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MATURATION AND FECUNDITY OF MACKEREL (*SCOMBER SCOMBRUS* L.) IN NORTHWEST ATLANTIC

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Studies were carried out in 1983—1984 on gonad development, sex ratio, and absolute and relative fecundity of mackerel from a pre-spawning concentration in Northwest Atlantic. Relationship between gonad development and fish length and sex was determined. Absolute fecundity varied from about 240 thousand to 1160 thousand eggs and correlated most strictly with the fish length.

INTRODUCTION

Studies on the biomass usually focus on the analyses of the fish yields, estimates of length- and age composition of the stocks, and assessments of the growth rate of particular species. Studies on the mackerel in Northwest Atlantic, undertaken in 1981 jointly by the Sea Fisheries Institute (MIR) in Gdynia and Northeast Fisheries Center (NEFC) in Woods Hole, are a good example of this. Their basic aim was to determine changes in the stock biomass after its commercial exploitation had ceased in 1977 (Giedz and Paciorkowski, 1988). Problems related to species reproduction are usually of a secondary or no interest. On the other hand, it is accepted that knowledge on the fish length and age at first sexual maturity is indispensable in order to estimate size of the spawning stock. Also absolute individual fecundity of females, i.e. one of the most important biological parameter of the species, can be taken advantage of in estimating the size of the spawning population (Berrien et al., 1981). It is also important that individual fecundity as well as female age at first spawning may change depending on the stock size (Bagenal, 1973; Ricker, 1981). In view of this, studies described in this paper embrace analyses of some aspects of sexual maturation in mackerel and of female fecundity in a stock which was not heavily exploited by the fishery.

Table 1

List of the materials

No.	Date	Geographic location	Number of fish examined		Length (l. caud.) range of the fish examined (cm)
			Sex and gonad maturity stage	Fecundity	
1.	30.03.83	39°50'N; 72°50'W	30	–	16–23
2.	2.04.83	37°44'N; 75°05'W	50	–	27–44
3.	4.04.83	37°20'N; 75°20'W	70	–	28–43
4.	5.04.83	37°18'N; 75°25'W	41	–	26–43
5.	12.04.83	37°27'N; 75°14'W	40	–	26–42
6.	19.04.83	39°26'N; 72°38'W	40	–	38–42
7.	20.04.83	39°16'N; 72°49'W	59	–	33–44
8.	23.04.83	39°30'N; 72°36'W	35	–	33–42
9.	28.04.83	39°50'N; 72°25'W	50	–	32–42
10.	29.04.83	39°40'N; 72°33'W	40	–	29–45
11.	1.05.83	39°38'N; 72°42'W	45	–	30–44
12.	3.05.83	40°00'N; 71°39'W	50	–	34–41
13.	4.05.83	40°11'N; 71°17'W	100	–	33–42
14.	5.05.83	40°21'N; 70°29'W	30	–	34–44
15.	15.01.84	38°24'N; 74°22'W	49	–	27–43
16.	15.01.84	38°16'N; 74°24'W	55	–	29–45
17.	22.01.84	36°49'N; 75°16'W	80	–	27–43
18.	23.01.84	37°51'N; 74°56'W	50	–	25–43
19.	6.02.84	37°06'N; 75°22'W	120	–	23–42
20.	7.03.84	36°28'N; 75°29'W	92	–	27–43
21.	9.03.84	36°27'N; 75°38'W	93	–	24–43
22.	10.03.84	36°21'N; 75°30'W	80	–	24–44
23.	23.03.84	36°03'N; 75°30'W	65	–	28–43
24.	24.03.84	36°08'N; 75°18'W	75	–	30–45
25.	28.03.84	36°26'N; 75°23'W	80	–	21–48
26.	18.04.84	39°39'N; 72°38'W	102	–	27–43
27.	24.04.84	39°42'N; 72°27'W	–	30	32–43
28.	25.04.84	39°45'N; 72°18'W	–	27	32–45
29.	27.04.84	40°13'N; 70°20'W	–	27	38–43
30.	28.04.84	40°12'N; 70°11'W	90	–	30–43
		Total	1711	84	16–48

MATERIALS AND METHODS

Fishes originated from commercial-research catches performed with a pelagic trawl by Polish trawlers m/t "Kunatka" and m/t "Admirał Arciszewski" in Northwest Atlantic in 1983 and 1984. Totally 680 fishes were analysed in 1983 and 1031 in 1984. Characteristics of the materials are given in Table 1.

