

ANNUAL MEETING - JUNE 1965Validity of the otolith method of age determination  
for American plaice in 4T

by P. M. Powles  
Fisheries Research Board of Canada,  
Biological Station, St. Andrews, N.B.

Introduction

In studies of age and growth of fish, validation of the age-determination method used is very important. In recent studies on American plaice in the Gulf of St. Lawrence (ICNAF Div. 4T), the seasonal pattern of rings on the otoliths was interpreted in the light of size and growth. The hyaline zones were found to be true annuli. Graham (1956) reviews seven techniques commonly used to demonstrate the reliability of otoliths and scales for ageing. Three of these methods were utilized in this study.

The first method combined an examination of otoliths from larvae and very small fish and observations on a succession of length modes for small fish at different seasons of the year. For American plaice this method was complicated because 0- and 1-year-old fish were not readily captured by bottom trawling. Special methods had to be used to collect these young fish. Some young-of-the-year were taken just off bottom in an Isaacs-Kidd trawl and both 0- and 1-year-old fish were obtained from stomachs of predators (cod, skate, eelpout); 2- to 4-year-old fish were taken by means of a special small-mesh bottom drag; an otter trawl with codend lined with 1 1/8 inch (2.9 cm) mesh was used to collect fish of 3 years and older. From the mean lengths at age obtained from the collection of small fish, it was possible to assign ages to the length modes.

The second method compared growth from age-length and tagging data. The growth of fish liberated and recaptured after one year was compared to growth computed from mean length-at-age data for the same period, by transforming each to straight-line relationships (Walford, 1946; Manzer and Taylor, 1947).

The third method employed studied the consistency of weak and strong year-classes in this stock of American plaice.

Results

Table 1 shows the length ranges and mean lengths at various ages by quarter for American plaice in Div. 4T. The major spawning takes place in early May. In the quarter May-June-July, the plaice larvae are pelagic. Otoliths taken from larvae at this stage (captured in plankton nets) show a small hyaline dot or nucleus in the centre of the otolith with no other otolith growth. The smallest fish, taken by Isaacs-Kidd trawl, was 1.7 cm in length. Its otoliths showed a completely formed nucleus. In the quarter August-September-October, no young of the year were captured; however, in the next quarter, November-December-January, a number of young of the year from 3.0 to 3.5 cm in length were captured and the otoliths examined. These otoliths showed a small nucleus surrounded by an opaque band and most showed a narrow hyaline edge.

Table 1. Mean lengths and ranges of young 4T American plaice together with seasonal appearance of the otoliths.

Quarter	Main edge type	Mean length and range (cm) and number of hyaline zones		
2*	Narrow Opaque	2.0 (1.7-2.3) (no hyaline)	3.5 (2.6-3.8) (1 hyaline)	8.5 (7.1-10.7) (2 hyaline)
3	Wide Opaque	-	4.6 (4.3-5.0) (1 hyaline)	9.9 (7.6-12.1) (2 hyaline)
4	Narrow Hyaline	3.2 (3.0-3.5) (1 hyaline)	6.0 (5.1-7.0) (2 hyaline)	- - (3 hyaline)
1	-	-	-	-

\* Quarters begin with February-March-April

Similar data were recorded for larger specimens taken by bottom trawling in 4T. These showed that during the period May-December, opaque material was built up on the otolith, and during the period January-April, the hyaline band was formed. The formation of consecutive opaque and hyaline bands was therefore associated with two particular seasons each year. The small central nucleus was interpreted as a structure formed during the pelagic phase. The first hyaline zone was associated with the first winter of life of American plaice.

These interpretations agree well with the order of growth of small plaice during their early years (Fig. 1). The peaks representing 2-year-old fish in Fig. 1B and 1C correspond to mean length at age shown in Table 1. Similarly peaks representing 4-year-old fish correspond to mean length at age determined from otolith readings. The progression of size through the seasons is shown clearly in Fig. 1.

#### Growth comparison between age-length and tagging data

The length at tagging and the age-length means for 1958 ( $L_t$ ) were plotted against length at recapture (adjusted by a shrinkage factor of 1.2%), and age-length means for 1959 ( $L_{t+1}$ ). The method of least squares fits for the two sets of points gave the following straight-line equations (Fig. 2):

$$L_{t+1} = 0.92 L_t + 4.9 \text{ for tagging data}$$

$$L_{t+1} = 0.89 L_t + 5.2 \text{ for age-length data}$$

The slope of both lines is almost the same and the two lines are separated on the y axis by only 0.3 cm.

Since the growth parameter arrived at by both methods is in good agreement, there is strong evidence for the validity of the ageing method used.

#### Relative abundance of year-classes

Ages of American plaice taken in research-vessel surveys during 1957-61 were used to calculate relative strengths of year-classes (Fig.3).

In 1957, among older fish, the 1950 year-class was dominant, and continued to be much stronger than its neighbouring year-classes right through to 1961.

