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An active fishery for American plaice, Hippoglossoides platessoides F., is prosecuted in ICNAF Division 4T (southwestern Gulf of St. Lawrence). Life-history studies and observations on the fishery during the period 1957 to 1962 have been analysed in the light of landings statistics. The principal fishing methods have been otter trawling and Danish seining, less than 5% of the landings being by hook and line.

Landings

Following an expansion in the Canadian trawler fleet, American plaice landings rose rapidly from 1 million lb in 1947 to a peak of 26 million lb in 1955. This peak was attributed primarily to exploitation of accumulated older fish. A slight decline in landings followed in the 1956 to 1958 period. Catches increased to 25 million lb in 1960, apparently because of increased effort in plaice seeking to offset poor cod catches. In 1961 and 1962 landings decreased slightly (from the 25 million lb in 1960) to 24 and 21 million lb, respectively.

The Stock

Tagging studies and analyses of fin-ray samples indicated that the 4T plaice stock is biologically discrete but consists of two main groups: In summer, one group concentrates in northern 4T (Chaleur Bay and Shippegan Gully), while a southern group concentrates mainly off Cape Breton in the lower part of Division 4T and northern portion of 4Vn (35-110 m). Little mixture of adult fish between the two groups was observed, nor did emigration occur. Regular but limited seasonal movements within each area did occur, however.

In late fall American plaice migrated from shallower water towards deep water along the Laurentian Channel. By winter (January-March) the best catches were in depths of 180 to 450 m (3-6°C). In spring (April) plaice were again found at intermediate depths (75-150 m) as in the fall.

Age and Growth

American plaice are relatively slow growers compared to Atlantic cod, not reaching marketable size (30 cm) until ages 7 to 8 years. Males and females grew at the same rate up to age 5, but from this age onwards, females grew more rapidly. The asymptotic length for females was 70 cm (age 26) while that for males was 54 cm (age 21).

A few females may mature at 30 cm (age 8), but 50% were not mature until they reached 41 cm (age 10). The 50% maturity point for males was 25 cm (age 6). Maximum spawning occurred during April to mid May.

The 1950, 1953, 1954 and 1957 year-classes were strong in survey catches from 1957 to 1961. Earlier commercial samples showed that broods produced in 1943 and 1947 were also relatively numerous. Because American plaice are relatively long-lived, brood strength is currently of limited

importance to production unless successive periods of weak or strong broods occur. The significance of relative strength of broods will, however, increase with reduction of mean size and age.

Feeding

Food utilization and food competition were studied as a factor possibly limiting the abundance of American plaice. The main food competitor in the area is Atlantic cod. Large plaice feed primarily on echinoderms and molluscs, whereas the bulk of the larger cod's diet is fish. Some inter-species food competition takes place between smaller sizes of cod and plaice, but small plaice do not apparently compete with larger plaice for food. Judging from the apparent abundance of food types utilized by plaice, shortage of, or competition for food, does not currently appear to be a very keen limiting factor.

The Fishery

Mesh selection experiments showed that the 50% selection points for American plaice for 3-inch manila and for $4\frac{1}{2}$ -inch and $5\frac{1}{2}$ -inch synthetic cod-ends were ages 3, 5 and 7 years, respectively (sexes combined). Observations made during surveys and commercial trips indicated that current discards at sea can be as high as 85% by number for otter trawl, and 54% by number for Danish seine. The hook-and-line fishery takes only fish of commercial size.

Survival experiments showed that all plaice under 30 cm died after a 45-minute deck exposure and 80% after 25 minutes. Coupled with observations on the commercial fishery, this meant that generally most small plaice are discarded, dead, into the sea by fishermen.

Age- and size-composition samples of 4T American plaice taken in 1917, 1950 and 1961 showed that the mean size and age have changed, becoming smaller and younger in later years.

The total annual mortality rate calculated from combined catch curves of 1957-1962 was 0.4 ($Z=0.5$), and from 1962 data alone, 0.5 ($Z=0.6$). Estimates of annual natural mortality rate from virgin and near-virgin stock were 0.13 and 0.14 ($M=0.2$). Apparent annual natural mortality from tagging studies varied from 0.1 to 0.3, but errors are suspected in these data. From age-composition samples, the more reliable source, estimates of the current instantaneous rates of natural and fishing mortality fell between:

$$\begin{aligned} M &= 0.1 \text{ to } 0.2 \\ F &= 0.3 \text{ to } 0.4 \end{aligned}$$

Ricker models (first approximation--sexes combined) of the American plaice fishery in 4T indicated that an instantaneous fishing rate of 0.3 to 0.4 could eventually diminish the usable stock to one third its original weight by reducing the mean size. Sustained yield with $4\frac{1}{2}$ -inch synthetic mesh would be greatest at $F = 0.2$ to 0.3, but maximum catches would be obtainable by use of a 6-inch mesh. However, since plaice are taken along with cod, the use of a 6-inch mesh would decrease catches of cod and other species. It appears that present landings could be increased by quickly returning discards to the sea, or by landing smaller fish, assuming that recruitment, growth, and density remain constant.

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