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Diurnal variation in the catches of American plaice  
(Hippoglossoides platessoides Fabr.)  
from the Grand Bank

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## Abstract

Data on the catches at various time periods obtained from records of a group of commercial otter trawlers and also from a research cruise of the A.T. Cameron indicated that more American plaice were caught during daylight than at night. There was less diurnal variability in the catches from shallow depths (100 m) than from deeper water (155 m and up) for both research and commercial catch data.

The average size of American plaice caught during the daylight hours was greater than that of the night catches.

This species apparently moves away from the bottom at night and are thus less vulnerable to the otter trawl than during the daylight hours.

## Introduction

A knowledge of the diurnal variation in the average size of the catches of commercial groundfish species is of interest to the fishing fleet since fishing activity can possibly be regulated in line with the periods of peak abundance. For fishery biologists, this knowledge is necessary when use is made of the catch per unit effort as an index of abundance of fish, especially in routine surveys by research ships where an area is surveyed by sampling at a number of fixed stations.

The largest commercial fishery for American plaice (Hippoglossoides platessoides) in the Northwest Atlantic occurs on the Grand Bank in those localities where the slope of the bank is in contact with the cold section of the Labrador Current (Fig. 1) in depths ranging from 65 to 230 m.

In conversation with several fishing captains, they reported that the catches of plaice were less for night drags than those made during daylight hours. This report contains a study made from statistics of the commercial fleet and a limited amount of research vessel data.

## Material and methods

The captains of commercial trawlers operating from St. John's keep detailed records of locality, date, depth, time and catch for individual sets.

From the records for 1960 to 1963, the average catch per hour for the different time periods as used in this paper, have been calculated.

In addition a cruise of the research ship A.T. Cameron provided additional information on the diurnal variation in the catches of American plaice. In October 1964 a total of 61 one-hour tows was made using the standard 41.5 otter trawl with the codend lined with nylon netting. Fishing was carried out at 100 m, 155 m and 183 m on the eastern slope of the Grand Bank at about 45°N and 49°W (Fig. 1) and a tow was made every 3 hours.

