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RESULTS OF A SURVEY OF THE SOUTH FLORIDA FISH-TRAP FISHING GROUNDS USING A MANNED SUBMERSIBLE

Wire traps were used to capture reef fishes off south Florida from at least 1919 (Schroeder 1924) until their use and possession in state waters was banned on 1 October 1980. Craig (1976), Sutherland and Harper (in press), and Taylor and McMichael (in press) described trap fishing gear, methods, grounds, and catches off Florida. Most traps were rectangular in shape, had a single funnel entrance, and were constructed of 14 gauge, 2.5 x 5.1 cm (1 x 2 inch), vinyl-coated, rectangular mesh wire. Traps were usually baited, individually attached to surface buoys, and fished 1-3 days before they were hauled. Some fishermen, however, attached 4-10 unbaited traps to 365-m (1200-ft) groundlines and hauled the traps once each 7-10 days. The traps were fished from Jupiter on the Atlantic coast of Florida, to the Dry Tortugas, and off Everglades City in the Gulf of Mexico. Though traps were fished in depths of 5-110 m, most were set in 20-45 m depths near coral reefs and rock ledges. Fish traps were frequently lost due to theft or vandalism of surface buoys, severing of buoy lines by vessels, entanglement with fishing gear or anchors, and by strong currents which submerged buoys or dragged traps from the location where they were set. Vinyl-coated wire traps do not readily corrode and are believed capable of catching fish for 6 months or more after being lost. The effect of lost traps on reefs and reef fish resources was unknown.

From September 24 to October 4, 1981, the Miami Laboratory of the Southeast Fisheries Center (NOAA), and the Harbor Branch Foundation, Inc., Ft. Pierce, Florida, carried out a cooperative survey of wire fish-trap fishing grounds off south Florida utilizing a manned submersible, JOHNSON-SEA-LINK I. Primary survey objectives were to determine the distribution and condition of derelict and ghost fish-traps and to make assessments of their effect on reef habitats and fishery resources. Derelict traps are defined as fish traps that fisherman cannot locate and retrieve but that are incapable of catching fish because of structural damage or deterioration. Ghost traps are lost traps still capable of catching fish (Smolowitz 1978).

Sixteen dives were made with the JOHNSON-SEA-LINK I in areas where trap fishing effort was reportedly most intensive (Figure 1). The submersible surveyed about 55.5 km (30 linear n mi) of sea floor in depths of 10-54 m during 43 hr of bottom time. The course and distance surveyed during each dive varied with bottom type, current speed, and underwater visibility. The underwater visual radius fluctuated during each dive and averaged from 5.5 to 11.6 m. In areas where high profile reefs occurred, the submersible usually traversed from the sand/reef interface to the top of the reef, then back down the reef onto the sand

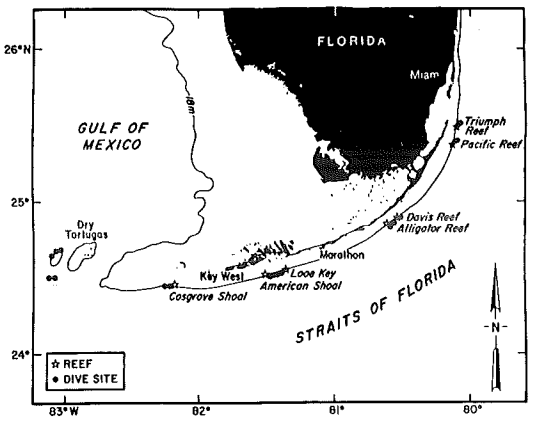

Figure 1. Dive sites of JOHNSON-SEA-LINK I off south Florida, September 24-October 4, 1981.

flats in a zigzig pattern. When the sea floor was flat or had a smooth slope, straight-line transects were usually made. Visual searches for traps during each transect over sand flats were augmented by use of the submersible's sonar which had an effective radius of 152 m. Sonar was not useful on or near reefs due to the multitude of contacts received from rocks and corals. Video tape recordings and 35-mm still photographs were taken of each derelict and ghost fish-trap that was observed during dives. We also recorded the following trap observations: status (derelict, ghost, or actively fished trap), shape, size, quantity of epifauna on trap, bottom type, and estimated distance to the nearest reef or live bottom (low profile patch reef) area. Species and numbers of fish in each trap were noted.

