

Seasonal and annual fluctuations in the Quantity of Pelagic Fish in Kaštela bay

Sezonska i godišnja kolebanja količine pelagične ribe u Kaštelanskom zaljevu

by
Ivo Kačić

Institute of Oceanography and Fisheries, Split

Observations on fluctuation and quantity estimations made by means of echo sounders belong also to the complex of observations made on pelagic fish.¹⁾

Results obtained mostly in northern seas refer to evaluation of abundance, estimation of fish quantities by means of automatic measuring calculation of intensity and number of return signals from fish comparing them with the traces on echograms and with other factors (Dragesund and Steinar 1965; Richardson et al 1959; Mitson and Wood, 1961; Truskanov and Sherbino, 1964), and to estimation of fish quantities by ranging the traces on echograms in length groups (Valdez and Cushing, 1959; Tungate, 1958).

An effort was made to determine the quantity and fluctuation of quantity of pelagic fish by using method of ranging fish-concentration traces into categories. For this purpose, traces of fish obtained on echograms were placed into three categories. In the first category (Table I) are the traces, the surface of which on the echogram is not over 1 mm². In the second are traces from 1 to 6 mm², and in the third, those from 6 to 25 mm². In this way an earlier division into two groups (Kačić; 1966) is completed to follow more easily eventual fluctuations, especially of larger concentrations of pelagic fish. An

¹⁾ I am honoured to thank Dr R. Mužinić, higher research fellow, on her help and advice during the work.

eventual error, which might occur while determining the size of fish concentrations with this method and due to some factors of biotic or abiotic nature, was reduced by a large number of observations.

Table 1. Distribution into categories of fish traces according to their surface (mm²) on echograms

Category	Surface of traces on echograms	
	Minimum	Maximum
I	0,01	1
II	>1	6
III	>6	25

These studies were made in Kaštela Bay from mid-1962 to the end of 1967, at first every two weeks and then generally in monthly intervals.

Notes were made on three profiles, beginning in the morning after sunrise and finishing in the first half of the day.

There were 71 altogether.

The echo sounder »Simrad« — Sildeasdic, type 580-4, frequency 30 kHz, was used.

1. Size of traces

Up to now investigations proved that fish traces, found in Kaštela Bay, were rather small. Their surface on echograms was rarely over 25 mm². Judging by these limits of traces, the fish did not form large concentrations (Kačić, 1966).

2. Fluctuations of fish quantity throughout the year

The data show that a calendar year is divided into two periods by quantity and number of concentrations of pelagic fish:

- (a) from May to October;
- (b) from November to April.

Such distribution is dictated by the appearance of traces on echograms and it could be called the summer winter season of pelagic fish concentrations in Kaštela Bay.

It is characteristic for the summer period that, during May, the number of pelagic fish concentrations starts to grow suddenly, and that this increase (of all the categories of traces), lasts throughout the summer, more or less intensive, but it is always seen distinctly.

Some less intensive concentrations can sometimes be seen in May and June, while in other summer months they are more intensive. This summer period is known as the »fishing season of pelagic fish in Kaštela Bay«.

By the end of October, and especially in November, a sudden decrease in the number of traces, i.e., of fish concentrations, begins in all the three categories.

The winter period is characterized by a very small number of fish concentrations. This is quite evident so that during a large number of observations, not a single trace of fish was noted on echograms (see Fig. 1, echogram »c«). It is also a fact that in all the years of investigations a smaller number of fish traces has been registered than in only one summer period.

The rhythm of appearance and disappearance of pelagic fish in the Bay, and connected with it also the fluctuations of its quantity in winter and summer periods, is shown on Table 2.

Table 2. Average number of traces of three categories according to observations in individual years

Year	Mean number of traces					
	Summer period (May — October)			Winter period (November — April)		
	I	II	III	I	II	III
1962	33.4	6.8	11.5	11.0	—	—
1963	34.0	19.9	35.5	9.1	4.4	8.3
1964	10.5	5.1	6.2	3.0	1.6	1.7
1965	19.8	13.1	12.1	1.8	1.8	1.4
1966	17.9	14.3	10.6	1.3	2.3	0.6
1967	12.7	15.8	11.3	4.2	4.2	2.6

Factors which influence the increase or decrease in the pelagic fish concentration in Kaštela Bay probably are numerous and in mutual dependence.