All fish were measured (l.caud.) up to 0.1 cm, rounding the result to the nearest centimeter, and weighed up to 5 g. Age was determined from otoliths, and sex was defined. Gonad development was estimated according to an 8-degree scale by Maier. Fish with gonads in stage I were defined as "immature" and their sex was not determined. Other fish (from stage II on) were considered as being "mature"; their sex could have been determined by visual inspection. Length at first maturity (L_m) was defined as the length at which 50% of all fish were sexually mature.

Gonads of 84 females were preserved in a solution of formalin and ethyl alcohol. These were used to determine individual absolute fecundity. Number of eggs was estimated with dry weight method. Whole preserved ovaries were thoroughly washed in running water, eggs were delicately removed, placed on a blotting paper, egg lumps were broken up, and the eggs were dried for a few days. Dried and broken up gonads were weighed with an accuracy up to 5 mg and three subsamples were immediately collected and weighed up to 0.5 mg. Eggs in the subsamples were immersed in water for at least 24 hours, so that they would swell, and then counted under a measuring microscope. The results were used in the equation:

$$F = \frac{n * A}{a} \quad (1)$$

where: F – number of eggs in the whole ovary (individual absolute fecundity),
n – number of eggs in the subsamples,
A – weight of all eggs,
a – weight of eggs in the subsamples.

Morse (1980) used the method described by Hislop and Hall (1974) to determine which eggs in mackerel ovaries would be spawned during the nearest spawning season. He concluded that yolked eggs with diameter 0.20 mm and more formed this year generation, while smaller eggs, almost transparent and without yolk, were a reserve which would develop in the next season. In view of this, only eggs containing yolk were counted in the subsamples, and if there were some doubts – only those bigger than 0.20 mm in diameter.

Relative fecundity was expressed as the number of eggs per 1 g of total fish weight. Equations of the regression of mackerel fecundity on selected parameters were calculated with the least square method.

RESULTS

Length and age at first maturity

Materials collected in this study were not sufficient to determine faithfully length at first maturity (L_m) of mackerel in 1983–1984. There were only 67 fish in the respective length range (16–30 cm), i.e. only 4 fish on the average in each 1 cm interval, and the distribution was not even. It was found that the smallest mature fish were only 20 cm in length, while the biggest immature ones were 30 cm in length. Assuming that the median of the length range with both mature and immature fish could represent the length at first maturity, this length would be 25 cm. It can be added that in the fish sample under study half of the mackerels 25 cm in length were mature and half were immature. This confirms reliability of the estimation. L_m was attained in 1983–1984 by the fish just on 2 years of age (average length of the fish belonging to age group 2 was 27.6 cm). To simplify the matter it was assumed that 2 years was the age at first maturity. Table 2 presents the data on sexual maturation of mackerel depending on the fish age. Almost 84% of fish belonging to age group 1 were immature. As regards age group 2, in 1983 only 2.3% were immature but in 1984 this percentage was 34.0%. This difference was probably caused by the differences in average fish length in the age group 2 in 1983 and 1984 (28.4 cm and 26.8 cm respectively). In 1983, age group 3 (average fish length 34.9 cm) did not contain immature fish, and in 1984 (average fish length 32.6 cm) their percentage was 1.3%.

Gonad development

Gonad development was examined since April till May 1983, and since January till April 1984 (Table 3). In January and February only gonad maturity stages II and III were observed. In February the mackerels were characterized by less developed gonads than the fish examined in January although the samples were collected in the same region (NAFO Division 6B). This was probably due to the fact that the fish caught in February were smaller (average length 32.9 cm) than those caught in January (average length 37.1 cm). This, in turn, would suggest a dependence between fish length and gonad development. Fish with gonads in stage IV (mostly males) and stage V (only males) appeared in March. April data from 1983 and 1984 suggest that in 1984 males were more and females less developed than in 1983. In April 1983 and 1984, and in May 1983, males had more developed gonads compared to females. Mackerel gonads clearly showed that in the first half of May 1983 and the end of April 1984 we still delt with prespawning fish concentrations.

