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Loggerhead Sea Turtles, *Caretta caretta*, Encountering Shrimp Trawls

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ABSTRACT—The behavior of three loggerhead sea turtles, Caretta caretta, *was observed by scuba divers during trawl operations. One turtle avoided trawl capture, but two did not. Before capture, the two turtles tried to outdistance the trawl but eventually tired and were overtaken and became entangled in the trawl's webbing. Suggestions are given for modifications of trawls to stop turtle capture.*

INTRODUCTION

The accidental capture of sea turtles by commercial fishermen occurs primarily along the Atlantic and Gulf of Mexico coasts of the United States. Shrimp trawls are the most frequently involved gear, and the loggerhead, *Caretta caretta,* and Atlantic ridley, *Lepidochelys kempi,* are the most frequently caught sea turtles (Liner, 1954; Caldwell et al., 1959; Caldwell, 1960; Chavez, 1969). The leatherback, *Dermochelys coriacea,* and green, *Chelonia mydas,* sea turtles have been caught in trawls, but less frequently (Ogren, unpubl. notes; Schwartz, 1954; Yerger, 1965).

The magnitude of accidental catches and the mortality rate of captured turtles by trawls are unknown. William W. Anderson stated that captures of loggerhead sea turtles off Georgia by shrimp fishermen once were frequent enough to be a nuisance (Caldwell et al., 1959). Net damage by turtles and loss of fishing time reduces the efficiency of the trawlers, as well as the loss of that portion of the catch crushed by turtles. In recent years, most strandings of dead sea turtles on coastal beaches adjacent to waters that are heavily fished have been attributed to shrimp trawlers.

Caldwell (1963) believed that half, or fewer, of the turtles caught in trawls survive. Those caught usually drown because they are held underwater too long. Shrimp fishermen have resuscitated some comatose turtles by placing them on their backs and pumping on their plastron, and some have survived when they were placed on their backs and occasionally wetted down. However, they should not be exposed to direct sunlight for long periods. If unconscious turtles were to be put overboard they would probably drown.

Although the capture of sea turtles in shrimp trawls is an accidental catch problem, as long as mortalities occur, conflicts between commercial fishermen and turtle conservationists will continue. Protection of critical nesting habitat along coastal beaches and reduction of mortalities at sea are needed for the conservation of sea turtles.

National Marine Fisheries Service, NOAA, scuba divers of the Southeast Fisheries Center laboratories at Pascagoula, Miss., and Panama City, Fla., observed the behavior of adult loggerhead sea turtles during encounters with experimental shrimp trawls. These observations and subsequent discussion are presented here to aid in designing trawls to stop the capture of sea turtles.

OBSERVATIONS

Turtle behavior was observed during October 1973 and 1974 in the waters off Panama City, Fla., by scuba diver/scientists using techniques similar to those described by Wickham and Watson (1976) to evaluate towing characteristics of trawls.

Successful Trawl Avoidance

This observation was made in 9 m of water by divers riding the headrope of an experimental 15-m (headrope length) semiballoon shrimp trawl being towed at about 2.5 knots by the RV *George M. Bowers*. A loggerhead turtle, about 1.2 m carapace length, was encountered approximately 1 m above the bottom, swimming leisurely in the same direction the trawl was being towed. When the trawl doors passed and the net began to overtake the turtle, its swimming speed increased until it equalled the speed of the trawl. The turtle remained oriented in the same direction as the trawl but increased its speed further by beginning to make powerful sweeps with its front flippers, swimming with a pulsated lunging motion. As the turtle began to outdistance the trawl, it moved at an angle toward the left side of the trawl, passed in front of the port door and out of the path of the trawl. This encounter lasted approximately 2-3 minutes.

Unsuccessful Trawl Avoidance

This observation was made under conditions similar to the preceding encounter. A loggerhead turtle, about 1.2

