulf is not assessed; and in the South Atlantic rock shrimp has been determined not to be experiencing overfishing, but it is unknown whether the stock is overfished. Ultimately, stock status in both regions is unknown and is therefore scored as moderate concern.

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table 2. The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8
White shrimp	below the threshold of 110,000 metric tons total annual spawning biomass	6.5	14.5 million pounds/year	5.1
Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low concern is given.

BROWN SHRIMP

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score
Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Low Concern

Brown and white shrimp stocks in the South Atlantic are considered healthy, and the pink shrimp stock in this region has been declared rebuilt. Pink shrimp in the South Atlantic had fallen below the overfished threshold, although experts agreed that this was due to environmental factors rather than fishing (SAFMC 2012a). Penaeid shrimp in the South Atlantic are not currently assessed using Stock Synthesis models that are employed in the Gulf; but the SAFMC shrimp review panel has recommended applying these models and additional survey data to better characterize shrimp stock status in the South Atlantic; the latest amendment to the South Atlantic Shrimp Fishery management plan incorporates these actions (SAFMC 2012b).

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table: The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

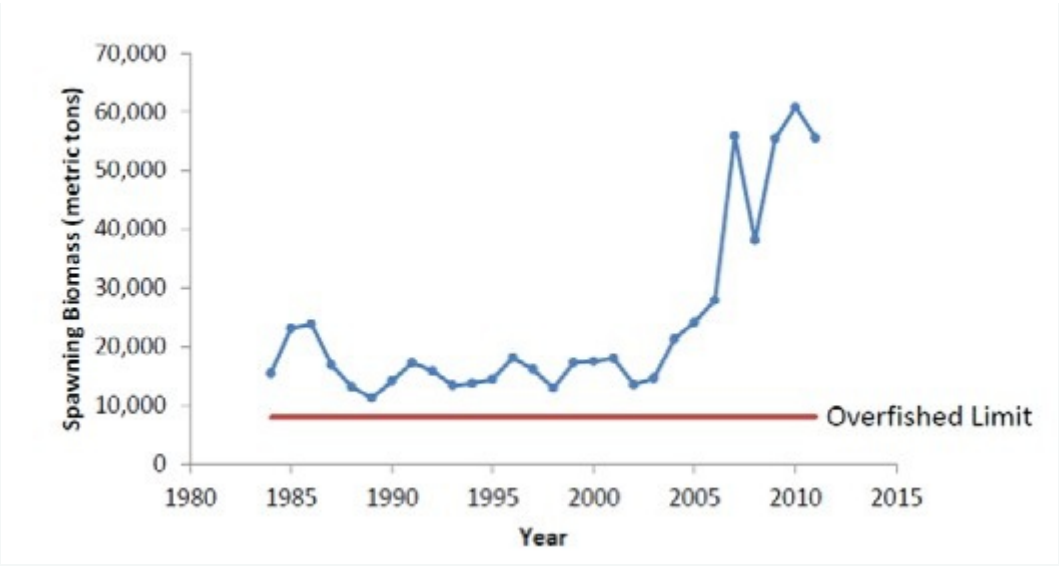
Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8
White shrimp	below the threshold of 110,000 metric tons total annual spawning biomass	6.5	14.5 million pounds/year	5.1
Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

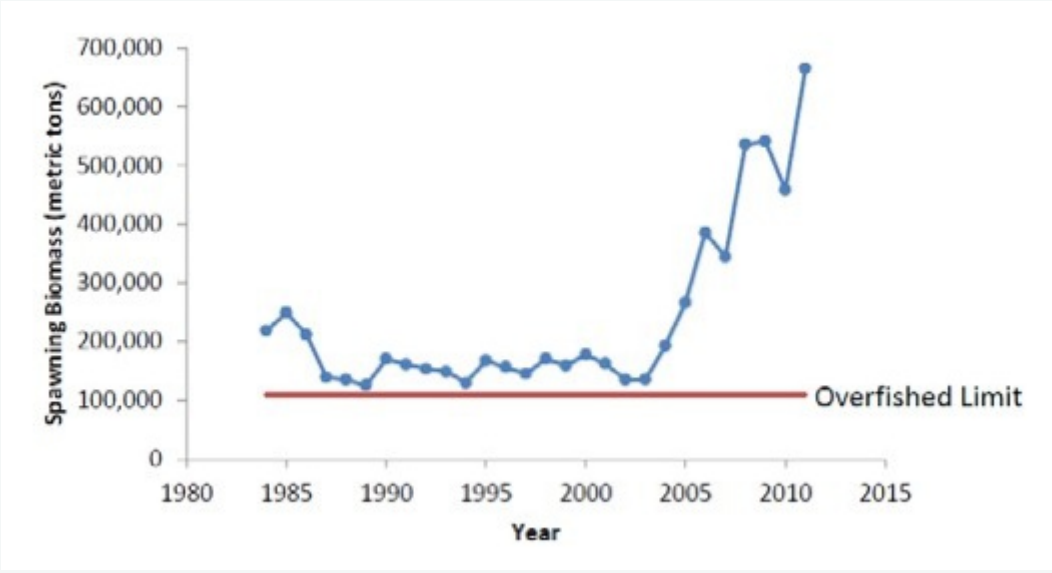
Very Low Concern

In both the Gulf and along the southeastern Atlantic, brown, white and pink shrimp generally have B/Bmsy proxies greater than one (NMFS 2012c). Until recently, Gulf shrimp stocks were assessed with Virtual Population Analysis (VPA), but these models failed to adequately compensate for large decreases in fishing effort over the past five years. NMFS has concluded that the Stock Synthesis model is better for estimating shrimp populations. The most recent Gulf stock assessments show spawning biomass of brown, pink and white shrimp to be well above the index levels (see Figures 1a-c below). There is no indication that shrimp stocks in the Gulf are overfished, or that recruitment fishing has occurred throughout the assessment period (Hart and Nance 2012).

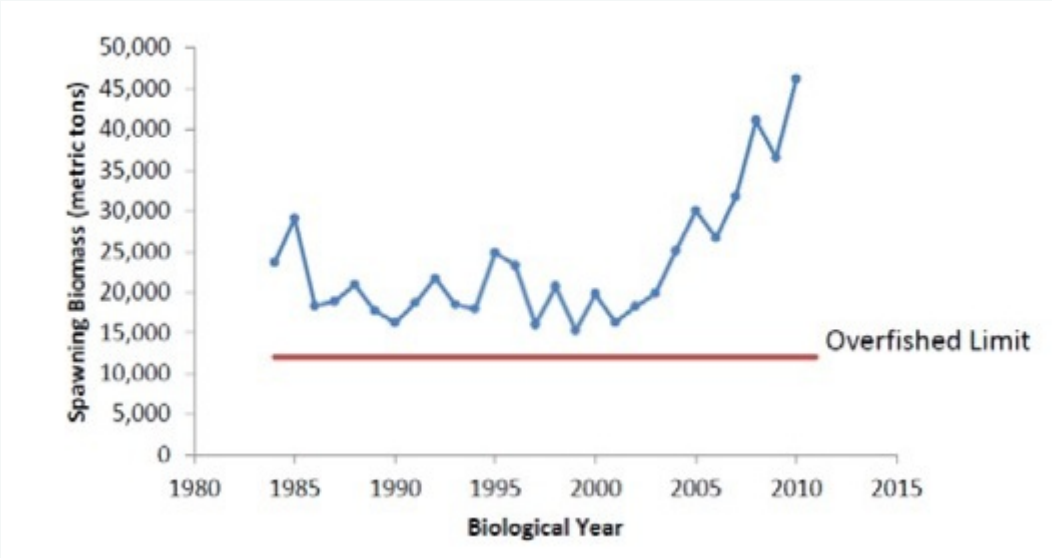
Justification:



Biological year spawning biomass for brown shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for white shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for pink shrimp in the US Gulf (Hart and Nance 2012).

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low concern is given.

PINK SHRIMP

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score

Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

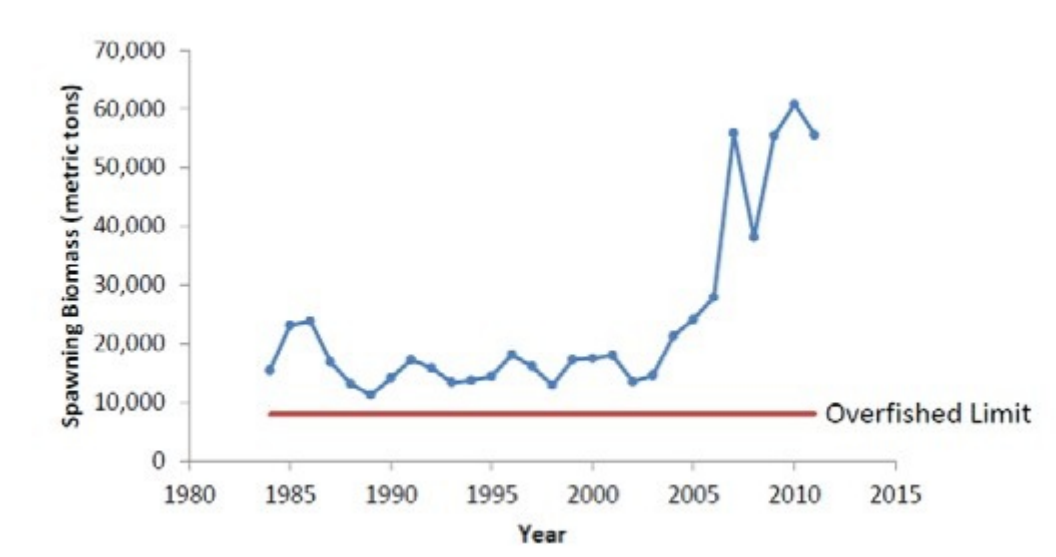
Factor 1.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