Sex ratio

Sex determination revealed that mackerel females were a little more numerous than males. Ratio between males and females was similar in the two years: 1:1.13 in 1983

Table 2

Sexual maturation of mackerel caught in 1983–1984 in Northwest Atlantic against fish age
o – immature fish, ♂ – males, ♀ – females

Period of studies		Age groups											
		I				II				III			
		o	♂	♀	Total	o	♂	♀	Total	o	♂	♀	Total
1983 March	n	25	3	2	30	–	–	–	–	–	–	–	–
April	n	–	–	–	–	2	44	40	86	–	12	12	24
May	n	–	–	–	–	–	–	2	2	–	14	15	29
1983 March – May	n	25	3	2	30	2	44	42	88	–	26	27	53
	%	83.3	10.0	6.7	100.0	2.3	50.0	47.7	100.0	–	49.1	50.9	100.0
1984 January	n	–	–	–	–	5	2	7	14	3	35	37	75
February	n	–	–	–	–	6	10	20	36	–	22	24	46
March	n	1	–	–	1	23	7	16	46	1	71	80	152
April	n	–	–	–	–	–	2	2	4	–	13	14	27
1984 January – – April	n	1	–	–	1	34	21	45	100	4	141	155	300
	%	100.0	–	–	100.0	34.0	21.0	45.0	100.0	1.3	47.0	51.7	100.0
1983 – 1984	n	26	3	2	31	36	65	87	188	4	167	182	353
	%	83.9	9.7	6.4	100.0	19.1	34.6	46.3	100.0	1.1	47.3	51.6	100.0

Table 3

Sexual maturity of mackerel gonads in Northwest Atlantic in 1983 and 1984 (according to Maier's scale)

Period of studies		Sex	Gonad maturity stage										Total	
			II		III		IV		V		VI			
			n	%	n	%	n	%	n	%	n	%	n	%
1983	April 1 st half	♂♂	33	32.4	13	12.7	56	54.9	–	–	–	–	102	100.0
		♀♀	38	39.2	13	13.4	46	47.4	–	–	–	–	97	100.0
	April 2 nd half	♂♂	–	–	1	1.0	94	93.1	6	5.9	–	–	101	100.0
		♀♀	1	0.8	5	4.1	116	94.3	1	0.8	–	–	123	100.0
	May 1 st half	♂♂	–	–	1	1.0	40	39.6	59	58.4	1	1.0	101	100.0
		♀♀	2	1.6	12	9.7	105	84.7	5	4.0	–	–	124	100.0
1984	January 1 st half	♂♂	33	75.0	11	25.0	–	–	–	–	–	–	44	100.0
		♀♀	24	40.7	35	59.3	–	–	–	–	–	–	59	100.0
	January 2 nd half	♂♂	29	46.0	34	54.0	–	–	–	–	–	–	63	100.0
		♀♀	25	41.7	35	58.3	–	–	–	–	–	–	60	100.0
	February 1 st half	♂♂	32	61.5	20	38.5	–	–	–	–	–	–	52	100.0
		♀♀	44	71.0	18	29.0	–	–	–	–	–	–	62	100.0
	March 1 st half	♂♂	15	13.1	63	55.3	35	30.7	1	0.9	–	–	114	100.0
		♀♀	32	24.1	93	69.9	8	6.0	–	–	–	–	133	100.0
	March 2 nd half	♂♂	14	14.4	44	45.4	32	33.0	7	7.2	–	–	97	100.0
		♀♀	19	16.4	85	73.3	12	10.3	–	–	–	–	116	100.0
	April 2 nd half	♂♂	2	2.5	6	7.4	17	21.0	56	69.1	–	–	81	100.0
		♀♀	5	4.5	52	46.8	54	48.7	–	–	–	–	111	100.0

