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Diurnal Variation and Seasonal Changes in Trawl Catches of Turbot (Scophthalmus maximus L.)

by

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Introduction

Data on the diurnal variations and seasonal changes of turbot (Scophthalmus maximus L.) in trawl catches are very rare. Only Rae (1957) describes in a preliminary article that turbot are more frequently taken during daylight fishing than in the dark. We were able to study the diurnal changes in the catches of turbot of a commercial fishing cutter WR 67 (200 hp) for the months March-October in the years 1956-1958. From data collected by the Statistical Department of the Ministry of Agriculture and Fisheries we were able to compose the catch of turbot in kgs. for each month per 100 fishing hours for the years 1959-1964. Earlier data were not available. Further, for the sake of comparison we made some activity recordings on turbot, under experimental conditions (natural conditions of illumination) with a new type of activity recorder for flatfish (de Groot and Schuyf, 1967). The principle of the apparatus is that it uses the induction voltage which is generated in a fixed coil when a flatfish provided with a permanent magnet crosses the coil.

Diurnal Variation in Trawl Catches

In the years 1956-1958 data were collected on the catch of turbot per haul by the skipper of the cutter WR 67, and for the months March-October inclusive, in total 2,022 hauls were analysed of which 1,047 were day-hauls and 975 night-hauls. The cutter was mainly fishing in the I.C.E.S. - rectangles J 5, 6, 7; K 6, 7; L 6, 7; M 6, 7. The data were converted to a duration of haul of $2\frac{1}{2}$ hrs. As the catches of turbot are very low as compared with plaice and sole, the data were first collected in two hour periods/two months. Although we obtained some information on diurnal variation in the catch, the phenomenon was far from clear. Therefore we compared the average day catch/haul with the average nigh catch/haul for the bimonthly periods (see Figure 1 and Table 1). It is now possible to distinguish a diurnal variation in the catch of turbot during the whole period of investigation. However, the difference is not very impressive. We also observed that the catches increase from March-April to September-October to reach in the latter part of the season about the double of the figure recorded for the early part of the season.

Seasonal Changes in the Catch

From the data collected by the Statistical Department of the Ministry of Agriculture and Fisheries it was possible to compose the Figures 3 and 4, showing the catch of turbot in kgs per 100 fishing hours in the above-mentioned area. Figure 3 is based on the average catch from 1959-1964, Figure 4 is only based on catch data of 1959; these figures show a great similarity. The catches of the first three months are about one half of the catches during the last three months. In the period April-August we observe a rather striking increase followed by a decline in the monthly catch. This increment coincides with the spawning period, May-June being the period of heaviest spawning.

Yearly Landings

Data derived from the same source as that mentioned above reveal that the yearly landings of turbot are still on the increase. The catches from 1950-1959 are on the average 0.75 million kgs/year. From 1959-1962 there is a rise to 1.28 million kgs, thereafter follows a decline till 1965, 1.07 million kgs. The catches of the last few years are, however, again higher; 1966 1.28 million kgs; 1967 1.53 million kgs. We should, however, consider, that the increase in yearly landings coincides with a

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considerable increase of the motor power used by the fleet of commercial cutters. Therefore the total annual catch in kgs per h.p. unit decreased from 1950, 50 kgs/h.p. unit to 12 kgs/h.p. unit (de Veen, 1968).

There are two main fishing areas in the southern North Sea for the Dutch cutters, the first and most important is in I.C.E.S. rectangles J 7, 8; K 8, 9 (Cleaver bank, Hospital ground, Whitebank) and the second in G 3; H 3 (Smith's Knoll, Brownbank).

Laboratory Experiments

Figure 2 shows the diurnal activity in the month of November of 5 turbot under experimental conditions. The data were collected with the apparatus mentioned in the introduction. We observed that the bottom activity is confined to the day time, when also swimming occurs at higher water levels. During the night period the bottom activity ceases, not however at higher levels (1.50 meters from the bottom of the tank). The daily activity (counts/day) is very low compared with other species of flatfish such as plaice (Pleuronectes platessa L.) flounder (Pleuronectes flesus L.) and sole (Solea solea L.) (data not published).

Discussion

From the catch data of the cutter WR 67, we can conclude that there is a diurnal variation in the catch of turbot at least from March to October. The day catches are about 50% higher than the night catches in that period. However, the catches are always so low and this phenomenon can hardly be of important significance for the fishery of turbot. The low catches of turbot could be explained by their general scarcity and it seems moreover likely that the rougher nature of the sea-bottom in the areas where turbots do occur in greater numbers, provides a good protection against their capture by trawls.

