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DISTRIBUTION OF YOUNG-OF-THE-YEAR HADDOCK ON THE SCOTIAN SHELF

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Abstract

Large numbers (up to 2830 per tow) of young-of-the-year haddock were caught during a September-October, 1980 groundfish survey on the Scotian Shelf. Four foci were identified in the distribution, the two major concentrations being to the southwest of Emerald Bank and on Browns Bank. Length-frequency distributions from all areas were similar, with a mode at 10.5 cm. Comparison of day-night catches suggests diurnal movement of the fish, with higher catch rates during the day. Catch rates in the Emerald and Browns Bank areas were approximately 3 times and 8 times those in 1979, respectively, indicating a strong 1980 year-class.

Résumé

Au cours d'un relevé des poissons de fond sur le plateau néo-écossais en septembre-octobre 1980, on a capturé un grand nombre (jusqu'à 2 830 par trait de chalut) d'aiglefin d'âge 0. Quatre foyers de distribution ont été identifiés, les deux plus importantes concentrations se trouvant au sud-ouest du banc Émeraude et sur le banc Browns. La distribution des fréquences de longueur est similaire dans toutes les régions, avec un mode à 10,5 cm. Une comparaison des prises diurnes et nocturnes suggère une migration nycthémérale des poissons; les prises les plus élevées se font le jour. Les taux de capture dans la région des bancs Émeraude et Browns sont d'environ 3 à 8 fois supérieurs, respectivement, à ceux de 1979. Ceci est le signe d'une abondante classe d'âge de 1980.

## Introduction

In November 1979 and September-October 1980, groundfish research trawling surveys were carried out on the Scotian Shelf. The cruises initiated an annual autumn survey program which, together with a well established summer survey and a newly instituted winter survey, will provide information on seasonal changes in groundfish distribution, abundance and biology in the area. During the 1980 cruise, exceptionally large numbers of juvenile haddock were caught over a wide area. Length-frequency (L/F) distributions indicated that they were young-of-the-year and the differences in catch rates in different areas and at different times suggested that the data might indicate nursery areas and possible diurnal variation in behavior. A consideration of the data is presented here and geographical distribution and catch rates compared for 1979 and 1980.

## Materials and Methods

The surveys were made by the LADY HAMMOND using a Western IIA bottom trawl with a fine mesh liner in the codend. A total of 139 half-hour tows was made in 1979, 145 in 1980, based on a depth-stratified random design, covering the Scotian Shelf and Bay of Fundy from the Fundian Channel in the southwest to the Laurentian Channel in the northeast (Fig. 1). All fish caught, or subsamples in the case of large numbers, were measured (fork length to the nearest centimeter), weighed, and the length frequencies for each species in each tow recorded. In the case of haddock, including the juveniles, lengths were grouped in 2-cm groups, the standard process for haddock. The depth and time of each tow was also recorded so that catch rates in relation to depth and time of day could be examined. For study of diurnal variation of catch rate, the catch data were divided into four groups corresponding to catches taken at: day - 0800-1600; night - 2000-0400; daybreak - 0400-0800; dusk - 1600-2000 h.

Young-of-the-year (0-group) haddock were defined, from examination of the length-frequency data, as those ranging in length from 0-18.5 cm. This length range composed a distinct, separate mode in the L/F distributions and was readily separated from the mode of the next-greater length group identified as the 1-group.

In 1980 catches per tow ranged up to a maximum of 2830 0-group haddock in the Emerald-Western-Sable Island area, with maxima of 752 in the Browns area, 516 to the north of Western Bank and 31 on Banquereau. A total of 14 884 fish lengths were utilized.