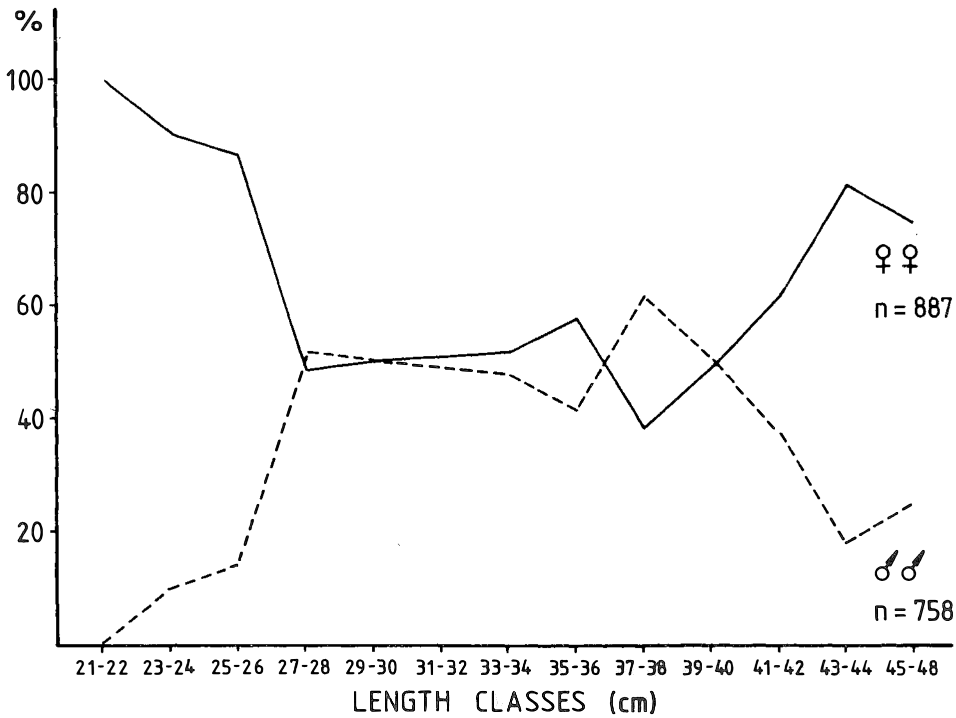

Fig. 1. Male to female ratio in relation to the length of mackerel from Northwest Atlantic

and 1:1.20 in 1984, the average for the two years being 1:1.17. It was observed that females were most numerous in the length ranges 21–26 cm and 41–48 cm (Fig. 1). In the length range 27–49 cm males and females represented 50% each on the average. Higher percentage of females in the group of smallest fish was probably due to easier sex determination with macroscopic methods. As regards the biggest fish (over 40 cm) females were more numerous due to their more rapid growth.

Individual absolute fecundity

Absolute fecundity of mackerel ranged from 243400 eggs in a female 33 cm long and weighing 340 g to 1158500 eggs in a female 42 cm long and weighing 900 g. Increasing fish length and weight resulted in increasing fecundity, notwithstanding variations (Table 4 and 5). Hence, the effect of fish length and weight on the absolute fecundity was analysed. The dependence of absolute fecundity (F) on fish length (l. caud.) was parabolic; it was expressed with the formula $F = 0.0579 \quad l. caud.^{4.4208}$ (Fig. 2). On the other hand, the relationship between total fish weight and absolute fecundity was almost linear, though the curve (Fig. 3) $y = ax^b$ was characterized by higher

Table 4

Absolute fecundity of mackerel from Northwest Atlantic in various length classes

Length classes (l. caud.) (cm)	Number of fish examined	Average absolute fecundity	Range of absolute fecundity
31–32	3	284400	243600–312400
33–34	5	291600	243400–346500
35–36	5	382900	260100–518600
37–38	8	521200	418100–640300
39–40	26	730100	514800–1019600
41–42	31	820400	554800–1158500
43–44	5	912300	676400–1085700
45	1	1026000	–

Table 5

Absolute fecundity of mackerel from Northwest Atlantic in various total body weight classes

Body weight class (g)	Number of fish examined	Average absolute fecundity	Range of absolute fecundity
300–399	8	288900	243400– 346500
400–499	5	382900	260100– 518600
500–599	6	494700	418100– 587600
600–699	12	663700	518800– 889100
700–799	29	755900	554800–1019600
800–899	21	859500	651300–1074000
900–999	3	1090100	1026000–1158500

coefficient of correlation (r) than the straight line y = ax + b (Table 6), proving that in reality this relationship was slightly curvilinear. The effect of mackerel age on its absolute fecundity was also determined (Fig. 4). This relationship also proved to be parabolic, although it was very close to a straight line (Fig. 4, Table 6). The exponent b was smaller than 1 i.e. the increases of absolute fecundity dominished in consecutive years of fish life despite the fact that the fecundity increased with fish length and weight. From among the three parameters under study, total weight was most strongly related to absolute fecundity, followed by fish length and age (Table 6).

