

UNITED NATIONS

GENERAL DOCUMENTS  
INDEX UNIT MAS

ASSEMBLY AUG 2 1955



Distr.  
LIMITED  
A/CONF.10/L.32  
FIRST DRAFT  
6 May 1955  
ORIGINAL: ENGLISH

INTERNATIONAL TECHNICAL CONFERENCE ON THE CONSERVATION  
OF THE LIVING RESOURCES OF THE SEA

Rome - 18 April 1955

Item 12(b) of the agenda

INTERNATIONAL TECHNICAL CONFERENCE ON THE CONSERVATION  
OF THE LIVING RESOURCES OF THE SEA

International conservation problems requiring solution ...

The Secretary-General has the honour to communicate the following draft of a paper, submitted by the Yugoslav Delegation to the International Technical Conference on the Conservation of the Living Resources of the Sea, by Dr. S. Zupanovic, Assistant at the Institute of Oceanography and Fisheries, Split, Yugoslavia.

PRODUCTIVITY AND INTENSITY OF EXPLOITATION OF THE ADRIATIC

by

Sime Zupanovic

UN/SEA-375

## I. INTRODUCTION

1. When dealing with the exploitation of a fishing region a clear distinction should first be made between the open seas and the enclosed seas and basins. This distinction is particularly necessary if we wish to examine fully the influence of man on the aquatic biota. In comparison with open marine areas, the enclosed seas or basins are much more influenced by man in this respect, and therefore the regulations required for the purpose of fishery management of various regions should not be standardized. Conclusions on the degree of the exploitation of a sea or basin, and on concrete measures needed to protect that particular area (but not other areas which, although similar, do not precisely correspond), can only be drawn on the basis of an analysis of factors influencing the productivity of that sea, of the extent of utilization by man, and so on.

2. These arguments were borne in mind when we attempted to compare the Adriatic with other, more, or less exploited seas.

3. Differing from other European seas, not excluding the branches of the Mediterranean, the Adriatic is notably poor in phosphates and nitrates. This deficiency is the result of a series of factors (e.g. insufficient chemical polarization, saturation with oxygen, inadequate liberation of  $PO_4$  from the sea bed, etc.), which contribute to increasing assumption, by the Adriatic, of the properties of an oligotrophic basin (Buljan, 1953(a)) 1/.

4. The deficiency in nutrient salts in a sea (by analogy with Liebig's Law of the Minimum) was found to influence its total productivity. By taking the production of the Adriatic as a function of its amount of phosphorus (Riley et al. 1949; Harvey 1950) and by comparing it with the English Channel, for example, we shall see how far these two fishing regions differ in their potential fertility.

## II. PHOSPHORUS CONTENT AND FERTILITY OF WATER MASSES

A. The Adriatic

5. The Adriatic covers an area of  $132,500 \text{ km}^2$  and has a volume of  $31.7 \times 10^{12} \text{ m}^3$ . Its average depth is 239.3 m. The exploited Continental shelf to a depth of 300 m., has an area of  $103,717 \text{ km}^2$ , with a volume of  $16.7 \times 10^{12} \text{ m}^3$

---

1/ Numbers within parentheses refer to items in the bibliography.

6. The amount of total phosphorus found in the central Adriatic along the profile Split-Monte Gargano, in 1952/53 averaged 9.1 P mg/t (Buljan 1953(b)). By multiplying this average amount by the total water volume of the Adriatic, we obtain a value of about 291,000 tons of total phosphorus, of which some 153,000 tons occurs in the waters over the exploited shelf, the extent of which is explained above.

7. About 74,000 tons of fish were caught in the Adriatic in 1953. This would correspond for a phosphorus content of 1.2<sup>0</sup>/oo in fish, to 89,0 tons of P or 0.03% of the P in the Adriatic as a whole, and 0.06% of the P in the waters over the exploited shelf. The value thus obtained represents a crop 70 to 80 times smaller than that of an artificially fertilized lake or lagoon.<sup>2/</sup>

B. The English Channel

8. The English Channel (area VII D + E on the maps of the International Council for the Exploration of the Seas) covers an area of 82,100 Km<sup>2</sup> and has a volume of  $5.9 \times 10^{12}$  m<sup>3</sup>. Its average depth is 72 m.

