Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

Jacks/Trevallies
(Carangidae)

Caranx ignobilis, C. lugubris, and *Psuedocaranx dentex*

(Image courtesy of Hawaiian Department of Aquatic Resources)

Original Report
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Stock Status Updated
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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 that originating from species, wild-caught or farmed, that can exist into the long-term through maintained or increased stock abundance and conservation of 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 Internet (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 purchasing 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", "Good alternative", 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.

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Executive Summary

Large carangids (jacks, trevallies) form an important component of shallow water reef, seamount and lagoon fish catches throughout the Pacific Islands. Many of their life history characteristics are not well studied, and their migrating behaviors are unknown. In Hawaii, four species of carangids are usually caught incidentally by a commercial fishery that targets other bottomfish species (e.g., snappers, groupers). These species are included in the group of demersal fish species managed by the Bottomfish and Seamount Groundfish Fishery Management Plan (FMP) under the auspices of the Western Pacific Regional Fishery Management Council (WPRFMC). Although some fishery data has been collected, a thorough analysis of the status of carangid stocks has not been conducted. The fishery data that does exist indicates a low but stable CPUE as well as an increasing average individual weight, signaling a stable population. However, there are no species-specific reference points to confirm this indication. In 2004, bottomfish in Hawaii were designated as undergoing overfishing due to excessive fishing mortality in the Main Hawaiian Islands, resulting in a Seafood Watch® ranking of "poor" stock status for jacks/trevallies from this region. Although the gear used to catch carangids is fairly selective, bycatch of undesirable species occurs frequently, with unknown ecosystem consequences. The fishing methods used, combined with the deep-water environment inhabited by carangids, result in only minor impacts to habitats and ecosystems. Lastly, management has been only moderately effective in regulating catch of carangids and other bottomfish to ensure sustained stocks. Considering the criteria described in this report, Seafood Watch® recommends carangids as a "**Good Alternative**".

This report was updated on September 13, 2005. Please see Appendix for a summary of changes made at this time.

Table of Ranks

	Conservation Concern			
Sustainability Criteria	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Wild Stocks			√	
Nature of Bycatch		√		
Habitat Effects	√			
Management Effectiveness		√		

Overall Seafood Recommendation:

Best Choices | **Good alternative** | **Avoid**

Introduction

Carangids are well represented in all tropical and subtropical seas. The family Carangidae contains 25 genera and approximately 145 species (Randall et al. 1997). Large carangids form an important component of shallow water reef and lagoon fish catches throughout the Pacific Islands. The various species of carangids are distributed throughout tropical and subtropical waters of the Indo-Pacific region, in shallow, coastal areas and estuaries, on reefs and deep reef slopes, and on banks and seamounts (Sudekum et al. 1991). Despite their importance to fisheries, little is known about the basic biology and habitat requirements of large carangids.

White trevally (*Psuedocaranx dentex*; Fig. 1) is one of the most abundant species of carangids found in Hawaii (Sudekum et al. 1991). It dominates commercial landings of carangids in Hawaii, accounting for 42% of landings of all carangid species in 1999 (DLNR 2002), though concerns have been expressed from the commercial fishery that large specimens of white trevally are ciguatoxic. White trevally is also a popular species in the recreational fishery. *P. dentex* is rarely caught in the main Hawaiian Islands (MHI - the major inhabited islands from Hawai`i at the southeast end of the Hawaiian archipelago north through Kaua`i and Ni`ihau), but is abundant in the Northwestern Hawaiian Islands (NWHI - the islands, atolls, and reefs of the Hawaiian archipelago northwest of Kaua`i and Ni`ihau; Fig. 4) where it is found at depths of 18–183 m (Seki 1986). In addition to living on deep reef slopes and banks, *P. dentex* can also be found in near-shore areas in large schools of 200–300 fish.

Giant trevally *(Caranx ignobilis*; Fig. 2), is a distant second to white trevally in terms of commercial landings, accounting for 9.6% of landings of all carangids in 1999 (DLNR 2002). Black jack (*Caranx lugubris*; Fig. 3) occurs singularly or in small groups on offshore banks and along steep outer reef slopes at depths of 12 to 354 m (Myers, 1991). In 1999, 75,386 pounds (lbs) of carangids were landed in Hawaii (of which 64,761 lbs were sold), representing at least 12 different species, with an ex-vessel value of $115,948 (DLNR 2002).

Figure 1. School of *Psuedocaranx dentex*, white trevally. (Photo courtesy of J. Randall)

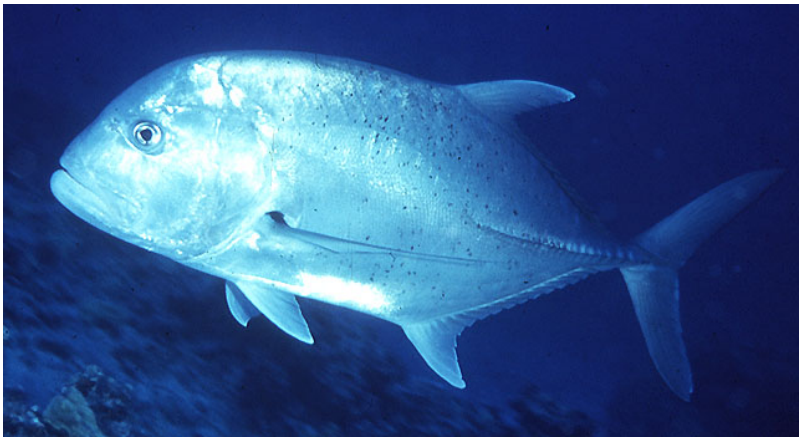

Figure 2. *Caranx ignobilis* (giant trevally). (Photo courtesy of J. Randall)

