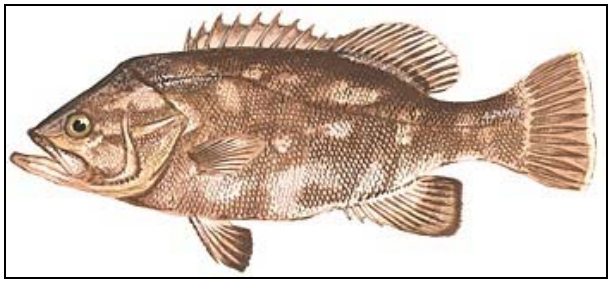
Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

Wreckfish
(Polyprion americanus)



Courtesy: SAFMC

Final Report
April 5, 2004

Melissa Mahoney Stevens
Fisheries Research Analyst
Monterey Bay Aquarium

About Seafood Watch® and the Seafood Reports

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

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

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

Disclaimer

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

Seafood Watch® and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation.

Executive Summary

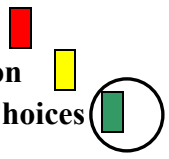
The wreckfish (*Polyprion americanus*) is a large (> 3ft/100 cm total length, TL), long-lived bass-like species living in deep (to 1,000 m) water around the world's temperate oceans. The stock found off the U.S. Atlantic coast (Blake Plateau) is part of a North Atlantic ocean-wide population whose members are advected and mixed by a large, clockwise oceanic gyre. Microsatellite genetic markers show that wreckfish in the North Atlantic and Mediterranean represent one stock. The species is characterized by an extended pelagic juvenile stage (2-3 years) associated with floating objects, or wreckage, hence the name 'wreckfish'. Upon settling, wreckfish may take up to 8 years to fully mature and may live 30-40 years. This species has a limited habitat niche (steep vertical relief), which may increase vulnerability to fishing pressure. The U.S. fishery expanded rapidly 1987 and landings then decreased following implementation of regulations in 1990, and a reduction in fishing effort that followed. Upon implementation of an ITQ system with an annual quota and seasonal closures, catch has stabilized and fleet size has been reduced significantly, lessening the probability that overfishing is occurring. The fishing method used to catch wreckfish, hydraulic hook and line, has minimal bycatch and habitat impacts. Management has acted in a proactive and responsible way to maintain stocks through the implemented regulations stated above.

Table of Ranks

List of Five Component Ranks	Green	Yellow	Red	**CRITICAL**
Inherently Vulnerability		√		
Status of Stocks		√		
Nature of Bycatch	√			
Habitat Effects	√			
Management Effectiveness	√			

Overall Seafood Rank:

Avoid
Caution
Best Choices



Introduction

The wreckfish (*Polyprion americanus*) is a relatively long-lived bass-like species inhabiting deep waters (40 to 1,000 m) on both sides of the North Atlantic Ocean (including the Mid-Atlantic Ridge), the Mediterranean, western South Pacific, and southern Indian Oceans (Carpenter 2002). It is only found in temperate waters, but is absent from the eastern and North Pacific Ocean. In the North Atlantic Ocean, this species has a unique ocean-wide distribution due to an extended pelagic juvenile stage that is subjected to a clockwise gyre of currents, including the Gulf Stream (Sedberry et al. 2001). Microsatellite genetic markers show that wreckfish in the North Atlantic and Mediterranean represent one stock (Ball et al. 2000). Off the U.S. Atlantic coast, adult wreckfish are found primarily on the Blake Plateau (Fig. 1). Originally thought to be rare in the western Atlantic, wreckfish were discovered in the early 1980s by a fisherman recovering lost gear, and have supported a directed commercial fishery on the bottom-dwelling adults since 1987 (GAO 2002).

