the average weight of Connecticut River fish was considerably less (Table 1). The difference in average weight between sea lampreys in the two populations is not due to the difference in location of upstream sampling sites, but possibly to differences in energetic requirements, food supplies, or some aspect of the environment during the oceanic parasitic phase. A difference in weight between populations has previously been found in landlocked sea lampreys in the Great Lakes (Smith 1971).

Acknowledgments

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AN IMPROVED OTTER SURFACE SAMPLER

Field trials using a neuston sampler described by Sameoto and Jaroszynski (1969) revealed serious sampling problems associated with coastal waters of British Columbia. Due to extensive freshwater runoff in the vicinity of large rivers, sampling conditions including choppy surface waters of lowered salinity and vertically depressed distributions of near-surface larval and juvenile fishes. Under such conditions, the S-J sampler behaved erratically, throwing considerable spray, and, when adjusted to increase depth of tow, the body and control surfaces deformed at speeds in excess of 5 knots. The modifications described here reflect our objectives of improving performance, increasing durability, and ease of handling, without increasing costs other than those incurred by adding a flowmeter to provide quantitative catches. The complete unit is depicted in Figure 1.

Detailed Description

Sampler Box

Constructed of 1/8" marine aluminum, this aluminum is folded into a body with one welded seam (Fig. 2). The leading edges are reinforced with 1/4" aluminum for attaching the bridles and depressor. The square mouth opening was sized to accomodate 0.25 m^2 bongo nets having a circumference of 185 cm. Body dimensions are 46 × 46 × 60 cm.

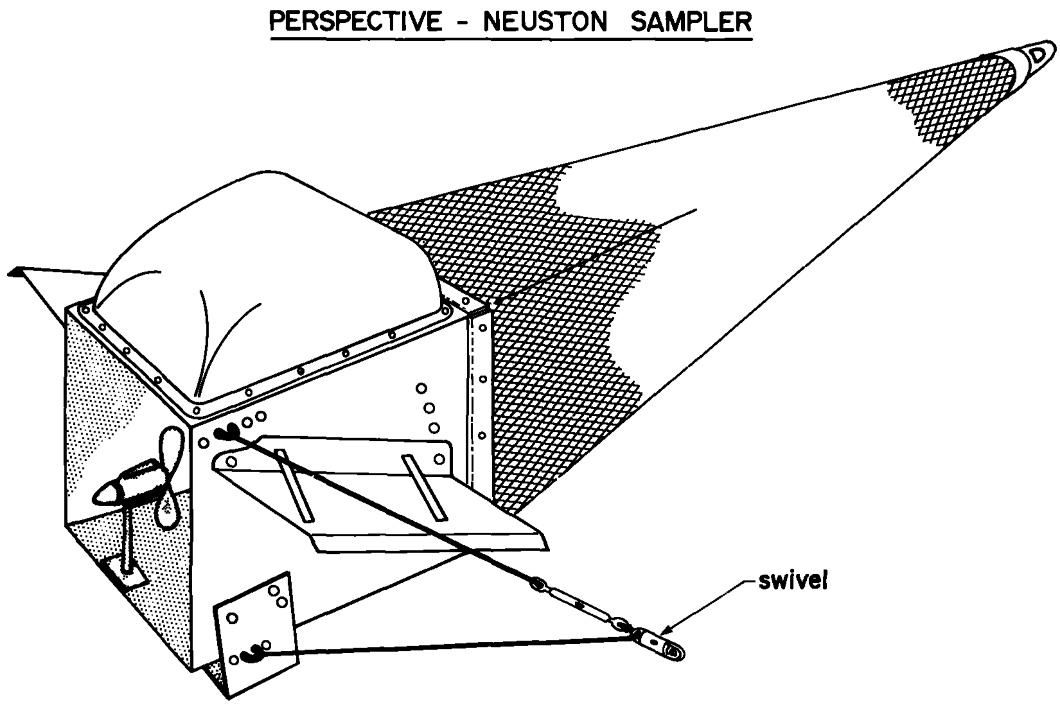

FIGURE 1.—Neuston sampler with net cod-end attached.

Net Attachment

We replaced the grommet and bolt-through net fastening system of the S-J sampler with an aluminum channel clamp (Fig. 2). Net slippage is prevented by sewing a 1/4" rope into the net collar. Stainless steel bolts remain permanently attached to the sampler body so that, to mount or replace the net, it is merely slid over the box and the channel placed over the bolts and secured. One man can replace the net in 5 min.

