ACTA ICHTHYOLOGICA ET PISCATORIA

Vol. V, Fasc. 1 Szczecin, 1975

Andrzej KOMPOWSKI

Systematics

THE INTRASPECIFIC GEOGRAPHICAL VARIABILITY OF HORSE MACKEREL *TRACHURUS TRACHURUS* (L.) IN THE WEST AFRICAN SHELF WATERS

WEWNĄTRZGATUNKOWA ZMIENNOŚĆ GEOGRAFICZNA OSTROBOKA POSPOLITEGO *TRACHURUS TRACHURUS* (L.) W WODACH SZELFU ZACHODNIEJ AFRYKI

Institute of Ichthyology

An attempt to distinguish local stocks of horse mackerel was made basing both on the comparison of morphological features of fish from three West African shelf regions (Ifni: 28°34′–29°52′N, Cap Blanc: 21°00′–24°52′N, Namibia: 22°34′–26°08′S) and on the literature data.

INTRODUCTION

The first step in attempting to assess the resources and to study the fisheries impact on any fish species is to obtain substantial informations as to its internal structure. It is generally accepted to distinguish, within a species, the subspecies or "geographical" and "ecological" races as well as stocks called also local populations, local stocks, or "unit stocks". The latter category was defined, among others, by Parrish and Sharman (1958), Lebedev (1967), and Cushing (1968). A preliminary discernment in the fish species internal structure is possible to obtain through investigations on the geographic variability of the species morphologic features.

Horse mackerel is a species of a wide geographic distribution, living under different ecological conditions, which undoubtedly has a bearing on the fish intraspecific differentiation. The problem is still poorly known as it is only recently that the large-scale commercial fishery exploitation of the species has begun. The present paper contains an attempt to supplement our knowledge of the problem, basing on the morphologic studies.

MATERIAL AND METHODS

The fishes studied were derived from the Polish trawlers catches from the West African shelf within the years 1972–1973. As a whole 765 fish individuals were examined. The localities of samples are shown on Fig. 1.

Fig. 1. Localities of sampling

The following features were examined:

1) a gill rakers count on the whole first gill arch;
2) a gill rakers count on the first gill arch ceratobranchiale;
3) a number of the lateral line (l.l.) scales;
4) a subsequent number of the second dorsal fin ray under which the seismosensoric system dorsal branches (*comissurae supra-temporale*) are terminated (l.l.d.);
5) a predorsal distance "PD", i.e., from the lower jaw anterior end to the beginning of the first dorsal fin;
6) a preanal distance "PA", i.e., from the lower jaw end to the beginning of the anal fin;
7) a preventral distance "PW", i.e., from the lower jaw end to the beginning of the right-side pectoral fin base;

Table 1

Morphologic features of *Trachurus trachurus* from the three western African shelf regions

Feature	Ifni (28°44'N – 29°52'N)				Cap Blanc (21°00'N – 24°52'N)				Namibia (22°34'S – 26°08'S)				Total number of fishes examined
	amplitude	$\bar{x} \pm m$	$\pm\sigma$	n	amplitude	$\bar{x} \pm m$	$\pm\sigma$	n	amplitude	$\bar{x} \pm m$	$\pm\sigma$	n	
Gill rakers count on the whole gill arch	59 – 67	62.81 ± 0.17	1.72	103	58 – 71	63.56 ± 0.12	2.22	349	64 – 74	69.20 ± 0.13	1.11	75	527
Gill rakers count on the gill arch lower part	43 – 49	46.27 ± 0.18	1.83	103	41 – 52	47.03 ± 0.08	1.66	352	48 – 56	51.45 ± 0.19	1.63	75	530
Number of l.l. scales	68 – 81	74.00 ± 0.18	1.78	103	69 – 80	47.07 ± 0.14	1.93	189	69 – 78	73.80 ± 0.26	1.93	54	346
Subsequent number of D_2 ray under which comissurae supra–temporale end	21 – 33	27.41 ± 0.21	2.18	104	23 – 34	28.51 ± 0.13	1.85	218	20 – 28	23.80 ± 0.34	2.50	54	376
In % of l. caud.													
Predorsal distance	31.15 – 36.12	33.69 ± 0.11	1.06	104	31.15 – 36.15	33.53 ± 0.07	1.01	223	31.59 – 36.86	34.74 ± 0.11	0.79	51	378
Preanal distance	51.29 – 58.91	55.09 ± 0.12	1.25	104	46.69 – 58.08	54.29 ± 0.10	1.54	223	52.78 – 59.22	55.88 ± 0.17	1.22	50	377
Preventral distance	29.02 – 33.56	31.40 ± 0.09	0.90	105	28.24 – 34.85	31.14 ± 0.07	1.01	224	30.04 – 34.83	32.51 ± 0.14	1.02	51	380
Head length	25.30 – 29.30	27.20 ± 0.06	0.84	231	25.09 – 30.71	27.44 ± 0.04	0.93	468	27.94 – 31.53	29.25 ± 0.11	0.92	66	765
Maximum body height	19.58 – 26.22	22.47 ± 0.11	1.15	105	19.33 – 26.14	22.78 ± 0.09	1.33	226	18.91 – 24.32	22.15 ± 0.16	1.18	52	383
Longitudo caudalis	19.9 – 38.3	27.78		231	13.5 – 35.4	25.28	468	468	23.3 – 34.6	28.85			765

8) a lateral head length "G", i.e., from the lower jaw end to the furthest point of the gill cover;
9) a maximum body height "MW", i.e., measured along the vertical line passing through the beginning of the first dorsal fin base.

Fig. 2 shows schematically all the measured elements; the plastic features (items 5–9) are expressed in % of *l.caud.* The results obtained were treated statistically, the standard deviation and standard error of the mean values being calculated (Table 1). Differences between mean values for the Ifni and Cap Blanc horse mackerels were worked out with the variance analysis after (Cramer 1958).