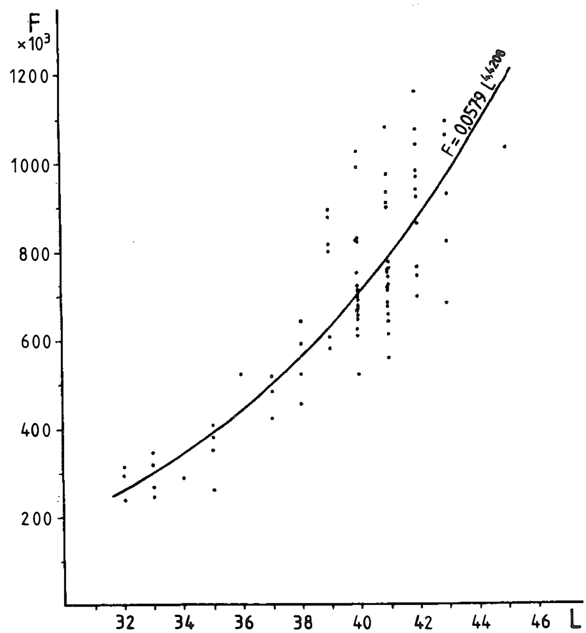

Fig. 2. Dependence of absolute fecundity (F) on caudal length (L) of mackerel from Northwest Atlantic

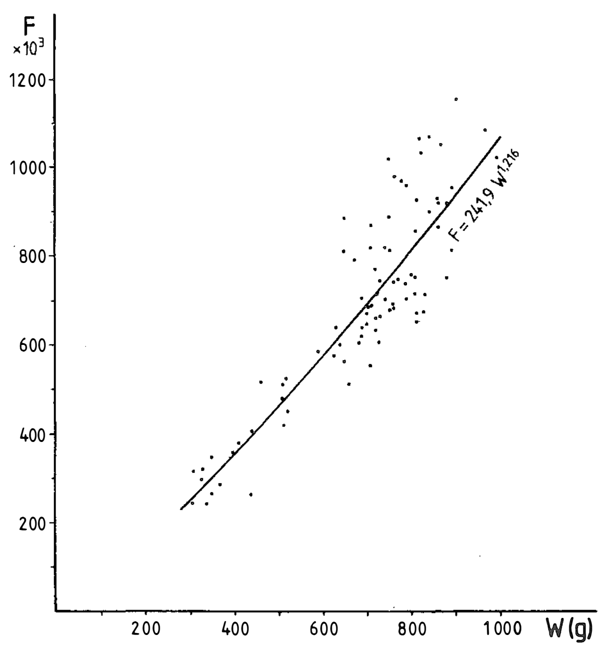

Fig. 3. Dependence of absolute fecundity (F) on total weight (W) of mackerel from Northwest Atlantic

Table 6

Regression equations and correlation coefficients (r) for the dependencies between absolute fecundity (F), relative fecundity (Fr) and caudal length (l. caud.), total weight (W) and age (A) of mackerel from Northwest Atlantic

Linear regression			Curvilinear regression (exponential)		
Regression equation $y = ax + b$	r	Statistical significance ($\alpha = 0.01$)	Regression equation $y = ax^b$	r	Statistical significance ($\alpha = 0.01$)
$F = 64660$ L.caud. $- 1857291$	0.839	+	$F = 0.0579$ L.caud.$^{4.4208}$	0.898	+
$F = 1187\ W - 122543$	0.882	+	$F = 241.9\ W^{1.2157}$	0.924	+
$F = 56499\ A + 243263$	0.820	+	$F = 164859\ A^{0.6951}$	0.869	+
$F_r = 18.684$ L.caud. $+ 257$	0.344	+	$F_r = 63.72$ L.caud.$^{0.7448}$	0.364	+
$F_r = 0.3597\ W + 747$	0.380	+	$F_r = 241.90\ W^{0.2157}$	0.395	+
$F_r = 20.546\ A + 830$	0.423	+	$F_r = 734.34\ A^{0.1471}$	0.443	+
$F_r = 5.35 \times 10^{-4}\ F + 623$	0.759	+	$F_r = 18.36\ F^{0.2973}$	0.716	+