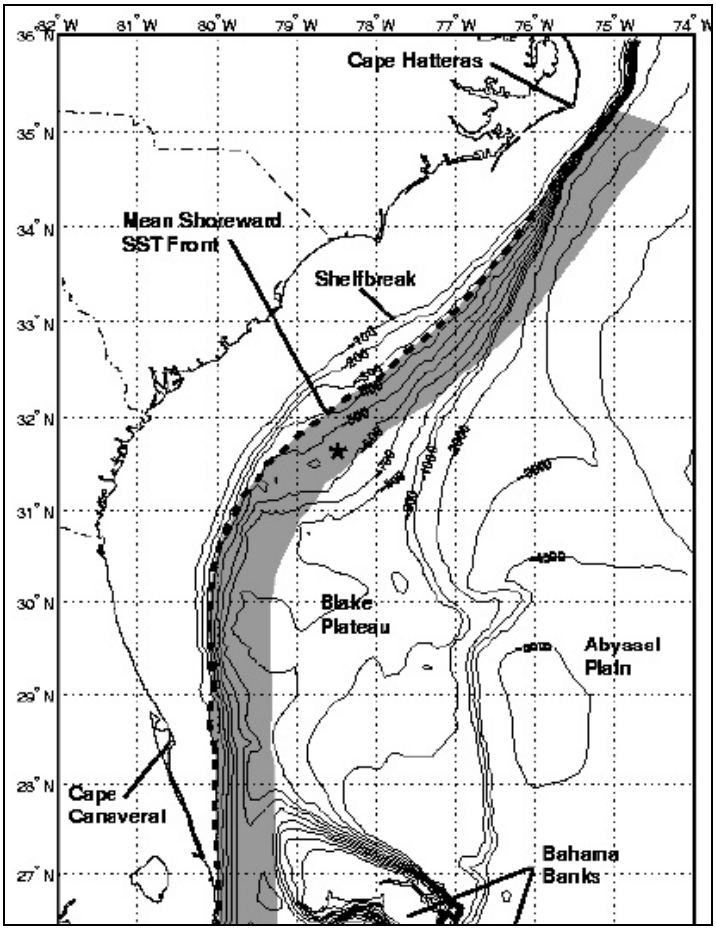


Figure 1. Bathymetric map of the Blake Plateau, with the Charleston Bump represented by an asterisk (Bane et al. 2001).

Scope of the analysis and the ensuing recommendation:

There are several fisheries for wreckfish prosecuted in the North Atlantic basin (Fig. 2). However, there appears to be few or no imports of wreckfish into the U.S. Therefore, this report evaluates the U.S. fishery only. It is important to bear in mind, though, that fishing in other areas of the North Atlantic likely affects the U.S. stock.

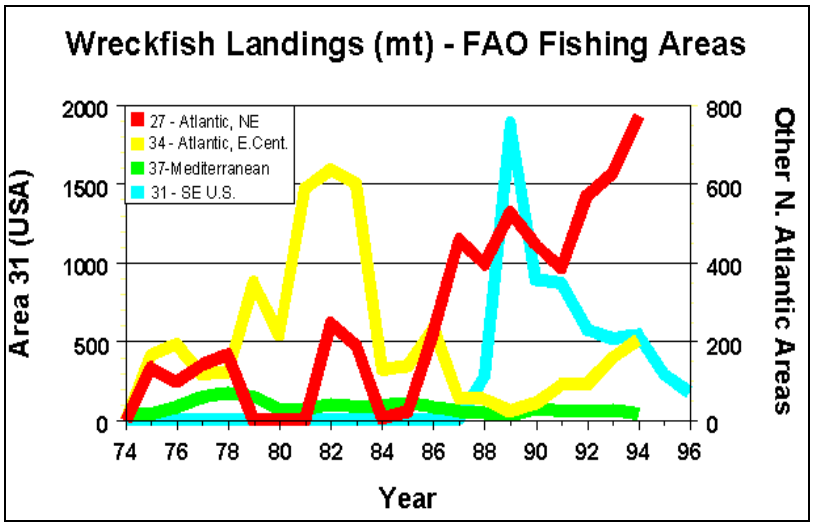


Figure 2. FAO reported wreckfish landings in the northeast Atlantic (Sedberry 2003).

Availability of Science

There is sufficient life history information for the wreckfish, particularly with respect to the U.S. stock. Age and growth characteristics have been estimated and validated in peer-reviewed literature (Sedberry et al. 1999; Vaughan et al. 2001). Population dynamics and dispersal are being studied through genetic markers. Intrinsic rate of increase (r) values are unknown.

Market Availability

Common/Market names

The wreckfish has no other distinct market name except 'sea bass' (Food and Drug Administration website[1]).

Seasonal Availability

The fishery is open from April 16 to January 14 of each year. Depending on fishing effort, wreckfish is available during those times.

Product forms

Wreckfish are sold fresh or frozen as a market substitute for snapper and grouper (GAO 2002).

Import/export Statistics

There are no records of imports or exports of wreckfish through U.S. Customs Districts; international trade is thought to be minimal[2].

Analysis of Criteria

Criterion 1: Inherent Vulnerability to Fishing Pressure

The life history characteristics of the wreckfish reflect its deep-living existence, with slow growth, later age at maturity, and a relatively long life. This species has a broad but genetically distinct oceanic distribution and is found in areas with high vertical relief (Sedberry 2003).