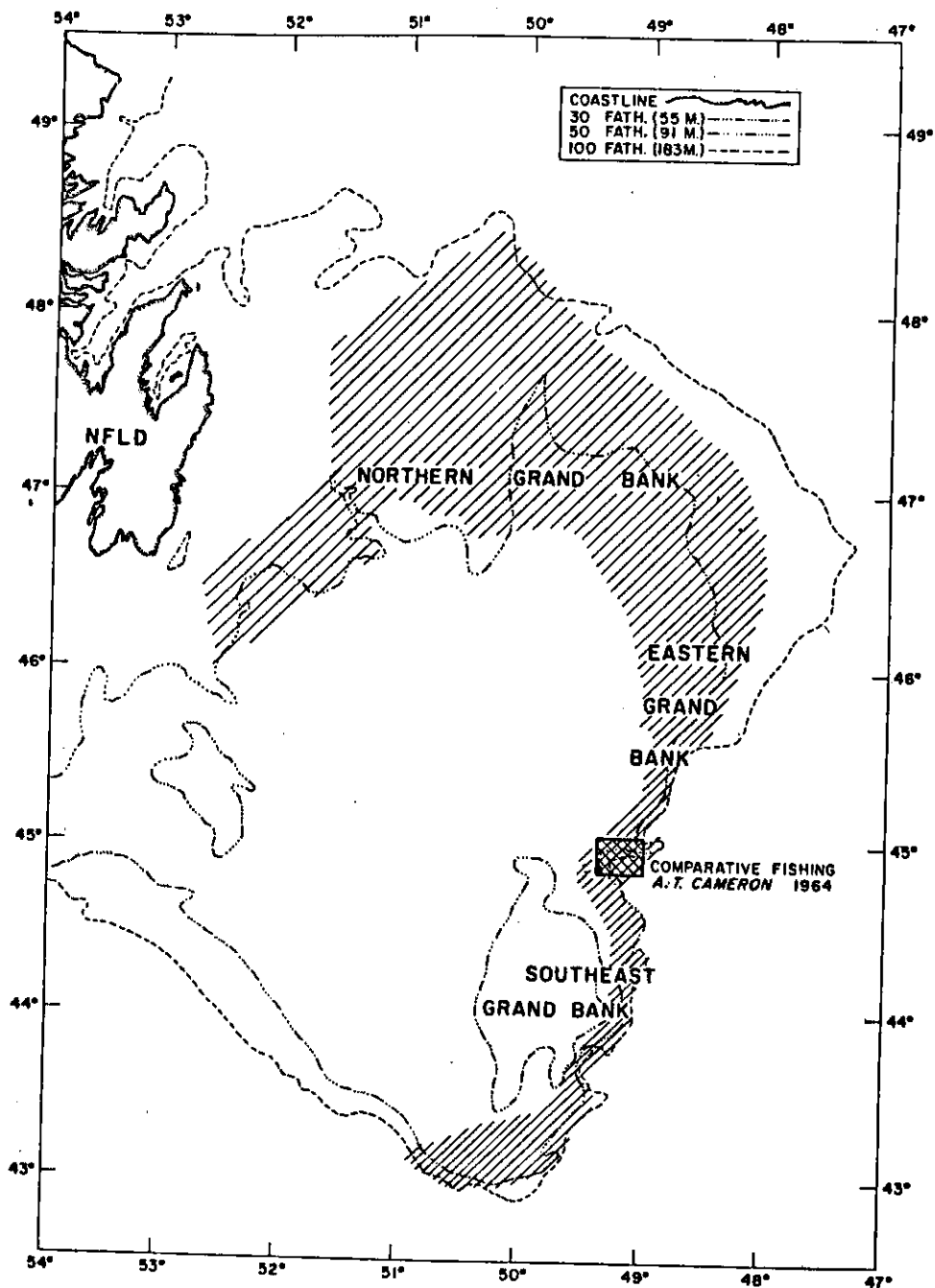


Fig. 1. Map of Grand Bank showing the locality (shaded areas) of the commercial plaice fishery.

For the commercial trawlers the data were tabulated by 2 hour periods and the records for April to September 1960-63, were used. Unfortunately the time of sunrise and sunset will vary, but it was necessary to combine records from these months to give sufficient data for the various combinations over a fairly short period of years when the size of the fishable population was probably fairly constant.

### Results

The catches for both the research and commercial vessel data indicate a greater average catch during daylight than during the darkness period.