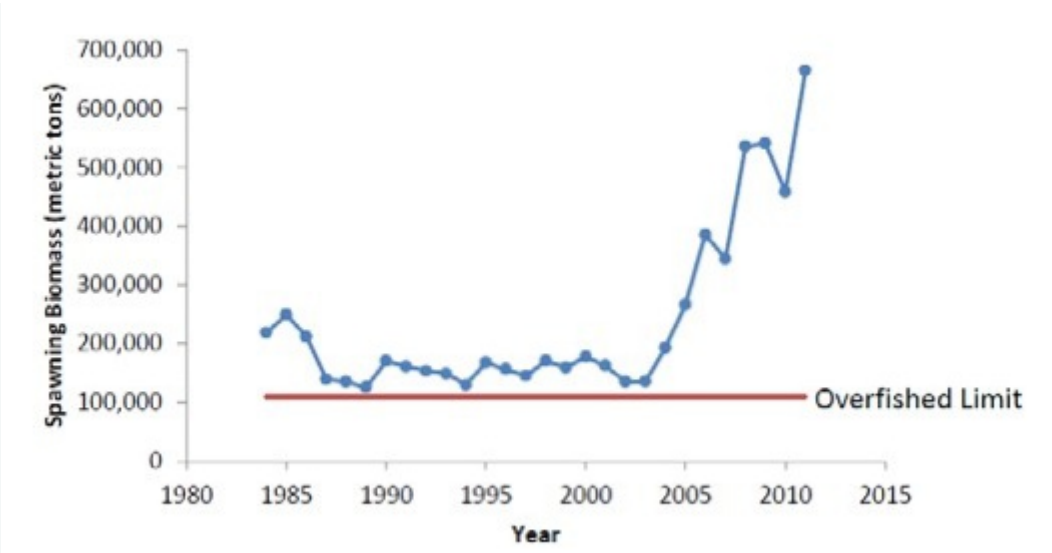
Very Low Concern

In both the Gulf and along the southeastern Atlantic, brown, white and pink shrimp generally have B/Bmsy proxies greater than one (NMFS 2012c). Until recently, Gulf shrimp stocks were assessed with Virtual Population Analysis (VPA), but these models failed to adequately compensate for large decreases in fishing effort over the past five years. NMFS has concluded that the Stock Synthesis model is better for estimating shrimp populations. The most recent Gulf stock assessments show spawning biomass of brown, pink and white shrimp to be well above the index levels (see Figures 1a-c below). There is no indication that shrimp stocks in the Gulf are overfished, or that recruitment fishing has occurred throughout the assessment period (Hart and Nance 2012).

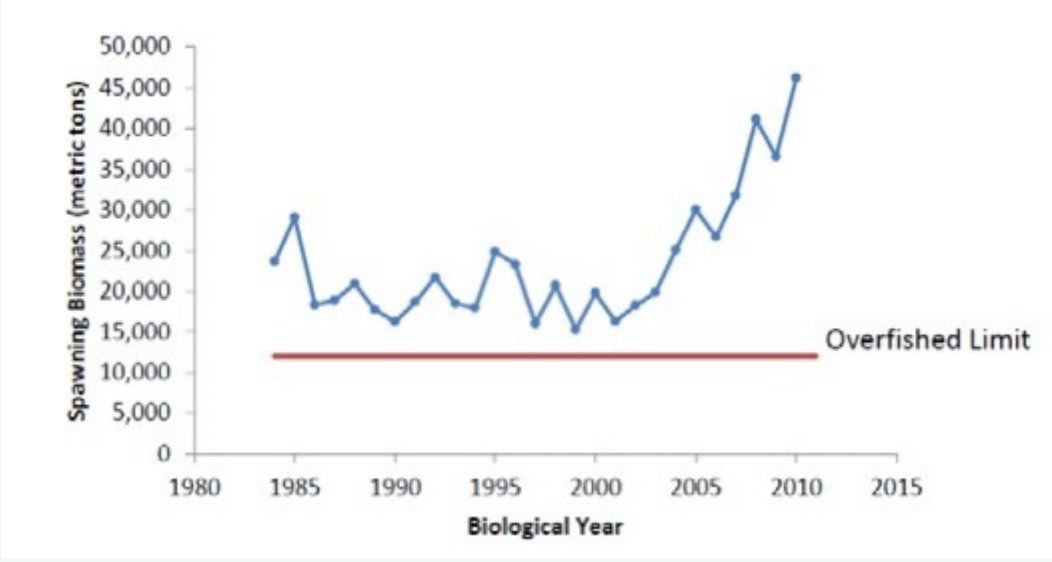
Justification:



Biological year spawning biomass for brown shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for white shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for pink shrimp in the US Gulf (Hart and Nance 2012).

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low Concern

Brown and white shrimp stocks in the South Atlantic are considered healthy, and the pink shrimp stock in this region has been declared rebuilt. Pink shrimp in the South Atlantic had fallen below the overfished threshold, although experts agreed that this was due to environmental factors rather than fishing (SAFMC 2012a). Penaeid shrimp in the South Atlantic are not currently assessed using Stock Synthesis models that are employed in the Gulf; but the SAFMC shrimp review panel has recommended applying these models and additional survey data to better characterize shrimp stock status in the South Atlantic; the latest amendment to the South Atlantic Shrimp Fishery management plan incorporates these actions (SAFMC 2012b).

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for

the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table: The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8
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Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low concern is given.

ROYAL RED SHRIMP

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score
Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

Factor 1.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Moderate Concern

Royal red shrimp stock status is less-studied than other species, likely owing to the fact that this species makes up a small percentage of overall catch. This species is also longer-lived than the other penaeid shrimp covered here, meaning that multiple year classes may be caught by the fishery. Royal red shrimp catch in the South Atlantic is minimal, and its stock status is unknown. In the Gulf, landings of royal red shrimp have never reached the overfishing limit of 392,000 pounds (Nance 2011). Royal red shrimp is not considered to be experiencing overfishing in the Gulf, but it is unknown whether the stock is overfished. For both the Gulf and South Atlantic regions, the status of royal red shrimp stocks is ultimately unknown.

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table: The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8
White shrimp	below the threshold of 110,000 metric tons total annual spawning biomass	6.5	14.5 million pounds/year	5.1
Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low

concern is given.

WHITE SHRIMP

Factor 1.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low

Shrimp, as invertebrates, do not have FishBase vulnerability scores. Where SeaLifeBase has calculated shrimp vulnerability scores – also based on work by Cheung et al. – they generally range from 10-13 out of 100. Brown, white and pink shrimp are short-lived species, completing their life cycle in 18-24 months (LDWF 2000) (NCDMF 2001). They are fast-growing, reaching sexual maturity in perhaps 6 to 12 months, and are broadcast spawners that release 500,000–1 million eggs. Royal red shrimp, a deepwater species, live for several years, and so several year-classes may occur on the fishing grounds at one time (GMFMC 2001).

Although they can be susceptible to extreme cold weather events (SAFMC 2012b), overall the penaid shrimp species discussed here are short-lived and very fecund. A quick analysis of their productivity attributes in the table below yields an average Productivity score of 3, making them inherently resilient to fishing. It is unclear to what extent other human activities (e.g. oil production, coastal development) impact penaeid shrimp populations. Environmental forces are more likely to affect shrimp populations than fishing (NMFS 2012) (SAFMC 2012a).

Justification:

Resilience Attribute	Penaid shrimp spp.	PSA Score
Average age at maturity	Generally <1 yr; royal red mature around 3 yrs	3
Average maximum age	Generally ≤2 yrs; royal red live for several years	3
Reproductive strategy	Broadcast spawner	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2

Factor 1.2 - Abundance

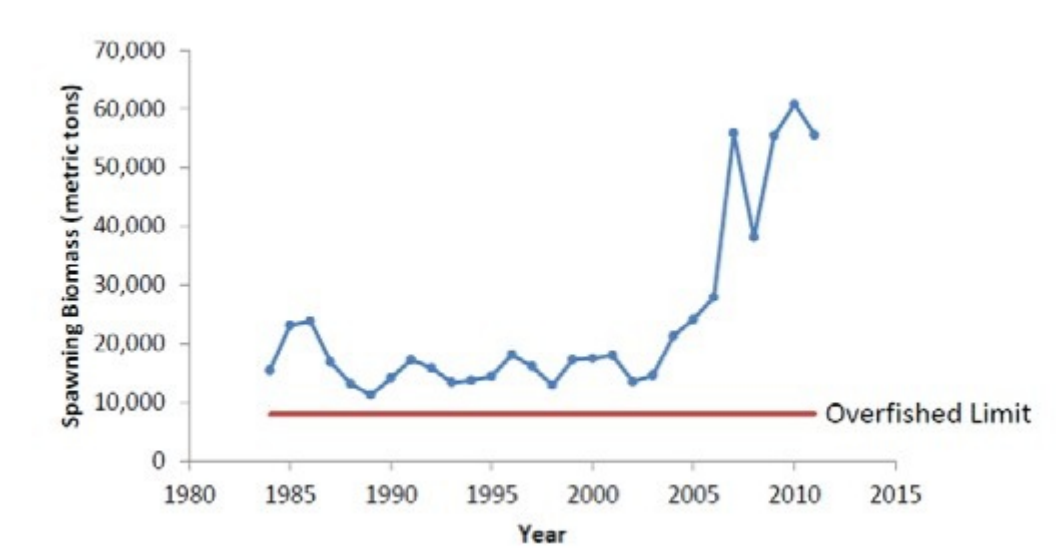
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

