

SUMMARY OF PRESENT KNOWLEDGE OF THE MACKEREL (*SCOMBER SCOMBRUS* L.) IN
THE ADRIATIC

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ABSTRACT - *The results refer to the identity of the Adriatic mackerel, its distribution, biology and ecology, as well as to its catch characteristics.*

RESUME - *Les résultats se rapportent à l'identité du maquereau adriatique, à sa distribution, à sa biologie et écologie, de même qu'aux caractéristiques de sa pêche.*

LISSNER (1939) studied the number of fin rays and vertebrae of the north Adriatic mackerel and assumed that there were some differences in relation to the populations from Bosphorus and the English Channel.

The mackerel is widely distributed in the Adriatic. Relatively abundant trawl catches were made, during the "Hvar" Fishery biological expedition, 1948 and 1949, off Dugi otok and Kornat, and more abundant between the Jabuka Pit and the south Adriatic pit, especially in the wider Palagruža area, this being in accordance with the distribution of the Yugoslav commercial catch (MUŽINIĆ, 1973). The Jabuka Pit seems to represent some barrier to the mackerel distribution. Rather important commercial fishing was carried out in the shallow most northern Adriatic (LISSNER, 1939; GAMULIN, 1964; MUŽINIĆ, 1973). The catch in the most southern Adriatic was poor (MUŽINIĆ, 1973).

The fish reaches 16-18 cm in the first year (LISSNER, 1939) and the first sexual maturity at the end of that year (LISSNER, 1939; MUŽINIĆ, 1956). The males are more advanced in the beginning of the maturation (MUŽINIĆ, 1956). The spawning is partial (MUŽINIĆ, 1956). It mostly takes

place in winter (summarized data in MUŽINIĆ, 1983). The spawning occurs in the north-eastern channels (summarized data in LISSNER, 1939), in the wider Palagruža area (GAMULIN, 1954; MUŽINIĆ, 1956; HURE, 1961) and off the Žirje Island (MUŽINIĆ, 1973).

The exponent value of the length-weight regression for the data given by LISSNER (1939) amounts to 3.14 and for the eviscerated fish from the Mid-Dalmatia waters to 3.28 (MUŽINIĆ, 1983). High monthly lipid values were recorded in the west Adriatic mackerel in summer and autumn, and low ones in winter and spring (COPPINI, 1967). The largest differences between the sexes appeared in late autumn. The individuals from the Mid-Dalmatia area with a mean length of 24.3 cm showed in the second half of 1955 a mean liver weight of 2.85 g (0.85–6.23 g) and a mean hepatosomatic ratio of 2.66 (1.34–4.33) (MUŽINIĆ, 1983).

The mackerel tagging (1949 and 1950) was not successful, due probably to high surface temperatures (MUŽINIĆ, 1983). The north Adriatic fish presumably carries out a trophic migration towards the shallow most northern waters in early spring and in the opposite direction, i.e. towards deeper more southern waters with higher temperatures and salinities, at the years end (LISSNER, 1939). After spawning a part of the adult stock migrates from the open sea to the inshore Mid-Dalmatia waters and may be found there from April to November; young fish from the Palagruža spawning ground disperses to some extent and in part also migrates inshore (MUŽINIĆ, 1973).

Young fish form separate shoals (LISSNER, 1939). Under the light, the mackerel is often found with the sardine (MUŽINIĆ, S., 1936; GAST, in MUŽINIĆ, 1983). Young individuals sometimes appear mixed with sardines, above the large mackerels.

In the "Hvar" area the mackerel was trawled at a mean bottom depth of 124 m, exceptionally at more than 190 m (MUŽINIĆ, 1973, 1983). Small individuals (<20 cm) or those appearing with one or two other smaller pelagic fishes were obtained at depths lower than those at which larger individuals or the mackerel alone were caught (MUŽINIĆ, 1979). In the spawning season the mackerel appears only in deeper waters, while out of it the fish is eurybathic (MUŽINIĆ, 1973).