9. The amount of total phosphorus found in the English Channel in 1947/48 averaged 15.0 P mg/t (Armstrong and Harvey, 1950), corresponding to about 88,000 tons of total phosphorus computed for that area.

10. The 1948 fish catch amounted to some 56,000 tons, equalling 67.0 tons of P or 0.08% of the total P of the area.

11. The ratio of nutrient salts, in the Minimum, is still less favourable in the Adriatic if, instead of total phosphorus, free phosphates (P-PO<sub>4</sub>) are considered, since these represent about 1/3 to 1/7 of P-total in the Adriatic, and up to 2/3 in the English Channel (Buljan, 1953(b)).

---

<sup>2/</sup> "Hier rechnet man bei einer einmaligen Düngungsgabe mit einer Rückgewinnungsquote von nur 0.7% im ersten Jahr, der allerdings in den weiteren Jahren noch weitere, allerdings wesentlich kleinere schnell abfallende Mehrerträge folgen" (Kalle, 1953).

## III. INTENSITY OF EXPLOITATION OF THE FISH RESOURCES

A. The Adriatic

12. According to the available data <sup>3/</sup>, the following catches were taken in the Adriatic after the World War II:

Catches in Tons

Year	1947	1948	1949	1950	1951	1952	1953	M
Pelagic Species	23,945	23,927	32,442 <sup>4/</sup>	34,833	30,558	34,318	36,667	30,957
Demersal Species	31,235	34,590	35,442	42,814	38,244	37,580	37,457	36,766
TOTAL	55,180	58,517	67,884	77,647	68,802	71,898	74,134	67,723

Of demersal species caught in the Adriatic, 80% are taken by trawlers. The number of trawlers, according to the available data, was as follows:

1947 <sup>5/</sup>	1951 <sup>5/</sup>	1952 <sup>5/</sup>	1953
920	1504	1683	2025

<sup>3/</sup> Annuario Statistico Italiano 1949-50, p. 210-214, tav. 188, 220, Ser. V., Vol. V. Istituto Centrale di Statistica, Roma, 1953

Statistica della pesca e della caccia, p. 17, 18, 51, 52, 85, 89 and 94. Istituto Statistico Italiano, Roma, 1954.

Federal Institute of Statistics, No. 93: Fish Catch-Distribution and Processing of Sea and Freshwater Fish in 1953, Belgrade, 1953. (The data on catches taken in the former Trieste Zone "B" have been added by the author). Institute of Statistics, P.R. of Croatia, No. 2/1954, Monthly Statistical Report, year III, p. 11: Trawl Fishing in the Waters under Territorial Competence of the P.R. of Croatia, Zagreb, 1954.

Basioli, J.: Development of Sea Fishing in the P.R. of Croatia, Institute of Economics, Zagreb, 1952.

<sup>4/</sup> No data for Thynnus sp. are given in Italian statistics.

<sup>5/</sup> Motor trawlers only (motorpescherecci) from 25 HP up were considered from the Italian Official Statistics for 1947, 1951 and 1952, while the number of vessels for 1953 was composed according to the method of work in this sort of fishery for the Adriatic coast as a whole.