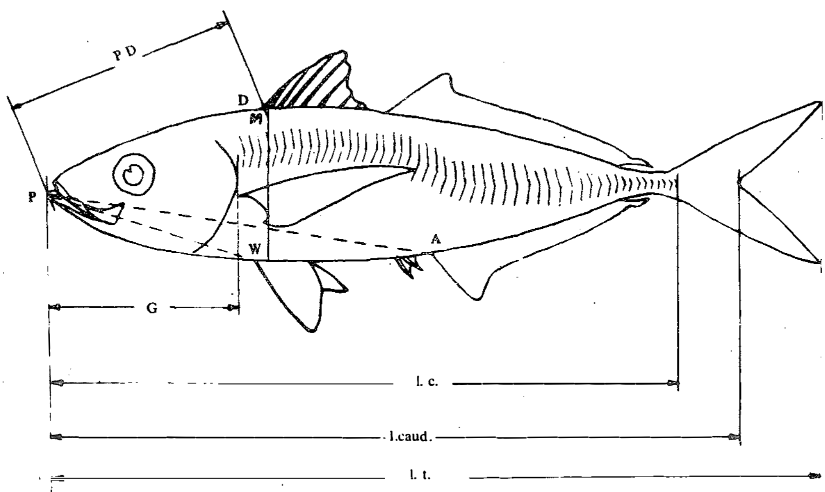

Fig. 2. Schematic diagram of measurements

THE RELATIONSHIP BETWEEN THE THREE KINDS OF LENGTH MEASUREMENT

Longitudo totalis (l.t.), *longitudo caudalis* (l.caud.), and *longitudo corporis* (l.c.) are the most commonly used fish length measurements. Unfortunately, a significant freedom exists in choosing a kind of a measurement for various fish species by different authors, thus giving rise to a non-comparability of data. Relations between the three measurements, calculated with a least squares method for the Cap Blanc horse mackerel are presented below. They will facilitate further comparisons of data obtained from various measurements.

1. Relation between l.t. and l.caud.

l.caud. = 0.8793 l.t.+2.05847

l.t. = 1.137251 l.caud. – 2.3410

r = 0.9998

2. Relation between l.t. and l.c.

l.t. = 1.17032 l.c.+1.7720

r = 0.9997

The above relationships were derived from 813 measurements of horse mackerel of the l.t. range 147–381 mm. High correlation coefficients approaching 1 indicated a linear relationship between the three lengths measured in the fishes of the total length range 14.7–38.1 cm; the regression straights defined by the above equations, however, are displaced as related to the beginning of the coordinates system, thus pointing out to an allometry in the three lengths' increase in the fishes of l.t. below 14.7 cm. Therefore the above formulae can be applied only to the horse mackerels longer than 14.7 cm, which is absolutely sufficient in studies on the so called "exploited stock".

MERISTIC FEATURES

Gill rakers

a) Gill rakers count on the gill arch lower part *(ceratobranchiale)*

Kreft (1958) observed an increase in gill rakers counts in the Atlantic – Scandinavian and North Sea herrings with their length. No similar increase was found in the West African shelf horse mackerels within the studied length range (Fig. 3,I). Thus the fish length should have no effect upon our observations.

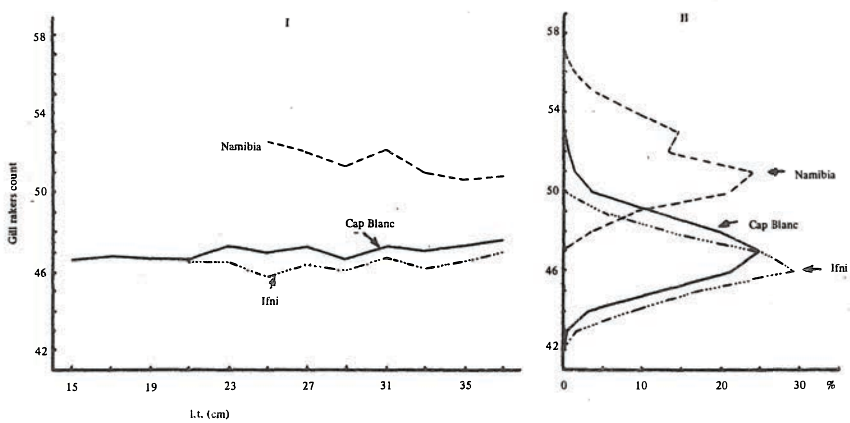

Fig. 3. I Region-dependent mean gill rakers count on the gill arch lower part in *Trachurus trachurus* of various sizes. II Region-dependent individual variability in gill rakers counts on the gill arch lower part in *Trachurus trachurus*

Fig. 3, I and II show some differences in gill rakers counts in the fishes from the three regions surveyed. The most pronounced difference is seen between the Namibia and Cap Blanc regions, the amplitudes, $\bar{x}$ values and modes being 48–56 and 41–52, 51.45 and 47.03, 51 and 47, respectively. A smaller but nevertheless statistically significant difference exists between the Cap Blanc and more northward Ifni; the amplitude, $\bar{x}$ value and mode amounting to 43–49, 46.27, and 46, respectively (Table 2).

Table 2

Significance test of differences between the Cap Agadir (x) and Cap Blanc (y) *Trachurus trachurus* morphologic features on the confidence levels p = 0.05 and 0.01

Features	$\bar{x}$	$\bar{y}$	$\bar{x} - \bar{y}$	$U_{0.05}$	Significance when p = 0.05	$U_{0.01}$	Significance when p = 0.01
Meristic features							
Gill rakers count on the whole arch	62.806	63.564	0.758	0.406	+	0.534	+
Gill rakers count on the gill arch lower part	46.272	47.030	0.758	0.394	+	0.518	+
Number of l.l. scales	74.000	74.074	0.074	0.440	–	0.578	–
Subsequent number of D_2 ray under which comissurae supra–temporale terminate	27.413	28.509	1.096	0.485	+	0.638	+
Plastic features expressed in % of l. caud.							
Predorsal distance	33.69	33.53	0.16	0.242	–	0.319	–
Preanal distance	55.09	54.29	0.80	0.314	+	0.413	+
Preventral distance	31.40	31.14	0.26	0.217	+	0.285	–
Maximum body height	22.47	22.78	0.31	0.280	+	0.368	–

The difference between means is significant when: $|\bar{x} - \bar{y}| > \lambda_p \sqrt{\frac{\sigma_x^2}{n_x} + \frac{\sigma_y^2}{n_y}} = U_p$

Significant difference "+", insignificant difference "–"

b) Gill rakers count on the whole gill arch

This feature is less reliable than the previous one owing to difficulties in thorough isolation of the upper part of the arch; this is probably the reason of the resulting polymodal distributions of the features.