During the period 1957-61 three other year-classes 1953, 1954, and 1955, were strong and dominant for several years in succession. The 1953 year-class was dominant from 1957 through 1959, but in 1960 it was displaced by the 1954 year-class which was dominant for the next two years. The consistency in abundance or scarcity of particular year-classes exhibited in these data is further evidence of the validity of the age-reading techniques used for American plaice from the Gulf of St. Lawrence (D.V. L.T.).

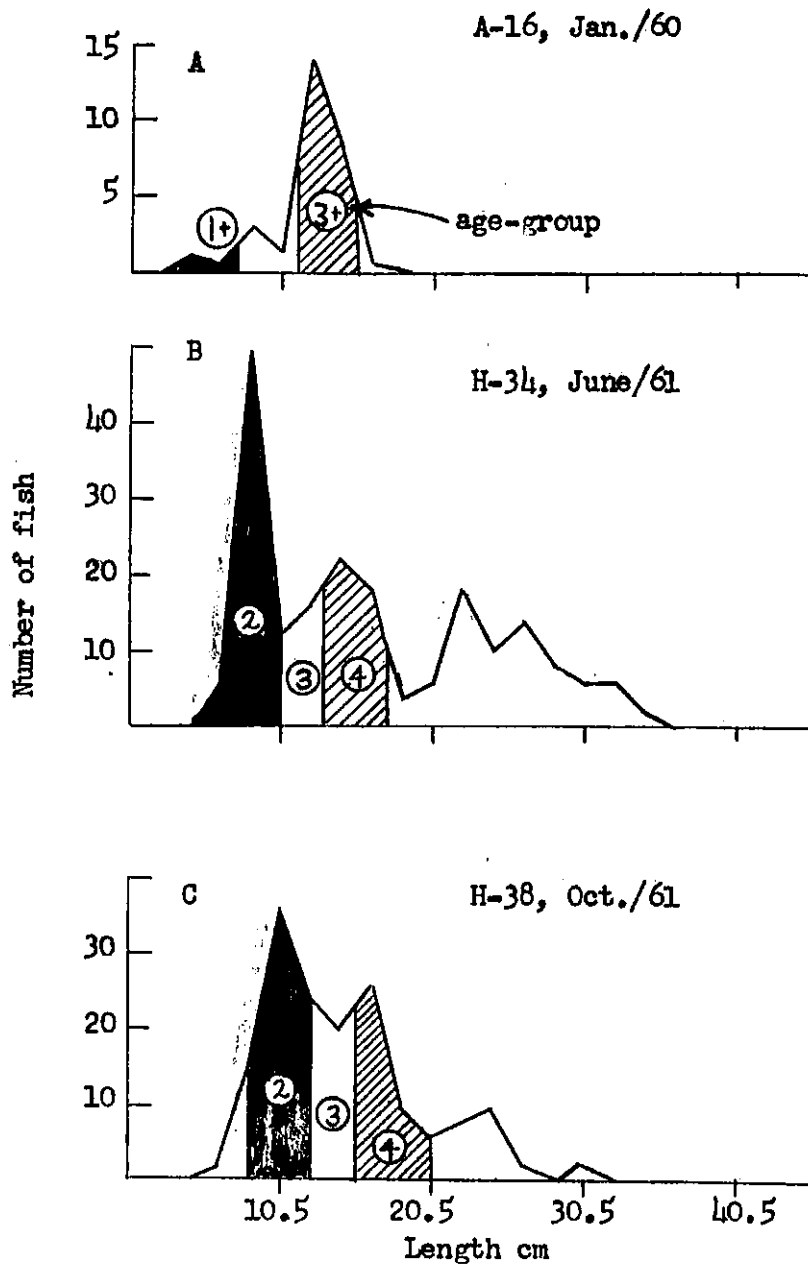


Fig. 1. Length distributions of small American plaice from one locality in LT sampled by special small-mesh drag. The positive modal shifts for each age-group represent growth over a 10-month period.