B. The English Channel

13. The data on catches referring to the area VIID + E have been taken from the Bulletin Statistique.<sup>6/</sup> The catches were as follows:

Catches in Tons							
Year	1947	1948	1949	1950	1951	1952	M
Demersal Species	25,670	37,246	44,388	31,051	27,193	40,909	34,410
Total Catch of all Species	41,377	55,778	57,942	67,013	85,112	123,171	71,732

The sudden increase shown by the catches taken in the English Channel from 1950 to 1952 should be attributed to the more intensive fishing by German trawlers equipped with stronger engines and more up-to-date devices for the detection of fish shoals, and to the extension of the herring season (Meyer, 1954). Other species, particularly the demersal were caught more or less in the same quantities during the above period. This fact has been considered when comparing the Adriatic and the English Channel with regard to their utilization and productivity, since it is on the demersal species that the influence of man becomes most manifest. Since natural fluctuations are likely to be less significant in these species, the predatory influence of man is of cardinal significance. It is quite different with the pelagic species where there are very marked natural fluctuations and the activity of man is barely felt (Rollefsen, 1951; Tester, 1951). In making the comparison, therefore, between the two fishing regions with regard to the intensity of exploitation of their demersal fish populations, we shall consider the sizes of their catches in relation to the free-phosphorus content per unit area.

#### IV. EXPLOITATION RATIO

14. The extended Continental shelf of the Adriatic yielded 37,688 tons of demersal fish, or 363 kg/km<sup>2</sup> per years during the five years period 1948-1953. The average yield of the English Channel, 1947-1952, was 34,410 tons of all demersal species, or 419 kg/km<sup>2</sup>.

15. We compare the total phosphorus, and free-phosphates the two fishing regions and the corresponding catches thus:

<sup>6/</sup> Bulleting Statistique, Conseil Permanent International pour l'Exploration de la Mer, Vol. XXXII - XXXVII, Copenhagen.

	<u>The Adriatic</u>	<u>The Channel</u>
1) The total P	291,000 t	88,000 t
2) P - PO <sub>4</sub>	33,000 t (291,000 x 0.115)	58,000 t (88,000 x 0.66)
3) Catch	38,000 t	34,000 t
4) P in catch	38 x 1.2	34 x 1.2
5) Ratio of $\frac{\text{P in catch}}{\text{P} - \text{PO}_4}$	$\frac{38 \times 1.2}{33,000}$	$\frac{34 \times 1.2}{58,000}$
6) Ratio of the $\frac{\text{fraction P removed in catch in A}}{\text{" " " " " " C}} = \frac{38 \times 1.2 \times 58,000}{33,000 \times 34 \times 1.2} = 2$		

That is, the fraction of available phosphorus removed in catch in the Adriatic is twice the fraction removed in the Channel.

16. This repeated removal of limiting salts from the Adriatic will probably lead to an unfavourable effect on the balance between the fish and the rest of the biomass within the eco-system. The composition of the ichthyocenosis in warmer shallow waters shows that the biomass of useful animals is kept down to the advantage of the remaining animals. (A larger number of species but a small number of individuals, probably linked with a retarded growth and little possibility of regeneration). The fishing process in the sea, particularly when it bears upon demersal species, thus results in gradual diminution of the total biomass of useful animals.

17. Although we are fully aware of the fact that these computations were made in a rough way and that they may, therefore, involve considerable errors, they still enable us to draw at least some general conclusions as to the productivity and intensity of exploitation of the two fishing regions compared.

#### V. THE BIOLOGICAL EFFECT OF EXPLOITATION

18. The restriction of fishing that occurred during the World War II had approximately identical effects on the demersal populations in the Adriatic and in the north European seas (Županović, 1953). An increase of all catches in 1946 by about 50% above the 1939-40 level was reported by D'Ancona (1950) for the north Adriatic, under identical conditions of weather, place and gear. We may look for causes of this increase in fish populations after the war either in the increase in the number of fishes on various fishing grounds,