The greatest count was observed in the fishes from the Namibia region, much smaller in the Cap Blanc fishes, while the Ifni ones showed still smaller counts, the amplitudes amounting to 64–74, 58–71, and 59–67 for the respective regions, while $\bar{x}$ values to 69.20–63.56, and 62.81, respectively (Fig. 4, I and II, Table 1). Similarly to the gill rakers count on the arch lower part, the differences between the mean values for Cap Blanc and Ifni are statistically significant (Table 2).

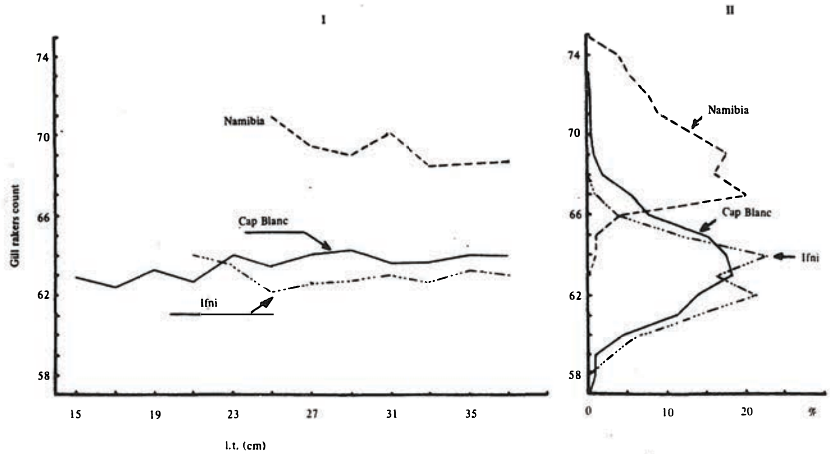

Fig. 4. I Region-dependent mean gill rakers count on the whole gill arch in *Trachurus trachurus.* II Region-dependent individual variability in gill rakers counts on the whole gill arch in *Trachurus trachurus*

Table 3 summarizes the results of studies on gill rakers counts in the East Atlantic *Trachurus trachurus* obtained by various authors. It can be seen that the gill rakers counts increase southwards. In the northern hemisphere, the most frequently found counts on the whole gill arch and its lower part increase from 57 and 40 to 63 and 47 in the Western English Channel and the Cap Vert region, respectively. In the southern hemisphere, horse mackerel in general show a higher count than in the northern one, such clear tendencies to alterations in this feature not being observed within the southern region. The mode ranges within 67–69 and 50–51 for the whole arch and its lower part, respectively. Aloncle (1960, 1964) was the first to note a southward increase of the horse mackerel gill rakers count; he interpreted it as an influence of a mean water temperature increase. His interpretation, seemingly right as far as the North-East Atlantic is concerned, offers no explanation for the occurrence of much higher gill rakers counts in the South-West African shelf horse mackerels than in the North-West ones in spite of much lower mean temperatures of bottom waters in the first region. Overko (1971a) tries to explain the differences in gill rakers counts referring to different natures of the fish's feeding habits in each region, giving, however, no precise account of those feeding differencies.

Table 3

Gill rakers counts in the East Atlantic *Trachurus trachurus*

Region	Gill rakers count on the whole gill arch				Gill rakers count on the gill arch lower part				Source of information
	Amplitude	$\bar{x}$	mode	n	Amplitude	$\bar{x}$	mode	n	
North Sea	–	59.35	–	100	–	–	–	–	Polonskij, Bajdalinov, 1964
Western English Channel	48 – 63	–	57	29	32 – 47	–	40	29	Aloncle, 1960
Western English Channel	–	58.96	–	100	–	–	–	–	Polonskij, Bajdalinov, 1964
Biscayne Bay	52 – 64	–	60	70	38 – 48	–	44	70	Aloncle, 1960
Region off Casablanca	57 – 65	–	62	17	41 – 48	–	44 – 46	17	Aloncle, 1960
Region off Casablanca	–	–	–	–	41 – 50	–	45	–	Aloncle, 1964
33°38′ N	–	60.45	–	–	–	–	–	–	Overko, 1971 b
31°23′ N	–	59.74	–	–	–	–	–	–	Overko, 1971 b
29°45′ N	–	59.94	–	–	–	–	–	–	Overko, 1971 b
Ifni	59 – 67	62.81	62 – 64	103	43 – 49	46.27	46	103	author's data
20°45′ N	–	61.43	–	–	–	–	–	–	Overko, 1971 b
Cap Blanc	57 – 70	62.89	63	379	–	–	–	–	Huỳnh Dinh Tiến, 1972
Cap Blanc	58 – 71	63.56	63	349	41 – 52	47.03	47	352	author's data
Cap Vert	–	62.44	–	25	–	–	–	–	Overko, 1971a
Cap Vert	57 – 69	63.06	63	107	–	–	–	–	Huỳnh Dinh Tiến, 1972
North–West Africa	54 – 69	–	–	–	–	–	–	–	Overko, 1971b
North–East Atlantic	52 – 71	59.7	–	658	32 – 54	44.7	–	49	Polonskij after Komarov, 1971
Angola shelf	65 – 76	–	–	–	48 – 54	–	51	99	Da Franca after Aloncle, 1960
Kunene River	–	68.22	–	50	–	49.30	–	50	Komarov, 1971
Namibia shelf	64 – 74	69.20	67 – 69	75	48 – 56	51.45	51	75	author's data
Walvis Bay	–	67.82	–	25	–	–	–	–	Overko, 1971a
Walvis Bay	–	69.25	–	25	–	50.68	–	25	Komarov, 1971
Cape Town	–	69.00	–	54	–	50.18	–	54	Komarov, 1971
Agulhas Bank	61 – 78	–	67	43	–	–	–	–	Nekrasov, 1970
Southern Africa	–	–	–	–	–	–	50	–	Smith, 1972
South – East Atlantic	62 – 76	68.74	68	129	42 – 56	49.54	50	129	Komarov, 1971