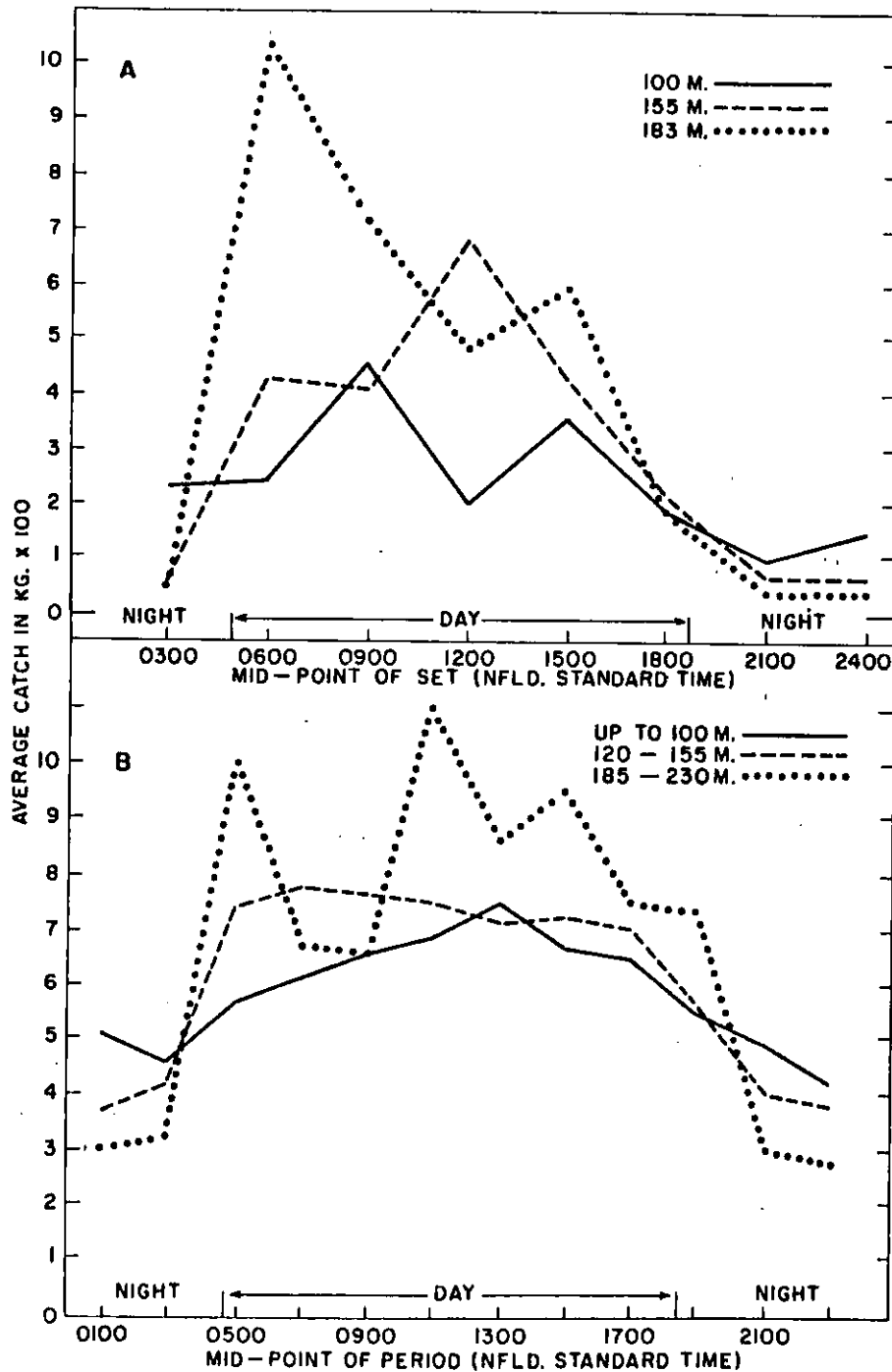


Fig. 2. (A) Average catch per hour for 24 hours fished by the A.T. Cameron at the 3 depths fished, and (B) Average catch per hour by selected commercial trawlers April-September 1960-63 over a 24-hour period for 3 depth ranges on the eastern slope of the Grand Bank (Fig. 1).

Comparison of day and night catches in relation to depth

The catches of American plaice from the 100 m sets of the A.T. Cameron varied less over the 24-hour period than did the catches from 155 and 183 m (Fig. 2a). The 100 m catches ranged from an average of 93 kg per hour for a 2100-hour (night) catch to 466 kg per hour for one at 0900 hours (day). Compared to this the 183 m average catches ranged from 25 kg per hour for the midnight period to 1,025 per hour for the first daylight set (0600 hours).

For the commercial data a similar relationship was found (Fig. 2b) with the catches for the shallower depths having less variability over the 24-hour period than those from deeper water localities.

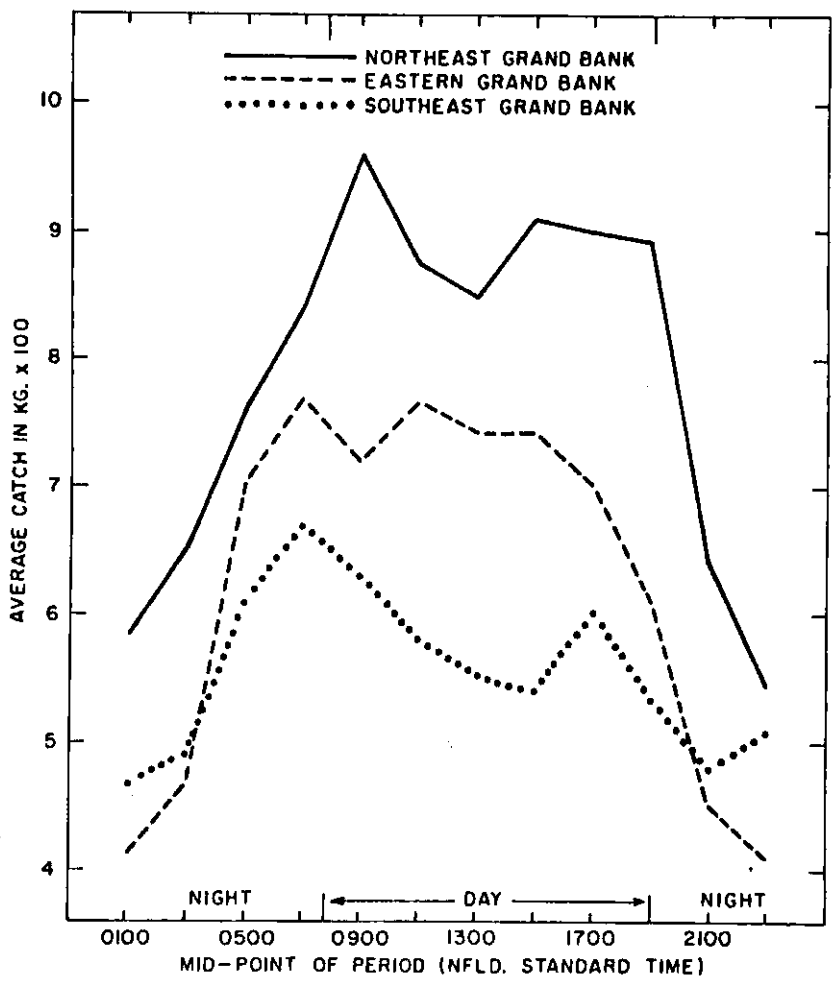


Fig. 3. Average catch per hour by selected commercial trawlers 1960-63 for 3 areas of the Grand Bank (Fig.1) April-September.

