## FIRST RECORD OF THE LONGFIN MAKO, *ISURUS PAUCUS*, IN THE GULF OF MEXICO

The longfin mako, *Isurus paucus*, (Guitart-Manday 1966) is a large, pelagic shark that has been reported from the western Indian, central Pacific, eastern North Atlantic, and the western North Atlantic Oceans (Compagno 1984). Guitart-Manday (1975, cited by Dodrill and Gilmore 1979) described the longfin mako as a relatively common catch of pelagic longliners off northwest Cuba. They are usually captured off the continental shelf at depths of 60-120 fathoms and infrequently at 10-50 fathoms. Dodrill and Gilmore (1979) reported the first North American continental longfin mako, found beached in the surf at Melbourne Beach, FL. This paper reports the first recorded occurrence of the longfin mako in the Gulf of Mexico.

A large female *I. paucus* was collected 1 April 1985 by longline fisherman, 80 mi south of Panama City, FL (lat. 28°55'N, long. 85°35'W) near the surface, over 300 fathoms of water. Standard length (precaudal length) measured 313.0 cm and fork length measured 342.0 cm. Total length could not be measured directly because of the sharks position on the boat deck and was estimated using a ratio of total length to fork length (TL/FL = 1.152) calculated from 7 large *I. paucus* (Harold Pratt[1]). Using this ratio, total length was estimated to be ca. 390 cm. Although no embryos were present in the oviduct, this fish appeared reproductively mature. The oviducts were 3-4 cm in diameter and ovarian eggs measured 2-3 mm in diameter. Gilmore (1983) proposed the reproductive strategy of *I. paucus* to be oviphagous, as remnants of yolk were found in the digestive tract and mouth of an examined embryo.

The ventral surface of the snout and gill areas of our shark exhibited a dark grey coloration. Garrick (1967) reported this coloration as an important distinguishing characteristic between *I. paucus* and the shortfin mako, *I. oxyrinchus*, which exhibits a creamy white coloration in that area. Gilmore (1983) reported the dusky coloration to be more extensive in larger *I. paucus*.

Pectoral fin length of our shark measured 80.6 cm. Gilmore (1983) compared an adult and embryo *I. paucus* and found that the pectoral fin length represented a greater percentage of SL in the embryo (31% of SL) than in the adult (28% of SL). Our Gulf of Mexico specimen was slightly larger than the specimen reported by Gilmore (1983) (313.0 cm vs 303.5 cm SL), and the pectoral fin represented 26% of SL. Guitart-Manday (1966) examined smaller *I. paucus*—195, 203, and 226 cm TL—and found pectoral fin length as percent total length to be 30.4%, 30.0%, and 29.2%, respectively. For this specimen, pectoral fin length as percent TL was about 21%. It appears that as *I. paucus* increase in length, the pectoral fins do not increase proportionately, resulting in reduced pectoral length to total length ratios in larger sharks.

This record suggests that the longfin mako at least occurs infrequently in the northern Gulf of Mexico. Three male *I. paucus* (191, 193, and 220 cm SL) captured 16 April 1985 off the Mississippi River (lat. 27°35'N, long. 89°55'W) further supports this suggestion (Stephen Branstetter[2]). These captures extend the known range of this species well into the northern Gulf of Mexico.

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# MOVEMENT OF SEA-RUN SEA LAMPREYS, *PETROMYZON MARINUS*, DURING THE SPAWNING MIGRATION IN THE CONNECTICUT RIVER[1]

Adult sea lampreys, *Petromyzon marinus*, first enter New England rivers in late March and early April (Bigelow and Schroeder 1953). The only information on river water temperatures during the migration were collected in 1974 from the St. John River, New Brunswick, where Beamish and Potter (1975) captured the first prespawning adults in a fish lift at Mactaquac Dam (river km 140) at 13°C in mid-June and the run peaked at 17°-19°C. Because thousands of sea lampreys are annually passed upstream of Holyoke Dam (river km 140) on the Connecticut River, the passage records provide an ideal opportunity to characterize the run relative to temperature. River flow was partially or totally controlled by the hydroelectric facilities at the dam, so we did not examine the effects of flow on the run.

The behavior and rate of movement of landlocked sea lampreys in the Great Lakes was determined using mark and recapture of adults at stream weirs (Applegate 1950; Applegate and Smith 1950; Smith and Elliot 1952; Moore et al. 1974). The only estimate of the rate of movement of sea-run sea lampreys was done by Beamish (1979) who used the energy expended during an upstream movement to estimate the distance traveled and the rate of movement of adults in the St. John River. Because this estimate of the rate of movement was not verified by direct observations on fish in the field, we believed that additional study was necessary. We selected radio telemetry to determine the rate of movement and diel behavior of sea lampreys. The abundance, size, and sex ratio of the Connecticut River population were reported by Stier and Kynard (1986).

## Methods

Radio-tagged sea lampreys were observed in the 46 km stretch of the Connecticut River from Brunelle's Marina to Cabot Station, a hydroelectric facility located 4.5 km below Turners Falls Dam (Fig. 1). The downstream half of this stretch flows slowly, creating a deep channel and shoals; the upstream half flows swiftly with pools and riffles. Major spawning areas are in the upper main-stem near Cabot Station, Russelville Brook, and the Fort, Mill, Sawmill, and Deerfield Rivers (Fig. 1).

The number of sea lampreys passed daily by the fish lifts from 1980 to 1983 were counted by personnel of the Massachusetts Cooperative Fishery Research Unit. Daily maximum river temperature was recorded at Holyoke Dam.

Sea lampreys were captured in the trap at the fish lifts during May and June 1982, measured for total length, and held for <24 h in a 1,325 L circular tank supplied with river water. We anesthetized fish with MS-222 (1:20,000) and tagged them first with a Floy tag inserted through the posterior dorsal fin, and second with a transmitter placed on the left side of the body along the first dorsal fin. Sex could not be accurately determined visually.

Cylindrical radio transmitters were constructed from the design of Knight (1975) and operated at a frequency of 30.05-30.25 MHz. Tags measured 34 × 10 mm, weighed 3.5-4.5 g in air, and transmitted for about 20 d. Each fish was identified by frequency and pulse rate. We located fish to within about 10 m, using receivers equipped with an omnidirectional, 1/8-wave antenna and a directional, tuned-loop antenna.

We released two to six sea lampreys at a time and observed them continuously for ≥6 h or until darkness. Subsequently, sea lampreys were located each day until they reached Cabot Station or entered a tributary. During all surveys, we noted the locations of fish to the nearest river kilometer. Diel movement was monitored for five 24-h periods. Additional fish were released during the day for this study.

## Results and Discussion

The water temperatures, and the year in parentheses, when sea lampreys first entered the fish lifts were 12.5°C (1980), 10.5°C (1981), 12.5°C (1982), and 15.5°C (1983) (Fig. 2). The lifts sampled the en-

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