## Results and Discussion

In 1979 catches were too low to provide significant distributional information but in 1980 sufficient data were obtained for interpretation (Fig. 2). The 0-group haddock were generally distributed along the Scotian Shelf from Browns to Sable Island Banks, mainly on the outer slope of the Banks (Fig. 2) and restricted to depths ranging from 40-90 fath (73-165 m), with "outliers" in the Bay of Fundy and on the eastern side of Banquereau. They were conspicuously absent from the deeper waters of the Gulf of Maine, the Scotian Gulf and the eastern Scotian Shelf, with the exception of the Banquereau occurrence mentioned above. All catches of more than 500 fish

per tow were made in the 40-60 fath (73-110 m) range. The few fish taken in depths greater than 90 fath (165 m) were considered to be remnants from the previous tow(s) in shallower water.

The geographical distribution was uneven with catch rates indicating three foci: a major focus south of Emerald Bank and lesser foci associated with Browns and Baccaro Banks (Fig. 2).

There was little variation in the length-frequency distributions from the different areas (Fig. 3). All showed a principal mode at 10.5 cm and were slightly skewed to the right. The Bay of Fundy L/F distribution was exceptional in being bimodal with a significant minor mode at 14.5 cm.

Overall mean lengths showed differences between areas, ranging from 10.19 cm in the Emerald-Western-Sable Island area, through 10.52 cm in Banquereau, 10.75 cm in Browns to 11.79 cm in the Bay of Fundy, the last high value due to the fish represented in the 14.5-cm mode on the L/F distribution. These differences in mean lengths were overshadowed by differences in mean lengths of individual samples within areas: Bay of Fundy - 9.30-14.5 cm; Browns - 10.39-11.59 cm; Emerald-Western-Sable - 9.54-13.83 cm; Banquereau - 9.98-11.33 cm. The differences in mean lengths between samples within areas may be due to dispersion of fish with age from the focus of the distribution. In the Emerald-Western-Sable Island area, for instance, mean lengths at the focus ranged from 9.99-10.17 cm, but reached 11.42 cm on Western Bank and 11.73 cm further from the focus, to the north of Western Bank. On Browns Bank mean lengths at the focus ranged from 10.71-11.11 cm, while in the southwest Nova Scotia area, to the north, they ranged from 11.33-11.72 cm, suggesting an onshore movement of the young fish. The bimodality of the Bay of Fundy L/F distribution, suggests the possibility of a local spawning group or groups in that area.

If there is dispersion of the young fish from the foci, it may be relatively minor but certainly sufficient to distribute the young fish over much of the Shelf. Needler (1931) notes that "the areas where young haddock occur seem to coincide with those areas on which the haddock are concentrated at spawning time," and R. G. Halliday (pers. comm.) has identified the area southwest of Emerald Bank, the area of the major focus for young-of-the-year haddock, as being a principal spawning area. This area also appears to be favored by juvenile silver hake (P. A. Koeller, pers. comm.) and is an area of special interest in egg and larval distribution for other species (A. C. Kohler, pers. comm.). Bottom temperature contours produced by Scott (1976) suggest that the area comes under the influence of the warm bottom waters of the Scotian Gulf which may provide a particularly suitable environment for young fish in terms of temperature, food, etc. All these considerations suggest that the area is not characterized by dispersion but by relative stability in the pre-adult stages of the haddock's life.

Mean catches (numbers) per tow for tows in which young haddock were caught at different times of the day and night in the Browns to Sable Is. area were (number of tows in brackets):

Day	556.5 (13)
Night	150.2 (9)
Dawn	342.8 (5)
Dusk	586.2 (6)

The highest catch rate was at dusk (1600-2000 h) closely followed by the daytime rate. The latter included the two highest catches of the survey, both in excess of 2000 fish, which may bias the results. Even without these tows, however, the daytime rate averaged 205 fish per tow, still well in excess of the night rate. The figures suggest that the fish are near bottom during the day, and available to the trawl, but at night they are less available to the trawl, probably being higher in the water column. The high catch rate at dusk is characteristic of many species, probably a result of the fish coming off bottom but still near bottom and more available to the trawl than at other times when different proportions may be available to the gear.