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m in carapace length, was swimming approximately 1 m above the bottom in the direction of the tow near the starboard side of the trawl. Its first reaction to the trawl was to swim ahead of the trawl with powerful strokes of its flippers (Fig. 1). The turtle kept just ahead or even with the net headrope and did not attempt to turn left or right. The turtle's swimming stroke slowed after 2 or 3 minutes, and the trawl began to overtake it. Then the trawl headrope passed over the turtle, and as the tapering sides of the trawl approached, the turtle increased its swimming effort. The turtle swam forward in the trawl about 2-3 m to the headrope, rested momentarily, and then was overtaken by the net. At times, the turtle pushed against the trawl with its flippers, occasionally getting its claws and outer shell scutes snagged in the webbing. This pattern of increased swimming effort—moving forward to the net headrope, swimming up against the top of the net, momentarily resting and then being overtaken by the net—was repeated for 8-10 minutes until the turtle finally was swept against the tapering side of the trawl near the top panel. At this point, the turtle appeared to be extremely fatigued but attempted to escape through the top of the trawl by clawing and biting at the webbing. It was then swept further back into the trawl, coming to rest on the right side of the net just ahead of the cod end section and made no further effort to escape (Fig. 2). The divers then cut the webbing and removed the turtle from the trawl. The turtle offered no resistance, but the divers had difficulty removing it because the scutes and claws were entangled in the webbing. The turtle surfaced immediately and was observed blowing heavily on the surface of the water.

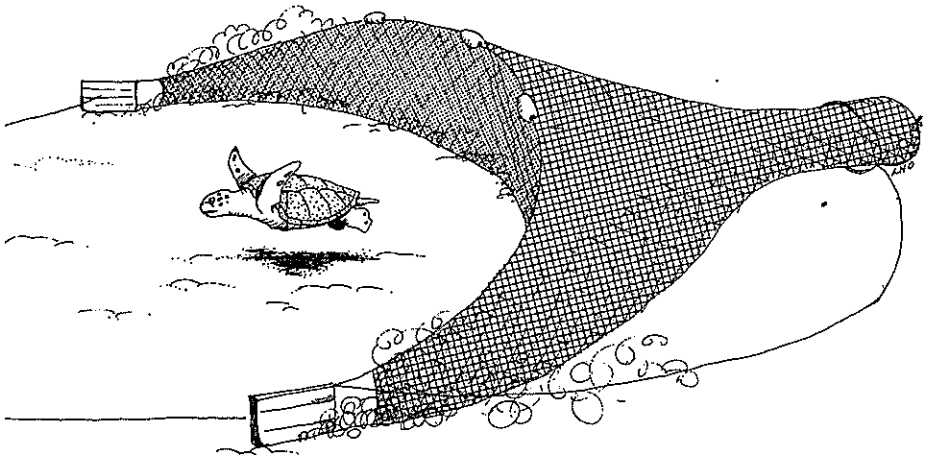

Figure 1.—Sea turtle attempting to escape trawl by outswimming it.

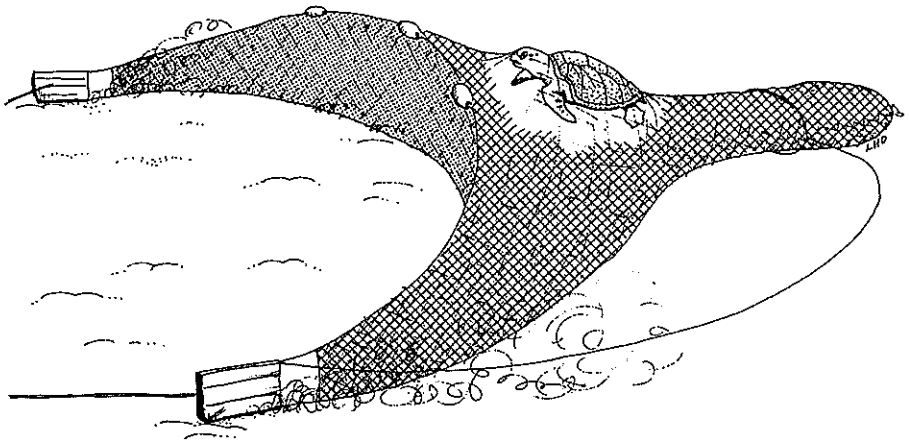

Figure 2.—Exhausted sea turtle caught in trawl and entangled in meshes.