Basing on the total gill rakers count on the first gill arch, Overko referred to above, worked out the following key to distinguish two subspecies of horse mackerel living in the West African shelf:

57–62 gill rakers – *Trachurus trachurus trachurus*

68–70 gill rakers – *Trachurus trachurus capensis*

Compared to data collected in Table 3, the above criterion appears to be completely insufficient.

Number of the lateral line scales

Aleev (1957) regards the number of the lateral line scales as a main feature differing the two horse mackerel subspecies dwelling in the East Atlantic, the number being higher in *Trachurus trachurus capensis*. Also Overko (1971a) observed a higher humber of the l.l. scales in *T.trachurus capensis* from the Walvis Bay than in *T.trachurus trachurus* from the Cap Vert region, the means values amounting to 72.68 and 70.84, respectively; he stated the statistical significance of the difference. However, our studies do not confirm the above statement (Fig. 5, I and II, Table 1). Mean numbers of scales in the fish from the regions are almost the same, occasionally occurring differences being statistically insignificant (Table 2). The modes are identical, amounting to 74. It is seen from the previously mentioned Fig. 5, that the fish length shows no significant influence here. Similar values of the mean l.l. scales number, close to 74, were obtained by Letaconnoux (1951, after Aleev, 1957) for the Biscayne Bay horse mackerel, Aloncle (1964) for the fishes from the region off Casablanca, as well as Huyñh Dinh Tiên (1972) in the Cap Vert and Cap Blanc regions. On the other hand, Barraca (1964) gives a considerably smaller number ranging within 63–77, both the mode and mean value amounting to 70, for the horse mackerel off Lisboa. The author observed on fishes of l. caud. 11–37 cm an increase in the l.l. scales number with a fish's length. It is difficult to explain the discrepancies listed above. Anyway the feature in question seems to have a limited applicability in studies on the horse mackerel intraspecific variability.

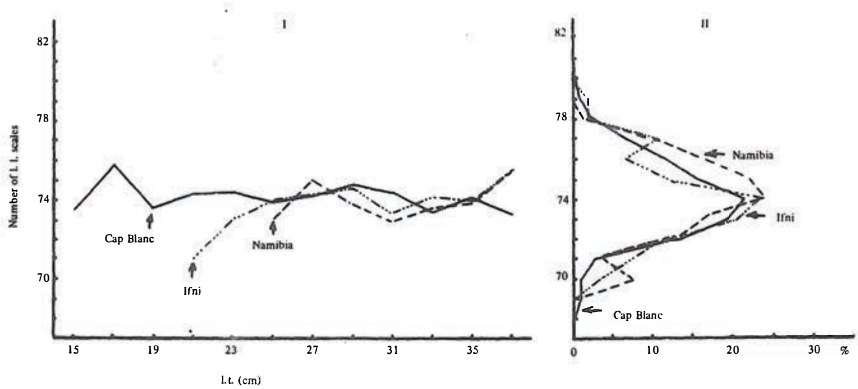

Fig. 5. Mean l.l. scales number in *Trachurus trachurus* of various sizes in particular regions. II Individual variability in the l.l. scales number in *Trachurus trachurus* in particular regions

Situation of the seismosensoric system dorsal branches termination (l.l.d.)

The feature was for the first time utilized in the taxonomy of *Carangidae* by Ramalho (1938a, b). The situation of the lateral line dorsal branches endings is the most reliable criterion distinguishing the species of the genus *Trachurus* which has been discussed in detail by, among others, Cadenat (1949), Aleev (1956, 1957), Blanc and Bauchot (1960), Huynh Dinh Tiên (1972). It is worthwile to follow the intraspecific variability of this feature in *Trachurus trachurus*. As it is shown on Fig. 6, I, the feature exhibits no well-defined changes with the fish's length within the length range studied. On the other hand, clear differences exist in the fishes from the three regions compared. An obvious difference is seen between the Namibia shelf fishes showing in average l.l.d. terminations under the 23.80th ray of the second dorsal fin (the mode and amplitude being 23 and 20–28, respectively) and the North-West African shelf ones with longer branches reaching, in average, to the 28.51st (the mode and amplitude being 29 and 23–24, respectively) and 27.41st rays (the mode and amplitude 28 and 21–33, respectively) in the fishes from Cap Blanc and Ifni, respectively. The differences between the two latter regions are statistically significant. Komarov (1971) studied the geographical variability of the feature in *T. trachurus capensis* along the South-West African shelf and found no significant differences. According to him the l.l.d. terminations are situated in *T. trachurus capensis* in average under the 24.95th ray of the second dorsal fin, the amplitude and mode being 19–30 and 25, respectively. In the northern hemisphere Aleev (1957) gives only variations within 20–32, while Komarov (1971) qoutes Polonski's data including also the variability range of 20–32.