In the "HVAR" area the mackerel was caught above the sandy and muddy bottoms (MUŽINIĆ, 1973). In the Palagruža area spawners were trawled at temperatures between 12 and 14°C, and at salinities exceeding 38.5‰ (MUŽINIĆ, 1973). Out of the spawning season the fish seemed to be eurytherme and euryhaline.

The total lengths of the large fish ranged from 23 to 35 cm in the most northern Adriatic, in 1925 (SELLA, in LISSNER, 1939), while in 1937 and 1938 they were smaller (18-31 cm) (LISSNER, 1939). In the central Adriatic, in 1922 and 1923, the individuals ranging from 17 to 25 cm were observed (GAST, in MUŽINIĆ, 1983). The fish from the central and southern Adriatic ranged, in 1954-1956, from 9 to 31 cm, those exceeding 27 cm being exceptional; the extreme lengths of the individuals trawled in 1954-1955 were 14 and 26 cm, and of the spawners from the Palagruža area 14 and 21 cm (MUŽINIĆ, 1956, 1973, 1983). The fish trawled in the "Hvar" area showed extreme lengths of 13 to 32 cm, those from the most abundant catches of 13 to 27 cm and the spawners from the wider Palagruža area of 15 to 27 cm, mostly up to 25 cm (MUŽINIĆ, 1983).

In the commercial catch from the most northern Adriatic the young fish dominated (group II in 1937 and III in 1938) (LISSNER, 1939). The spawners trawled in the Palagruža area were, in January 1955, mostly at the end of their first year (MUŽINIĆ, 1983). The recruitment took place in the first year, in late spring (LISSNER, 1939; MUŽINIĆ, 1973, 1983).

In the food of postlarvae were found appendicularians and fish larval stages, especially those of the sardine, but also of the poor cod (*Trisopterus minutus capelanus* /LAC./), and of the mackerel itself (KARLOVAC, J., 1962). The juveniles fed on young fish, especially on anchovy (SELLA, in LISSNER, 1939), while the adults took from the molluscs pteropods, from crustaceans mysids and amphipods, and from fishes *Aphia minuta* (RISSO) and *Atherina boyeri* RISSO (LISSNER, 1939).

In the captures by light the mackerel occurred most frequently with the sardine; sometimes one or two other fish species were present (GAST, in MUŽINIĆ, 1983) and even three (MUŽINIĆ, 1983).

Sagitta sp. and the mackerel postlarvae themselves were found to be

predators of the postlarval mackerel (KARLOVAC, J., 1962). The hake was recorded as a predator of the mackerel (KIRINČIĆ and LEPETIĆ, 1955; KARLOVAC, O., 1959).

A copepod was found as an external parasite in the mackerel postlarvae (KARLOVAC, J., 1962). *Ascaris capsularia* RUD. caused, in 1891, an epidemic in the Adriatic mackerel (MOLA, 1928). Otherwise, the nematodes were rare in the individuals from the Adriatic (LISSNER, 1939; MUŽINIĆ, 1983).

In the northern Adriatic LISSNER (1939) recorded marked fluctuations in the mackerel annual catch. In the eastern central Adriatic a statistically significant negative correlation ($P < 0.05$) was found in the fluctuations of the annual catches of mackerel and Spanish mackerel in 1931-1940 (MUŽINIĆ, 1958). An upward trend in the Yugoslav annual catch in 1947-1961 and a downward one in 1962-1978 were recorded (MUŽINIĆ, 1982). The catch in 1959 reached a maximum of 3,324 t and in 1973-1983 it was mostly far lower than 100 t.

The highest seasonal indices in the Yugoslav catch were found for the summer quarter and lower for the spring one in all the four eight-year periods within 1947-1978 (MUŽINIĆ, 1982). The indices for the autumn quarter in the later three eight-year periods were higher than in the first one.

REFERENCES

The references are given in the *in extenso* paper "The mackerel (*Scomber scombrus* L.) in the Adriatic" published by the author in 1983, in Pomorski zbornik, 27:477-504 (in Croatian, English summary).