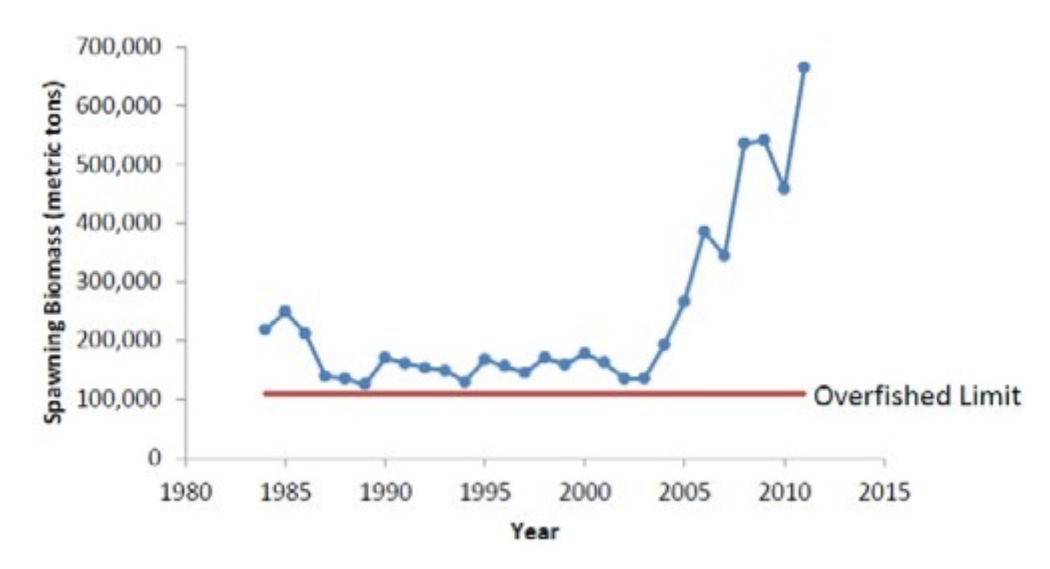
In both the Gulf and along the southeastern Atlantic, brown, white and pink shrimp generally have B/Bmsy proxies greater than one (NMFS 2012c). Until recently, Gulf shrimp stocks were assessed with Virtual Population Analysis (VPA), but these models failed to adequately compensate for large decreases in fishing effort over the past five years. NMFS has concluded that the Stock Synthesis model is better for estimating shrimp populations. The most recent Gulf stock assessments show spawning biomass of brown, pink and white shrimp to be well above the index levels (see Figures 1a-c below). There is no indication that shrimp

stocks in the Gulf are overfished, or that recruitment fishing has occurred throughout the assessment period (Hart and Nance 2012).

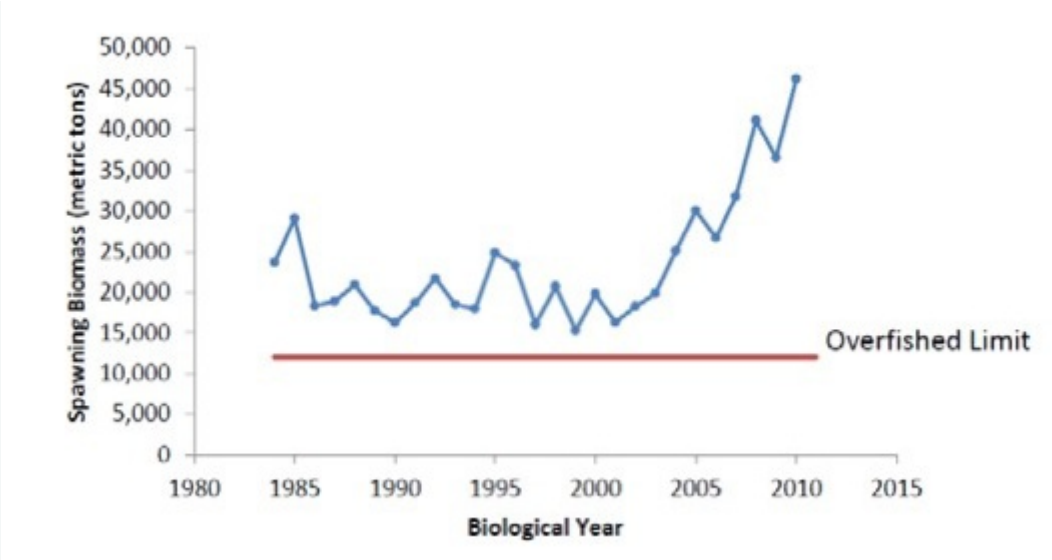
Justification:



Biological year spawning biomass for brown shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for white shrimp in the US Gulf (Hart and Nance 2012).



Biological year spawning biomass for pink shrimp in the US Gulf (Hart and Nance 2012).

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Low Concern

Brown and white shrimp stocks in the South Atlantic are considered healthy, and the pink shrimp stock in this region has been declared rebuilt. Pink shrimp in the South Atlantic had fallen below the overfished threshold, although experts agreed that this was due to environmental factors rather than fishing (SAFMC 2012a). Penaeid shrimp in the South Atlantic are not currently assessed using Stock Synthesis models that are employed in the Gulf; but the SAFMC shrimp review panel has recommended applying these models and additional survey data to better characterize shrimp stock status in the South Atlantic; the latest amendment to the South Atlantic Shrimp Fishery management plan incorporates these actions (SAFMC 2012b).

Justification:

The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage, respectively (see Table 2 below). Gulf overfished definitions are based upon abundance of a "parent stock", or stock of breeding adults, the year before fishing takes place; the Gulf council updated definitions in 2012 (GMFMC 2002)(GMFMC 2012). In the South Atlantic, overfishing is defined as a fishing mortality rate that diminishes the stock below the Maximum Sustainable Yield (MSY) for two consecutive years (SAFMC 2012).

Table: The Gulf of Mexico and South Atlantic Fishery Management Councils have established an overfished level for the penaeid species they manage.

Shrimp species	Gulf Overfished Definition	Gulf B/Bmsy Proxy (FSSI)	South Atlantic "MSY" definition	South Atlantic B/Bmsy Proxy (FSSI)
Brown shrimp	below the threshold of 8,000 metric tons total annual spawning biomass	4.9	9.2 million pounds/year	10.8

White shrimp	below the threshold of 110,000 metric tons total annual spawning biomass	6.5	14.5 million pounds/year	5.1
Pink shrimp	below the threshold of 12,000 metric tons total annual spawning biomass	0.8	1.8 million pounds/year	1.1
Royal red shrimp	Landings greater than MSY, or 392,000 lbs	none	n/a	n/a
Rock shrimp	n/a	n/a	6,829,449 pounds/year	Not estimated

Factor 1.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

The most recent FSSI (NMFS 2012c) indicates that there is no overfishing occurring for all managed shrimp species (brown, white, pink, or royal red shrimp in the Gulf; and brown, white, pink, or rock in the South Atlantic). Furthermore, effort levels have declined substantially in recent years and are not expected to increase any time soon. Although fishing mortality is largely unknown for rock and seabob shrimp caught incidentally in the Gulf, and for royal red shrimp in the South Atlantic, it is expected to remain low for these incidental species. Brown, white and pink shrimp in the Gulf are viewed as an "annual crop" and have sustained landings for more than four decades (Nance 2011); meanwhile average annual catches of brown and white shrimp – respectively, approximately 6 and 12 million pounds annually - are below the South Atlantic "MSY" definition as outlined in the table above. For royal red shrimp in the Gulf, and rock shrimp in the South Atlantic, catches have never reached the MSY proxies defined above. In addition, fishing effort has declined significantly in recent years. Therefore, although there is more uncertainty regarding stocks for pink, rock, royal red and seabob shrimp, mortality rates are deemed to be fairly low. Hence, a score of very low concern is given.