Twenty-three derelict and ghost fish-traps were found in depths of 12 to 35 m during the survey (Table 1). Ten traps were found between American Shoal and Looe Key, three near Alligator Reef, four near Davis Reef, five near Pacific Reef, and one near Triumph Reef. No fish traps were observed during six dives off the Dry Tortugas and Cosgrove Shoal where fishing effort was reportedly quite intensive (Sutherland and Harper, in press; Taylor and McMichael, in press). The Dry Tortugas fishing grounds were so vast, however, that the submersible surveyed a relatively insignificant amount of the total area. At other survey sites, trap fishing was concentrated in a narrow band along the Florida Shelf because of the location of reefs, depth, and speed of the Florida Current. The limited amount of area suitable for trap fishing made it easier to conduct a thorough survey of these sites.

Eighteen (78.3%) of 23 lost traps were derelicts. Derelict traps had small holes or breaks in the wire mesh, gaps between ceiling or floor panels and trap walls, or entire wire panels which were deteriorated or missing. Though derelict traps often had no major structural damage, small holes or breaks of even one piece of wire mesh apparently rendered them ineffective as fish traps. Two adult blue runners (*Caranx crysos*) were observed inside one derelict trap, but seams along the top edge of this trap's funnel had separated and the wire mesh was bent outward creating a large hole through which the fish could escape the trap at will. Fish were rarely caught in actively fished traps with holes or breaks in the mesh (Craig 1976, Sutherland and Harper, in press)

Although adult fishes were rarely observed in or near derelict traps, juvenile fishes were sometimes extremely numerous in and around the traps. Derelict traps and other man-made objects such as wood lobster traps and wreckage apparently serve as artificial reefs on "barren" sand sea floor areas. The number of juvenile fishes in and around derelict traps and the amount of epifaunal encrustation on the traps appeared related to the distance between the traps and nearest reef area.

Schools of juvenile tomtate (*Haemulon aurolineatum*), mahogany snapper (*Lutjanus mahogoni*), gray triggerfish, (*Balistes capriscus*), juvenile black groupers (*Mycteroperca bonaci*), gray angelfish (*Pomacanthus arcuatus*), and a rare juvenile misty grouper (*Epinephelus mystacinus*) were observed swimming in and around five derelict traps that were more than 10 m from the nearest reef. The misty grouper was observed near a chevron-shaped trap in 27 m of water about 5 km southwest of Looe Key. The rare Florida occurrence of misty grouper was documented by Robins (1967). The juvenile fishes swam in and out of the traps through the fun-

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Table 1. Derelict and ghost fish-trap data observed off south Florida from the JOHNSON-SEA-LINK I, 9/24/81 - 10/4/81.

Dive Location	Depth (m)	Trap status	Trap shape	Trap size (m)	Frame material	Epifauna (qty.)	Bottom type	Distance to reef (m)
American Shoal	14.6	Derelict	Rectangular	1.2x0.9x0.6	Metal rod	Light	Reef	0-10
American Shoal	21.3	Derelict	Rectangular	1.2x0.9x0.6	No frame	Light	Sand	0-10
American Shoal	13.1	Derelict	Rectangular	1.4x1.2x0.6	Metal rod	Light	Reef	0-10
Looe Key	18.3	Derelict	Chevron	1.2x1.2x0.6	Metal rod	Heavy	Sand	11-30
Looe Key	29.3	Derelict	Rectangular	1.2x0.9x0.6	No frame	Heavy	Sand	30+
Looe Key	24.3	Derelict	Chevron	1.2x1.2x0.6	Wood pole	Heavy	Sand	30+
Looe Key	17.1	Derelict	Rectangular	1.2x0.9x0.6	No frame	Light	Reef	0-10
Looe Key	15.2	Derelict	Rectangular	1.2x0.9x0.6	Metal rod	Light	Reef	0-10
Looe Key	12.2	Derelict	Oval	1.2x0.9x0.6	Metal rod	Light	Sand	0-10
Looe Key	13.1	Derelict	Rectangular	1.2x0.9x0.6	Metal rod	Light	Algae	0-10
Alligator Reef	19.2	Derelict	Rectangular	0.9x0.6x0.5	Metal rod	Heavy	Sand	30+
Alligator Reef	25.6	Derelict	Heart	1.2x0.9x0.6	Metal rod	Heavy	Sand	30+
Alligator Reef	27.4	Derelict	Heart	1.2x0.9x0.6	Metal rod	Light	Sand	0-10
Davis Reef	32.3	Derelict	Rectangular	1.2x0.9x0.6	No frame	Heavy	Sand	0-10
Davis Reef	34.7	Derelict	Rectangular	1.2x0.9x0.6	No frame	Heavy	Sand	0-10
Davis Reef	32.9	Derelict	Rectangular	1.2x0.9x0.6	No frame	Light	Sand	0-10
Davis Reef	35.0	Derelict	Rectangular	1.2x0.9x0.6	No frame	Heavy	Sand	0-10
Pacific Reef	33.5	Derelict	Rectangular	1.2x0.9x0.6	No frame	Light	Sand	0-10
Pacific Reef	25.6	Ghost	Z	2.4x0.6x0.5	Metal rod	Light	Live	0-10
Pacific Reef	25.6	Ghost	Z	2.4x0.6x0.5	Metal rod	Light	Live	0-10
Pacific Reef	25.6	Ghost	Z	2.4x0.6x0.5	Metal rod	Light	Live	0-10
Pacific Reef	25.6	Ghost	Z	2.4x0.6x.05	Metal rod	Light	Live	0-10
Triump Reef	33.5	Ghost	Z	2.4x0.6x0.5	Metal rod	Heavy	Sand	30+