[1] http://www.cfsan.fda.gov/

[2] George Sedberry. Personal Communication. South Carolina Department of Natural Resources, Marine Resources Research Institute, PO Box 12559, Charleston SC 29422-2559.

Consequently, wreckfish stocks may show high site fidelity to certain areas with deep ledges, caves, and outcrops (Sedberry et al. 2001). This type of habitat is limited and may increase vulnerability to overfishing.

Age and growth studies on the U.S. (western North Atlantic) stock indicate wreckfish reach a maximum age of 30-40 years (Sedberry et al. 1999; Vaughan et al. 2001). The growth rate (k value[3]) is approximately 0.03/yr (sexes combined; Vaughan et al. 2001). Wreckfish may reach a maximum length of up to 6.5 feet TL (~2 m, 100 kg) and commonly exceed 3 feet (100 cm) and 30 lb (15 kg; Sedberry et al. 2001). Sexual dimorphism is apparent in that males are usually smaller than females at the same age (Wyanski and Meister 2002). Age at full maturity is approximately 8 yr (84 cm) for females (Vaughan et al. 2001). Length at 50% maturity in females is approximately 790 mm, and all females over 850 mm are mature. Males appear to be fully mature after reaching 700 mm length (Wyanski and Meister 2002).

The Blake Plateau/Charleston Bump area off the U.S. Atlantic coast is currently the only documented spawning area for wreckfish in the North Atlantic (Sedberry 2003); however unpublished observations from fish caught on the mid-Atlantic ridge indicate that wreckfish probably spawn there (G. Sedberry, pers. comm.). Here, wreckfish spawn primarily in February and March (Wyanski and Meister 2002; Sedberry 2003). Fecundity estimates for the western Atlantic stock ranged from 1.4 to 4.1 million eggs for fish 933 to 1,280 mm total length (TL; (Wyanski and Meister 2002). Spawned larvae develop into pelagic juveniles as they drift in a northeasterly direction with the Gulf Stream and approach eastern North Atlantic islands such as the Azores and Madeira (Sedberry et al. 1996; Sedberry 2003). This migration is thought to take 4.5-6.5 months, and a complete circuit of the North Atlantic (from Blake Plateau to eastern Atlantic and back) could be done in approximately 9 to 11 months (Sedberry 2003). Juveniles are pelagic and remain in surface waters for 2-3 years (~ 60 cm) before settling out (Sedberry et al. 1999). The low abundance of juvenile wreckfish in the western North Atlantic supports this migration pattern (Sedberry et al. 2001).

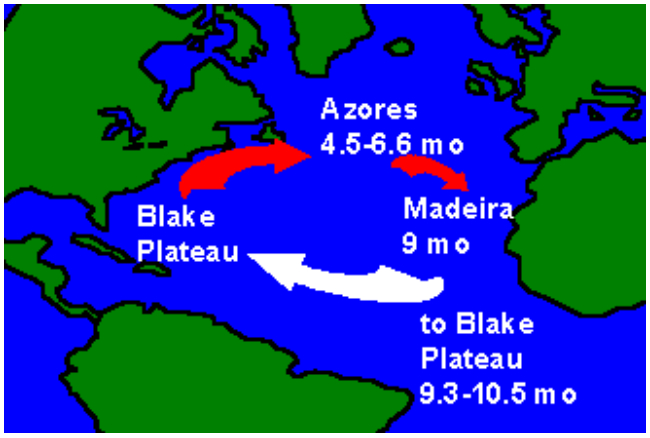


Figure 3. Major circulation patterns in the North Atlantic, indicating possible dispersal and movements of pelagic juvenile wreckfish from U.S. spawning grounds. Probable transit times in months (mo) are from values given by the Defense Mapping Agency charts (1973).

[3] The value 'k' is the growth coefficient from a widely used fish growth model, the von Bertalanffy growth funtion, VBGF.

Synthesis
The wreckfish is thought to live 30 years or more and the western Atlantic population is not fully mature until approximately age eight. Fecundity estimates indicate reproductive potential is relatively high. This species is found in multiple ocean basins (although genetic studies on wreckfish between oceans have revealed the presence of genetically distinct sub-stocks) and is shown to exhibit site fidelity due to distinct habitat needs, especially off the U.S. coast (e.g. Charleston Bump). The limited availability of deep rocky slopes may make this species more susceptible to fishing pressure. Based on these factors, wreckfish vulnerability to fishing pressure is considered moderate.