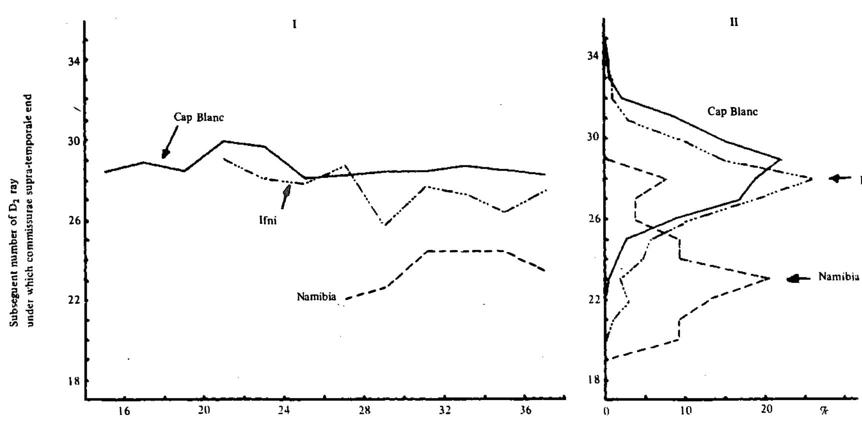

Fig. 6. I Mean position of commissurae supra-temporale (l.l.d.) terminations in *Trachurus trachurus* of various sizes in each region. II Individual variability in position of l.l.d. terminations in *Trachurus trachurus* in each region

Aleev (1956, 1957) regarded the length of the l.l. dorsal branches as an evidence of the evolutional progression of the *Carangidae*, i.e., the longer the organs, the younger evolutionally was the species. Applying this principle to the intraspecific variability analysis we must regard *Trachurus trachurus capensis* as a more primary form than *T.trachurus trachurus.*

PLASTIC FEATURES

Predorsal distance

Aloncle (1964) recorded a negative allometry of the distance /l.caud. ratio in horse mackerel off Casablanca. Our observations show a rather clear negative allometry between the two distances only in the Agadir region fishes (Fig. 7, I). The Namibia region horse mackerels show a clearly greater predorsal distance than the fishes off Cap Blanc and Ifni do (Fig. 7, II). The difference between the mean values of the feature in the latter two regions is negligible and statistically insiginificant (Table 2).

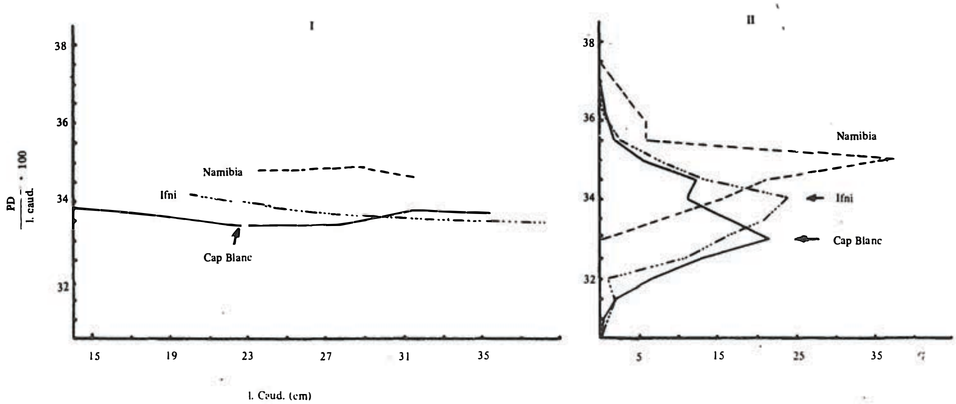

Fig. 7. I Predorsal distance PD/l.caud. mean ratio in *Trachurus trachurus* of various sizes in different regions. II Individual variability in predorsal distance PD/l.caud. ratio in *Trachurus trachurus* in different regions

Preanal distance

The distance grows isometrically to l.caud. (Fig. 8, I). Similar results were reported by Aloncle (1964). The distance is, in average, in its greatest in the Namibian fishes, while the smallest one is noted for the Cap Blanc horse mackerels. Intermediate values of the preanal distance are obtained from the Ifni fishes (Fig. 8, II). The difference between the distance/l.caud. mean ratios for the Cap Blanc and Ifni regions is statistically significant (Table 2).

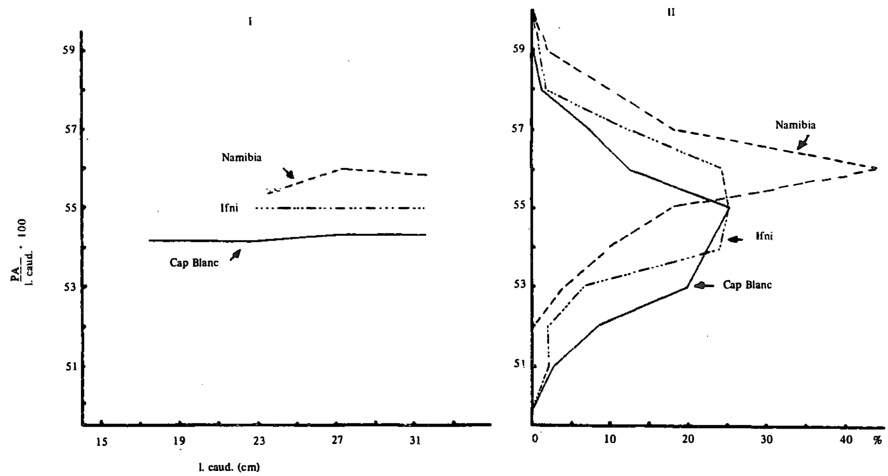

Fig. 8. I Preanal distance PA/l.caud. mean ratio in *Trachurus trachurus* of various sizes, depending on the region. II Individual variability in preanal distance PA/l.caud. ratio in *Trachurus trachurus*, depending on the region

Preventral distance

The distance/l.caud. ratio does not subject to any definite changes with the fish length (Fig. 9, I). In average the greatest distance is noted in the Namibian shelf fishes, while a difference between those from the Cap Blanc and Ifni regions is small and statistically significant on the 5% confidence level only (Table 2).