Figure 3. Black Jack**,** *Caranx lugubris*. (Photo courtesy of J. Randall)

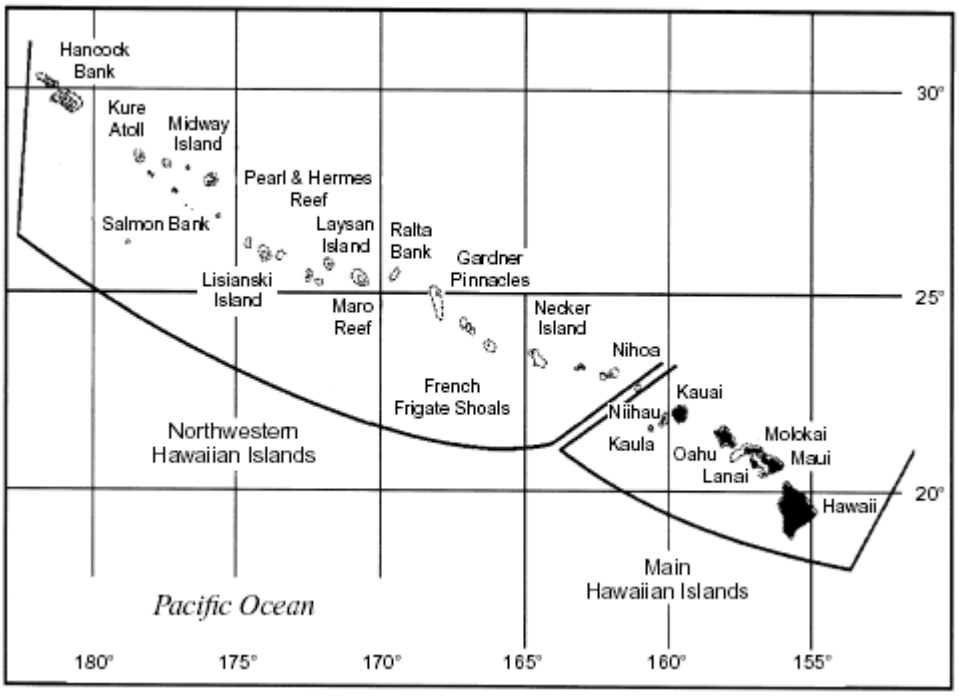

Figure 4. The Hawaiian archipelago. (Courtesy NMFS)

Market Availability

Market Names:
In the continental U.S., *P. dentex* is known as *white trevally* or *thicklip trevally*, *C. ignobilis* is known as *giant trevally*, and *C. lugubris* is known as *black jack*. In Hawaii, these species are known as *butaguchi*, *white ulua*, and *black ulua*, respectively. In French their names are: *carangue dentue, grosse carangue,* and *carangue noire*, respectively. In Japanese they are called: *shimaaji*, *rônin-aji*, and *kappore*, respectively. In Spanish their names are: *jurel dentón*, *jurel gigante*, and *jurel negro*, respectively.

Seasonal Availability:
Carangids are caught year-round in the Hawaiian Islands, and are usually available in the market year-round. Several species of imported carangids are available year-round as fresh or frozen product.

Product Forms:
Carangids can be found in the market in several forms. The smaller fish are available fresh on ice, or frozen. Most of the larger specimens are filleted, and the product sold fresh or frozen. Carangids landed from the main Hawaiian Islands are marketed through fish auctions in Honolulu and Hilo, through intermediary buyers on all islands, and directly from fishermen to retail stores and restaurants. In 2011, the Northwestern Hawaiian Islands will be closed to fishing; carangids will only be available from the main Hawaiian Islands at that time.

Statement on the Availability of Science:
In general, data for most species of carangids in Hawaii is poor. Some data exists on sexual maturity and age and growth characteristics, but there is little information about larval distribution and settlement, and the distribution and movement of juveniles and adults. Extant information usually exists of commercial catch by species, catch-per-unit effort (CPUE) and length-frequency. These data are the minimum needed for adequate management of carangids in Hawaii.

Data and analysis of studies of carangids are found in several forms: published journal articles, NOAA Fisheries Technical Memos and Administrative Reports, Western Pacific Regional Fishery Management Council (WPRFMC) publications, State of Hawaii Department of Aquatic Resources (DAR) reports, Masters Theses, and Doctoral Dissertations.

Analysis of Seafood Watch® Criteria

Criterion 1: Vulnerability to Fishing Pressure

Because of the similarity in habitat utilization patterns and life history, the general profile that follows covers the closely related FMP management unit species: *C. ignobilis*; *P. dentex*; and *C. lugubris.* Species-level information is provided if available. Note: *Seriola dumerili* is not covered in this report because it is currently not marketed due to its ciguatoxicity.