Inherent Vulnerability Rank: Vulnerable ☐ **Moderate** ☐ Resilient ☐

Criterion 2: Status of Wild Stocks

History of U.S. Fishery
The fishery for wreckfish began in earnest in 1987 off Georgia and South Carolina in an area known as the Charleston Bump. This area is characterized by a deep, north-facing scarp starting in about 500 m of water and leveling off at about 630 m (Sedberry 2003). Once the wreckfish stock was discovered there, the fishery expanded rapidly. Landings in 1989 (4.2 mil lbs) were almost seven times greater than 1988 landings (618,000 lbs; Fig. 4) (Vaughan et al. 2001). A management plan was implemented in 1990 to regulate catch and prevent overfishing. Part of the plan was the creation of an Individual Transferable Quota (ITQ) Program, which took effect in 1992 (NOAA 2001). Since then landings have been at or below the total allowable catch (TAC) of 2 million lbs (907 mt), and the fishery has decreased in size. For example, in 1991 there were 38 active vessels, but by 1997 only 7 remained (Vaughan et al. 2001). In 2000, only three vessels reported wreckfish landings totaling about 168,000 pounds—or about 8 % of the total allowable catch (GAO 2002). The reason for fishers leaving the wreckfish fishery has been attributed to high gear expense, fishing difficulties (lines must be set in deep water and high Gulf Stream currents), and decreased demand for the product[4].

[4] Based on statements made by individual fishers in the wreckfish ITQ Program, Samuel Ray and John Gauvin. Comments available at: http://www.lobsterconservation.com/wreckfish.

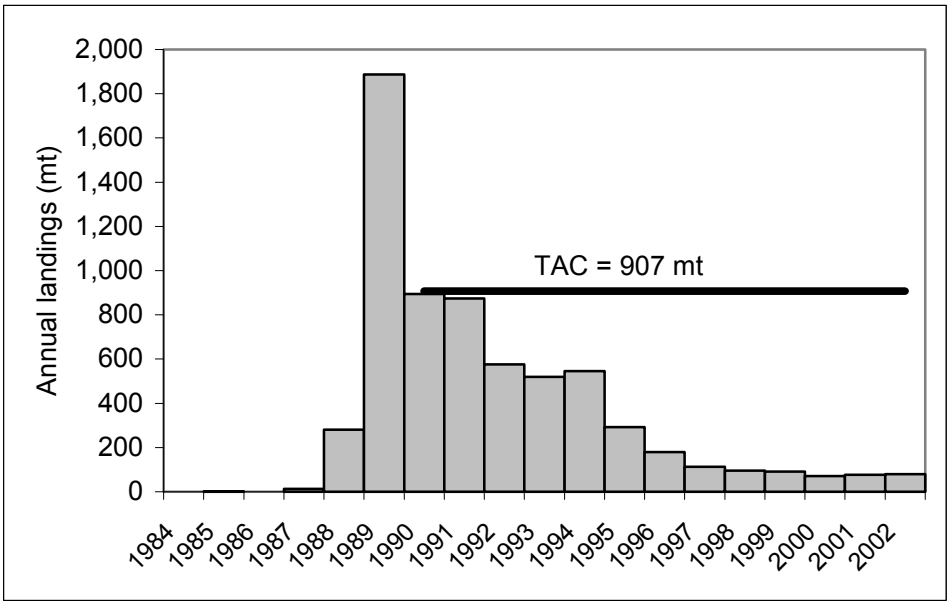


Figure 4. Annual commercial wreckfish landings, 1984-2002[5]. (Courtesy G. Sedberry and D. Vaughan, personal data).

Status of U.S. stock

The latest published stock assessment for the Blake Plateau wreckfish was conducted by Vaughan et al. (2001) and used a calibrated virtual population analysis (FADAPT) to estimate fishing mortality and population biomass. Data available for the study included historical landings, annual length-frequency distributions (from commercial catch), and annual or seasonal age-length keys (from otoliths of commercially caught fish). Natural mortality (M) was estimated from life history characteristics and three values were applied to the model. Catch per unit effort (CPUE) came from logbook data for participating vessels.

The CPUE data shows a decrease from 1991 to 1996, and a general increase up to 2002 (Fig. 5). The initial decline may be due to overfishing prior to 1994, which lead to a depressed stock condition (Vaughan et al. 2001). Mean weight of individually caught fish has been stable over time (Fig. 6). If the stock is not being supplemented by recruitment from the eastern North Atlantic, then this is an indication that stock biomass has not been compromised. There are no data to support an isolated U.S. stock, however, so the former possibility of recruitment may delay signs of overfishing for a 14-16 year period (based on the modal age in the fishery; Vaughan et al. 2001).