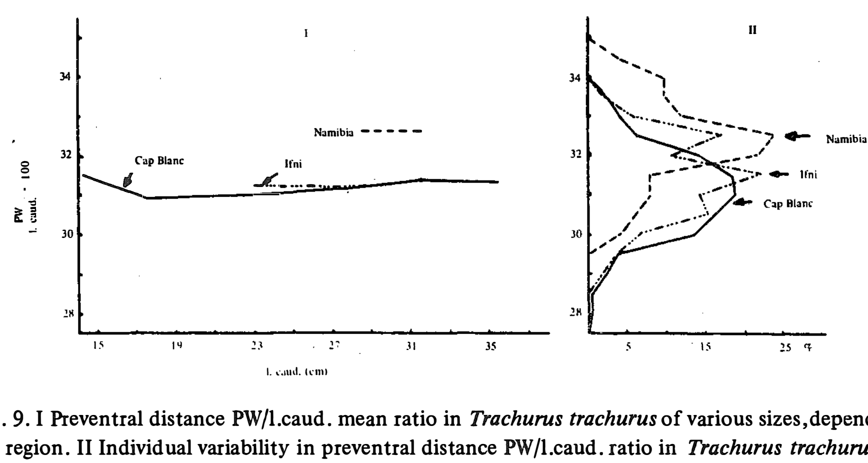

Fig. 9. I Preventral distance PW/l.caud. mean ratio in *Trachurus trachurus* of various sizes, depending on the region. II Individual variability in preventral distance PW/l.caud. ratio in *Trachurus trachurus*, depending on the region

Lateral head length

The distance/l.caud. ratio clearly decreases with the fish length (a negative allometry), what is seen on Fig. 10, I. Gail (1952) notes a similar phenomenon in the fishes off Casablanca. Fig. 10, I also shows that the Namibian shelf horse mackerels have, in average, much longer heads than the fishes of the same length from the North-West Africa shelf. The differences in this respect between the Cap Blanc and Ifni regions are negligible.

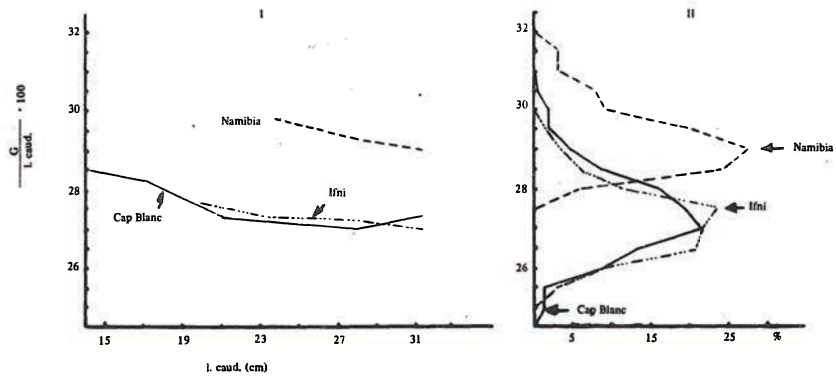

Fig. 10. I Head length G/l.caud. mean ratio in *Trachurus trachurus* of various sizes, depending on the region. II Individual variability in head length G/l.caud. ratio in *Trachurus trachurus*, depending on the region

Maximum body height

The feature/l.caud. ratio grows with the fish length (a positive allometry). Among the fishes of the same length the greatest ratio is, in average, observed in the fishes off Cap Blanc, while the smallest one in those from the Namibia region (Fig. 11, I and II).

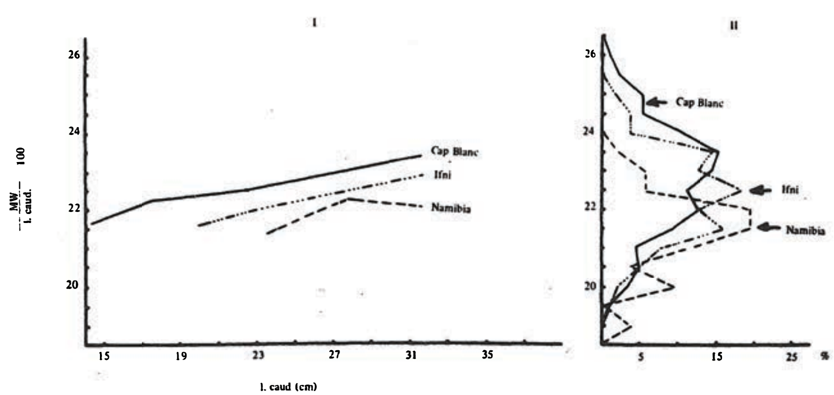

Fig. 11. I Maximum body height MW/l.caud. mean ratio in *Trachurus trachurus* of various sizes in particular regions. II Individual variability in maximum body height MW/l.caud. ratio in *Trachurus trachurus* in particular regions

Thus horse mackerel from the shelf of Namibia, when compared to the fishes of the same length from the Nort-West African shelf, possess more posteriorly placed anal and first dorsal fins, show a smaller maximum body height and larger head, therefore their body being more slender. Overko (1971a) who had also observed this when comparing the plastic features of the Walvis Bay and Cap Vert horse mackerels, stated that the differences were statistically insignificant in most plastic features. The only exception was the maximum body height and maximum scale height in the posterior l.l.part.

RECAPITULATION

The main distribution area of horse mackerel, *Trachurus trachurus* (L.) is stretched along the eastern coasts of the Atlantic, inhabited by the two subspecies, *T.trachurus trachurs* (Linné, 1758) and *T.trachurus capensis* Castelnau 1861. The latter differs from the former by its higher gill rakers count, shorter lateral line dorsal branches, longer head, and lower body.

The both subspecies evolved presumably at the end of the glacial period. In this time with a much lower mean water temperature of the Atlantic, *Trachurus trachurus* found more suitable conditions of life in the equatorial zone and formed a compact population. After an up-warming, the temperature in equatorial waters became too high to meet the fish requirements and the previously compact distribution splitted into two regions separated by the thermal barrier.