No conclusion could be drawn about the influence of clouds on the less possibility to register fish concentrations. It seems, however, that temperature rhythm of the Bay and sardine movement during spawning and feeding (Karlovac 1964, Vučetić, 1963) i.e., transport of pelagic fish larvae, sardine in particular, toward the Bay is of basic importance to establish the quantity fluctuation of pelagic fish, especially sardine, which is most often found in the Bay (Mužinić, 1954; Kačić, 1966). Tagging sardines (Mužinić, 1952) and investigations into its ecology in the mid-Adriatic (Mužinić, 1954) suggest this as well as some observations on the movement of sardine larvae from the region of spawning toward the coast (Karlovac, 1965).

3. Fluctuations in individual years and in the whole investigated period

The year 1963 is clearly distinguished from all other years, especially 1964, by the quantity of fish concentrations. While the number and size in 1963 were considerable, in 1964 they were remarkably small (see Table 2). A considerable number of fish concentrations in 1963 was registered in November and December, which was not found in other years and this makes it also different from other years.

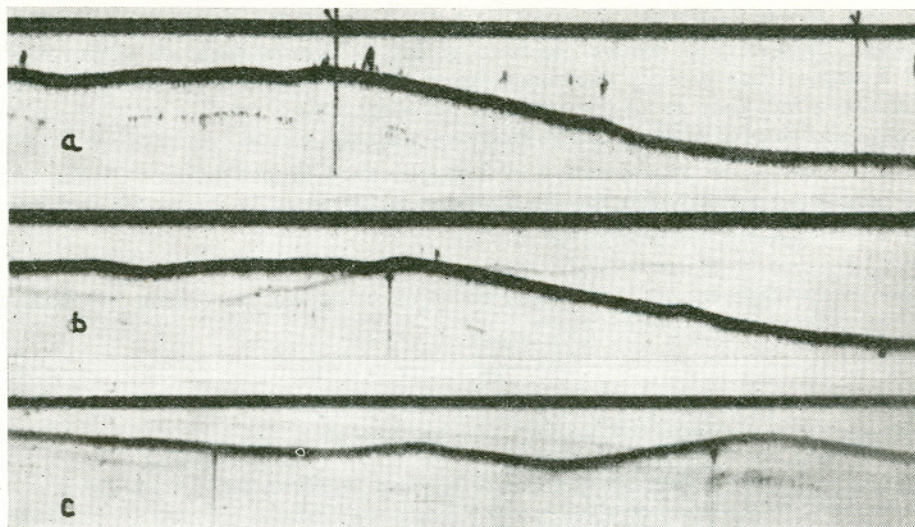


Figure 1. Echograms in the year of the greatest and the smallest number of pelagic fish concentrations in Kaštela Bay. All the echograms were obtained about 9 o'clock in the morning rather clear or completely clear weather a — 18.7.1963; b — 22.7.1964. The echogram c was obtained in winter (26.2.1963).

Studying the categories of traces the whole period of investigations, i. e., from 1962 to the end of 1967, it is clearly seen that number of traces decreased noticeably in all three categories during the winter period (see Table 3).

Table 3. Mean number of fish traces of three categories according to observations for summer and winter periods of 1962 — 67.

Year	Period	Mean number of traces		
		I	II	III
1962—67	summer	21,3	12,5	14,6
1962—67	winter	5,1	2,4	2,4

4. Fluctuation in individual months

The quantity of pelagic fish changes in the Bay during summer in the same months and about the same dates but in different years (see Fig. 1). Such changes in the same months of different years are very frequent.

Investigations show that by using method of putting the traces of pelagic fish concentrations into categories the fluctuation and estimation of approximate quantities of fish can be, to a certain degree, followed even in the seas which do not abound in rich fish funds or large concentrations.