[5] 2002 data are preliminary (Vaughan 2003).

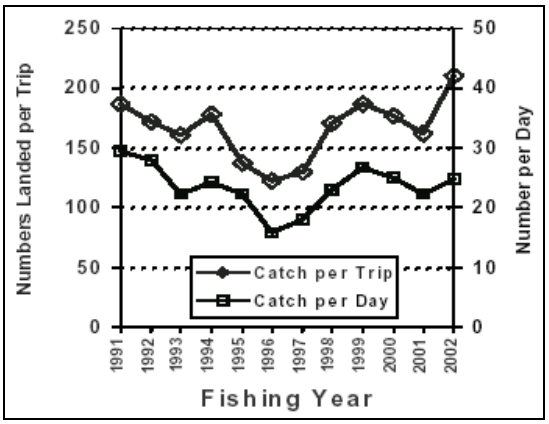


Figure 5. Wreckfish landings in numbers CPUE (trips or days) from logbooks, 1991-2002 fishing years (Vaughan 2003).

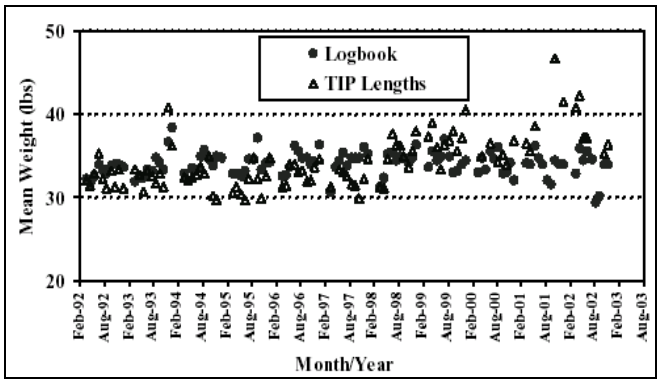


Figure 6. Mean weight (lbs) of wreckfish from logbooks and biological sampling, 1992-2002 (Vaughan 2003).

Stock biomass (as analyzed by FADAPT) has generally declined from 1991 to 1998. Biomass of ages 7+ in 1998 has decreased to 10-14% of 1988 levels (based on $M=0.1yr^{-1}$) (Vaughan et al. 2001). However, recruitment at age seven and annual estimates of spawning potential ratio (SPR, inverse of fishing mortality) have risen since 1994 (Fig. 7). The sex distribution (male: female ratio) in fishery-dependent samples was reported to be 1:1.77 in 1989-1993, and 1:0.73 in 2000-2002, indicating a decrease in the abundance of females in the population (Wyanski and Meister 2002). The ratio was similar to those observed in other fished populations off New Zealand (1:0.86; Roberts 1989 *in* Wyanski and Meister 2002).