or, more likely, in the increase of the average size of fishes in the population owing to the diminished mortality and to the greater probability of survival. This latter hypothesis is confirmed by the 1951 findings in the Bay of Kvarner and in the Podvelebit Channel (along the east coast of the Adriatic). The Bay of Kvarner, owing to its unswept mine-fields, preserved its virgin stocks until 1951 when the trawling was resumed there. The average length of Merluccius vulgaris, from the economic point of view the most important species of the Adriatic deep sea trawl fishery was 28.34 cm, with 75.3% of specimens above 25 cm (according to Zei, (1940), this limit is the border-line between the juvenile and adult specimens.) The average length of Merluccius caught in the Podvelebit Channel in 1938, when trawling was prohibited there, was 27.3 cm, while in 1951, coming as a consequence of a more intensive trawling in that narrow sea during the postwar years, the average length of this species dropped to 23.4 cm with only 59.3% of specimens above 25 cm. This trend of decrease in the average length of the population of Merluccius is evident in other channels also. Thus the Crikvenica Channel yielded the following average lengths: 1938: 21.0 cm; 1947: 27.5 cm; 1950: 23.0 cm, and the Kvarnerić Channel, 1938/40: 20.2 cm; 1947: 29.12 cm; 1950: 25.7 cm. (Županovich, 1953).

19. As regards the open Adriatic, we can avail ourselves of the data on Merluccius catches supplied by some of the commercial trawlers only. These data refer to the fishing region lying west of Blitvenica Lighthouse 7/ in the direction 270° (43°30' N and 15°13' E). The data are included in Table I (unbracketed numerals refer to the total catch by all vessels during the month concerned, while bracketed numerals show the computed catch for 100 hours of work).

Table I

Year	Days of work		No. of vessels taking part	<u>Merluccius vulgaris</u>
	No. of days	From - to		Total kg.
1951	96	3.XI.- 29.XI.	8	8180 (1065.10)
1952	71	1.X - 17.X.	9	4147 (730.10)
1953	44	4.XII.-28.XII.	4	2053 (583.23)
1954	26	3.XI. - 31.XI.	4	1055 (507.21)

7/ This region is intensively exploited by Yugoslav trawlers.

20. The decrease in the average size of specimens within populations of economically important species, which is closely connected with the decrease in catches per unit of effort, was until lately considered one of the fundamental indications of overfishing by the majority of fishery biologists. This factor, however, if taken separately, does not prove over-fishing any longer (Graham, 1951), and its consequences have rather an economic than biologic importance.

21. Further investigations will help us to solve the question whether the decrease in the average size of Merluccius in the Adriatic is really caused by activities of man or is the consequence of some as yet unknown natural fluctuations and migrations of adult specimens.

#### VI. THE ECONOMIC EFFECT OF EXPLOITATION

22. The fundamental economic problem in which we are here interested is the relation between the catch and its cost. These relations differ widely with regard to various components of which they consist, and their symbolic formulas may be given in one of the following ways:

$$\begin{array}{lll} \text{i)} & T_p & \gg c_v + c_f \\ \text{ii)} & T_p & \approx c_v + c_f \\ \text{iii)} & T_p & < c_v + c_f \end{array}$$

where  $T_p$  stands for the total proceeds from catch,  $c_v$  for variable cost, and  $c_f$  for fixed cost.

23. In the first case, the total proceeds ( $T_p$ ) is much higher than the composite total cost ( $c_v + c_f$ ) and may represent the maximum net return. One could talk here about profit from fishery.

24. But the competition among the fishing units, particularly in the enclosed basins like the Adriatic, do not allow that maximum of net return to remain for a long time at the point where "the marginal cost equals marginal production" (5), and the exploitation goes on even beyond that maximum, causing the variable cost to rise out of proportion to the catch value, this logically leading to a balance between the total proceeds ( $T_p$ ) and total composite cost. (ii)

25. In the third case we have an example where the catch proceeds do not cover the total cost any more and where the fisherman's employed work is by far underpaid in comparison with other similar professions. At this exploitation rate the variable cost is particularly high (fuel, effort, etc.) and the total catch remains constant or can even grow smaller owing to decimation of the average size of adult specimens of economically important species in the population.



26. By applying these deductive conclusions on the trawling in the Adriatic which involves about 80% of all the catches of demersal species, we might say without demur that today in some of the zones, the situation is not far from our third case with regard to the economic aspect of exploitation.