Lateral Wings

Individual fins bolt directly to the sides of the body and are made of 1/8" aluminum with the inside edge bent at 90° for an attachment face (Fig. 3). The outer edge is bent downward 15° to stiffen it and to reduce side slippage under tow. The wings pivot on a bolt anteriorly and are adjusted through a series of holes in the sampler body (Figs. 1, 2).

Depressor

Bolted directly to the body and adjusted as for the wings (Figs. 1, 2), the depressor is made from 1/4" marine aluminum bent at right angles on either end for attachment (Fig. 3). It serves also as the lower towing point and stiffens the body.

Tow Points

The sampler is adjusted in relation to the towing vessel by a stainless steel turnbuckle on the upper bridle (roll aspect), and by selecting the lower tow point (depressor) and upper tow point (leading top corner of the body) from a series of holes (Figs. 1, 2, 3). The tow point fastening is a threaded U-bolt, fastened on both sides of the sampler frame (Fig. 3).

Flotation

A streamlined float constructed of fiberglassed, polyurethane foam which bolts to the upper face of the body (Figs. 1, 2). At neutral buoyancy the sampler floats with the mouth opening just below the water surface. As with the S-J sampler, vertical positioning under tow is the balanced outcome of downward depressor force and lift from the lateral fins. These adjustments are made to maintain an 8-10 cm headspace of air in the sampler while under tow.

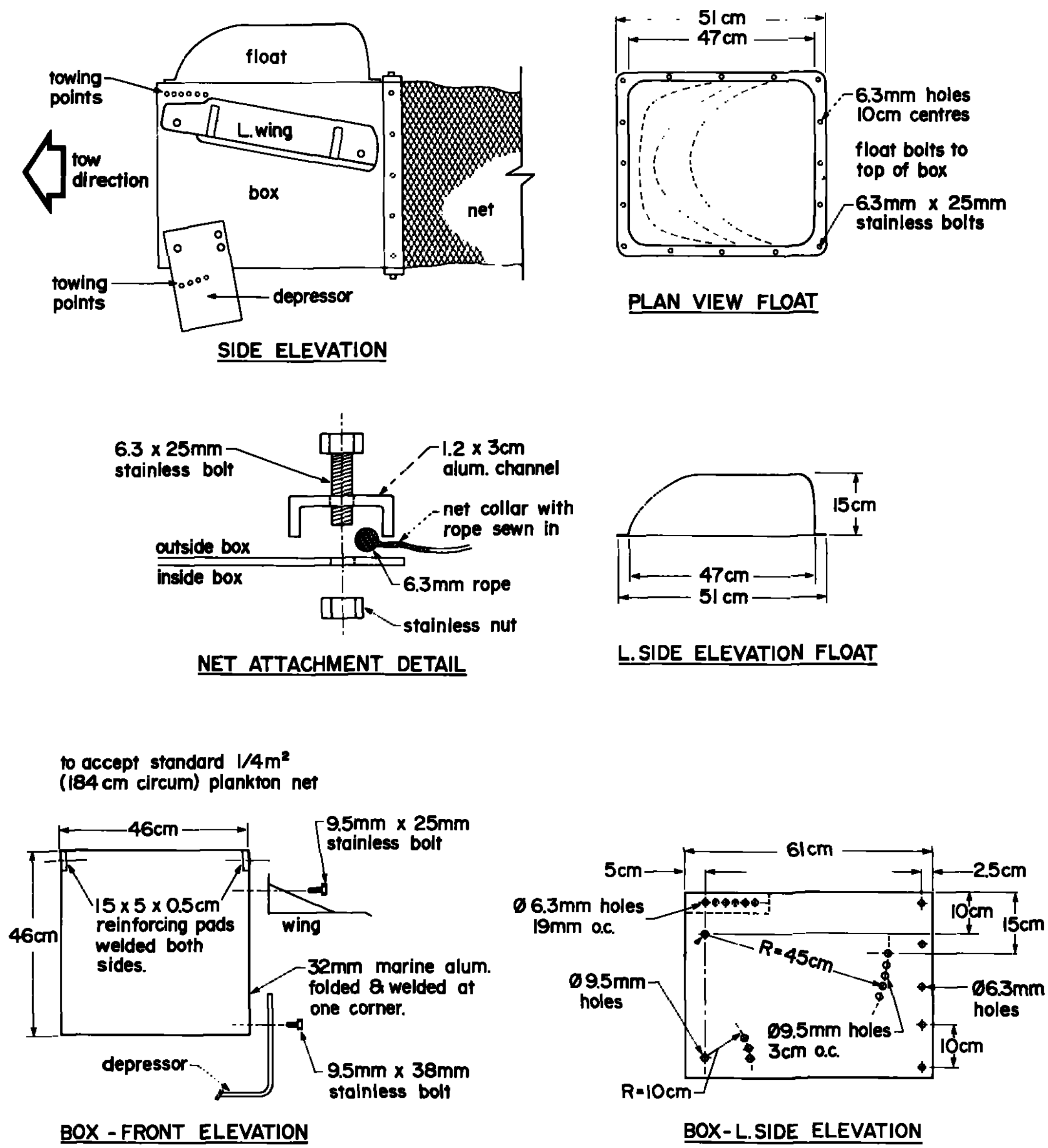

FIGURE 2.—Scale drawings of the sampler body and float, and net attachment detail.