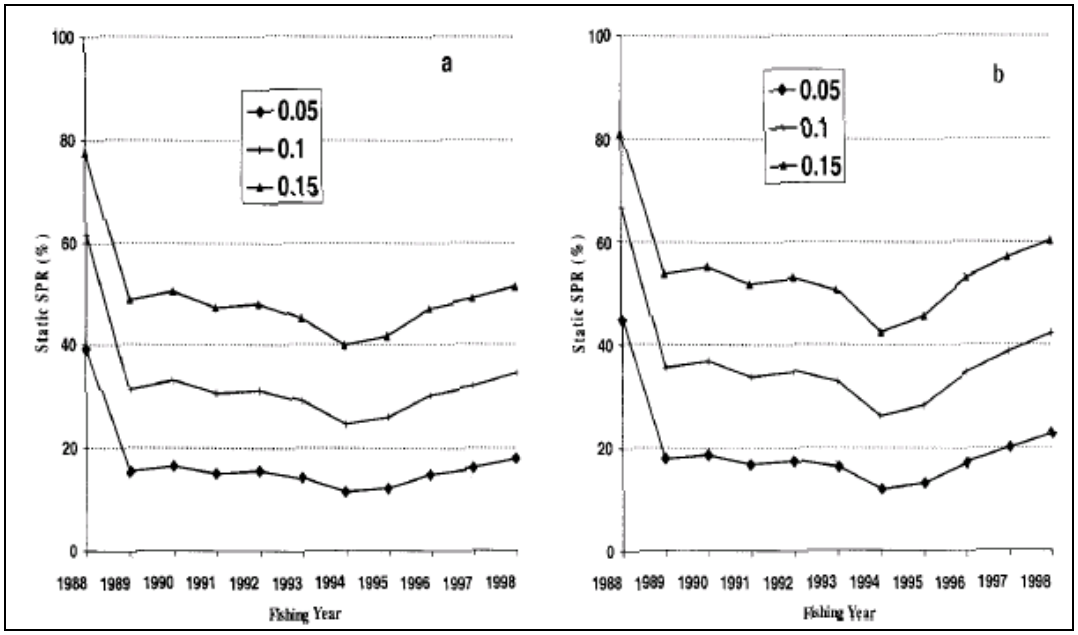


Figure 7. Estimates of static spawning potential ratio (SPR) of wreckfish from FADAPT with three levels of natural mortality (M) based on a) annual, and b) seasonal catch matrices for 1988–1998 (Vaughan et al. 2001).

The stock assessment is somewhat inconclusive with respect to overfishing due to uncertainty with respect to natural mortality (M). Researchers applied three different estimates of M, which translated to the following ranges of SPR:

Natural Mortality Estimate (M)	SPR range
0.05	12-14%
0.10	26-34%
0.15	43-48%

The overfishing threshold as defined by SAFMC is 30% of SPR, so an accurate estimate of M is critical in determining whether overfishing is occurring. According to Vaughan et al. (2001), "values of M lower than 0.1 yr^{-1} will suggest increasing concern for overfishing, while values of M greater than 0.1 yr^{-1} will suggest decreasing concern. Based on current ageing techniques with a maximum age of 39 observed in the two studies, M is probably close to or slightly greater than 0.1 yr^{-1}" (p. 116). Essentially, the authors have concluded a lower probability of overfishing occurring, but cannot be sure without a robust estimate of M.

Although the assessment elucidated certain trends in stock status and fishing pressure, it is problematic in that it does not address whether the stock is indeed overfished, but only whether overfishing is occurring. In addition, the assumption that the U.S. stock was separate from the eastern Atlantic population was made, even though genetic evidence suggests one stock in the entire North Atlantic (Vaughan et al. 2001). If mixing does occur (and most research suggests that it does) then stock status may only be assessed after considering fishing mortality and stock structure of eastern North Atlantic populations. This kind of analysis has not yet been undertaken due primarily to lack of data for the eastern Atlantic stock.

Synthesis

Some signs (recruitment of age-7 individuals, increase in CPUE and SPR values, stable mean weight) indicate a positive trend in wreckfish stock biomass. However, conclusions are severely limited by the potential violation of the single stock assumption and uncertainty with respect to mortality. Therefore, stock status should be regarded with caution.

Status of the Stocks Rank: Critical ☐ Poor ☐ **Caution** ☐ Healthy ☐

Criterion 3: Nature of Bycatch

There are no data relating to bycatch in the wreckfish fishery. However, fishers have caught minor amounts of various species such as barrelfish (*Hyperoglyphe perciformis*), red bream (*Beryx decadactlyus*), and spiny dogfishes (*Squalus acanthias and cubensis*)[6]. Such incidental minor take is of low concern, particularly when it is utilized.

Nature of Bycatch Rank: Critical ☐ High ☐ Medium ☐ **Low** ☐

[6] Samuel Ray. Personal Communication. Commercial Wreckfish fisherman. Charleston, South Carolina (843-571-5844).

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

The wreckfish is fished over the Blake Plateau in areas of moderate to strong current using heavy-duty hydraulic reels spooled with 1/8 inch thick cable (Sedberry 2003). The fishing end of the cable is weighted with 50-200 lbs and 3 to 20 large circle hooks baited with squid are attached (Fig. 8). The hooks are paid out until they reach the bottom, they are then reeled up a few feet to prevent snagging. The boat maintains low speed headed into the current during fishing (G Sedberry, S. Ray. Pers. comm.).

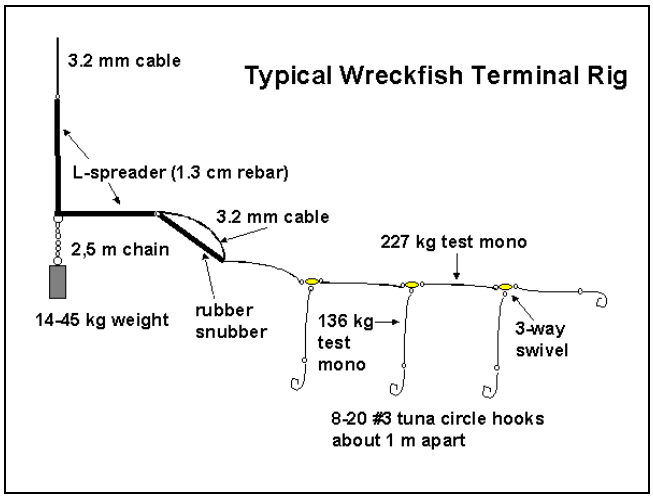


Figure 8. Drawing of fishing gear used to catch wreckfish (Sedberry 2003).