Criterion 2: Impacts on other species

All main retained and 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 to species 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. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

ATLANTIC SEABOB - FLORIDA/WESTERN CENTRAL ATLANTIC - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)	
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)	
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)	

ATLANTIC SEABOB - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

ATLANTIC SEABOB - UNITED STATES OF AMERICA/GULF OF MEXICO - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)

Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

BROWN ROCK SHRIMP - UNITED STATES OF AMERICA/ATLANTIC - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	
Atlantic sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)	
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)	
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)	
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
Brown shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	

BROWN ROCK SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	

Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

BROWN SHRIMP - FLORIDA/WESTERN CENTRAL ATLANTIC - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**		**Subscore**
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern		Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern		Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern		Yellow (2.24)
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern		Yellow (3.16)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern		Green (3.87)
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern		Green (4.47)
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern		Green (4.47)

BROWN SHRIMP - UNITED STATES OF AMERICA/ATLANTIC - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Atlantic sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)

BROWN SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)

Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

BROWN SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA

Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

PINK SHRIMP - FLORIDA/WESTERN CENTRAL ATLANTIC - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA

Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)

Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

PINK SHRIMP - UNITED STATES OF AMERICA/ATLANTIC - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	
Atlantic sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)	
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)	
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)	
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)	
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
Brown shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	

PINK SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

PINK SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

ROYAL RED SHRIMP - UNITED STATES OF AMERICA/ATLANTIC - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	
Atlantic sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)	
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)	
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)	
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
White shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	
Brown shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)	

ROYAL RED SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)	
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)	
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)	
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	

Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
White shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

WHITE SHRIMP - FLORIDA/WESTERN CENTRAL ATLANTIC - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

WHITE SHRIMP - UNITED STATES OF AMERICA/ATLANTIC - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Atlantic sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	2.00:High Concern	5.00:Very Low Concern	Yellow (3.16)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Pink shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)
Brown shrimp	3.00:Low	4.00:Low Concern	5.00:Very Low Concern	Green (4.47)

WHITE SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - BOTTOM TRAWLS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern	Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)
Red snapper	2.00:Medium	2.00:High Concern	3.67:Low Concern	Yellow (2.71)
Royal red shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)
Brown rock shrimp	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern	Green (3.87)

Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)

WHITE SHRIMP - UNITED STATES OF AMERICA/GULF OF MEXICO - PUSHED SKIMMER NETS - UNITED STATES OF AMERICA					
Subscore:	**1.00**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.75**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**		**Subscore**
Sea turtle (unspecified)	1.00:High	1.00:Very High Concern	1.00:High Concern		Red (1.00)
Smalltooth sawfish	1.00:High	1.00:Very High Concern	2.33:Moderate Concern		Red (1.53)
Gulf Sturgeon	1.00:High	1.00:Very High Concern	5.00:Very Low Concern		Yellow (2.24)
Blacknose shark	1.00:High	3.00:Moderate Concern	2.33:Moderate Concern		Yellow (2.64)
Atlantic seabob	3.00:Low	3.00:Moderate Concern	5.00:Very Low Concern		Green (3.87)
Pink shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern		Green (5.00)
Brown shrimp	3.00:Low	5.00:Very Low Concern	5.00:Very Low Concern		Green (5.00)

There are hundreds of species caught incidentally in shrimp nets, whether trawl or skimmer trawls. Generally, this bycatch is discarded. Species taken as bycatch include benthic macroinvertebrates (crabs, non-targeted shrimps, bivalves, sea stars, sea urchins, sea anemones, sponges, etc.) (GMFMC Amendment 10, 2002), groundfishes, swimming crabs, pelagic finfishes (NMFS 1998)(NMFS 2011b) and small coastal sharks (NMFS 2003)(NMFS 2012d). Bycatch in the federal Gulf of Mexico fishery is estimated to be triple the weight of shrimp landings – or about 600 million pounds of bycatch to about 200 million pounds of shrimp (NMFS 2011b). A comprehensive study by NMFS' Southeastern U.S. Shrimp Trawl Bycatch Program (NMFS 1998) found that, in the Gulf of Mexico, an average of 1.8 (individual) finfish are taken as bycatch for every (individual) shrimp commercially harvested by trawl (NMFS 1998). These data pre-date the regulations requiring more effective BRD designs that reduce finfish bycatch, and therefore likely overestimate the amount of finfish bycatch, but can still serve as a useful source of data for the composition of bycatch.

In the South Atlantic, the main finfish bycatch species included Atlantic croaker, spot, king mackerel, Spanish mackerel,and weakfish. In Gulf fisheries, they included juvenile red snapper, Atlantic croaker, seatrout and weakfish, longspine porgy, king mackerel, and Spanish mackerel (NMFS 1998)(NMFS 2011b). In addition to these finfish species, a substantial number of blue crabs are taken in Gulf of Mexico shrimp fisheries,

particularly in Louisiana and Texas, where shrimping effort is high (Guillory 2001).

Generally, the finfish species mentioned above have abundant or healthy populations, and are species which are resilient to fishing pressure (NMFS 2012c). Gulf and South Atlantic shrimp fisheries also interact with small coastal sharks, namely Atlantic sharpnose, bonnethead, and blacknose sharks (NMFS 2012c). Bycatch of 'grouped sharks' is estimated about 5.7 million pounds in the federal Gulf of Mexico shrimp fishery (NMFS 2011b). The most recent stock assessment for blacknose sharks resulted in an 'overfished' definition for the Atlantic stock; thus a rebuilding plan is in development and will have ramifications for other fisheries that contribute to shark mortality.

The following section focuses on those species of potential conservation concern that may be significantly impacted by the shrimp trawl fishery.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Inherent Vulnerability

(same as Factor 1.1 above)

Factor 2.2 - Abundance

(same as Factor 1.2 above)

Factor 2.3 - Fishing Mortality

(same as Factor 1.3 above)

SEA TURTLE (UNSPECIFIED)

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

High

Sea turtles are long-lived, slow-growing, late-maturing animals with high vulnerability to fishing pressure (NMFS 2012b). Five of the seven highly migratory sea turtle species - the loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricate*), and leatherback sea turtle (*Dermochelys coriacea*) - are present throughout the Gulf and South Atlantic.

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very High Concern

All sea turtle species occurring in U.S. waters are listed by the Endangered Species Act (ESA) as either endangered or threatened. Estimates of sea turtle populations vary depending on the species and data available. Endangered leatherback sea turtle abundance patterns in the Atlantic are less clear than their dramatic declines in the Pacific: estimates of total population size are difficult to make due to inconsistent nesting data, although Florida nesting data indicates annual nesting growth from 1989–2006 (NMFS 2012b). Hawksbill sea turtles appear globally to be declining, depleted, or remnants of larger populations, and there are no reliable estimates or trends for nonnesting turtles (NMFS 2012b). Of remaining extant sea turtle stocks, the Kemp's ridley sea turtle has the smallest range and has declined to the lowest population level relative to other sea turtles – although nesting data since the 1990s have indicated an increasing Kemp's ridley population (Finkbeiner et. al. 2011), with a 2011 NMFS model predicting the population to increase by 19% annually (NMFS 2012b). Further nesting data will be required to determine whether the predicted population trajectory proves true: nesting data from 2010 showed an unexpected and still-inexplicable drop, but 2009 and 2011 nesting data were on-track with the model (NMFS 2012b).

Green and loggerhead sea turtles are listed as threatened under the ESA. Various studies and reviews of the Northwest Atlantic Distinct Population Segment (DPS) of loggerhead sea turtles have not resulted in a reliable estimate of population size (NMFS 2012b). While long-term loggerhead nesting data indicates an overall decline (e.g. 43% in Florida between 1998 and 2006); in-water research suggests that the abundance of neritic juvenile loggerheads is steady or increasing (Witherington et. al. 2009)(NMFS 2012b). Nesting populations of green sea turtles in the western Atlantic appear to show steady or positive abundance trends (NMFS 2012b).

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

High Concern

Shrimp fisheries in both regions are considered to have had the largest fishery-related negative impact on sea turtle populations in the southeastern U.S. for many years (NMFS 2012b).

Recent research indicates that shrimp trawling accounts for 98% of annual overall U.S. fishing interactions with sea turtles, and upwards of 80% of sea turtle deaths (Finkbeiner et. al. 2011). Table 3 below indicates estimated incidental interactions and mortalities of key turtle species by shrimp otter trawls based on 2007 data – these are now thought to be *underestimates* given new information about sea turtle strandings and TED compliance, particularly in the Gulf of Mexico (NOAA 2012b). For instance, bycatch estimates updated from 2007 to 2009 effort data estimate over 61,000 annual loggerhead interactions with shrimp trawls occur throughout both regions (46% Gulf and 54% Southeast Atlantic), leading to 1450 loggerhead deaths (54% Gulf and 46% Southeast Atlantic) (Finkbeiner et. al. 2011). Since the shrimp fishery is a substantial contributor to sea turtle mortality, and all sea turtles stocks are of special concern, but there is effective management in place (required turtle excluder devices; see management section) to greatly reduce sea turtle bycatch, sea turtle bycatch mortality is a high concern.

Justification:

Table: **Estimated annual number of interactions between sea turtles and shrimp trawls in the Gulf of Mexico shrimp fisheries associated estimated mortalities based on 2007 Gulf effort data taken from Nance et al. (Nance et al. 2008). Table from (NMFS 2012b).**

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

> 100%

Trawl gear has great potential for unselective fishing, and shrimp trawl fisheries throughout the world have the unfortunate distinction of having the highest levels of bycatch. Globally, shrimp trawls discard over 1.8 million metric tons of bycatch annually; this amounts to 62% of the total catch (landings plus discards) (Kelleher 2005). With the highest discard rate of any fishery, warmwater shrimp trawl fisheries alone are responsible for more than 27% of total estimated discards from all fisheries worldwide (Kelleher 2005).