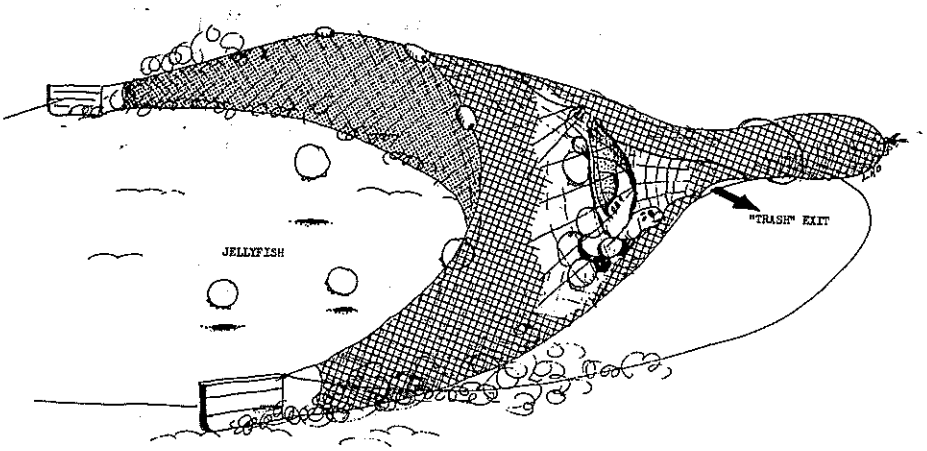

Figure 3.—Sea turtle in trash chute of separator trawl.

Entanglement in Separator Trawl

This observation was made during the evaluation of an experimental shrimp trawl with a 15-m headrope and a separator panel of large mesh size. The separator panel narrowed into a trash chute which led to an opening in the bottom. The trawl was towed in 9-12 m of water at a speed of approximately 2 knots by the University of Georgia's *Capt. Gene*. When the divers reached the net, approximately 20 minutes after it was set, a female loggerhead turtle about 1.2 m in carapace length was trapped in the narrow part of the inner trawl ahead of the trash chute (Fig. 3). The turtle was

oriented vertically, head down, forming a plug in the trash chute, with its scutes and parts of its flippers tangled in the webbing. Jellyfish, electric rays, and other fish were accumulating in the body of the trawl ahead of the turtle. The turtle was still alive, but it was completely immobilized by the water pressure and webbing. The divers cut through the inner and outer webbing and released the turtle from the trawl—it was soon observed blowing at the surface astern of the trawler.

DISCUSSION

The reactions of turtles when encountering a trawl enhances the probability of their capture and entanglement in the trawl, with drowning if they are held submerged for an extended time. Even though turtles attempt to escape trawls by outswimming them, this maneuver is seldom successful because they cannot maintain maximum swimming speed for a sufficient period. Further, turtles encountering trawls at night or in turbid water probably do not detect the approaching trawl until they are within the net.

Some turtles can escape capture if they detect the trawl early enough and their swimming carries them out of the path of the trawl, either to one side or up to a sufficient elevation for the trawl to pass under them. One of the observed turtles, however, did not turn away from the towing direction of the trawl, but persisted in swimming directly ahead of the trawl near the bottom, turning neither right nor left, nor attempting to surface. This might be a negative response to the trawl doors, especially if the water was clear enough for it to be a visual stimulus. The large trawl doors, looming to the right and the left of the turtle's escape path, plus the turbidity clouds stirred up by the heavy metal shoes on the doors, may have guided the turtle straight ahead of the trawl. In highly turbid waters, noise from the strumming of the cables or chains striking the doors might also be important cues. At night, phosphorescence, produced by the movement of the gear through the water, may be another factor in turtle response to trawls.

The turtle that escaped the trawl did not make an overt maneuver to avoid the net but swam at a slight angle to the tow direction, which resulted in its moving out of the trawl path. It appears that the reactions of turtles encountering trawls make their capture highly probable and that these reactions are similar to those observed for fishes. Since the strenuous effort of attempting to outswim the trawl or to escape through the webbing causes an increase in oxygen consumption, drowning of the turtle is likely, especially if the duration of the tow is long.

It has been suggested that separator trawls, designed to eliminate jellyfish or noncommercial fish species through an exit chute or simply through a hole cut in the bottom panel, would allow turtles to escape. It is doubtful if this type of gear would be successful in eliminating sea turtles because their peripheral scutes, flippers and claws, and encrusting organisms become entangled in the webbing. However, juvenile turtles may pass unhindered through this kind of trawl, but some shrimp loss would also occur. Neonate or "hatchling" sea turtles are seldom encountered by trawls because they do not swim or dive deeply below the surface. The intense locomotor activity associated with the neonate's seaward goal away from its natal beach and subsequent epipelagic habits may explain their absence in catches of trawlers that fish adjacent to nesting beaches and offshore.

Perhaps the best method to prevent turtles from entering the trawl would be to place an excluder panel of large mesh webbing or other suitable material across the mouth of the net, extending from wing to wing and headrope to a footrope attached to the doors. Because the turtle's behavior consists of swimming directly ahead of the trawl, apparently guided by the gear, this type of modification might be successful in leading the turtle away from the mouth of the net and out of its path. It is believed that this trawl design would have little or no effect on the shrimp catch.

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