Trachurus trachurus trachurus occurring in the northern hemisphere forms a continuous chain of local stocks, from the Celtic and North Seas to the region south off Cap Vert, gradually altering their morphologic features. Bajdalinov and Staroselskaja (1964), and Polonskij and Bajdalinov (1964) suggest that two separate stocks live in the English Channel and in the northern Biscayne Bay.

As far as the North-West African coasts are concerned, the hypothesis of Boely, Wysokinski and Elwertowski (1973) seems to be the most probable one. They suggest that a single large stock of horse mackerel inhabits waters along the Mauretania and Senegal coasts, the stock undertaking seasonal migrations along the shelf following the northward or southward movement of a contact zone between the Canary Current waters and warm "Guinean" ones. Northwards of this hydrographic front – and upwelling current-confined stock, another horse mackerel stock (stocks) exists, presumably off the Spanish Sahara and Morocco, the morphologic differences between the Cap Blanc and Ifni regions, found by the present author, serving as an evidence.

The South-East Atlantic inhabited by *Trachurus trachurus capensis* shows less diversified ecological conditions than the North-East Atlantic. This is the reason of a smaller variability in the morphologic features of the subspecies, as it was pointed out by Komarov (1971) who distinguished two "subpopulations" in the South-West African shelf: a northern one inhabiting a part of the shelf from Angola to the Walvis Bay and a southern one living off the Cape of Good Hope.

REFERENCES

Aleev J.G., 1956: O sistematičeskoj položenii stavridy Čornogo Moria. Voprosy Ichtiologii, 7: 174–184.

Aleev J.G., 1957: Stavridy morej SSSR Trudy Sevastopolskoj Biostancji AN SSSR, 9: 167–242.

Aloncle H., 1960: Remarques numériques préliminaires sur les branchicténies de Trachurus trachurus (Linné 1758). Bulletin de l'Institut des Pêches Maritimes du Maroc, 4: 3–8.

Aloncle H., 1964: Note sur la croissance et quelques caractères numériques de Trachurus trachurus (Linné 1758) des côtes atlantiques du Maroc. Bull. Inst. Pêch. Marit. Maroc, 11: 25–38.

Bajdalinov A.P., Staroselskaja A.G., 1964: O vozrastnom sostave i tempe rosta stavridy proliva La Manš i Biskajskogo zaliva. AtlantNIRO – Trudy, 13: 5–13.

Barraca I.F., 1964: Quelques aspects de la biologie et de la pêche du chinchard Trachurus trachurus (L.) de la côte portugaise. Notas e Estudos do Instituto do Biologia Maritima, 29.

Blanc M., Bauchot M., 1960: Sur quatre genres de Carangidae (Téléostéens Perciformes) de la côte occidentale d'Afrique: Decapterus, Caranx, Trachurus, Suareus. Affinités et rapports phylogéniques. Bull. Mus. Nat. Hist. Nat. 2 – 32, 6: 484–497.

Boely T., Wysokiński A., Elwertowski J., 1973: Les chinchards des côtes sénégalaises et mauritaniennes. Office de la Recherche Scientifique et Technique Outre-Mer. D.S.P., 46.

Cadenat J., 1949: Description de quatre Téléostéens nouveaux de la Côte Occidentale d'Afrique. Bull. Mus. Nat. Hist. Nat. 2-ser., 21, 6: 663–671.

Cramer H., 1958: Metody matematyczne w statystyce. PWN Warszawa. [Mathematical methods of statistics].

Cushing D.H., 1968: A study in population dynamics. The Univ. Wisconsin Press.

Gail R., 1952: Trachurus. Etat sexuel et croissance du saurel des côtes atlantiques du Maroc (Trachurus trachurus L.). Annales Biologiques Cons. Perm. Int. Expl. Mer., 8: 90–91.

Huynh Dinh Tiên, 1972: Studia nad trzema gatunkami z rodzaju Trachurus i Caranx z rejonu północno-zachodniej Afryki. Rozprawa doktorska, maszynopis, Instytut Ichtiologii AR w Szczecinie. [The study on Trachurus and Caranx genera in NW African region.Dissert.].

Komarov J.A., 1971: K'opredeleniju jedinic zapasa južnoafrikanskoj stawridy (Trachurus trachurus capensis Castelnau). AtlantNIRO – Trudy, 41: 33–42.

Kreft G., 1968: Counting of gill rakers as a method of morphological herring investigations. Rapp. Proc.-Verb. Reun. Cons. Perm. Int. Expl. Mer., 143, 2: 22–25.

Lebedev N.V., 1967: Elementarnyje populacji ryb. Izd. „Piščevaja promyšlennost".

Nekrasov V.V., 1970: Stavridy (sem. Carangidae) vostočnogo poberežja Afriki. Trudy AzčerNIRO, 29: 89–138.

Overko S.M., 1971a: K'sistematičeskomu položeniju stavrid roda Trachurus zapadnogo poberežja Afriki. AtlantNIRO – Trudy, 41: 82–87.

Overko S.M., 1971b: Morfologja, biologia i promysel obyknovennoj stavridy (Trachurus trachurus Linne) centralno-vostočnoj Atlantiki. Sistematičeskoje položene i morfologičeskije osobennosti. AtlantNIRO – Trudy, 41: 102–121.

Parrish B.B., Sharman D.P., 1958: Some remarks on methods used in herring "racial" investigations, with special reference to otolith studies. Rapp. Proc.-Verb. Reun. Cons. Perm. Int. Expl. Mer., 143, 2: 66–80.

Polonskij A.S., Bajdalinov A.P., 1964: O sistematičeskom položenii stavridy proliva La Manš, Biskajskogo zaliva, Keltskogo i Severnogo Morej. AtlantNIRO – Trudy, 13: 60–65.