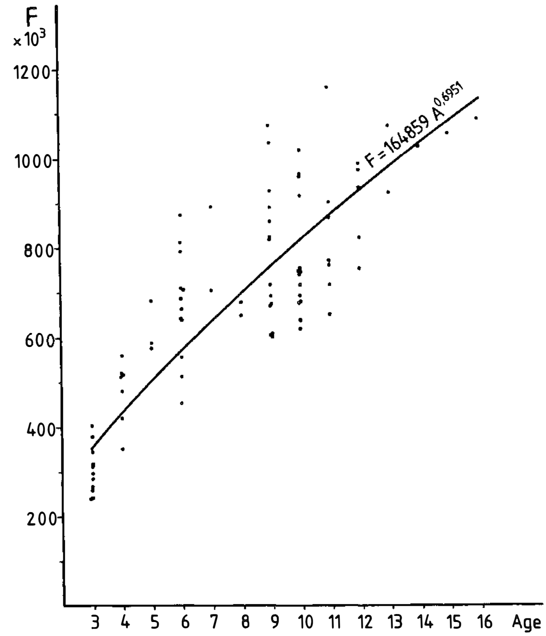

Fig. 4. Dependence of absolute fecundity (F) on age (A) of mackerel from Northwest Atlantic

Relative fecundity

Relative fecundity of mackerel females ranged from 591 to 1368 eggs per 1 g of total weight, being 995 eggs/g on the average. It was found that bigger fish were characterized by higher relative fecundity (Table 7 and 8). Correlation coefficients for the dependence between relative fecundity and fish length and weight (Table 6) revealed that there was weak though statistically significant ($\alpha = 0.01$) correlation between these parameters*. Relative fecundity correlated most strictly with mackerel age ($r = 0.443$), but the closest correlation was observed between absolute and relative fecundity ($r = 0.759$). In case of the relationship between relative fecundity and fish length, weight and age, correlation coefficients calculated for a logarithmic transformation of the exponential regression were higher than those obtained for linear regressions, while the opposite was true in case of the correlation between relative and absolute fecundity (Table 6).

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* Significance was tested with the t-test.

Table 7

Relative fecundity of mackerel from Northwest Atlantic in various length classes

Length class (l. caud.) (cm)	Number of fish examined	Average relative fecundity eggs/g	Range of relative fecundity
31–32	3	898	786–1008
33–34	5	840	716– 990
35–36	5	888	591–1127
37–38	8	938	820–1016
39–40	26	1037	780–1368
41–42	31	1018	781–1306
43–44	5	1029	815–1215
45	1	1036	–

Table 8

Relative fecundity of mackerel from Northwest Atlantic in various total body weight classes

Body weight class (g)	Number of fish examined	Average relative fecundity eggs/g	Range of relative fecundity
300–399	8	862	716–1008
400–499	5	888	591–1127
500–599	6	938	820–1003
600–699	12	1005	780–1368
700–799	29	1021	781–1359
800–899	21	1023	804–1306
900–999	3	1147	1036–1287