The commercial fishery for American plaice on the southeast part of the Grand Bank was in shallower water than for the other two areas (Table 1). For this area nearly 80% of the fishing was in depths of 110 m or less, whereas in the other two areas only 26-37% of the fishing was as shallow as this. Thus, the difference between average day and night catches was less variable than from the other two areas (Fig. 3 and Table 1).

Table 1. Percent of the effort of commercial trawlers at 5 depth ranges for 3 areas of the Grand Bank.

Depth range <u>m</u>	Grand Bank		
	Northeast	East	Southeast
70 and under	nil	2.0	26.4
71-110	37.1	24.2	52.4
111-145	43.7	32.8	14.5
146-183	15.0	33.6	4.5
184 and over	4.2	7.4	2.2
Total no. sets	1,194	1,453	2,556

Comparison of sizes of plaice for day and night fishing

The average size of the American plaice from day catches was significantly greater than those for the night catches (Fig. 4 and Table 2). The average size of the plaice caught increased with depth and so also did the difference between the average day and night sizes, from 1.3 cm at 100 m to 2.2 cm at 183 m.

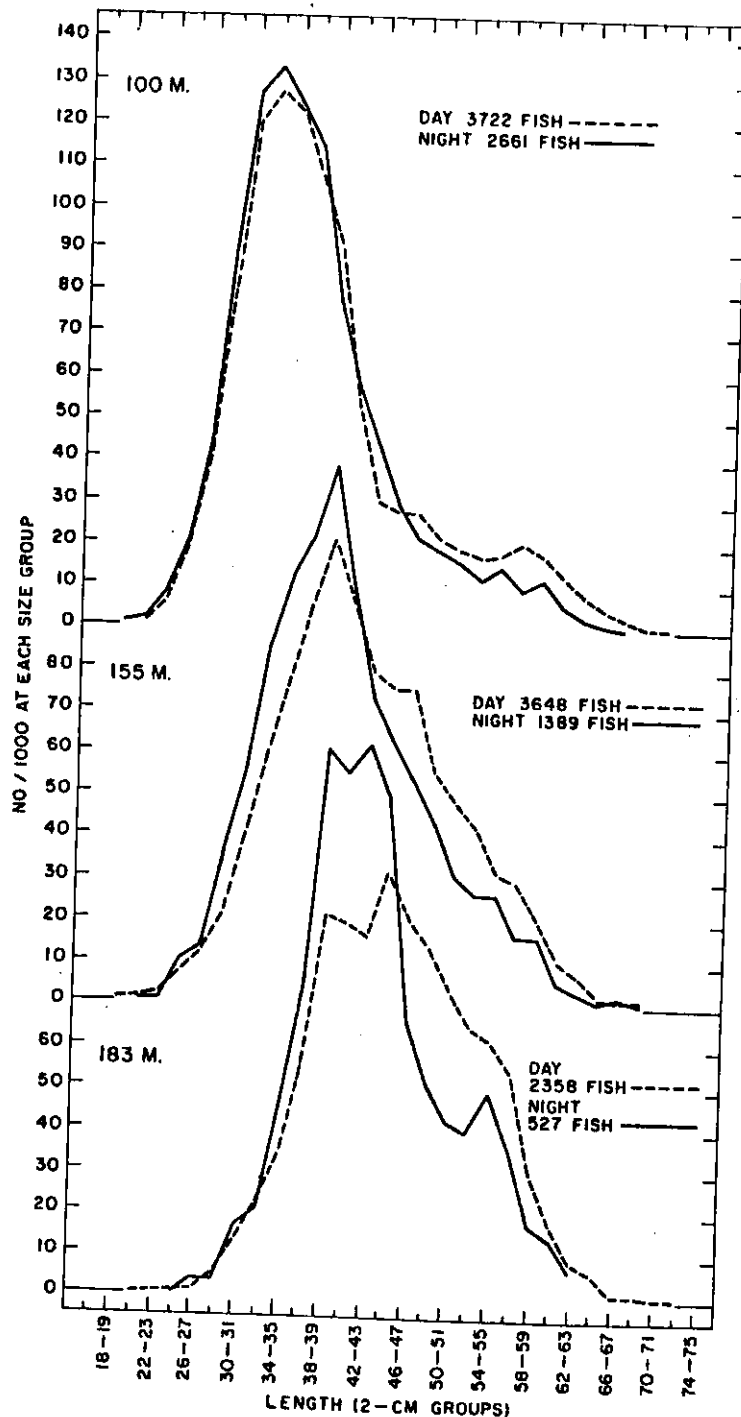


Fig. 4. Length frequencies of American plaice for day and night catches from 100, 155 and 183 m.

#### Discussion

Diurnal variation in the catches of commercial trawlers are well known. For flatfish there appears to be differences between species and for the same species from different localities. Jones (1954) for lemon sole (Microstomus kitt) and Parrish, Blaxter and Hall (1964) with North Sea plaice (Pleuronectes platessa) and dab (Hippoglossoides platessoides) found that almost always the largest catches were at night. In contrast to this Woodhead (1960 and 1964) with plaice and Bagenal (1958) with witch

Table 2. Average size of American plaice for day and night catches - A.T. Cameron Cruise 93, October 1964.

Depth	Day	Night	Difference
<u>m</u>	<u>cm</u>	<u>cm</u>	<u>cm</u>
100	37.5	36.2	1.3
155	42.0	40.1	1.9
183	45.9	43.7	2.2

(Glyptocephalus cynoglossus) and dab for the Clyde area report that the largest catches were during daylight hours. For the Northwest Atlantic Beamish (1966) found that American plaice were caught in larger numbers during daylight hours but the other flatfish: winter flounder, Pseudopleuronectes americanus; the greyscale, Glyptocephalus cynoglossus; yellowtail, Limanda ferruginea had the largest catches during the night.

The information as presented here from commercial trawler and research vessel data point definitely to a greater average catch during the daylight than during the darkness period (Fig. 3 and 4).