Synthesis

Although there may be an occasional interaction with bottom habitat through hook snagging, it is most likely avoided by fishers because of the obvious disadvantage (fouling of gear). Lost gear may have cause damage to some habitat, but quantifying such impacts is nearly impossible. Given the present gear type and skill level, there appears to be little effect of fishing on habitat structure. The ecosystem impacts of fishing/removing wreckfish from the Blake Plateau area are unknown.

Effect of Fishing Practices Rank: Critical ☐ Severe ☐ Average ☐ **Benign** ☐

Criterion 5: Effectiveness of the Management Regime

Wreckfish is included in the Snapper-Grouper Fishery Management Plan (FMP) and managed by South Atlantic Fishery Management Council (SAFMC). The fishery was unregulated during its first three years (1987-1989). During that time the fleet and catches grew exponentially. Concern about overfishing prompted the SAFMC to act. In 1990 a TAC was set at two million pounds (907 mt), half the record catch in 1989. The implementation of a quota caused a 'derby-style' fishery that year as fishers raced to catch their share. The TAC was reached half way through the season and the fishery had to be shut down (Vaughan et al. 2001). In 1992 an Individual Transferable Quota (ITQ[7]) system was implemented. An ITQ system guarantees each

[7] An ITQ (or IFQ) is an allocated privilege to land a specified portion of the total annual fish catch in the form of quota shares. Quota shares designate how the total annual fish catch (i.e., the TAC) is to be divided into specified portions for individual quota holders. ITQ management differs from the traditional open access for commercial

fisher a share of the catch, thus eliminating the "race to fish" and allowing fishermen flexibility over the rate and timing of their fishing (Buck 1995). This kind of program has been proven to decrease fishing capacity, improve safety and market value of the catch, and conserve fish stocks and habitat (Buck 1995). Each ITQ holder is required to submit a fish ticket describing location, effort (days or hours fished) and volume of each catch, which is used to assess fishing mortality and stock status. The system seems to have succeeded in its goals, as fishing capacity and pressure have decreased to a reasonable level. Other management measures include a closure of the fishery during the main spawning period from January 15 to April 15 each year. Catch statistics prior to this closure indicated vastly increased catches and CPUE during this period, perhaps because of aggregation of wreckfish during spawning. Monitoring of catch is conducted through fish tickets and dockside sampling.

Synthesis

Management has conducted a stock assessment (although with inconclusive results) and regularly monitors commercial catch and logbook data. There do not appear to be any regulations related to bycatch or habitat protection, probably because such measures are unnecessary (bottom hook and line). Although the stock status of U.S. wreckfish is inconclusive, it appears that management has taken appropriate steps to assess stock status, prevent overfishing, and maintain the integrity of the stock.

Effectiveness of Management Rank

Critical ■ Ineffective □ Moderately effective □ **Highly effective** □

Overall Evaluation and Seafood Ranking

The wreckfish (*Polyprion americanus*) is a long-lived species living in deep (to 1,000 m) water around the world's temperate oceans (except the North Pacific). The stock off the U.S. Atlantic coast (Blake Plateau, off South Carolina) is part of a North Atlantic basin-wide population, whose members are advected and mixed by a large, clockwise oceanic gyre. The species is characterized by an extended pelagic juvenile stage (2-3 years) associated with floating objects. Upon settling, wreckfish may take up to 8 years to fully mature and may live 30-40 years. The U.S. stock is thought to be in a stage of decreased abundance due to heavy fishing in years prior to regulation of the fishery (before 1990). Upon implementation of an ITQ system with an annual quota and seasonal closures, catch has stabilized and fleet size has been reduced, lessening the probability that overfishing is occurring. Whether the stock is presently overfished is uncertain. The fishing method used to catch wreckfish, hydraulic hook and line, is assumed to have minimal bycatch and habitat impacts. Management has acted in a proactive and responsible way to maintain stocks through the implemented regulations stated above.