DISCUSSION

Studies on sexual maturity of mackerel, carried out in 1969–1975 in the New England and Nova Scotia areas (Isakov, 1976), showed that almost half of the fish attained sexual maturity at age 2, while share of mature fish at age 3 was 80%, and it was almost 100% at ages 4 and 5. In Isakov's study mackerel length at first maturity (L_m) was 27–28 cm, and all fish 32 cm long were sexually mature. In the Newfoundland waters (Moores et al., 1975) less fish (22.8%) attained maturity at age 2, but in older age groups (3–5) share of mature fish was the same as found by Isakov (1976). Also all these authors stated that males matured earlier than females. Length at first maturity was estimated in this region at 28–29 cm. Lower L_m values obtained in this study were probably caused by different method of dividing the fish into mature and immature ones. Moores et al. (1975) assumed that all fish which attained 3rd stage of sexual development (in 8-degree scale*) were mature. In this paper it was assumed that fish were mature when this fact could have been stated with a naked eye, i.e. when the fish were in gonad maturity stage II. There are some doubts as to mackerel age at first maturity. It was stated in the past (Isakov, 1976; Moores, 1976 after Anderson, 1979) that mackerel attained first maturity at the age of 2 years. STACRES Committee of the International Commission for the Northwest Atlantic Fisheries used these data to assume that spawning stocks of mackerel contained 50% of the fish at age 2 and 100% of the fish at ages 3 and older (Anon., 1976). This assumption was frequently used to estimate mackerel resources in Northwest Atlantic (Anderson and Paciorkowski, 1980). However, in the Newfoundland area, no mackerel at age 2 were found during the spawning season (June, July) (Moores et al., 1975). In August no mature and ready-to-spawn fish (stage 4–6) were found, but there were maturing ones, classified as being in stage 3. It is known that older fish appear first at the spawning grounds, and that these are the first to spawn (Lockwood et al., 1981; Dawson, 1986). This might explain lack of mackerel at age 2 in the peak of the spawning season, but it can hardly be assumed that the youngest fish spawned in late autumn, the more so that in September there were no fish in stage 4–6, nor even in stage 3 (Moores et al., 1975). Hence, it is possible to assume that mackerels belonging to age group 2 attained some degree of maturity (for instance stage 3/III) and were classified as fully mature although in reality they did not spawn (or only a few did), and their sexual products (anyway not fully mature) were resorbed. In the studies on mackerel fecundity, carried out in 1977 from Maryland to Rhode Island (Morse, 1980), there was only one female belonging to age group 2 among 218 examined, although only ripe fish (corresponding to stage V) were collected. However, it is possible that fish at age 2 ready to spawn were not collected as the sampling ended on May 22, while spawning took place still in June, though its intensity (measured in the number of eggs spawned during one day per 1 m^2) at that time was 10 to 100 times lower than in May (Berrien et al., 1981). A year later it was found in course of a research (Morse, personal communication, after Berrien et al., 1981) that the share of ripe females was 1.6% at fish length 29 cm, 13.4% at the length of 30 cm, 45.5% at 31 cm, 80.0% at 32 cm, and only females longer than 35 cm were all ripe. Length range 29–32 cm corresponds rather to age 3+ than 2+ (Isakov, 1976; Morawski, 1976; Anderson and Paciorkowski, 1980; Neja, 1990). A question arises whether as many as 50% of mackerels at age 2 really do spawn since no fish of this

* Gonad development is described with Arabic numbers when Maier scale is not used.

age are found among those fully ripe as well as among spent females. To answer this question it is necessary to carry out broader studies on sexual maturation and spawning of mackerel, and most of all on age composition of the spawning stocks throughout the spawning season.

Dawson (1986) also noted that mackerel males attained sexual maturity more rapidly than females in the pre-spawning period (Table 3). His data referred to the Western stock, spawning between the west of Ireland and the Bay of Biscay. Dawson stated that a most striking feature of the data on gonad development was that male gonads were more developed than female ones in all regions and all months. Testes seemed to be in spawning condition about a month earlier than ovaries and remained in that condition throughout the spawning season.

Sex ratio changes in the annual cycle and from year to year, the variations being normally much greater than those observed in 1983 and 1984. Apart from length distribution of the sampled fish (which affected this ratio, Fig. 1), period of sampling was also very important. A number of authors agree (Parsons and Hodder, 1970; Lockwood et al., 1981; Dawson, 1986) that mackerel females are always more numerous. A somewhat different picture was obtained when sex ratio was determined in other seasons, not in spring. In those cases males and females were equally numerous (Bigelow and Schroeder, 1953; Uciński, 1973).

