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Validation studies of Subarea 4 cod otolith age determinations

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The report of the 1959 ad hoc sub-committee on the ICNAF cod otolith exchange program (ICNAF Redbook, 1959, p. 48) listed several methods of improving interpretation of zones in cod otoliths. Among these were "field studies, e.g., by sampling the youngest year-group throughout a year" and "experiments in connection with tagging of cod--and with cod kept in tanks where certain conditions can be introduced and controlled". Studies of the validity of Subarea 4 cod otolith age determination have been carried out at St. Andrews using the above recommended techniques supplemented by some other methods. Results of the investigations for which adequate data are available are set out below.

First of all, data on type of otolith edge formation was investigated by following rhythmic changes throughout the year. For this purpose the best data available were from samples taken of the commercial longline fishery in Division 4X in the years 1948 to 1958. Readings of the samples produced data on the type of material being deposited on the periphery of the otolith at various times during the year. This information is summarized in Figure 1. It showed that the predominant edge material was hyaline from December to April and opaque from June to September. In the intervening months the dominant edge type varied from year to year. The indication of annual formation of one hyaline and one opaque zone in the otoliths is considered to be good evidence that the combination is a valid year-mark in the majority of cod sampled.

In pursuing the problem further it was found that special collections of pre-commercial sizes of cod were necessary in order to establish criteria for identification of the initial year-zones in Division 4T cod. To collect these small fish for study, special small-mesh covers or liners were placed on the codends of otter trawls fished from research vessels. Length compositions of catches taken from the area in three seasons of the year are shown in Figure 2. Ages were assigned to modes in the length frequencies of pre-commercial sizes on the basis of knowledge of spawning times and growth of these cod. Thus, peaks were evident for one- and two-year-olds in the June sample, for age-groups zero and one in the October sample, and for zeros and one-year-olds in the January sample. With the ages of these small fish indicated from the length-frequency modes, their otoliths were examined and a basis for interpreting the hyaline and opaque zones in the early years of life was established. In this particular case the first hyaline year-mark was found to be smaller than that laid down in otoliths of some other Subarea 4 cod populations. This is presumed to be because of later spawning of these fish than those resident in the Nova Scotian bank area.

Other pieces of evidence have been used in the validation studies. For instance, the constancy of relative strengths of year-classes of cod landed from the fishery from year to year (e.g., ICNAF Document 10, Section B, Fig. 1) indicates that our methods of reading are consistent. Consistency of age reading has also been checked by having different readers examine the same samples independently, and

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by having individuals re-examine samples originally read by themselves. Examination of the causes of disagreement in these tests has led to the identification of characteristic difficulties in otoliths of the various Subarea 4 populations.

Indirect validation of the methods used came from a study of growth data obtained independently by the tagging and age-length methods (North Atlantic Fish Marking Symposium, Contribution No. 12). Here, growth data from tagging experiments showed essentially the same increment per year for Division 4T cod as that obtained from otolith readings and fish lengths. It was concluded from this that our readings were at least accurate enough to give good estimates of growth.

Thus, accumulation of evidence on the validity of otolith aging methods from close examination of our routine age determination, plus the addition of special studies of the problem in specific areas where the need presented itself, have resulted in a reasonable amount of confidence in our present age-determination work. This is a project which is constantly subject to review because of the possibility of new variations showing up from year to year.