The first U.S. National Bycatch Report estimates a national bycatch ratio (ratio of bycatch to total catch, where total catch equals landings plus bycatch) of 0.17 for all fisheries studied (NMFS 2011b). Based on 2005 data, the Gulf of Mexico shrimp trawl fishery had the nation's highest fishery bycatch-to-catch ratio of 0.76, where the annual estimate of directed landings (shrimp) was 213.5 million pounds, and bycatch was 681 million pounds (NMFS 2011b) – indicating a bycatch:landings ratio of approximately 3.2. More recent fishery-wide data on bycatch and discards is difficult to obtain, likely owing to continued low observer coverage levels (see Management discussion below).

The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).

Criterion 3: Management Effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Harvest Strategy	Bycatch Strategy	Score
Florida / Western Central Atlantic / Pushed skimmer nets / United States of America	5.00	2.00	Yellow (3.16)
United States of America / Atlantic / Bottom trawls / United States of America	5.00	2.00	Yellow (3.16)
United States of America / Gulf of Mexico / Bottom trawls / United States of America	5.00	2.00	Yellow (3.16)
United States of America / Gulf of Mexico / Pushed skimmer nets / United States of America	5.00	1.00	Yellow (2.24)

Management of shrimp stocks is generally effective, whereas there are concerns with management pertaining to bycatch, particularly for sea turtles. Florida is considered separately for the skimmer trawl fishery, as the only state that requires TEDs in skimmer trawls.

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Harvest Strategy

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 there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

Factor 3.1 Summary

FACTOR 3.1 - MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region / Method	**Strategy**	**Recovery**	**Research**	**Advice**	**Enforce**	**Track**	**Inclusion**
Florida / Western Central Atlantic / Pushed skimmer nets / United States of America	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective
United States of America / Atlantic / Bottom trawls / United States of America	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective
United States of America / Gulf of Mexico / Bottom trawls / United States of America	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective
United States of America / Gulf of Mexico / Pushed skimmer nets / United States of America	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective

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.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

There has been active federal management of U.S. southeastern shrimp fisheries for just over 30 years in the Gulf of Mexico, and almost 20 years in the South Atlantic. Amendments to Shrimp FMPs have focused on juvenile shrimp habitat, gear conflicts, and MSY and other thresholds for shrimp populations. Research needs have been identified, although it is unclear when they will be acted upon.

Justification:

The Gulf of Mexico Fishery Management Council has actively updated and amended its Shrimp FMP since its first iteration in 1981, to protect shrimp stocks from overfishing, reduce turtle mortality, reduce finfish bycatch, and protect essential fish habitat. The original Gulf Shrimp FMP established area and seasonal closures to protect juvenile pink and brown shrimp (GMFMC 1981). The focus of the first Gulf Shrimp FMP and several subsequent amendments was to stop growth overfishing, creating seasons and regulations to protect juvenile

shrimps during their migrations from estuary to ocean and allow them to gain full size (GMFMC 2002).

The original South Atlantic Shrimp Fishery Management Plan set a basic form of MSY and outlined ways the SAFMC would reduce shrimping effort in years following winter freezes (which kill adult shrimp and result in low stocks the following year) (SAFMC 1993). In the ensuing years, South Atlantic shrimp management has evolved to include ecosystem and habitat measures, additional species (rock shrimp), and bycatch mitigation measures.

Shrimp fishing also occurs in state waters. While this report focuses on management in place at the federal level, most of the states with shrimp fisheries have closed seasons to protect spawning and/or juvenile shrimp, and also employ minimum mesh size requirements (NMFS 2012b). The strategy and implementation of the shrimp fishery's management of retained species is considered highly effective because the respective FMPs in both regions set reasonable goals, and management has been generally effective at maintaining shrimp populations.

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.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

N/A

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 achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

NOAA's Southeast Fisheries Science Center labs in Galveston, TX and Miami, FL collect fishery- dependent and fishery-independent data to assess and monitor shrimp stocks, and shrimp fishery effects on other species. Fishery-independent data are available through the SEAMAP survey in the Gulf, as well as maintained by states' agencies. Shrimp stock assessments are conducted periodically in the South Atlantic, and annually in the Gulf. Research and monitoring of shrimp populations is considered highly 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.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

Scientific advice for shrimp fisheries is considered highly effective – both Gulf and South Atlantic Fishery Management Councils coordinate with the NOAA Southeast Fishery Science Center and state agencies for fishery-dependent and some fishery independent data. The Gulf Shrimp FMP has been successively modified to refine shrimp overfishing indices and definitions (GMFMC 199}(GMFMC 2005).

The South Atlantic Fishery Ecosystem Plan and Comprehensive Ecosystem FMP amendments detail ongoing research needs for species managed by the South Atlantic Fishery Management Council. For shrimp, research needs include better understanding of life history and ecological roles; improving stock health parameters; impacts of beach renourishment projects on shrimp; and impacts of water quality alteration on shrimp productivity, growth and survival (SAFMC 2009). Additionally, the recent Amendment 9 to the South Atlantic Shrimp FMP called for additional research on data types and availability for an updated shrimp assessment model (SAFMC 2012b).

Subfactor 3.1.5 – Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

Shrimp closures, such as the Tortugas Shrimp Sanctuary, are enforced by both federal and state law enforcement. Logbooks are voluntary.

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 is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
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UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

Shrimp catches have been effectively maintained relatively steadily over the long-term, although this trend is likely also due to shrimp life history as much as management.

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 rating is given if the management process is transparent and includes stakeholder input.

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UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Highly Effective

The U.S. federal fishery management process is public and transparent, and therefore considered effective with respect to stakeholder inclusion.

Factor 3.2 - Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating 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 rated 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 substatntially impacted by the fishery*

FACTOR 3.2 - BYCATCH STRATEGY

Region / Method	All Kept	Critical	Strategy	Research	Advice	Enforce
Florida / Western Central Atlantic / Pushed skimmer nets / United States of America	No	No	Moderately Effective	Ineffective	Moderately Effective	Ineffective
United States of America / Atlantic / Bottom trawls / United States of America	No	No	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective
United States of America / Gulf of Mexico / Bottom trawls / United States of America	No	No	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective

United States of America / Gulf of Mexico / Pushed skimmer nets / United States of America	No	No	Ineffective	Ineffective	Ineffective	Ineffective

The most severe conservation concerns associated with the South Atlantic and Gulf of Mexico shrimp trawl fishery are high bycatch, including threatened and endangered sea turtles, and damage to the seafloor habitat due to bottom trawling. To address bycatch concerns, management has implemented numerous regulations mandating TEDs in trawls, and fleetwide use of BRDs, but bycatch remains high and still regularly includes threatened and endangered sea turtles. Low observer coverage (consistently less than 2% in federal waters) throughout the fishery results in an unclear picture of the effectiveness of bycatch regulations, and uncertainty regarding the impacts on many bycatch species. In addition, the success of these regulations largely depends on compliance. There have been documented TED compliance issues (of various types of violations, and including net retailers) in recent years, primarily in the Gulf region {NMFS 2012a}{NMFS 2012b}; however, compliance has recently improved. The level of observer coverage in the fishery is not sufficient to adequately measure the impact on bycatch species of concern. For these reasons, shrimp trawl fishery management of bycatch species is still a high concern in both regions.

There is far less data on bycatch in Gulf of Mexico skimmer trawls. Combined with recent developments including increases in the number of stranded sea turtles, many showing signs of drowning; information surrounding alternative tow-time restrictions; and current regulations, management of bycatch in this shrimp fishery sector is considered a very high concern. The exception is Florida, where skimmers are required to carry TEDs to reduce turtle bycatch.

Subfactor 3.2.2 – Management Strategy and Implementation

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
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UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Moderately Effective

A main focus of shrimp management in the U.S. is mitigating bycatch, with an emphasis on endangered and threatened sea turtles. The most recent ESA Section 7 consultation Biological Opinion traces the management history; by 1992 shrimp trawlers in both regions were generally required to use TEDs in both inshore and offshore waters (NMFS 2012b). In both regions, multiple Shrimp FMP amendments (Gulf amendments 9, 10, 13 and 14; and South Atlantic amendments 2, 4 and 6) focus on bycatch reduction and/or quantification and reporting. For the most part, state management efforts on shrimp bycatch duplicate or exceed federal management. Despite continued management attention over many years, success of bycatch regulations in shrimp trawl fisheries is uncertain and debated (NMFS 2012a)(NMFS 2012b); therefore bycatch management in these sectors is considered moderately effective.

Skimmer, pusher-head, and butterfly (wing net) trawls have been exempted from TED requirements if they

operate with alternative tow-time restrictions, which mean that trawl times cannot exceed 55 or 75 minutes during specific times of the year (NMFS 2012). Such restrictions are difficult to enforce, and there is information to suggest that some fishermen are not even aware of them (NMFS 2012). Skimmer trawls are used in Louisiana, Alabama, Mississippi, North Carolina and Florida, but Florida is the only state to require TEDs in skimmer trawls (NOAA 2012a). There is a paucity of data covering the effectiveness of alternative tow- time regulations, as well be discussed in further detail below. Overall, bycatch management in the skimmer trawl shrimp sector is deemed ineffective.

UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Ineffective

A main focus of shrimp management in the U.S. is mitigating bycatch, with an emphasis on endangered and threatened sea turtles. The most recent ESA Section 7 consultation Biological Opinion traces the management history; by 1992 shrimp trawlers in both regions were generally required to use TEDs in both inshore and offshore waters (NMFS 2012b). In both regions, multiple Shrimp FMP amendments (Gulf amendments 9, 10, 13 and 14; and South Atlantic amendments 2, 4 and 6) focus on bycatch reduction and/or quantification and reporting. For the most part, state management efforts on shrimp bycatch duplicate or exceed federal management. Despite continued management attention over many years, success of bycatch regulations in shrimp trawl fisheries is uncertain and debated (NMFS 2012a)(NMFS 2012b); therefore bycatch management in these sectors is considered moderately effective.

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Subfactor 3.2.3 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met

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UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Ineffective

Observer coverage is present for otter trawls in both regions, but has always been and remains low – recent coverage rates in federal waters are generally less than 2% (NMFS 2011b). Given the rarity and endangered or threatened status of the species the fishery is impacting, particularly sea turtles, far greater observer coverage is needed to ascertain the impact of the fishery and ensure the effectiveness of regulations. Observer coverage historically has not included skimmer trawls, but observer coverage was implemented in the skimmer trawl fishery starting in 2012 to investigate possible causes for increases in sea turtle strandings

(Scott-Denton et al. 2014); however, the coverage for the skimmer fishery remains low. Due to the low observer coverage, and significant bycatch levels in shrimp fisheries, including protected species, scientific research and monitoring in all sectors is ineffective.

Subfactor 3.2.4 – 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.

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UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Moderately Effective

NOAA Fisheries reasonably coordinates information between its relevant divisions (namely Office of Protected Resources and Office of Sustainable Fisheries), and fishery independent data on the various bycatch species are incorporated. Yet despite new information about sea turtle interactions and documented compliance issues across sectors over the past few years, management has not effectively addressed these problems. Adherence to scientific advice on bycatch in otter trawl fisheries is considered moderately effective.

The use of tow time restrictions (55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31) as the primary management measure preventing sea turtle mortality in skimmer trawls is not supported by scientific advice. A recent analysis of turtle captures found that mortality rates of turtles in skimmer trawls were higher in winter than summer, and could approach about 20% within 75 minutes (the legal limit) in the winter (Sasso and Epperly 2006). Sasso and Epperly (2006) suggested that tow times no longer than 10 minutes would be needed to ensure that only negligible mortality occurred. Epperly et al. (Epperly et al. 2002) notes that "because skimmers are typically rigged to fish higher in the water column, the potential for turtle capture may be greater than a lower opening otter trawl." In addition, there is known to be a lack of awareness of tow-time regulations for skimmer trawls by fishermen (NMFS 2012a).

In 2012, the NOAA Southeast Regional Office issued a proposed rule to require TEDs in place of seasonal tow time restrictions, based on concerns with very low compliance with tow time regulations and lack of effectiveness. Later that year the proposed rule was withdrawn, following research that raised some concerns, including that the majority of turtles caught in skimmers were small enough to pass through the bar spacing in the TEDs, that TEDs weren't enforced by state law enforcement agents in Louisiana state waters where most skimmer trawl fishing occurs (note: effective August 1 2015 state law enforcement agents in Louisiana will enforce federal TED requirements), and that observer data indicated a high survival rate of captured turtles even when tow times were exceeded (of 24 observed captures in 2012, all turtles were released alive with one comatose at capture, even though 65% of the observed tows exceeded tow time regulations) (Scott-Denton et al. 2014). However, further data collection and analysis has confirmed that mortality of turtles in skimmer trawl tows remains a concern. The biological opinion issued in 2014, based on the 2012 observer date, estimated that due in large part to a compliance rate with tow time restrictions of only about 35%, an estimated 2000 turtles were killed annually in the skimmer trawl fishery (NOAA 2014). Observer data from 2014 found a higher mortality rate than the 2012 data (3 mortalities out of 10 captures, with a similar amount of observed effort) (Scott-Denton et al. 2014), indicating that the total mortality due to the skimmer trawls may be even higher. Despite the scientific concerns that have been raised regarding the insufficiency of tow time regulations, sea turtle bycatch in skimmers is not yet adequately addressed, although NOAA is currently testing TED designs with closer bar spacing for potential future implemention (Scott-Denton et al. 2014).

Thus, adherence to scientific advice regarding bycatch in the skimmer trawl sector, except Florida, is considered ineffective. Adherence to scientific advice regarding bycatch is considered moderately effective in Florida's skimmer trawl fishery. Although the effectiveness of the current TED designs in skimmer trawl fisheries is still under investigation, the requirement for skimmer trawls to use TEDs in Florida represents a precautionary approach in keeping with scientific advice that suggests regulations beyond tow times are needed.

UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Ineffective

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precautionary approach in keeping with scientific advice that suggests regulations beyond tow times are needed.

Subfactor 3.2.5 – 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 consistent enforcement of regulations and verification of compliance.

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Ineffective

Research throughout the shrimp fishery indicates that properly installed and well-maintained TEDs should result in a 95–98% sea turtle exclusion rate (NMFS 2012a), but it does not appear that this level of reduction of bycatch has been achieved. Some studies have suggested that lack of enforcement and incomplete compliance with TED regulations contributed to lower than predicted reductions in turtle strandings after TED regulations were implemented (Crowder et al. 1995)(Lewison et al. 2003)(Moore et al. 2009)(Witherington et al. 2009), and the degree of compliance with TED regulations could make the difference between recovery and continued decline for loggerhead turtles (Lewison et al. 2003). It is worthwhile to note that observers are not responsible for TED or BRD compliance checks; NMFS Office of Law Enforcement as well as the Coast Guard enforces regulations (Lightner 2012), and NMFS has a Gear Management Team (GMT), which works extensively with fishermen on awareness, training and installation of TEDs and BRDs (Barnette 2012). Recent monitoring throughout the region indicated substantial compliance issues with TEDs in the Gulf region (NOAA 2012a). These issues were more likely to be improper installation (e.g. TED grid angles) rather than lack of a TED or a TED being sewn shut, but improper installation can be of significant concern. For instance, TED grid angles that are too steep can prevent juvenile turtles from escaping the net (NMFS 2012).

Following the updated ESA Biological Opinion (NMFS 2012b), NOAA established a new TED performance standard fleetwide. Otter trawls are limited to an overall 12 percent sea turtle capture rate. A February 2012 Fishery bulletin (SERO 2013) reminded fishermen of the new management approach and performance standard. In addition, fishermen were reminded of the existing tow-time restrictions (following withdrawal of the proposed rule for skimmer trawls) (SERO 2013b). Currently, it is estimated that the shrimp otter trawl fleet is achieving and will continue to achieve a level of compliance that meets the performance standard (NOAA 2014). However, observed compliance with the tow time restrictions used as the only mandatory mitigation measure in the skimmer trawl fishery is much lower, ranging from 28 to 38 percent compliance rates on observed vessels between 2012 and 2014 (Scott-Denton et al. 2014). Enforcement of sea turtle bycatch regulations in shrimp fisheries is currently considered moderately effective in the otter trawl fishery, and ineffective in the skimmer trawl fishery.

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Moderately Effective

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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 Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Florida / Western Central Atlantic / Pushed skimmer nets / United States of America	2.00: Moderate Concern	0.25: Minimal Mitigation	3.00: Moderate Concern	Yellow (2.60)
United States of America / Atlantic / Bottom trawls / United States of America	2.00: Moderate Concern	0.25: Minimal Mitigation	3.00: Moderate Concern	Yellow (2.60)
United States of America / Gulf of Mexico / Bottom trawls / United States of America	2.00: Moderate Concern	0.25: Minimal Mitigation	3.00: Moderate Concern	Yellow (2.60)
United States of America / Gulf of Mexico / Pushed skimmer nets / United States of America	2.00: Moderate Concern	0.25: Minimal Mitigation	3.00: Moderate Concern	Yellow (2.60)

Criterion 4 Assessment

SCORING GUIDELINES

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 (*
- *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.*

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 are in place (e.g., vulnerable habitats protected but other habitats not protected); there are 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*

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 is protected with marine reserves, and 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. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*
- *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 place to mitigate these impacts*
- *2 (High Concern)—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)—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.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

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Moderate Concern

Penaeid shrimp in the Gulf and South Atlantic are found and fished on silt, mud, shelly or sandy bottoms (SAFMC 2009a){NMFS 2012a). While a number of gear modifications have been used in other regions in an attempt to reduce the impact of bottom trawling, these have not yet been required in the Gulf shrimp fishery.

It should be noted that although the majority of trawling for rock shrimp in the South Atlantic is over sandy mud-bottom, it can occur in close proximity to deepwater *Oculina* coral. However, the South Atlantic Fishery Management Council has implemented several Coral Habitat Areas of Particular Concern (HAPCs) to protect

deepwater coral (SAFMC 2009a), and is considering expansion of these areas. This combined with the fact that brown and white shrimp make up the majority of South Atlantic shrimp landings (NMFS 2013) means that shrimp trawling in the South Atlantic generally takes place over soft bottom habitat, which is of moderate concern.