Growth
Carangids in general are relatively fast-growing (Fig. 5), and can reach large sizes. The von Bertalanffy growth coefficients (k) for the jacks and trevallies covered in this report range from 0.20 to 0.3 per year (Froese and Pauly 2003). The maximum size ($L\infty$) for *P. dentex* is reported to range from 44 to 46 cm. *C. ignobilis* is the largest of the carangids found in the Indo-Pacific region ($L\infty$ = 50 to 184 cm), and may obtain a total weight of over 50 kg, with a lifespan in excess of 15 years (Froese and Pauly 2003; Lewis et al. 1983). *C. lugubris* reaches sizes of up to 85–100 cm (Froese and Pauly 2003; Randall et al. 1990).

Reproduction
In the MHI, peak spawning for *C. ignobilis* occurs between May and August; gravid fish are found in the NWHI between April and November (Sudekum et al. 1991). Johannes (1981) reports that *C. ignobilis* spawns in pairs within larger aggregations during new and full moon events, while Myers (1991) reports that *C. ignobilis* gather to spawn on offshore banks and shallow seaward reefs.

Sexual maturity for *P. dentex* is reached at 34.5 cm (0.75 $L\infty$, age 1 – 2 yrs; Froese and Pauly 2003). Sexual maturity for *C. ignobilis* is reached at about 3.5 years (60 cm; Sudekum et al. 1991). Sudekum et al. (1991) found the sex ratio of males to females for *C. ignobilis* in Hawaii to be slightly skewed in favor of females—1:1.4. In contrast, Lewis et al. (1983) report a sex ratio for *C. ignobilis* in Fiji of nearly 2:1, in favor of males.

Eggs and Larvae

Carangids are pelagic spawners that release large numbers of tiny, buoyant eggs (Randall et al. 1997). In Hawaii, carangid larvae are common in near-shore waters (Miller et al. 1979). Caragnid eggs are planktonic, spherical and 0.70-1.3 mm in diameter (Laroche et al. 1984; Miller et al. 1979), and one to several oil globules are usually present on the eggs (Laroche et al. 1984). Carangid eggs hatch in 24 to 48 hours after spawning, at water temperatures of 18 to 30 C° (Laroche et al. 1984). The identification of carangid eggs to even the family level is frequently impossible because of their similarity in size and appearance to many other marine fishes (Laroche et al. 1984).

Carangid larvae are relatively small, 1.0 to 2.0 mm, at hatching (Laroche et al. 1984). The larvae have a relatively large yolk sac and possess an oil globule at the anterior end of the sac (Laroche et al. 1984). The lack of diagnostic morphological features makes it difficult to identify newly-hatched carangid larvae to even the family level (Laroche et al. 1984).

Juveniles

In Hawaii, carangids are best known as *papio* when they are young (under about ten pounds) and *ulua* when they are larger (over ten pounds). The juveniles of several species, including *C. ignobilis*, are often found in brackish estuaries, or foraging far into freshwater streams and rivers (Smith and Parrish 2002; Randall et al. 1997). Juvenile *C. ignobilis* are often found in near-shore and estuarine waters (Lewis et al. 1983) and in small schools over sandy inshore reef flats (Myers 1991). In a study of juvenile carangids in a Hawaiian estuary, Smith and Parrish (2002) estimated the von Bertalanffy growth coefficients (k) for juvenile *C. ignobilis*, as shown in Fig. 5 below:

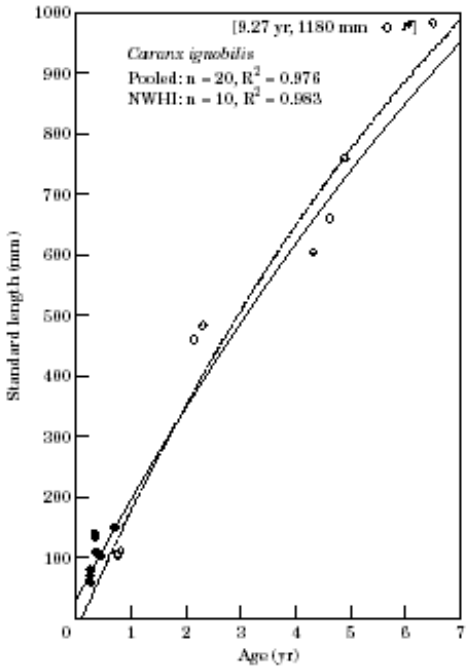

Figure 5. Growth data and von Bertalanffy growth curves derived for *Caranx ignobilis*. – – – NWHI; —— Pooled; ⭘ NWHI; ●Hanalei. (Source: Smith and Parrish 2002)

The data and growth curve presented in Figure 5 compares fish populations from the Hanalei estuary in the MHI with data from the NWHI, obtained from Sudekum et al. (1991), and indicates that the extrapolation of the growth curve based on juveniles accurately depicts growth for the larger age-classes.

Adults

Carangids are highly-mobile, wide-ranging predators that travel throughout the water column from the surface to depths of 250 m, although they are more affiliated with the demersal habitats where they feed (Uchida and Uchiyama 1986; Sudekum et al. 1991). As predators, they are thought to play an important role in the ecology of tropical and subtropical neretic marine ecosystems (Smith and Parrish 2002).