Comparison of 1979 and 1980 data shows that accompanying the increase in maximum numbers per tow in 1980, mentioned previously, there was a considerable increase in mean catch per tow (for tows in which young-of-the-year haddock occurred only):

	Mean number per tow (No. of fish)	
	1979	1980
Browns	54 (604)	410 (5750)
Emerald-Western-Sable Is.	78 (1797)	262 (8914)

The increase in 1980 indicates a significantly stronger year-class of 0-group haddock in that year than in 1979, as much as 8 times stronger in the Browns area and 3 times in the Emerald area, with an overall increase in mean catch per tow (all tows included) from 18.4 in 1979 to 102.6 in 1980 for the Scotian Shelf as a whole.

#### References

- Needler, A. W. H. 1931. The migrations of haddock and the inter-relationships of haddock populations in North American waters. Contrib. Can. Biol. Fish. 6: 241-313.
- Scott, J. S. 1976. Summer distribution of groundfish on the Scotian Shelf 1970-74. Fish. Mar. Serv. Res. Dev. Tech. Rep. 635.

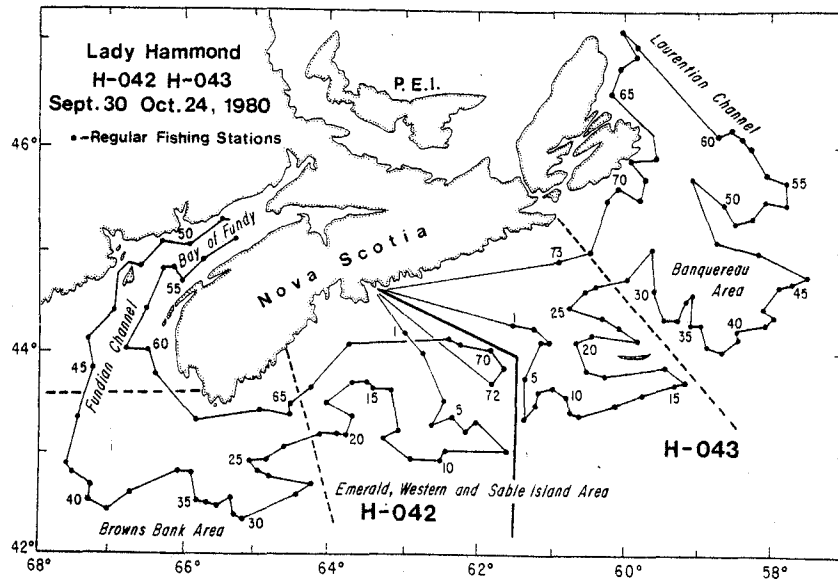


Fig. 1. Cruise track of *Lady Hammond* groundfish survey, September-October 1980, showing station numbers for the two parts of the cruise (H-042, H-043) and distributional areas.