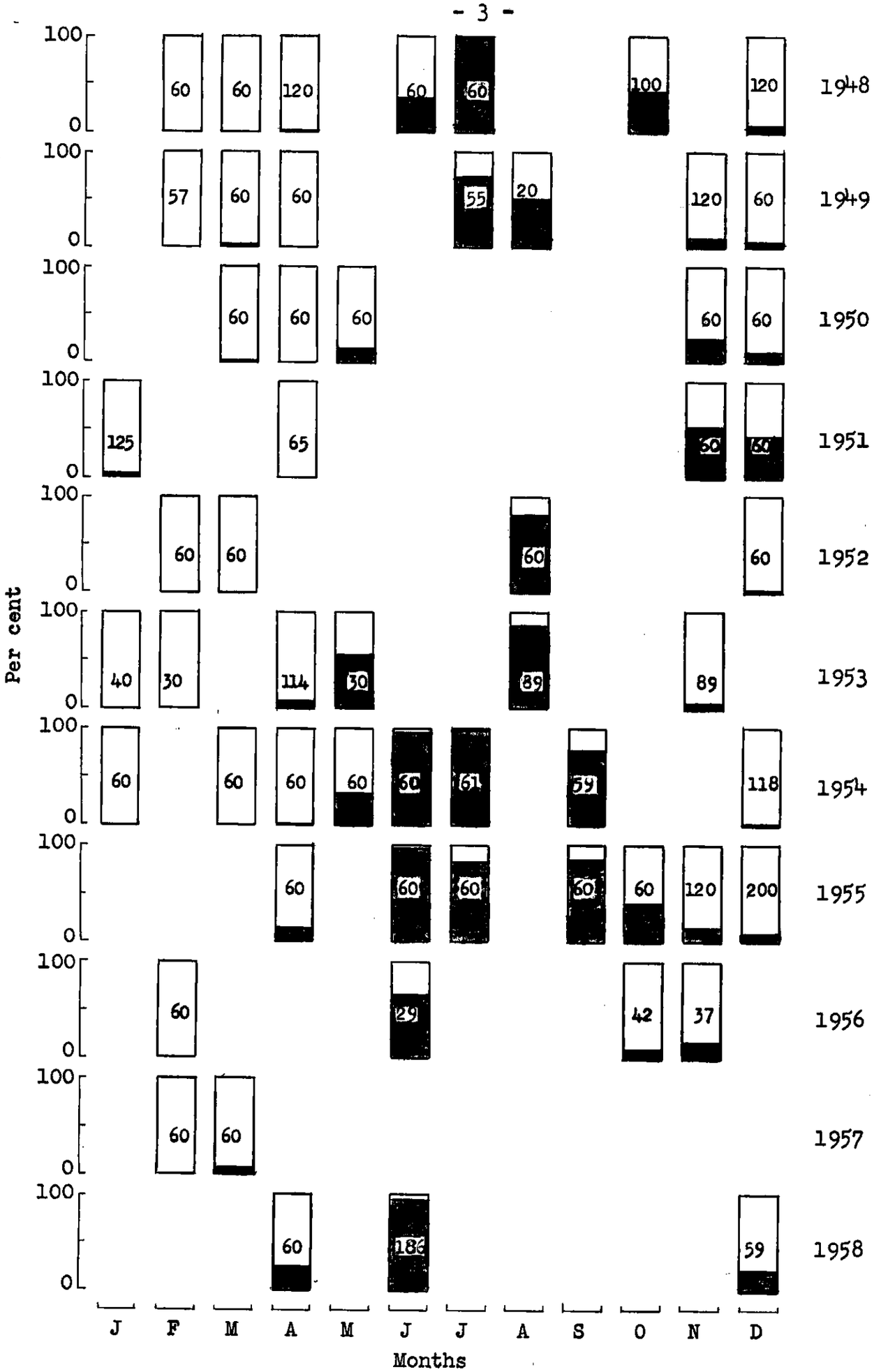

Figure 1. Type of edge deposition on cod otoliths from ICNAF Division 4X. Numbers of fish in each sample are shown. Shaded parts of the blocks indicate opaque edges. Light parts indicate hyaline edges.

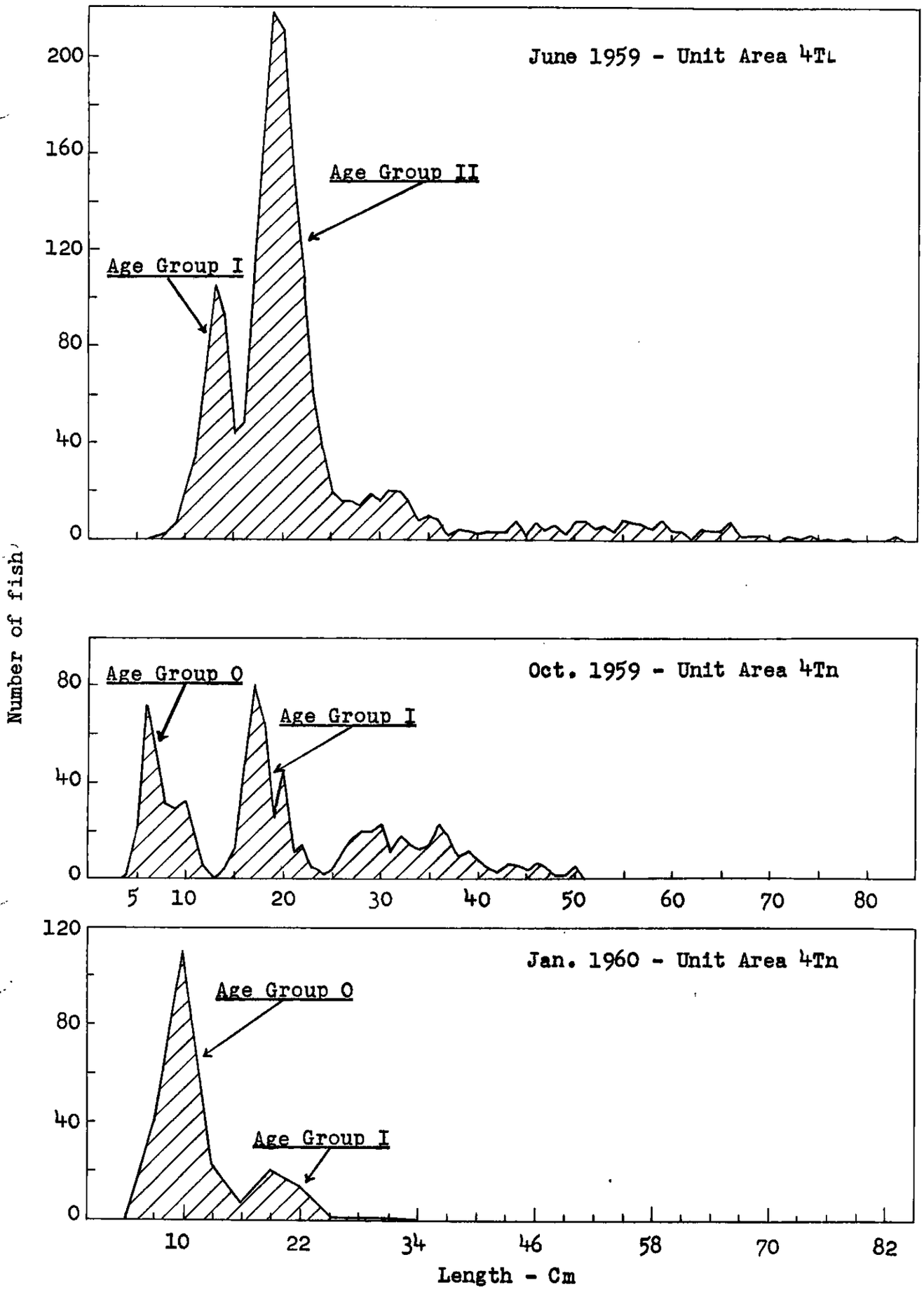

Figure 2. Length distributions of special collections of small cod from ICNAF Division 4T taken to check age determination methods. In identifying age-groups the fish birthday is taken to be February 1.