Overall Seafood Rank: Avoid □ Proceed with Caution □ **Best Choices** □

---

fisheries in that, for open access, there is no individual limitation on catch, and thus no individual responsibility for stock conservation (Buck 1995).

Acknowledgements

The Seafood Watch staff would like to thank Dr. George Sedberry and Dr. David Wyanski of the South Carolina Department of Natural Resources, Marine Research Institute, as well as one anonymous reviewer, for their review of this report. Samuel Ray, wreckfish fisherman, provided detailed descriptions of the fishery and we thank him as well.

Scientific review does not constitute an endorsement of Seafood Watch on the part of the reviewing scientists. The Seafood Watch staff is solely responsible for the conclusions reached in this report.

Literature Cited

Ball, A. O., G. Sedberry, M. S. Zatcoff, R. W. Chapman and J. L. Carlin. 2000. Population structure of the wreckfish *Polyprion americanus* determined with microsatellite genetic markers. *Marine Biology* 137: 1077-1090.

Bane, J. M., L. P. Atkinson and D. A. Brooks. 2001. Gulf Stream physical oceanography at the Charleston Bump: deflection, bimodality, meanders and upwelling. *In*: Island in the Stream: Oceanography and Fisheries of the Charleston Bump. G. Sedberry, American Fisheries Society Symposium, Bethesda MD. 25**:** 3-24.

Buck, E. H. 1995. Individual Transferable Quotas in Fishery Management, CRS Report for Congress. National Library for the Environment. http://www.ncseonline.org/NLE/CRSreports/Marine/mar-1.cfm?&CFID=12699160&CFTOKEN=30843204

Carpenter, K. E. 2002. The living marine resources of the Western Central Atlantic. Volume 2: Bony fishes part 1 (Acipenseridae to Grammatidae). FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and herpetologists Special publication No. 5. FAO**:** 1297-1298. Rome Italy.

GAO. 2002. Individual Fishing Quotas, Better Information could improve program management. Government Accounting Office, Report to the Chairman and Ranking Minority Member, Subcommittee on Oceans, Atmosphere, and Fisheries, Committee on Commerce, Science, and Transportation, U.S. Senate**:** 56pp. http://www.conservefish.org/site/GAOIFQ.pdf

NOAA. 2001. Proposed Information Collection; Comment Request; Economic Data Collection for the Atlantic Wreckfish Fishery. *Federal Register* 66(235): 63371. http://csrc.nist.gov/publications/fips/fips197/fips197-frn.pdf

Sedberry, G. 2003. Fishery Biology, Life History and Genetic Population Structure of Globally-distributed Wreckfish, *Polyprion americanus*. South Carolina Department of Natural Resources. http://www.dnr.state.sc.us/marine/mrri/wreckfish/wreckfish.html.

Sedberry, G., C. A. P. Andrade, J. L. Carlin, R. W. Chapman, B. E. Luckhurst, C. S. I. Manooch, G. Menezes, B. Thomsen and G. F. Ulrich. 1999. Wreckfish *Polyprion americanus* in the North Atlantic: Fisheries, Biology, and Management of a widely distributed and long-lived fish. *In*: Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals. J. Musick.

Sedberry, G., J. L. Carlin, R. W. Chapman and B. Eleby. 1996. Population structure in the pan-oceanic wreckfish, Polyprion americanus (Teleostei: Polyprionidae), as indicated by mtDNA variation. *J Fish Biology* 49 (Supp. A): 318-329.

Sedberry, G., J. C. McGovern and O. Pashuk. 2001. The Charleston Bump: An Island of Essential Fish Habitat in the Gulf Stream. *In*: Island in the Stream: Oceanography and

Fisheries of the Charleston Bump. G. Sedberry, American Fisheries Society Symposium, Bethesda MD. 25**:** 3-24.

Vaughan, D. S. 2003. Data summary of southeastern US Atlantic wreckfish stock for fishing years 1988-2002. Report for South Atlantic Fishery Management Council. NOAA/SAFMC**:** 5pp. 101 Pivers Island Rd, Beaufort, NC 28516.

Vaughan, D. S., C. S. Manooch III and J. C. Potts. 2001. Assessment of the Wreckfish Fishery on the Blake Plateau. *American Fisheries Society Symposium* 25: 105-120.

Wyanski, D. M. and H. S. Meister. 2002. Analytical Report on the Sex Ratio, Maturity, Reproductive Seasonality, and Annual Fecundity of Wreckfish, Polyprion amercanus, off the Southeastern United States. South Carolina Dept. Natural Resources. PO Box 12559, Charleston, SC 29422.