From the data on the catch per 100 fishing hours we can conclude that there are seasonal changes in the trawl catches of turbot in the area investigated. The catches are relatively high in the last three months of the year; there is, however, a tendency of increment in the catches from February onwards to the end of the year. The spawning period seems to have its influence upon the catch (onset April till completion in August). A considerable rise in the catch is observed from April to May-June (a relative rise of about 35%) and a decline from June to August (a relative decline of about 35%). The higher catches during May-June coincide with the period when spawning is at its maximum. There is a difference between our data and the Scottish monthly landings (Rae, 1963). The Scottish catches of turbot are at their maximum during April-May. A secondary peak was found in August for the years 1955-1958; however, this phenomenon did not reappear in the later years (1959-1962). In this respect it is interesting to note that the period of maximum Dutch landings of turbot has shifted from 1950-1960; this is the period May-June and a secondary peak in October; from 1960-1967 the situation is reversed.

The activity-recording of turbot confirms our catch observations. The turbot is a distinct visual feeder and a fish feeder (de Groot, 1968; Redeke, 1906). Turbot with a length above 20 cm are especially fish feeders (see Table 2, P=Polychaeta, M=Mollusca, C=Crustacea, F=Fish). Mostly turbot lies on the bottom, hardly dug in and remarkably adapted to the background. The eyes search the environment for prey. Only when the prey is at a striking distance, the turbot jumps up and expands its mouth enormously and sucks in its prey. For a while the turbot shows the phenomenon of "excitement darkening", in which a rapid dispersion of melanocyte pigment occurs (two or three seconds). Soon, however, the adaptation to the background is again complete. Sometimes the turbot will swim up to 1.50 m above the bottom, especially during the day time. During the night the bottom activity is very low, but the fish sometimes leaves the bottom for short swimming periods.

Summary

Turbot is not a very active fish, compared with the other flatfish species. It lies in wait for his prey rather than catching it in active pursuit. There is a distinct diurnal variation in the catch, at least from March to October. The difference between day and night catch is not very great, perhaps also due to the fact that turbot is more lying on the bottom than dug in. This is perhaps due to the fact that the colour pattern of its skin is very well adapted to its natural surroundings. The spawning period has a positive influence on the catch-ability of turbot. The turbot catches per 100 fishing hours are lower in the beginning than in the end of the year. The total Dutch annual catch of turbot is still increasing, however, as expressed in kgs/h.p. unit it is decreasing.

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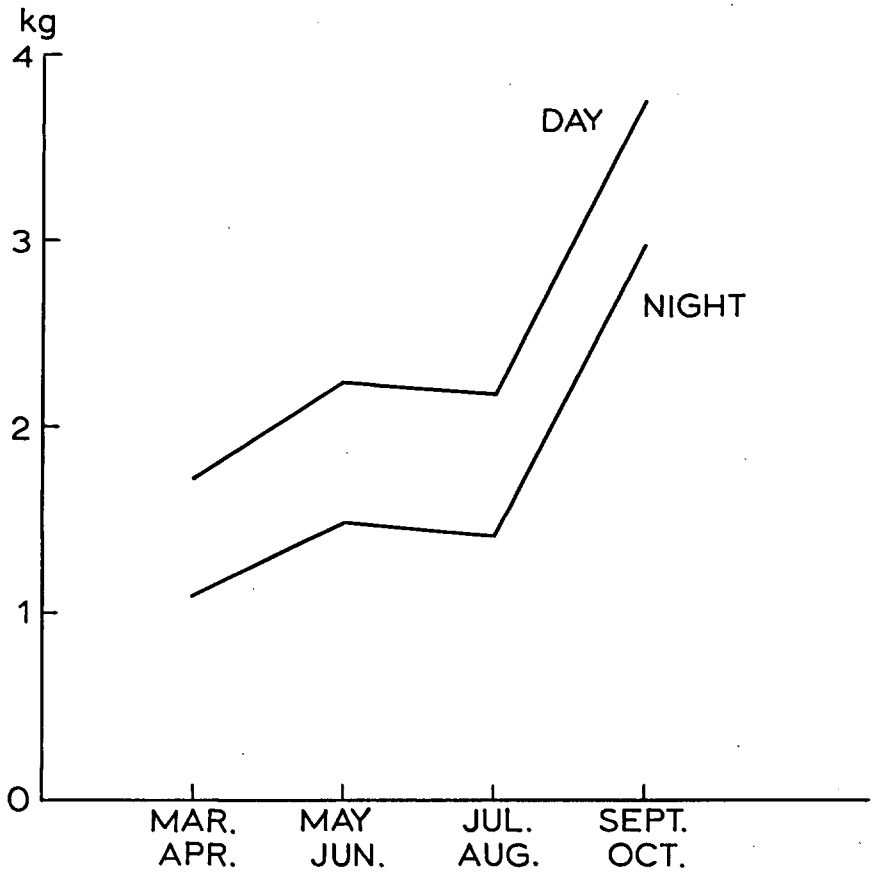