Some factors of biotic and abiotic nature, which perhaps influence the fluctuation of pelagic fish quantities in Kaštela Bay, are under observation.

SUMMARY

Concentrations of pelagic fish in Kaštela Bay was followed with an echosounder from 1962 to the end of 1967. Traces of fish concentrations on echograms were grouped according to their superficies in order to estimate the abundance of fish and their fluctuations. Differences in quantity (relative to the number of concentrations) of pelagic fish between winter and summer periods and between individual years and months were found. Generally, larger quantities were found in summer than in winter; especially in 1963 as opposed to other years, and in particular 1964, which had the least.

SEZONSKA I GODIŠNJA KOLEBANJA KOLIČINE PELAGIČNE RIBE U KAŠTELANSKOM ZALJEVU

Ivo Kačić

Institut za oceanografiju i ribarstvo, Split

KRATAK SADRŽAJ

Pratilo se koncentraciju pelagične ribe u Kaštelanskom zaljevu od sredine 1962. do kraja 1967. godine upotrebom ultrazvučnog detektora. Znakovi koncentracija riba dobiveni na ehogramima grupirani su prema njihovoj površini, radi mogućnosti procjene količine pelagične ribe i njezinog kolebanja. Nađene su razlike u količini (dnosno broju koncentracija) pelagične ribe između zimskog i ljetnog razdoblja i između pojedinih godina i mjeseci. Veće količine zabilježene su u ljetnim nego u zimskim razdobljima, te 1963. nego ostalih godina, a naročito u odnosu na 1964. godinu.

Bibliography

- Dragesund, O. and S. Olsen. 1965. On the possibility of estimating year-class strength by measuring echo-abundance of O-group fish. *Fisk Dir. Dkr. Havundersk* 13 (8): 48—62 Bergen.
- Kačić, I. 1966. Some observations on behaviour of sardine in natural habitat. *Simpozij Biološki problemi Jadrana* (in press). Rovinj.
- Karlovac, J. 1964. Mriješćenje srdele (*Sardine pilchardus* Walb.) u srednjem Jadranu u sezoni 1956—1957. *Acta Adriatica*. 10 (8): 40 p. Split.
- Karlovac, J. 1965. Distribution des larves et des postlarves de sardine (*Sardina pilchardus* Walb.) provenant de l'aire de ponte au large de Dugi otok, Adriatique, *Proc. tech. pap. gen. Fish. Coun. Mediterr.*, 8; 197—9. Rome.
- Mitson, R. B. and R. J., Wood. 1961. An automatic method of counting fish echoes, *J. Cons. perm. int. Explor. Mer.* 25 (3) : 283—91. Copenhagen.
- Mužinić, R. 1952. Tagging of sardine (*Clupea pilchardus* Walb.) in the Adriatic in 1950. and 1951. *Acta Adriatica*. 4 (11): 373—92. Split.
- Mužinić, R. 1954. Contributin a l'étude de l' oecologie de la sardine (*Sardina pilchardus* Walb.) dans l'Adriatique orientale. *Acta Adriatica* 5 (10): 241—457. Split.
- Richardson, J. D., D. H. Cushing. F. R. H. Jones, R. H. J. Beverton and R. W. Blacker. 1959. Echo souding experiments in the Barents Sea. *Fishery Invest. Lond.*, 22 (9) : 57 p. London.
- Sherbino, M. N. and M. D. Truskanov 1964. Method of direct calculation of fish concentrations by means of hydroacoustic apparatus. *Lectures on Seminar of Fish. Biology and Oceanography* (mimeo). 23 p. Moscow.
- Tungate, D. S. 1958. Echo-Sounder Survey in the Autumn of 1956. *Fishery Investigations*, 22 (2): 11 p. London.
- Valdez, V. and D. C. Cushing. 1959. East Anglian echo surveys, *ICES* (46): 17 p. Copenhagen.
- Vučetić, T. 1963. Ishrana odrasle srdele (*Sardina pilchardus* Walb.) u srednjem Jadranu. *Acta Adriatica.*, 10 (2): 45 p. Split.