Ramalho A., 1938: Trachurus trachurus (Linné 1758). In Joubin "Faune ichthyologique de l'Atlantique Nord", 4. Cons. Perm. Int. Expl. Mer. 1929.

Ramalho A., 1938: Trachurus picturatus (Bowdich). In Joubin "Faune ichthyologique de l'Atlantique Nord., 4. Cons. Perm. Int. Expl. Mer. 1929.

Smith J.L.B., 1972: The sea fishes of Southern Africa.

Translated: mgr Teresa Radziejewska.

WEWNĄTRZGATUNKOWA ZMIENNOŚĆ GEOGRAFICZNA OSTROBOKA POSPOLITEGO – *TRACHURUS TRACHURUS* (L.) W WODACH SZELFU ZACHODNIEJ AFRYKI

Streszczenie

W pracy przeprowadzono porównanie niektórych cech morfologicznych ostroboka pospolitego z trzech rejonów szelfu zach. Afryki: Ifni (28°44'–29°52'N), Cap Blanc (21°00'–24°52'N) i szelfu Namibii (22°34'S–26°08'S) – Fig. 1. Ogółem zbadano 765 ryb pochodzących z połowów polskich trawlerów w latach 1972–1973.

Ostroboki z szelfu Namibii należące do podgatunku *Trachurus trachurus capensis* Castelnau, 1861 charakteryzują się w porównaniu z ostrobokami tej samej długości z szelfu pn.-zach. Afryki należącymi do podgatunku *Trachurus trachurus trachurus* (Linné, 1758) – większą liczbą wyrostków filtracyjnych, krótszymi grzbietowymi gałęziami układu sejsmo-sensorycznego, przesuniętą bardziej ku tyłowi płetwą odbytową i pierwszą płetwą grzbietową, większą głową i niższym ciałem (Tab. 1, Fig. 3–11).

Ostroboki z rejonu Agadiru różnią się od ostroboków z rejonu Cap Blanc w sposób istotny statystycznie liczbą wyrostków filtracyjnych, położeniem grzbietowych gałęzi l.l. oraz odległością preanalną (Tab. 2). Przypuszczalnie w obu tych rejonach bytują odrębne stada.

Dla rejonu Cap Blanc obliczono metodą „najmniejszych kwadratów" zależności między l.t., l.c. i l.caud.:

l.caud = 0,8793 l.t.+2,0585
r = 0,9998
l.t. = 1,1373 l.caud.–2,3410
l.t. = 1,1703 l.c.+1,7772 r = 0,9997

Podgatunek *Trachurus trachurus trachurus* (L.) tworzy nieprzerwany łańcuch stad lokalnych – od szelfu Celtyckiego i M. Północnego aż po rejony leżące na południe od Cap Vert, zmieniających stopniowo swoje cechy morfologiczne.

Podgatunek *Trachurus trachurus capensis* Castelnau, bytujący w mniej zróżnicowanych warunkach ekologicznych, tworzy mniejszą liczbę stad lokalnych, różniących się nieznacznie pod względem cech morfologicznych.

Obydwa podgatunki uformowały się najprawdopodobniej gdy skończyła się epoka lodowcowa i nastąpiło przegrodzenie barierą termiczną zwartego dotychczas obszaru występowania ostroboka pospolitego we wschodnim Atlantyku.

ВНУТРИВИДОВАЯ ГЕОГРАФИЧЕСКАЯ ИЗМЕНЧИВОСТЬ СТАВРИДЫ ОБЫКНОВЕННОЙ – Trachurus trachurus (L.) В ШЕЛЬФОВЫХ ВОДАХ ЗАПАДНОЙ АФРИКИ

Резюме

В работе сопоставлены некоторые морфологические признаки ставриды обыкновенной из трёх районов шельфа Западной Африки: Ифни (28°44' – – 29°52' с.ш.), Кап-Блан (21°00'-24°52' с.ш.) и шельфа Намиб (22°34' – – 26°08' ю.ш.; рис. I). В общем исследовано 765 экземпляров рыб, выловленных польскими рыболовными траулерами в 1972-1973 гг.

Ставрида из шельфовых вод Намиб, относящаяся к подвиду Trachurus trachurus capensis Castelnau 1861, характеризуется по сравнению со ставридой таких же размеров из шельфовых вод Северо-Западной Африки, относящейся к подвиду Trachurus trachurus trachurus(Linné, 1758), большим количеством

фильтровальных придатков, более короткими спинными лучами сейсмо-сенсорного аппарата, сдвинутым к хвосту анальным плавником и первым спинным плавником, более крупной головой и более низким телом (табл. I, рис. 3-11).

Ставрида из района Ифни существенным с точки зрения статистики образом отличается от ставриды из района Кап-Блан числом фильтровальных придатков, расположением спинных лучей, а также преанальным расстоянием (табл. 2). Вероятно, в обоих вышеназванных районах обитают отдельные стада.

Для района Кап-Блан методом „наименьших квадратов" вычислены зависимости между l.t., l.c. и l. caud.:

= 0,8793	+ 2,0585	
= I,I373	- 2,34I0	= 0,9998
= I,I703	+ I,7772	= 0,9997

Подвид Trachurus trachurus trachurus (L.) образует непрерывную цепь местных стад от Кельтского шельфа и Северного моря вплоть до районов, расположенных на юг от Кап-Верт; эти стада постепенно изменяют свои морфологические признаки.

Подвид Trachurus trachurus capensis Castelnau , обитающий в менее дифференцированных экологических условиях, образует меньшее количество локальных стад, незначительно отличающихся друг от друга своими морфологическими признаками.

Оба подвида сформировались, вероятно, в послеледниковый период, когда наступило разделение термическим барьером монолитной до того времени территории, на которой обитала в восточной Атлантике ставрида обыкновенная.

Address:

Received: 11 III 1975 r.

Dr Andrzej Kompowski
Instytut Ichtiologii AR
71-550 Szczecin, ul. Kazimierza Królewicza 4
Polska – Poland