Adults are found in many near-shore habitats, including rocky shores, reefs and bays. *C. ignobilis* is predominantly piscivorous, with fish comprising >90% of its diet (Sudekum et al. 1991; Parrish et al. 1980). It also preys on crustaceans, gastropods and cephalopods. Sudekum et al. (1991) found that the diet of *C. ignobilis* included parrotfish (Scaridae), as well as roundscads or opelu, wrasses (Labridae), bigeyes (Priacanthidae), eels (Muraenidae, Congridae), cephalopods and crustaceans (crabs, shrimps and lobsters).

The predominance of reef fishes in the diet of *C. ignobilis* strongly suggests that shallow-water reef habitats are of prime importance as foraging habitat for large carangids. However, the occurrence of small pelagic fish such as roundscads and squid in the diets of these species indicates that they also spend time foraging in the water column (Sudekum et al. 1991). *C. ignobilis* appears to be primarily a nocturnal feeder (Sudekum et al. 1991; Okamoto and Kawamoto 1980). It has been estimated that *C. ignobilis,* along with *C. melampygus,* another large carangid, may annually consume as much as 30,000 metric tons (mt) of prey at French Frigate Shoals in the NWHI (Sudekum et al. 1991).

Analysis Criteria

1) Growth rate: **High**
2) Age at sexual maturity: **Low**
3) Maximum age: **Medium**
4) Fecundity: **High**
5) Natural population size: **Large**
6) Species range: **Broad**
7) Behaviors that increase ease of capture: **No**
8) Evidence of population variability driven by cyclical oceanographic events: **No**

Synthesis

The growth rate for carangids is fairly high, with population doubling times in the range of 1.4 to 4.4 years (Froese and Pauly 2003). These fish are wide-ranging carnivores with large natural population sizes. Because they are pelagic, broadcast spawners, the likelihood of the population being detrimentally effected by local depletion is small.

Inherent Vulnerability Rank:

Resilient | **Neutral** | Vulnerable

Criterion 2: Status of Wild Stocks

Bottomfish yields in the western Pacific bottomfish fishery are usually estimated on the basis of yield per nautical mile of the 100-fathom contour that surrounds an island or bank (Polovina 1985; Polovina et al. 1985). As part of this resource assessment, a depletion experiment was carried out at Pathfinder Reef, a seamount west of the Northern Mariana Islands. The estimated yield of 403 lbs of bottomfish per year per nautical mile of 100-fathom isobath appears to be representative of the maximum sustainable yield (MSY) that can be expected from bottomfish resources of tropical islands in the Pacific, as noted in Amendment 1 of the Bottomfish and Seamount Groundfish Fishery Management Plan (FMP).

In Hawaii, the Spawning Potential Ratio (SPR) determines the minimum stock size threshold for bottomfish. The SPR is the ratio of the spawning stock biomass per recruit at the current level of fishing to the spawning stock biomass per recruit that would occur in the absence of fishing. As stated in Amendment 6 to the Bottomfish and Seamount Groundfish FMP, this value ranges from 20% to 33%, based on an analysis of the most common species. SPR has not been calculated for carangids.

Three pieces of fishery dependent information exist for carangids: CPUE, mean weight of fish landed, and annual catch rates. Figure 6 depicts a relatively stable CPUE since 1989, and Figure 7 indicates that the average weight of at least one commercially important species has slowly increased since 1990. The average size of the fish in the catch is above the size at maturity, indicating that recruitment overfishing is likely not occurring (WPRFMC 2002).

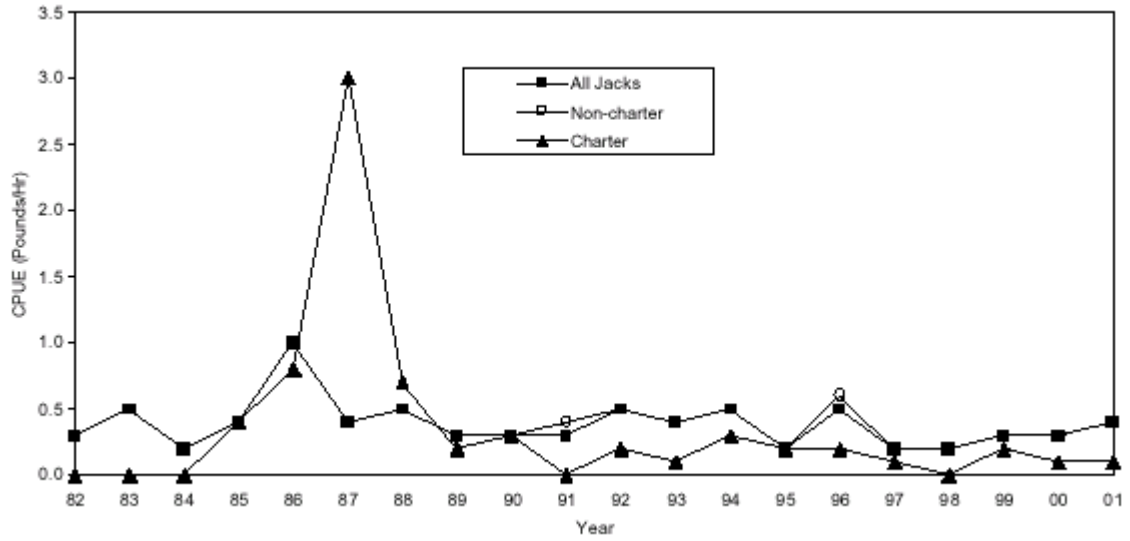

Figure 6. CPUE of jacks from Guam. (WPRFMC 2003)