Skimmer trawls do not have doors that plow through the substrate, but the tickler chains and weighted shoe strike the seafloor and re-suspend sediment (Barnette 2001). Skimmer trawls tend to be lighter-weight and of smaller capacity than otter trawls and to be used closer to shore, in state waters 3.05 m deep or less (Barnette 2001). Barnette (2001) notes that the tickler chains of skimmer trawls can snag and damage aquatic vegetation. However, one study based on underwater observations found that skimmer trawls do less damage than otter trawls (skimmer trawls do not dig up the bottom) ((Coale et al. 1994), as cited in Barnette 2001).

Barnette (2001) recommends keeping skimmer trawls out of beds of aquatic vegetation, but suggests that skimmer trawls cannot be said to do more damage than otter trawls, and possibly do less. Kennedy, Jr. (1993; as cited in Barnette 2001), however, proposed that the habitat loss caused by skimmer trawls and otter trawls are expected to be about the same. Seafood Watch considers both skimmer trawls and otter trawls used in soft bottom habitat to be a moderate concern.

Justification:

The otter trawl is the only federally-authorized gear in the South Atlantic; and continues to be the primary shrimp gear in Gulf fisheries (NMFS 2012b). Most shrimp trawlers now fish "quad- rigs", or twin trawls on each outrigger from the vessel (NMFS 2012a). Each net is 40-50 feet wide, so that an area of 160-200 feet across is trawled.

Skimmer trawls, in which a rigid beam is fixed across the mouth of the net to hold the net open, are also used in the Gulf of Mexico shrimp fishery (Barnette 2001)(GMFMC 2001). For a skimmer trawl, beam trawl nets are fixed on outriggers to skim over the seafloor on a metal shoe or skid (Barnette 2001). Skimmers do not have doors that plow through the substrate, but the tickler chains and weighted shoe strike the seafloor and re-suspend sediment (Barnette 2001). Skimmer trawls tend to be lighter-weight and of smaller capacity than otter trawls and to be used closer to shore, in state waters 3.05 m deep or less (Barnette 2001).

Factor 4.2 - Mitigation of Gear Impacts

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Minimal Mitigation

In recent years, U.S. shrimp fisheries have experienced declines in fishing effort, due to a variety of natural and human-influenced disasters and economic influences (e.g. hurricanes, oil spills, and increased fuel prices). Fishermen may modify gears to have a lighter footprint for improved fuel efficiency, which has the benefit of reducing habitat impact. However, no gear modifications are required or adopted by the entire fleet. Meanwhile, management has limited fishing through limited access permits, fishery closures, and gear restrictions. Although significant declines in fishing effort has reduced the intensity and frequency of trawling dramatically, management efforts to directly mitigate gear impacts are minimal.

Justification:

In the Gulf, license data indicate that over 900 vessels have exited the fishery over the past five years (NMFS 2012a) – likely due to the formerly open-access federal permit which 'sunset' in 2007, combined with general

economic decline. Fishing effort in the Gulf during 2008-2009 was an estimated 61% less than in 2001; and overall effort reduction in the South Atlantic between 2002 and 2009 is estimated at 38% (NMFS 2012b).

The GMFMC implements seasonal and temporary shrimp fishery closures in the Gulf of Mexico. A two-month Texas closure is designed to increase brown shrimp catches by allowing the shrimp to grow to a larger size (Coleman et al. 2004). While other fishery closures are designed to minimize gear conflicts, they have the effect of limiting fishing. Because some closures can vary by year or season, overall percentage of habitat in shrimp closures is unknown.

Factor 4.3 - Ecosystem-Based Fisheries Management

FLORIDA / WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA / GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Moderate Concern

As discussed above, regardless of the mitigating measures in place, shrimp fisheries still generate high levels of bycatch. That this bycatch has some effect on the trawled ecosystem, whether through removing juvenile fishes, decreasing populations of jellyfish and other pelagic organisms, and/or redistributing biomass from the bottom to the surface, is unquestioned (Watling 2004)(EJF 2003)(Hall et. al. 2000). The exact nature and extent of the impact remains unquantified, however---partly because no extensive untrawled areas currently exist in the Gulf/Southeast to serve as controls (Barnette 2003). Ongoing research and management actions are aimed at addressing bycatch in shrimp fisheries (NOAA 2012a).

In addition, both management councils have amended management of shrimp fisheries in response to issues related to other species' or related ecosystem concerns. As there are no explicit information and policies in place related to food web and ecosystem functioning, but the fishery is not targeting species of exceptional importance to the ecosystem, ecosystem- based fishery management is a moderate concern.

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.

Seafood Watch would like to thank Christopher Pincetich, Ph.D., Turtle Island Restoration Network, consulting researcher, Maggie Ostdahl and four anonymous reviewers for graciously reviewing this report for scientific accuracy.

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Appendix A: Extra By Catch Species

BLACKNOSE SHARK

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

High

Blacknose shark are a subtropical shark species found in the Western Atlantic, throughout the spatial extent of southeastern U.S. shrimp fisheries. They have a vulnerability score of 70, indicating high vulnerability to fishing pressure (Compagno 1984).

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Moderate Concern

Blacknose shark in the South Atlantic have been determined to be overfished, with overfishing still occurring; while stock status in the Gulf remains unknown, or a moderate concern, due to uncertainty surrounding the assessment model, which is in the process of being redone (SEFSC 2011).

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

High Concern

Blacknose shark in the South Atlantic have been determined to be overfished, with overfishing still occurring; while stock status in the Gulf remains unknown due to uncertainty surrounding the assessment model, which is in the process of being redone (SEFSC 2011).

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Moderate Concern

Estimates of numbers of individual blacknose shark bycatch in the shrimp fishery appear to have declined somewhat, and are lower in the South Atlantic than the Gulf of Mexico (NMFS 2012d). In the South Atlantic, an estimated 863 and 1,025 blacknose sharks were encountered in shrimp trawls in 2008 and 2009 respectively, roughly 3% of total catch (NMFS 2012d). In the Gulf of Mexico, an estimated 13,193 and 15,668 blacknose sharks were encountered in shrimp trawls, roughly 60% of total catch (NMFS 2012d).

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very Low Concern

Estimates of numbers of individual blacknose shark bycatch in the shrimp fishery appear to have declined somewhat, and are lower in the South Atlantic than the Gulf of Mexico (NMFS 2012d). In the South Atlantic, an estimated 863 and 1,025 blacknose sharks were encountered in shrimp trawls in 2008 and 2009 respectively, roughly 3% of total catch (NMFS 2012d). In the Gulf of Mexico, an estimated 13,193 and 15,668 blacknose sharks were encountered in shrimp trawls, roughly 60% of total catch (NMFS 2012d).

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

> 100%

Trawl gear has great potential for unselective fishing, and shrimp trawl fisheries throughout the world have the unfortunate distinction of having the highest levels of bycatch. Globally, shrimp trawls discard over 1.8 million metric tons of bycatch annually; this amounts to 62% of the total catch (landings plus discards) (Kelleher 2005). With the highest discard rate of any fishery, warmwater shrimp trawl fisheries alone are responsible for more than 27% of total estimated discards from all fisheries worldwide (Kelleher 2005).

The first U.S. National Bycatch Report estimates a national bycatch ratio (ratio of bycatch to total catch, where total catch equals landings plus bycatch) of 0.17 for all fisheries studied (NMFS 2011b). Based on 2005 data, the Gulf of Mexico shrimp trawl fishery had the nation's highest fishery bycatch-to-catch ratio of 0.76, where the annual estimate of directed landings (shrimp) was 213.5 million pounds, and bycatch was 681 million pounds (NMFS 2011b) – indicating a bycatch:landings ratio of approximately 3.2. More recent fishery-wide data on bycatch and discards is difficult to obtain, likely owing to continued low observer coverage levels (see Management discussion below).

The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).

RED SNAPPER

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Medium

Red snapper have a vulnerability score of 55, indicating medium vulnerability to fishing pressure (Allen 1985).

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

High Concern

Red snapper are currently considered overfished in both the Gulf and South Atlantic (NMFS 2012c).

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Low Concern

Red snapper are not encountered as bycatch in South Atlantic shrimp trawls; their preferred habitat does not overlap. The 2005 stock assessment for Gulf red snapper indicated that directed (red snapper) fishery mortality was 5-6 million fish; shrimp fishery discards were 25-45 million fish (GMFMC 2007), but the shrimp fishery discards are primary composed of juveniles, which have a high natural mortality rate. Similar comparisons are not available from the 2010 stock assessment. The next stock assessment update for red snapper in the Gulf is scheduled for 2013. For Gulf red snapper, overfishing is officially no longer occurring (NMFS 2012c), but there is some uncertainty about this determination.

Gulf Shrimp FMP Amendment 9 (1997) specifically required Gulf shrimp fishers to reduce bycatch fishing mortality FB of juvenile red snappers by 44% by the year 2002, as compared to FB values from the late 1980s (Gulf Synopsis 2003)(Stevens 2003). For juvenile red snapper, NOAA (NOAA 2004) found a reduction in the bycatch fishing mortality rate of only 11% due to BRDs, far lower than the 44% reduction required by the Gulf Shrimp FMP Amendment 9 (GMFMC 1997), although according to personal communications with fisheries scientists, bycatch mortality was actually reduced by at least 50% between 1997-2002 (Stevens 2003). More recently, Gulf Shrimp FMP Amendment 14 required a 74% reduction in the bycatch mortality rate of red snapper relative to the 2001-2003 baseline (GMFMC 2007). An analysis projects that because red snapper bycatch mortality has been found to be directly proportional to shrimping effort in the 10-30 fathom depth zone, this reduction has been exceeded through reduced effort in the shrimp fishery alone (an 84% decline since 2001-2003 baseline in the 10-30 fathom depth zone) (LGL Ecological Research Associates 2009). Red snapper mortality is likely to have declined even more than 84% taking into account the mandatory use of effective BRDs. Some models and analysis suggest that red snapper may currently be limited by juvenile habitat availability or by predation by other bycatch species, which are currently increasing as shrimp trawling effort declines (Walters et al. 2008)(Gallaway et al. 2009).