## VII. CONCLUSIONS

27. In comparison with the English Channel, the Adriatic is 5.4 to 6.0 times poorer in free-phosphates ( $P - PO_4$ ). But the proportion of phosphorus removed from the Adriatic by taking demersal species, is twice the removal proportion from the English Channel.

28. The biological effect of the exploitation of the Adriatic manifests itself in the decrease of the average size of Merluccius vulgaris, economically the most important species in the Adriatic deep sea trawl fishery, and in the reduction in catch per unit of effort. Further investigations may show in what degree these decreases are to be attributed to the activity of man and in what proportion are they the consequence of natural fluctuations and migrations of adult individuals.

29. The economic effect of exploitation by means of trawls in the Adriatic reflects itself in the fact that fishing is unprofitable as a consequence of the increased intensity of fishing by a growing number of trawlers in some zones of the Adriatic and in the decrease in weight of the total catch of demersal species.

30. It would be useful, in my opinion, to make an early attempt to reach a scientific solution of the problem, since this would enable us to have better knowledge of the present status of fish resources in some zones of the Adriatic, and clearer ideas about the proper measures to constitute a fishery management aimed at improvement in that status.

BIBLIOGRAPHY

- ARMSTRONG, F.A.J. and HARVEY H.W., 1950. The cycle of phosphorus in the waters of the English Channel. Journ.mar.biol.Ass. Vol.XXIX,1. Cambridge.
- BULJAN, M. 1953. Utjecaj sume na produkciju u vodama. Sumarski list, No.9/10/ The influence of woods on the production in the waters. Journal of Forestry. Zagreb.
- BULJAN, M. 1953. The nutrient salts in the Adriatic waters. Acta Adriatica, Vol. V. No.9, Split.
- D'ANCONA, U. 1950. Rilievi statistici sulla pesca nell'Alto Adriatico. Atti dell'Istituto Ven.Scien.T.CVIII. Venezia.
- GORDON, H. Scott. 1953. An economic approach to the optimum utilization of fishery resources. J. Fish.Res. Bd. Can. 10/7 /. Toronto.
- GRAHAM M. 1951. Overfishing. Proceedings, U.N.S.C.C.U.R., Vol. VII. New York.
- HARVEY, H.W. 1950. On the production of living matter in the Sea off Plymouth. Journ. mar. biol. Ass. Vol. XXIX, 1 Cambridge.
- KALLE, K. 1953. Der Einfluss des englischen Küstenwassers auf den Chemismus der Wasserkörper in der südlichen Nordsee. Ber.Dtsch.Wiss.Komm. Meeresforsch. XIII,2. Stuttgart.
- MEYER, A. 1954. Die ersten drei Jahre Kanalfischerei deutscher Fischdampfer 1950/51 bis 1952/53. "Archiv für Fischereiwissenschaft", 5 Jahr.1/2. Hft. Braunschweig.
- RILEY G.A., STOMMEL L., and BUMPUS D.F., 1949. Quantitative ecology of the plankton of the Western North Atlantic. Bull.Bingham Oc.Coll., XII, 3 New Haven.
- ROLLEFSEN, G. 1951. Changes in the abundance of the Fish Populations. Proceedings, U.N.S.C.C.U.R., Vol. VII, New York.
- TESTER, A.L. 1951. Fluctuations in the Abundance of Herring on the West Coast of Vancouver Island, British Columbia. Proceedings, U.N.S.C.C.U.R., Vol.VII. New York.
- ZEI, M. 1940. A short account of results of the fishery investigations of the oceanographical Institute in the Channel of the Croatian Coast. Annuaire de l'Institut Ocean. T.II. Split.
- ZUPANOVIC, S. 1953. Statistical analysis of catches by trawling in the fishing regions of the eastern Adriatic in 1951. Acta Adriatica, Vol.V, No.8. Split.