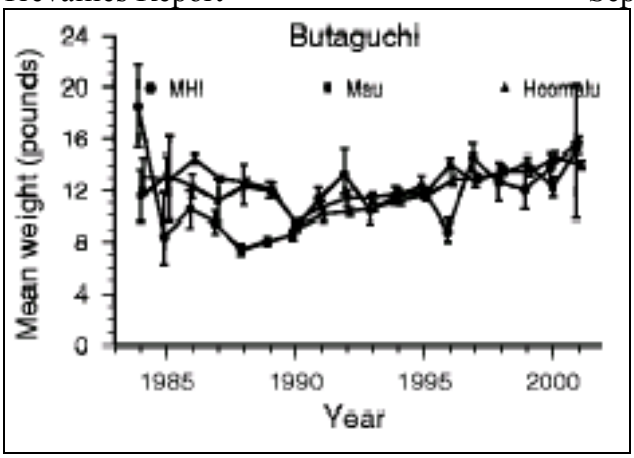

Figure 7. Mean weight of *P. dentex*, or thicklip trevally. (WPRFMC 2003)

Analysis Criteria

1) Population relative to over-fishing threshold: **Unknown**
2) NOAA-Fisheries classification status: **Above MSY**
3) Long-term trends in abundance as measured by CPUE: **Flat**
4) Short-term trend in CPUE: **Stable**
5) Overfishing occurring: **Occuring in the MHI**
6) Current life history parameter distribution: **Unknown**
7) Stock status uncertainty: **HIGH**

Synthesis

Due to the lack of in-depth analyses on carangids, Seafood Watch® concludes that the degree of overfishing is unknown, and therefore, the status of carangid stocks is also unknown.

Status of Wild Stocks Rank (Main Hawaiian Islands):

Healthy | **Unknown** | Poor | Critical

Criterion 3: Nature and Extent of Bycatch

Carangids are caught with line gear that is relatively selective (Fig. 8), usually in association with the fishery targeting the snapper/grouper complex on outer reef slopes and seamounts. Experienced snapper fishermen have the ability to catch desired species with little bycatch or incidental catch; however, it is impossible to completely avoid non-target species. Sharks, oilfish, snake mackerel, pufferfish and moray eels are common bycatch species, discarded because they are not marketable. In contrast, ulua (Carangidae) and kahala are discarded despite being palatable due to their short shelf life and low market value. Kahala, once a major component of commercial and recreational landings, are now seldom retained as they have been implicated in incidents of ciguatera poisoning. Also, in addition to undesirable species, releases of damaged fish are considered bycatch; these amounted to 8% of the total catch of NWHI handline-caught bottomfish in 1998 (WPRFMC 1998). Data collected during NMFS research

cruises in Hawaii indicate that species generally regarded as bycatch represent about 19% of the total catch (WPRFMC 1998).

Logbook data and research programs conducted by the State of Hawaii and the NMFS indicate that bycatch accounts for approximately 8–23% of the total catch in bottomfish fisheries in the Hawaiian archipelago. The major discard species in the NWHI bottomfish fishery are given in Table 1. It should be noted that a large percentage of the snappers, and groupers, listed below are included as bycatch because of damage from sharks.

Table 1: Percent discards from bottomfishing trips with NMFS observers, 1990-1993. (From: Nitta 1999)

Species	No. Caught	No. Discarded	% Discarded
Kahala	2438	2266	92.9
Kalekale (yellowtail)	40	22	55.0
Sharks	176	92	52.3
Misc. fish	115	59	51.3
Jacks (white)	127	62	48.8
Misc. snappers/jacks	189	91	48.1
Butaguchi	3430	1624	47.3
Jacks (black)	23	10	43.5
Taape	110	40	36.4
Misc. fish (unidentified)	174	26	14.9
Kalekale	874	52	6.0
Opakapaka	5092	107	2.1
Ehu	1185	20	1.7
Uku	2209	28	1.3
Hapu'upu'u	1593	19	1.2
Gindai	459	3	0.7
Onaga	1141	8	0.7
Alfonsin	1	0	0.0
Armorhead	1	0	0.0
Lehi	3	0	0.0
TOTAL	19,380	4,759	23%

The incidental catch of protected species, such as monk seals, is of greater concern in the western Pacific bottomfish fishery, particularly in the NWHI. However, observer data from the early 1990s indicates there are no known mortalities of monk seals associated with commercial fisheries in that area. Currently, fishermen licensed to fish in the NWHI are required to attend a

NMFS protected species workshop and must notify the agency at least 72 hours prior to leaving port if they intend to fish within established protected species study zones. NMFS has the authority to place federal observers aboard these vessels to record interactions with protected species if the agency determines such action to be necessary (WPRFMC 1998).