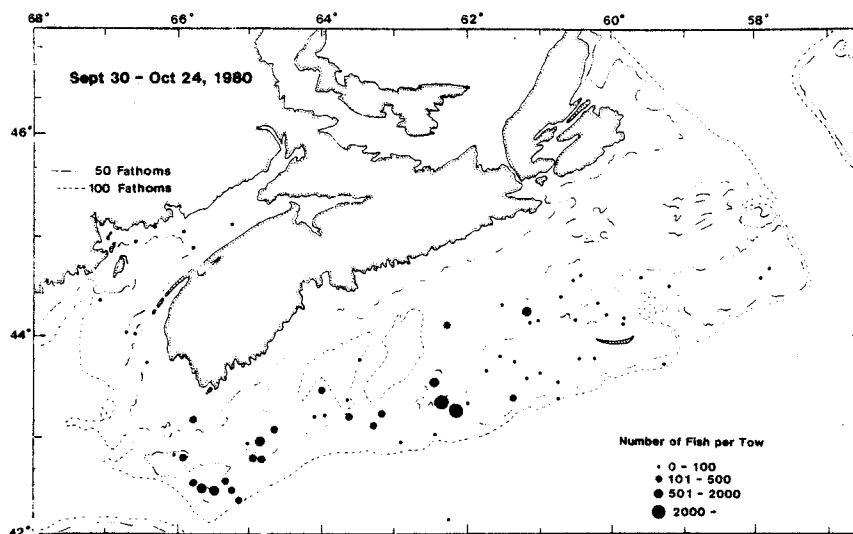
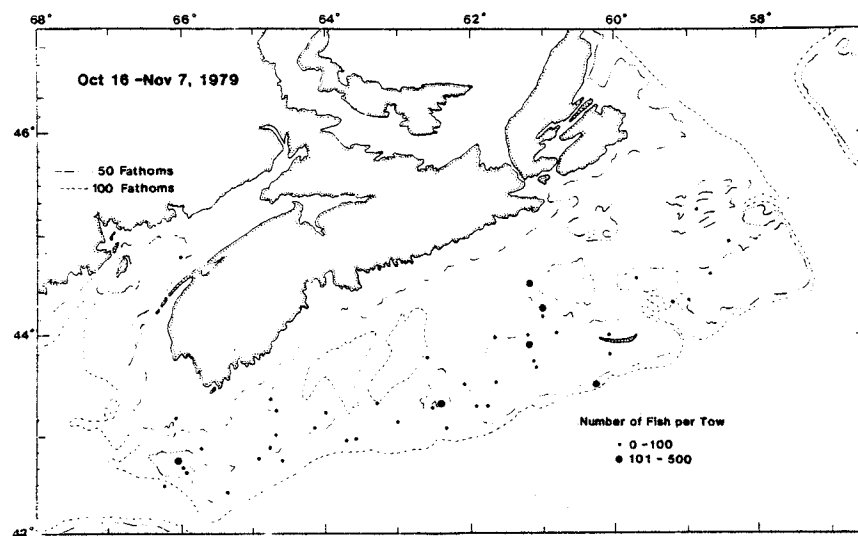


Fig. 2. Autumn distribution of young-of-the-year haddock on the Scotian Shelf in 1979 and 1980.

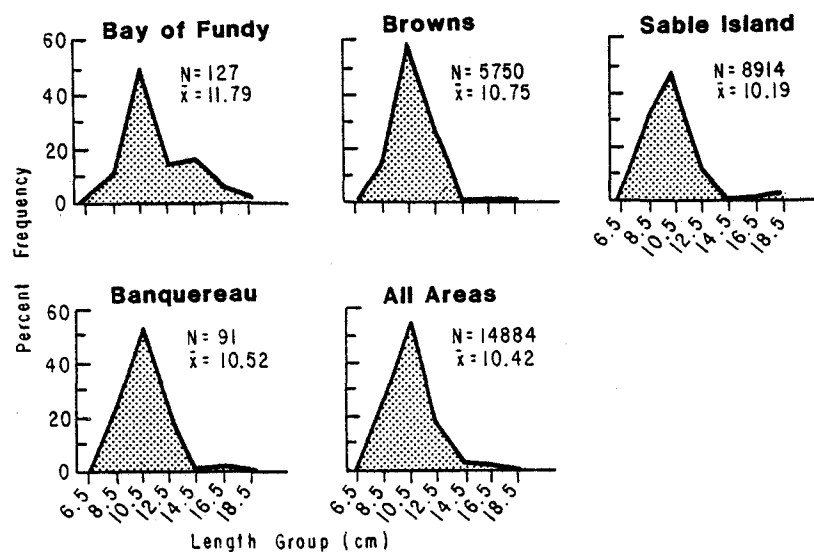


Fig. 3. Length frequency distributions of young-of-the-year haddock in different areas of the Scotian Shelf, September-October 1980. (N = number;  $\bar{X}$  = mean length)