Fig.1 Average day and night catch/haul in kgs for 1956, 1957, 1958 in rectangles J5,6,7, ; K6,7 ; L6,7 ; M6,7 ; based on data collected by the commercial cutter WR 67

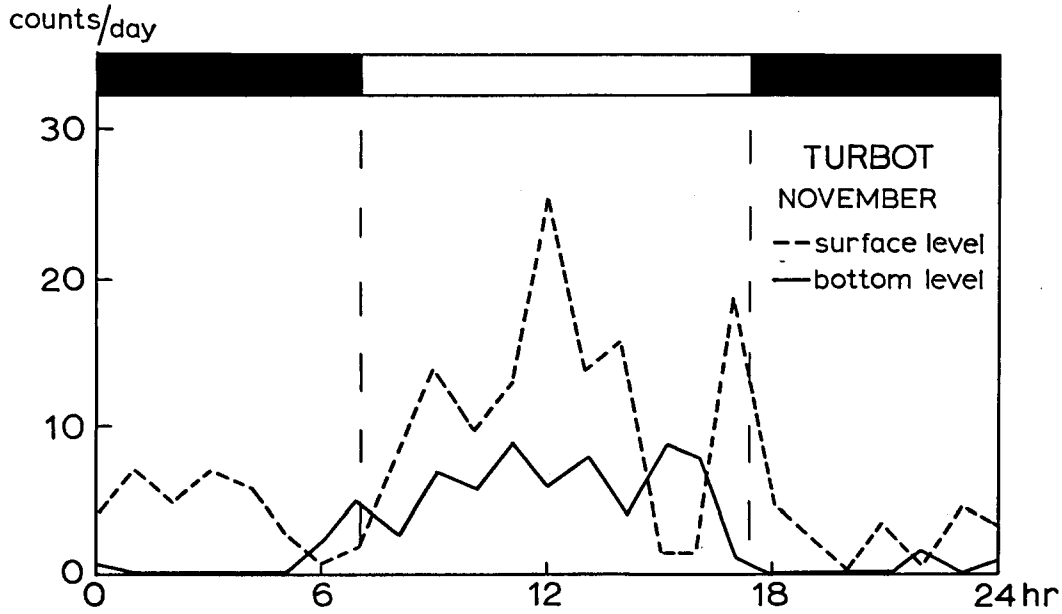
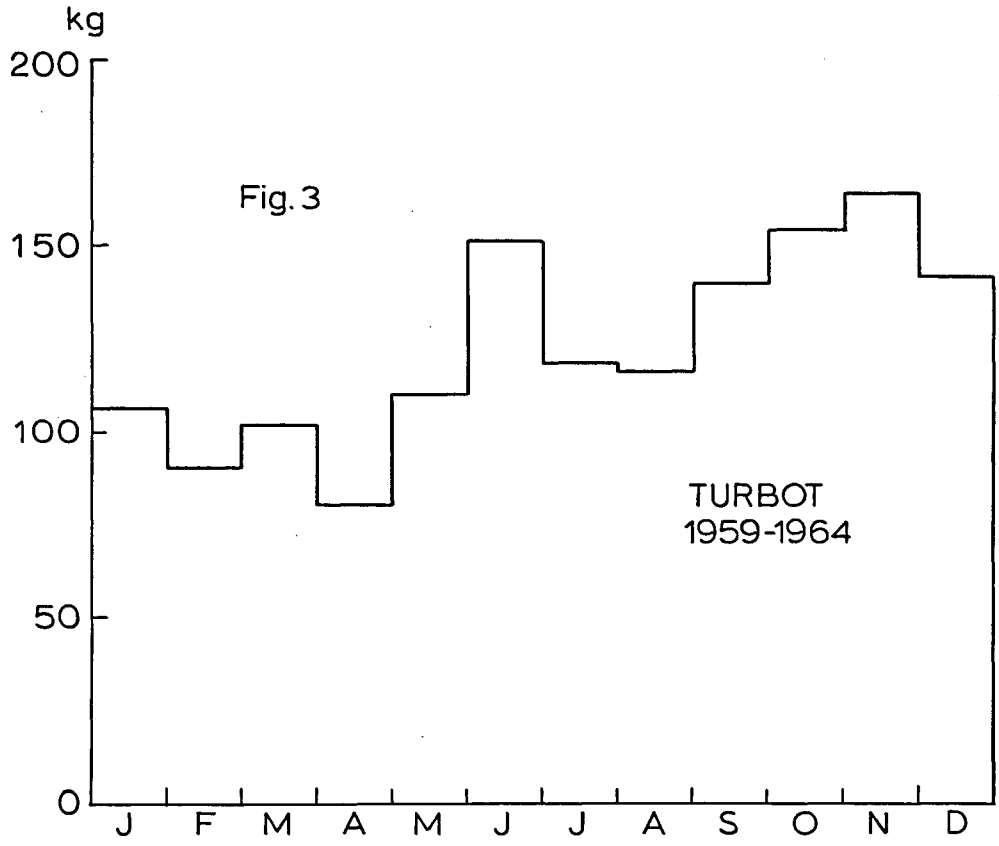