To further address concerns that bottomfishing operations could pose some risk to monk seals, the WPRFMC Plan Team recommended that the following additional precautions be taken:

- Bottomfishers must stop fishing and retain all gear on deck whenever a monk seal is sighted in an area within a 10-yard radius of the vessel.
- Bottomfishers must retain all bycatch while fishing is underway. Discard of offal and bycatch shall occur after fishing operations have ceased and only if there are no monk seals in the area.
- Annual protected species regulatory workshops should be held for all NWHI bottomfish permit holders and vessel operators, including training on monk seal life history, mitigation efforts, etc. (WPRFMC 2002)

Bycatch Analysis Criteria

1) Composition diversity of bycatch: **Low**
2) Bycatch population consequences: **Low**
3) Bycatch/target species ratio: **Medium**
4) Bycatch quantity trend: **Flat**
5) Ecosystem effects: **Unknown**

Synthesis

Because bottomfishing gear is relatively selective, bycatch diversity in the bottomfish fishery is fairly low. However, large numbers of kahala and other carangid species are discarded. There is no evidence that the amount of bycatch in the bottomfish fishery is increasing, but whether there are any detrimental changes to the ecosystem is unknown.

Nature and Extent of Bycatch Rank:

Low | **Moderate** | High | Critical

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

In Hawaii, commercial fishing for carangids is conducted from vessels that usually target bottomfish (snappers, groupers), utilizing handlines that are set and hauled on electric, hydraulic, or hand-powered reels (Fig. 8). The fishing method is relatively selective. Vessels are usually equipped with depth sounders, fish echo sounders and satellite navigational devices. The MHI and NWHI bottomfish fisheries are separately managed. In the NWHI, all participants fish commercially on a full or part-time basis, while in the MHI fishery there are also recreational fishermen. Available data suggest that the magnitude of the effort in the MHI fishery has been declining since the late 1980s.

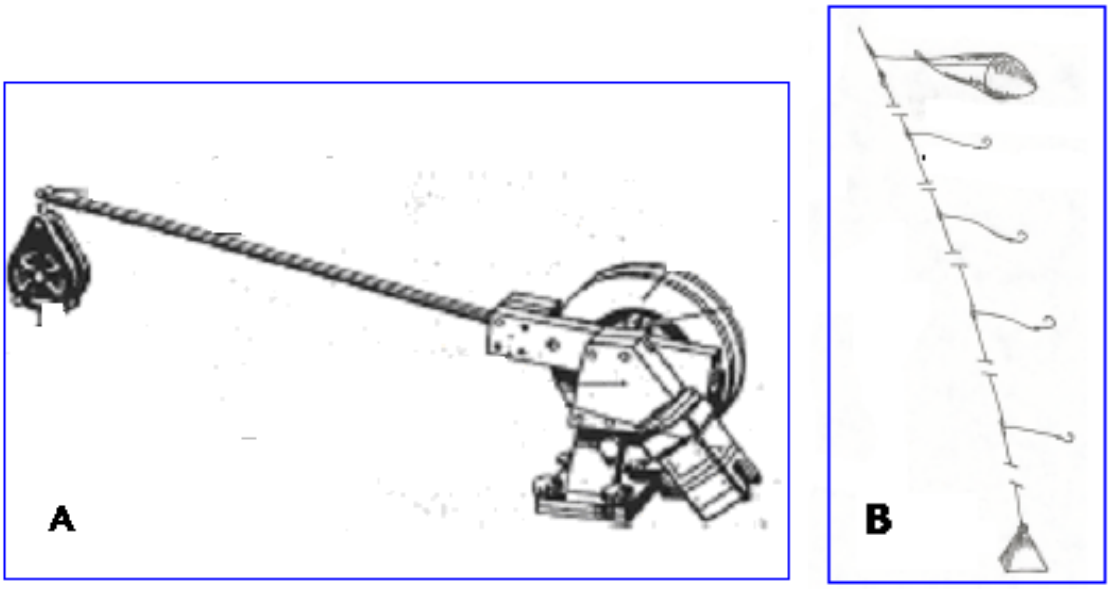

Figure 8. Bottomfishing gear. A: Surface reel/hauler. B: Terminal rig.

Unlike the U.S. mainland, with its continental shelf ecosystems, the Pacific Islands are primarily volcanic peaks with steep drop-offs and limited shelf ecosystems (Ralston 1979). Bottomfish are found concentrated on the steep slopes of deepwater banks of these islands. In the Hawaiian deep-sea handline fishery, 13 species of snapper and carangid and one species of grouper are commonly caught at depths of 60 to 350 m (Ralston and Polovina 1982).

Although the impact of bottom handlining in Hawaii is though to be minimal, the dropping of handline weights on marine substrate could theoretically affect benthic habitat. However, most bottomfishing occurs at depths (100–400 m) deeper than the part of the photic zone where coral reefs and other sensitive reef-building organisms are normally found (WPRFMC 2001). The effects of handlining for bottomfish on the habitat and ecosystem are, therefore, likely to be minimal (WPRFMC 2001).

Fishing activities in general can produce various negative effects on the environment, including lost oil, sewage, garbage and debris, and potential for habitat damage through anchoring and grounding. Although it is thought to be minimal, the effect of bottomfish operations on coral reef substrate in the NWHI remains unknown. Therefore, it is possible that, as with any fishery in the region, bottomfishing activities might increase the risk of environmental impact when added to other anthropogenic impacts. As with any fishery, impacts may occur through grounding, which can damage coral reef structure, release fuel and oil, and perhaps introduce alien species into a sensitive habitat. Seafood Watch® concludes that none of these effects are likely to be significant in this case.