Flatfish are usually considered to be bottom dwellers, but there are records to show that they do leave the bottom habitat and swim at shallow depths. North Sea plaice have been caught by mid-water trawls well above the sea-bed (Woodhead, 1960) and De Veen (1964) reports sole swimming at the surface near the Dutch coast. In 1958 a research ship operated by the St. John's Station of the Fisheries Research Board of Canada using a surface line trawl caught 2 American plaice at 9-18 m where the bottom depth was about 146 m.

Harder and Hempel (1954), Woodhead (1964) and De Groot (1964) in aquaria experiments with plaice and sole showed that flatfish usually remained on the bottom partly covered with sand during bright sunlight and swam actively at all depths during the darkness period. However De Groot (1964)



shows that in light conditions similar to that of the natural habitat, during daylight, plaice move actively along the bottom.

The feeding habits of American plaice for the Grand Bank have not been studied in detail but it is known that those caught on this particular cruise of the A.T. Cameron on the eastern slope of the Grand Bank (Fig. 1) were feeding almost exclusively on sand lance (Ammodytes dubius). This species is known to make some vertical diurnal movements so that the activity of the American plaice could be related to these.

It is doubtful if the search for food can entirely account for the difference in day and night catches. Plaice from the Northeast Grand Bank generally feed on bottom forms such as mollusks, echinoderms and polychaete worms, yet the same diurnal variations were noted in the average catch as for the other areas (Eastern and Southeastern Grand Bank, Fig. 4), where the diet consists primarily of capelin and lance.

Ellis (1956), in the Barents Sea, recorded compact shoals of cod in 183 m during daylight with dispersal at sunset to reform again at sunrise and Beamish (1966) showed an echogram of American plaice indicating that they move off the bottom during the night. The behaviour of plaice, in the experiments with flatfish by Harder and Hempel (1954) and Woodhead (1964) referred to in a previous paragraph, can be considered a schooling behaviour so that when the flatfish are on the bottom during daylight hours they are more vulnerable to the otter trawl. The fish are disturbed by the footrope moving along the bottom and swept into the net whereas at night they tend to scatter vertically and are less likely to be caught in this type of gear.

No explanation can be offered for the fact that there was less variation between day and night catches from shallow than from deep water, but it is apparent that fish in deep water react to a greater degree to the change in light intensity than do those in a shallower environment.

Experimental fishing in areas where American plaice are feeding on bottom forms is needed as well as a detailed investigation of the feeding habits of this species.

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