nels and holes in the wire mesh and never strayed far from them. The five traps were heavily encrusted with bryozoans, hydroids, sponges, and tunicates. Epifaunal encrustation usually decreased and fish were absent or rare near derelict traps on or adjacent to reefs. Ten of 13 derelict traps on or within 10 m of reefs had light epifaunal encrustations.

Five (21.7%) of 23 lost fish traps were undamaged ghost traps, The five traps, four of which were attached to a single groundline, were Z-shaped and equipped with zinc anodes to retard corrosion. Each ghost trap measured 2.4 x 0.6 x 0.5 m, had two funnel entrances, and had an internal frame of reinforcing bar. The traps held eight black grouper, three scrawled cowfish (*Lactophrys quadricornis*), one hogfish (*Lachnolaimus maximus*), one gray angelfish, one spiny puffer (*Diodon holocanthus*), 14 spiny lobster (*Panulirus argus*), and the skull of one barracuda (*Sphyraena barracuda*). During previous studies of fish traps (Sutherland and Harper, in press) it was found that barracudas frequently did not survive confinement within fish traps; 14 of 16 barracudas caught in traps during that study were dead. The robust condition of the groupers and other fishes suggested they had been in the traps for only a short time. Some groupers did have small cuts or abrasions on the undersides of their snouts, but no other injuries were apparent. Hogfish, angelfish, puffer, and cowfish swam slowly back and forth within the traps while groupers remained motionless, resting on the trap floors.

With the exception of the five ghost traps, it was impossible to tell by the amount of epifaunal encrustation or physical appearance how long the traps had been lost. The corroded condition of zinc anodes on Z-shaped ghost traps suggested they had been lost 4-6

months. The Z-shaped traps were undamaged and their 2.5 x 5.1 cm vinyl-covered wire mesh was intact. None of the 18 derelict traps of various shapes were equipped with zinc anodes. Two derelict traps constructed of 3.8 cm hexagonal "chicken coop" galvanized wire mesh had large holes or entire wall and ceiling panels that had corroded and fallen apart. The effect of corrosion on 16 derelict traps constructed of 2.5 x 5.1 cm vinyl-coated wire mesh was less apparent; corrosion may have been masked by the vinyl covering. Escapement of fish from derelict traps that had only small holes in the wire mesh may have resulted from random movements through the trap's funnels (Munro *et al.* 1971, Munro 1974), because the holes appeared to be too small for most adult fishes to swim through.

In addition to derelict and ghost fish traps, nine actively fished Z- or modified Z-shaped traps were observed in the Federal Fishery Conservation Zone. Fifteen species of reef fishes were in the traps and all fish appeared to be in good physical condition. Every Z-shaped trap, both actively fished and ghost, was lying upside-down or on its side. Entrances to the traps were designed to funnel fish downward into the traps, but the usually inverted trap orientation caused the entrances to funnel fish upward. The inverted trap orientation is apparently common to all Z-shaped traps fished off Florida. During a study of the south Florida trap fishery, however, fishermen who used Z-shaped traps had the highest catch rates (Sutherland and Harper, in press).

Fish traps caused little apparent damage to reef habitats. Fifteen traps were on sand or algal flats near, but not atop, reefs. Four derelict traps were sitting on high profile reefs and four ghost traps were observed within a live-bottom area. There was no visual evidence that traps on the high profile reef killed or injured corals or sponges. One uprooted gorgonian was observed atop a ghost trap in a live-bottom area.

We made no attempt to estimate the total number of derelict and ghost fish-traps on the fishing grounds nor to assess the number of traps per unit area from data obtained during this brief survey due to extreme variation in underwater visibility, the intermittent use of sonar to detect traps on sand flats or smooth slopes, and the non-random positioning of dive locations on the fishing grounds.

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