Flowmeter

A General Oceanics meter is attached inside the body by means of a hinged strut which folds forward to facilitate reading the meter (Figs. 1, 3). The meter is free-pivoting in the horizontal plane and offset 17 cm from the center of the mouth opening.

Evaluation

This modified version of the otter neuston sampler has been used extensively since 1981, offshore to Station Papa (Mason et al. 1983) and in inside waters under all weather conditions, including a full gale. It performs best when towed into or across the wave direction at 4-6 knots. At higher speeds, disturbance due to backsplash from the fins and bridal may cancel out potential advantage of further increase in tow speed. Sampling efficiency is deemed to be relatively high when using a 500 μm mesh net at night. Catches of juvenile fishes in the Strait of Georgia are quantitatively comparable with those

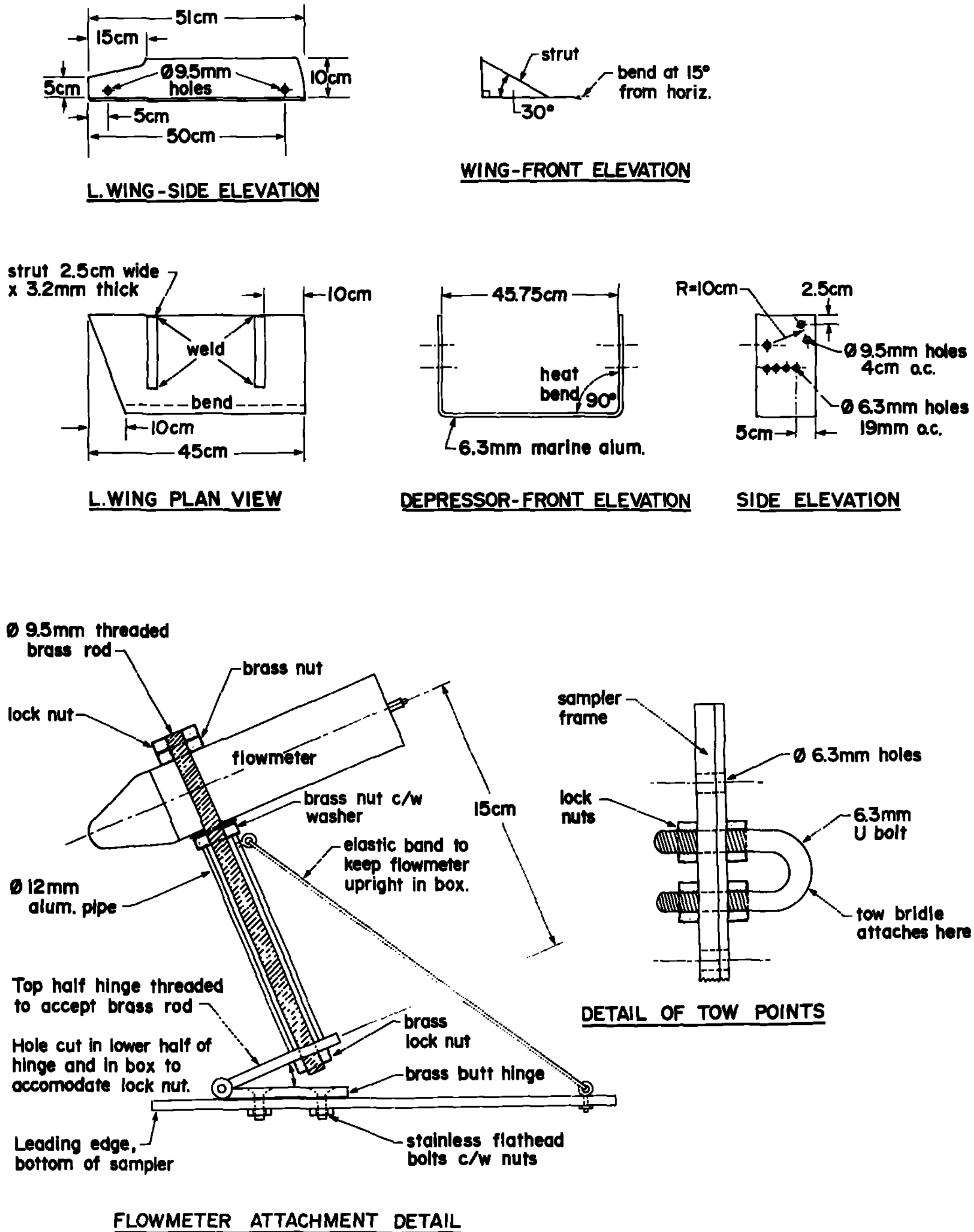

FIGURE 3.—Scale drawings of the depressor and wings, and tow point and flowmeter details.

made with a large volume, two-boat surface trawl as employed by Barraclough et al. (1966). We found no significant difference (student's *t*-test) between mean total catch (12.9 and 12.1 fish/100 m^3) for nine taxa common to both gears in eight pairs of tows made locally in the Strait of Georgia, British Columbia, during March-April. Among the fish sampled by this gear in offshore and shelf waters are juvenile Pacific salmon to 14 cm, Pacific saury to 25 cm, juvenile sablefish, rockfish, greenlings, and squid, in addition to the routine catches of ichthyoplankton and general zooplankton.

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MORPHOLOGICAL EVIDENCE FOR STARVATION AND PREY SIZE SELECTION OF SEA-CAUGHT LARVAL SABLEFISH, *ANOPLOPOMA FIMBRIA*

One of the major causes of larval mortality is starvation, this being related to the patchiness of food resources (Hunter 1981). While starvation has been induced under laboratory conditions [e.g., herring, *Clupea harengus*, and plaice, *Pleuronectes platessa* (Ehrlich et al. 1976); northern anchovy, *Engraulis mordax* (O'Connell 1976); jack mackerel, *Trachurus symmetricus* (Theilacker 1978, 1981)], starved larvae have rarely been observed in nature (northern anchovy, O'Connell 1980; jack mackerel, Theilacker 1986). Various methods have been used to characterize starvation in fish larvae, including condition factor (Blaxter 1971), chemical analyses (Ehrlich 1974), histological analyses (Umeda and Ochiai 1975; O'Connell 1976, 1980; Theilacker 1978, 1986), and morphological analyses (Shelbourne 1957; Nakai et