Analysis Criteria

1) Area extent of fishing gear effects: **Limited**
2) Effect of fishing gear on habitat: **Minimal**
3) Resilience of habitat to disturbance: **Moderate**
4) Evidence that removal of target species disrupts the food-web: **No**

5) Evidence that fish removal causes ecosystem changes: **No**
6) Evidence that the fishing method causes ecosystem changes: **Uncertain**

Synthesis
The type of gear used in the Hawaiian bottomfish fishery is thought to have a minimal impact on the environment, but the amount of this impact is not quantified and remains uncertain. However, most bottomfishing occurs at depths (100–400 m) deeper that the part of the photic zone where coral reefs and reef-building organisms are normally found.

Effect of Fishing Practices Rank:

Benign Moderate Severe

Criterion 5: Effectiveness of the Management Regime

The Western Pacific Regional Fishery Management Council (WPRFMC) is the policy-making organization for the management of fisheries in the U.S. western Pacific, Exclusive Economic Zone (EEZ). The EEZ extends from 3 to 200 miles offshore around the State of Hawaii, the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands and U.S. Pacific island possessions.

Carangids are managed under the Bottomfish and Seamount Groundfish FMP, which became effective in 1986. The FMP prohibits certain destructive fishing techniques, including explosives, poisons, trawl nets and bottom-set gillnets, and implements a permit system for fishing for bottomfish in the EEZ around the NWHI. The plan also established a management framework that includes adjustments such as catch limits, size limits, area or seasonal closures, fishing effort limitations, fishing gear restrictions, access limitations, permit and/or catch reporting requirements and a rules-related notice system.

The Bottomfish and Seamount Groundfish FMP has been amended six times.

- **Amendment 1** includes the establishment of limited access systems for bottomfish fisheries in the EEZ surrounding American Samoa and Guam within the framework measures of the FMP.
- **Amendment 2** was developed to diminish the risk of biological overfishing and improve the economic health and stability of the bottomfish fishery in the NWHI. The amendment divided the EEZ around the NWHI into two zones: the Hoomalu Zone and the Mau Zone. A limited access system was established for the Hoomalu Zone. Access to the Mau Zone remained unrestricted, except for excluding vessel owners permitted to fish in the Hoomalu Zone. The Mau Zone was intended to serve as an area where fishermen could gain experience fishing in the NWHI, thereby enhancing their eligibility for subsequent entry into the Hoomalu Zone.
- **Amendment 3** defined recruitment overfishing as a condition in which the ratio of the spawning stock biomass per recruit at the current level of fishing to the spawning stock biomass per recruit that would occur in the absence of fishing is equal to or less than

20%. Amendment 3 also delineated the process by which overfishing is monitored and evaluated.

- **Amendment 4** requires vessel owners or operators to notify NMFS at least 72 hours before leaving port if they intend to fish in a 50 nautical mile (nm) "study zone" around the NWHI. This notification allows federal observers to be placed on board bottomfishing vessels to record interactions with protected species if this action is deemed necessary.
- **Amendment 5** created a limited entry system for vessels fishing in the Mau Zone of the NWHI.
- **Amendment 6** addressed the requirements of the re-authorization of the Magnuson-Stevens Fishery Conservation and Management Act (Sustainable Fisheries Act). This Act requires the establishment of a reporting method for bycatch and a plan to minimize bycatch and bycatch mortality. The plan includes specifying data on commercial, charter, and recreational fishing and quantifying trends in their respective landings, in order to describe essential fish habitat, minimize adverse effects to essential fish habitat, describe impacts on fishing communities, specify overfishing criteria, and include preventative measures. Amendment 6 was implemented in 1998.

In July 1998, the State of Hawaii implemented a management plan that established refuges for bottomfish in response to critical declines in bottomfish resources in the main Hawaiian Islands (Fig 9). The established refuges were intended to allow rebuilding of ehu and onaga stocks to healthy levels with spawning stocks of 40–50% of original levels.

The administrative rule (Chapter 13-94) enacted to provide protection for ehu and other bottomfish in the MHI:

- Restricts bottomfishing gear;
- Sets the non-commercial bag-limit at 5/day per person for onaga and ehu;
- Establishes 20 closed areas in the MHI, which comprise 20% of the bottomfishing grounds in the MHI (Fig.9);
- Requires bottomfishing vessel identification on all vessels (commercial and non-commercial) fishing for bottomfish; and
- Sets a control date of 1 June 1998 which may be used to qualify applicants for a limited entry program in the future.