The shrimp fishery is one of the major contributors to mortality of juvenile red snapper, but mandated BRDs are in place to reduce snapper (and other finfish) bycatch (NMFS 2012c) and analysis indicates red snapper mortality has declined as required by management goals.

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

> 100%

Trawl gear has great potential for unselective fishing, and shrimp trawl fisheries throughout the world have

the unfortunate distinction of having the highest levels of bycatch. Globally, shrimp trawls discard over 1.8 million metric tons of bycatch annually; this amounts to 62% of the total catch (landings plus discards) (Kelleher 2005). With the highest discard rate of any fishery, warmwater shrimp trawl fisheries alone are responsible for more than 27% of total estimated discards from all fisheries worldwide (Kelleher 2005).

The first U.S. National Bycatch Report estimates a national bycatch ratio (ratio of bycatch to total catch, where total catch equals landings plus bycatch) of 0.17 for all fisheries studied (NMFS 2011b). Based on 2005 data, the Gulf of Mexico shrimp trawl fishery had the nation's highest fishery bycatch-to-catch ratio of 0.76, where the annual estimate of directed landings (shrimp) was 213.5 million pounds, and bycatch was 681 million pounds (NMFS 2011b) – indicating a bycatch:landings ratio of approximately 3.2. More recent fishery-wide data on bycatch and discards is difficult to obtain, likely owing to continued low observer coverage levels (see Management discussion below).

The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).

SMALLTOOTH SAWFISH

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

High

Smalltooth sawfish are tropical rays, with limited studies to suggest that they have a high intrinsic vulnerability score of 86, or a very high vulnerability to fishing pressure (NMFS 2012b)(Last and Stevens 1994).

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Very High Concern

The U.S. Distinct Population Segment (DPS) of smalltooth sawfish is listed as endangered under the ESA. Data

are very limited, but Simpendorfer (Simpendorfer 2000) used anecdotal data to estimate population levels to be 5% of historic abundance; currently the only known reproducing population is in south and southwest Florida.

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

Moderate Concern

There has never been much of a directed fishery for smalltooth sawfish; the primary reason for their significant decline in abundance is due to them becoming bycatch in other commercial and recreational fisheries (NMFS 2012b). Fishing mortality due to shrimp fishing is unknown, or a moderate concern. One of the reasons for a re-initiated Section 7 consultation and Biological Opinion under the Endangered Species Act was that 2005 shrimp fishery observer data indicated that the incidental take of smalltooth sawfish had been exceeded (NMFS 2012b).

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA

> 100%

Trawl gear has great potential for unselective fishing, and shrimp trawl fisheries throughout the world have the unfortunate distinction of having the highest levels of bycatch. Globally, shrimp trawls discard over 1.8 million metric tons of bycatch annually; this amounts to 62% of the total catch (landings plus discards) (Kelleher 2005). With the highest discard rate of any fishery, warmwater shrimp trawl fisheries alone are responsible for more than 27% of total estimated discards from all fisheries worldwide (Kelleher 2005).

The first U.S. National Bycatch Report estimates a national bycatch ratio (ratio of bycatch to total catch, where total catch equals landings plus bycatch) of 0.17 for all fisheries studied (NMFS 2011b). Based on 2005 data, the Gulf of Mexico shrimp trawl fishery had the nation's highest fishery bycatch-to-catch ratio of 0.76, where the annual estimate of directed landings (shrimp) was 213.5 million pounds, and bycatch was 681 million pounds (NMFS 2011b) – indicating a bycatch:landings ratio of approximately 3.2. More recent fishery-wide data on bycatch and discards is difficult to obtain, likely owing to continued low observer coverage levels (see Management discussion below).

The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish

bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).

GULF STURGEON

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

High

Gulf sturgeon are a subspecies of Atlantic sturgeon, and as such are also long-lived, late- maturing, highly vulnerable species. Estimates of numbers of individuals vary, but it appears Gulf sturgeon population abundances in the eastern part of their range are stable or slightly increasing, while population trends in the western range are less clear (NOAA 2012b).

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very High Concern

Atlantic sturgeon are grouped into DPS throughout their U.S. range, with most of these estimated to have less than 300 spawning adults. The Carolina DPS and South Atlantic DPS are listed as endangered under the ESA. The South Atlantic DPS may have more spawning adults, but is still estimated to be 6% of its historical population size.

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very Low Concern

The decline in Atlantic sturgeon was brought about by intense directed fishing mortality; continued bycatch in other commercial fisheries is limiting their recovery. In the case of Gulf Sturgeon, all directed fishing ceased in 1990. Shrimp trawl mortality on Gulf sturgeon is likely extremely rare: the first observed incidental take was in 2009 and was released alive. Still, the incident indicated the possibility that endangered Gulf sturgeon may be encountered by shrimp trawls (NMFS 2012b). Since the shrimp fishery is not a substantial contributor to mortality, fishing mortality is considered a very low concern.

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

> 100%

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The first U.S. National Bycatch Report estimates a national bycatch ratio (ratio of bycatch to total catch, where total catch equals landings plus bycatch) of 0.17 for all fisheries studied (NMFS 2011b). Based on 2005 data, the Gulf of Mexico shrimp trawl fishery had the nation's highest fishery bycatch-to-catch ratio of 0.76, where the annual estimate of directed landings (shrimp) was 213.5 million pounds, and bycatch was 681 million pounds (NMFS 2011b) – indicating a bycatch:landings ratio of approximately 3.2. More recent fishery-wide data on bycatch and discards is difficult to obtain, likely owing to continued low observer coverage levels (see Management discussion below).

The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).

ATLANTIC STURGEON

Factor 2.1 - Inherent Vulnerability

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

High

Atlantic sturgeon show clinal variation, with earlier maturation in the southern portions of their range. However, they are a long-lived species with egg production concentrated later in life, and they may not spawn every year. Atlantic sturgeon are considered to have a high vulnerability (85 out of 100) (Page and Burr 1991).

Factor 2.2 - Abundance

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very High Concern

Atlantic sturgeon are grouped into DPS throughout their U.S. range, with most of these estimated to have less than 300 spawning adults. The Carolina DPS and South Atlantic DPS are listed as endangered under the ESA. The South Atlantic DPS may have more spawning adults, but is still estimated to be 6% of its historical population size.

Factor 2.3 - Fishing Mortality

UNITED STATES OF AMERICA/GULF OF MEXICO, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA
FLORIDA/WESTERN CENTRAL ATLANTIC, PUSHED SKIMMER NETS, UNITED STATES OF AMERICA
UNITED STATES OF AMERICA/GULF OF MEXICO, BOTTOM TRAWLS, UNITED STATES OF AMERICA

Very Low Concern

The decline in Atlantic sturgeon was brought about by intense directed fishing mortality; continued bycatch in other commercial fisheries is limiting their recovery. In the case of Gulf Sturgeon, all directed fishing ceased in 1990. Shrimp trawl mortality on Gulf sturgeon is likely extremely rare: the first observed incidental take was in 2009 and was released alive. Still, the incident indicated the possibility that endangered Gulf sturgeon may be encountered by shrimp trawls (NMFS 2012b). Since the shrimp fishery is not a substantial contributor to mortality, fishing mortality is considered a very low concern.

Factor 2.4 - Discard Rate

UNITED STATES OF AMERICA/ATLANTIC, BOTTOM TRAWLS, UNITED STATES OF AMERICA

> 100%

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The above estimates from the National Bycatch report should be considered best estimates, but there has been a great deal of work in previous years to accurately quantify bycatch in fisheries, and indications that shrimp trawl bycatch has been reduced. NMFS data suggests a ratio of 10:1 existed in the 1970s, before measures were put in place to reduce growth overfishing of shrimp (Leard 1999). Using landings and discard

data from before the fleetwide BRD requirement was implemented, and incorporating a bycatch reduction rate of 16.5%, Harrington et al. (2006) estimated that bycatch:shrimp landing ratios in the Gulf of Mexico and South Atlantic under the new regulations were 4.56 and 2.95, respectively. However, the less effective bycatch reduction devices have recently been decertified, and effective May 2009, BRD designs that reduce finfish bycatch by at least 30% are required (Southeast Fishery Bulletin 2008). Applying a 30% reduction in bycatch to the bycatch and landings data used in Harrington et al. (Harrington et al. 2006), we calculated a bycatch ratio of about 2.6 in the south Atlantic and 4.0 in the Gulf of Mexico. The skimmer trawl fishery has a lower bycatch rate than the otter trawl fishery, though the bycatch: shrimp ratio still exceeds 100%. According to the most recent (2014) observer data, penaeid shrimp catch was estimated to account for 35% of the total weight of the skimmer trawl catch, with a bycatch to landings ratio of 1.94 (Scott-Denton et al. 2014).