Fig.2 Average counts/day of activity marks produced by five turbots during five weeks



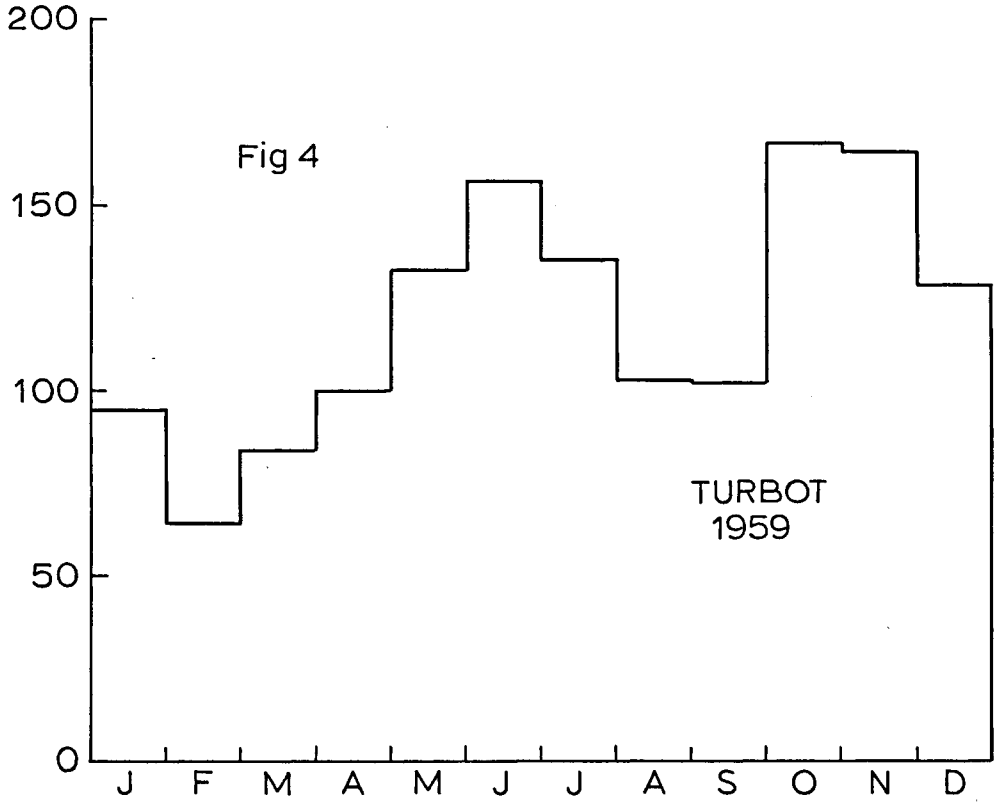


Fig. 3.4. Catch of turbot in kgs per 100 fishing hours ; fig. 3, the average catch for 1959 - 1964 , fig. 4 the catch for 1959. in rectangles J 5,6,7 ; K 6,7; L 6,7; M 6,7; (data collected by Statistical Dept. Ministry of Agriculture and Fisheries)

Period	DAY			NIGHT		
	catch/kgs.	hauls	kgs/haul	catch/kgs.	hauls	kgs/haul
Mar.Apr.	326.6	191	1.71 +	269.4	246	1.09 -
May.Jun.	779.2	350	2.23 +	379.1	288	1.32 -
Jul.Aug.	618.6	282	2.19 +	235.2	167	1.41 -
Sept.Oct.	839.5	224	3.75 +	817.9	274	2.98 -

Table 1

Average day and night catch/haul in kgs for 1956-58 in rectangles J5,67; K6,7; L6,7; M6,7, based on data collected by the commercial cutter WR 67.

Length	Number	Frequency of occurrence	P	M	C	F
0 - 10	58	P.9x, M.7x, C.4x, F.1x	1	2	3	4
11 - 20	10	C.7x, F.6x, Gobius spec. Ammodytes spec.			1	2
21 - 30	15	F.16x, C.5x, Clupea spec. Ammodytes spec. Pleuronectes spec.			2	1
31 - 40	9	F.9x, Ammodytes spec. Gadus spec.				1

Table 2.

Frequency of occurrence of main types in the food of turbot.