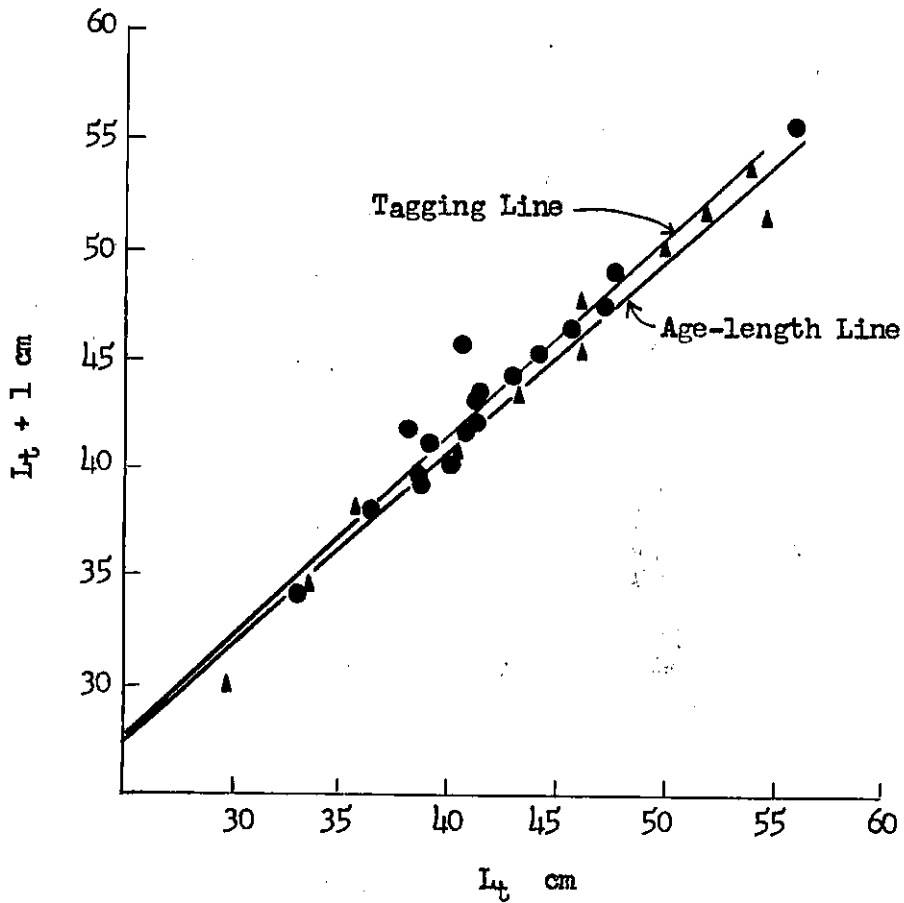


Fig. 2. Straight line growth transformations of American plaice from tagging and age-length data. Total lengths ( $L_t$ ) are plotted against lengths one year later ( $L_{t+1}$ ). Triangles indicate mean length-at-age, while the circles represent lengths of individual (tagged) fish.

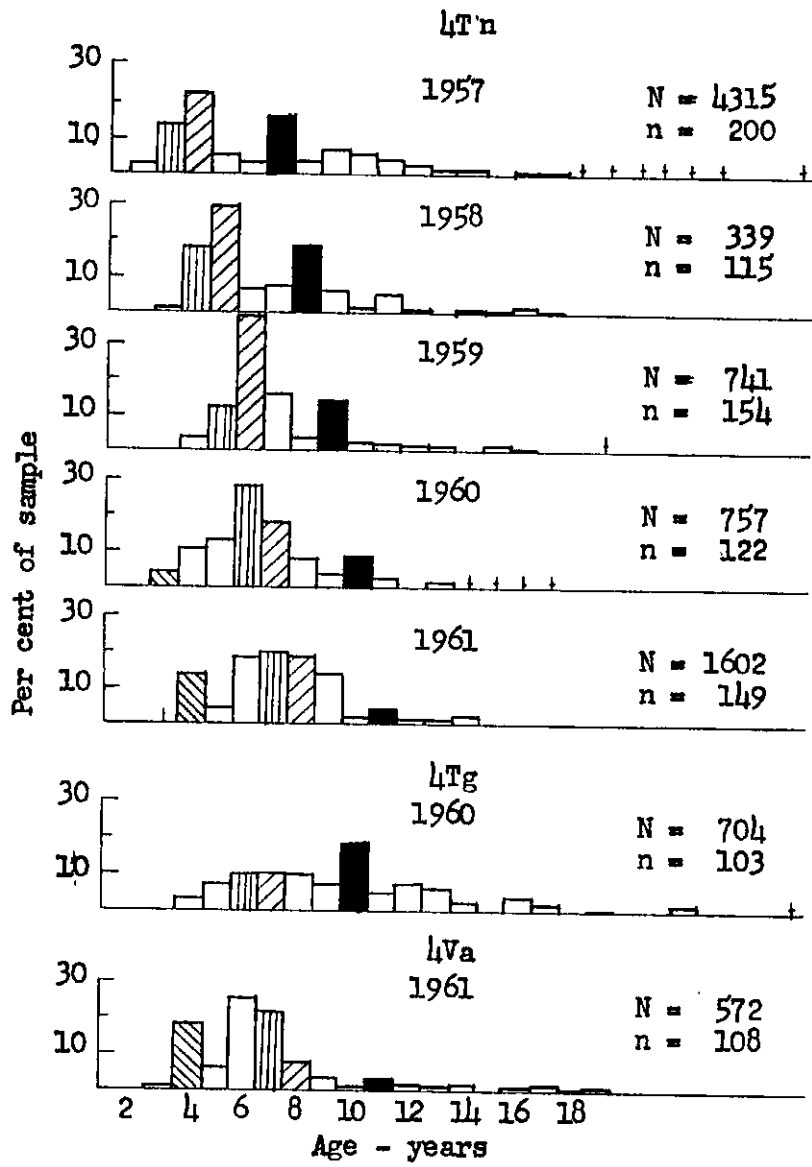


Fig. 3. Age composition of female American plaice in the Magdalen Shallows, 1957 to 1961. N is the number of fish measured and n is the number of otoliths taken.