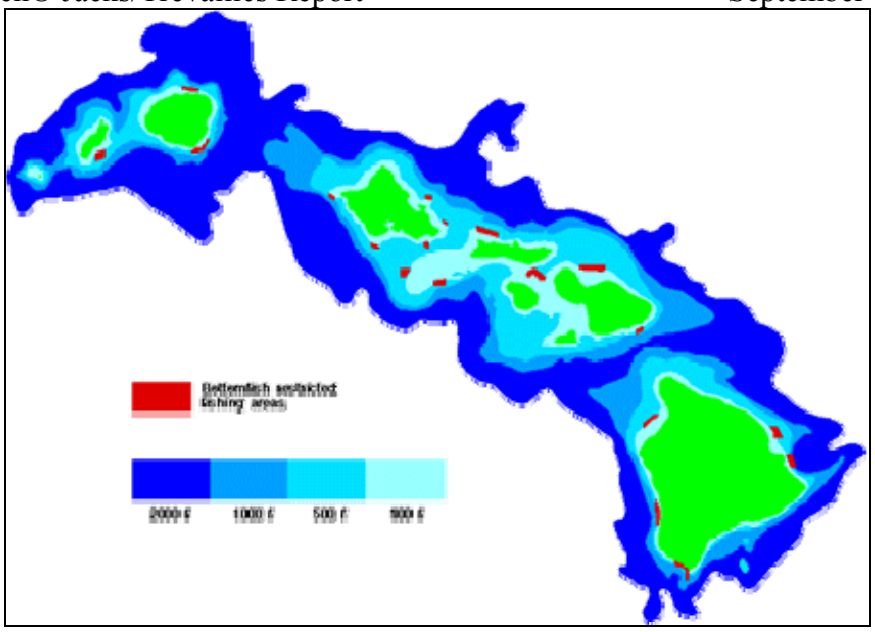

Figure 9. Areas closed to bottomfishing under Administrative Rule 13-94. Closed areas are shown in red. (Source: DLNR 2002)

In January 2003, the State of Hawaii revised the fishing regulations of several marine and freshwater species. For carangids, the minimum size in the commercial fishery was increased from 30 cm total length (TL) to 40.6 cm TL, and a bag limit of 20/day (all species combined) was implemented.

Analysis Criteria

1) Management implements stock assessments: **Yes**
2) Management collects data for stock abundance analysis: **Mainly fishery-dependent data**
3) Management research plan seeks scientific knowledge on the short- and long-term status of the stock, and takes a precautionary approach regarding ecosystem impacts: **Yes**
4) Management acts in a timely fashion to ensure sustainability, and minimize bycatch and habitat damage: **Yes**
5) Management implements a bycatch plan: **Yes**
6) Management routinely ignores scientific recommendations: **No**
7) Management enforces fishery regulations: **Yes**
8) Management track record**: Regulations have not prevented declines**

Synthesis

The suite of federal management measures implemented since the inception of the Bottomfish and Seamount Groundfish FMP in 1986 indicates that many possible measures are being taken to ensure the long-term viability of carangid stocks in Hawaiian waters managed by the federal government. However, many of these measures were implemented only after significant declines in other bottomfish species. A limited entry system has been in place since 1988, and the first biological reference points were developed in 1990. Because of the actions required under the Sustainable Fisheries Act, several new methods of calculating stock-status biological reference points are being created, and rebuilding plans are under development. Measures have been taken to document bycatch, and reduce bycatch if a problem is identified. The State of

Hawaii has also created twenty no-fishing zones in areas of critical bottomfish habitat. These zones are expected to decrease fishing mortality for snappers and carangids and should act to increase recruitment over time.

Effectiveness of Management Rank:

Highly effective | **Moderately effective** | Ineffective

Overall Evaluation and Seafood Recommendation

Carangids (jacks, trevallies) are widely distributed throughout the tropics and in most Hawaiian waters, including those of both the main Hawaiian Islands and the Northwestern Hawaiian Islands. Much of their life history characteristics are not well studied, and their migrating behaviors are unknown. Most importantly, a thorough analysis of the status of carangid stocks has not been conducted. The fishery data that does exist indicates a low, but stable, CPUE and average individual weight, signaling a stable population. However, there are no species-specific reference points to confirm this indication. Although the gear used to catch jacks is fairly selective, bycatch of undesirable species occurs frequently, with unknown ecosystem consequences. The fishing methods used, combined with the deep-water environment inhabited by carangids, result in only minor impacts to habitats and ecosystems. Lastly, management has been only moderately effective in regulating catch of carangids and other bottomfish to ensure sustained stocks. Considering the criteria described in this report, Seafood Watch® gives jacks/trevallies the overall recommendation of **Good alternative**.

Table of Ranks

	Conservation Concern			
Sustainability Criteria	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Wild Stocks			√	
Nature of Bycatch		√		
Habitat Effects	√			
Management Effectiveness		√		

Overall Seafood Recommendation:

Best Choices | **Good alternative** | **Avoid**

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Appendix

Prior to the release of the 2004 status of U.S. fisheries report (NMFS 2005), it was thought that recruitment overfishing was not occurring because the average size of fish being caught was above the size at maturity (WPFMC 2002), and the stock status of carangids in Hawaii were "Unknown" according to Seafood Watch® criteria. However, NMFS (2005) lists the bottomfish multi-species complex in the Hawaiian archipelago as undergoing overfishing. The overfishing status of this complex is due to excessive fishing pressure in the MHI, rather than in the NWHI (WPFMC 2005). The recent change in stock status results in a continued ranking of "Unknown" for carangids from the NWHI, and a "Poor" stock status ranking for carangids from the MHI. Overall, carangids from Hawaii receive a recommendation of "Good Alternative".

In 2011, the Northwest Hawaiian Islands will close to fishing; carangids will only be available from the main Hawaiian Islands at that time; the NWHI recommendation will no longer be valid at that time.