In the history of the studies on mackerel in West Atlantic only a few authors attempted to estimate absolute individual fecundity of this species. Earlier papers gave rather low estimates of 400000–500000 eggs (Brice, 1898, after Bigelow and Schroeder, 1954), or 360000–450000 eggs in an "average-sized" female (Bigelow and Welsch, 1925, after Anderson and Paciorkowski, 1980). Later Morse (1980) found that mackerel fecundity could be much higher, being within the range 285000–1980000 eggs. Morse stated that the relationship of fecundity-length was curvilinear, while the relationships of fecundity-weight and fecundity-age were linear, although it was also underlined that logarithmic transformation of the variables always yielded higher correlation coefficients (r), so the correlations must have been slightly curvilinear. Figures 2–4 and Table 6 reveal that the relationships found in this study were of the same character although some differences were also noted. In Morse's data correlation between absolute fecundity and length was more strict ($r = 0.88$) than between fecundity and weight ($r = 0.81$). What is more important, mackerel fecundity estimated in 1977 was much higher. Average theoretical absolute fecundity resulting from Morse's regression was about 573 thousand eggs for a female 35 cm long, and about 1202 thousand eggs for a female 40 cm long, while in this study the respective values were 388 thousand and 700 thousand eggs (Fig. 2).

CONCLUSIONS

1. The degree of gonad development in mackerel depended on the fish length and sex; bigger fish and males matured more rapidly.

2. Sex ratio in a pre-spawning concentration of mackerels 27–40 cm in length was close to one. Females dominated among longer fish.

3. Absolute fecundity of mackerel females 32–45 cm long was within the range 243400–1158500 eggs. It correlated significantly with the fish length, weight and age.

4. The relationship of fecundity-length was curvilinear (parabolic), while tne relationships of fecundity-weight and fecundity-age were close to linear.

5. Relative fecundity of mackerel ranged from 591 to 1368 eggs/g and correlated most strictly with the absolute fecundity, followed by female age, weight and length.

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DOJRZEWANIE PŁCIOWE I PŁODNOŚĆ MAKRELI (*SCOMBER SCOMBRUS* L.) W PÓŁNOCNO-ZACHODNIM ATLANTYKU

STRESZCZENIE

W latach 1983 i 1984 przeprowadzono badania nad stopniem dojrzałości gonad, proporcją obu płci oraz nad płodnością absolutną i względną makreli, tworzącej koncentracje przetarłowe w północno-zachodnim Atlantyku (tab. 1).

Na podstawie stopnia dojrzałości gonad ustalono, że długość pierwszej dojrzałości (L_m) makreli wynosi 25 cm. Stwierdzono, że wśród ryb należących do 1 grupy wieku zdecydowana większość była niedojrzała płciowo, w 2 grupie wieku przeważały osobniki dojrzałe, natomiast w obrębie 3 grupy wieku osobniki niedojrzałe stanowiły niewielki odsetek (tab. 2). Szybkość rozwoju gonad makreli, jak wynika z obserwacji prowadzonych od stycznia do maja, zależy od długości i płci ryb. Wyższe stadium dojrzałości gonad wcześniej osiągają ryby dłuższe oraz samce (tab. 3). Stosunek liczebności samców do samic kształtował się przeciętnie dla obydwu lat badań jak 1:1,17. W zakresie długości 27–40 cm samce i samice reprezentowały po około 50% ogółu ryb, zaś wśród osobników krótszych i dłuższych liczebnie przeważały samice (rys. 1).

Płodność absolutna samic, oszacowana metodą wagową na sucho, wahała się od 243400 do 1158500 jaj (tab. 4). Ustalono, że indywidualna płodność absolutna makreli jest zależna od długości, masy i wieku ryb, przy czym korelacja pomiędzy długością a płodnością samic ma charakter krzywoliniowy (paraboliczny), natomiast korelacje masa-płodność i wiek-płodność mają przebieg zbliżony do prostoliniowego (rys. 2, 3 i 4, tab. 6). Płodność względna wynosiła przeciętnie 995 jaj na 1 g masy ciała, zawierając się w granicach od 591 do 1368 jaj/g (tab. 7). Wzrost długości, masy ciała i wieku samic wpływa na zwiększenie się płodności względnej makreli, niemniej jednak wymienione cechy są słabo, choć istotnie statystycznie, skorelowane z płodnością względną (tab. 6).

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