al. 1969; Ehrlich et al. 1976; Theilacker 1978, 1981, 1986). While histological and chemical analyses are based on qualitative changes in tissues that result from starvation, their methodologies require special preservation techniques, negating their application to samples preserved without these techniques in mind. To characterize starvation in samples that have not been specially preserved, measures of morphology and/or condition factor are more appropriately applied. In the present study, in the absence of special preservation techniques, the occurrence of starvation in sea-caught larval sablefish, *Anoplopoma fimbria*, was examined using morphological measures.

The sablefish inhabits the continental shelf of the North Pacific Ocean and is the subject of an intensifying fishery off the west coast of North America, yet little is known about the early life history of the species. Recent evidence obtained off Canada suggests that sablefish spawn in water deeper than 300 m, with spawning activity peaking in February. Eggs (1.8-2.2 mm in diameter) descend while developing, and hatching probably occurs at depths in excess of 400 m (Mason et al. 1983). Although size at hatching and the size at first feeding have not been clearly defined, Mason et al. (1983) reported collecting recently hatched larvae of 5-6 mm. After hatching, larvae ascend to surface waters and become neustonic (Kendall and Clark 1982[1]). Juveniles apparently remain in shallow water until they mature. Beyond reports of distribution (Kendall and Clark fn. 1; Clark 1984[2]) and descriptive work (e.g., Kobayashi 1957; Ahlstrom and Stevens 1976), studies of larval and early juvenile sablefish have concentrated on aging and growth (Boehlert and Yoklavich 1985; Shenker and Olla in press).

Our aim in the present study was to detect the possible occurrence of starvation in larval sablefish collected off Washington and Oregon during April and May 1980 (Kendall and Clark fn. 1), using selected morphological measurements to determine variability in larval condition. Further, to elucidate the possible relationship between larval condition and feeding requirements, prey size-selection and diet were analyzed.

Methods

Sablefish larvae were collected by using a 0.5 m neuston net (Sameoto and Jaroszynski 1969) with 0.505 mm mesh, towed for 10 min from the RV *Tikhookaenskiy*, during the first cooperative U.S.-U.S.S.R. ichthyoplankton survey off the Washington and Oregon coast in 1980 (Kendall and Clark fn. 1). Larvae from stations 20, 24, 25, 34, 38, 50,

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