ABSTRACT

The purpose of the paper is assessment of possible use of parasitological data for investigation of population structure of commercial pelagic fish species of the Central-East Atlantic (CEA). Frozen samples of three commercial fish species (*Sardina pilchardus*, *Trachurus trachurus* and *Scomber japonicus*), a total of 1402 specimens, collected from the neritic area of the North African coast (32-17°N) and from the Azores Archipelago banks (the Great Meteor Bank, the Hyeres Bank and the Irving Bank) were examined using the total parasitological dissection method. Geographical variability of parasite fauna in the neritic areas of North Morocco (32-26°N), South Morocco (26-20°N), and Mauritania (20-17°N), which correspond to three natural latitudinal zones with different neritic ichthyofaunas was studied (Domanevskiy, 1998). Three variants of parasitological data analyses were used: 1) analysis of ontogenetic dynamics of infestation of the fish from discriminated areas; 2) analysis of geographical variability of the parasite composition using the set theory method; 3) analysis of mean abundance indices of parasites-tags dispersion (Mackenzie, 2002). All above variants of parasitological data analyses can be used in complex investigations for distinguishing the intraspecific groups of sardine, horse mackerel and chub mackerel from the CEA. However it should be mentioned that the use of these variants for different fish species had different effect.

Keywords: chub mackerel, horse mackerel, parasite, population, sardine, tag.

INTRODUCTION

The development of measures aimed at the rational exploitation of commercial stocks is most important in fishery. This is possible only with correct identification of stock units (populations) and monitoring of their abundance dynamics. Recently, the complex researches have been used to analyze fish population structure, applying different methods and including data on parasites being the biological markers. This work presents the evaluation of possibility to use parasitological data in studies of the population structure of commercial pelagic fishes in the Central-Eastern Atlantic Ocean (CEA).

MATERIAL AND METHODS

Frozen samples of sardine *Sardina pilchardus* (536 individuals of 7-27 cm in length), horse mackerel *Trachurus trachurus* (286 ind. of 5.9-45 cm in length) and chub mackerel *Scomber japonicus* (580 ind. of 11.0-47 cm in length), collected from the neritic zone of the North African coast (32-17°N) and from the Azores Archipelago banks (the Great Meteor Bank, the Hyeres Bank
and the Irving Bank) in 1994-2004 were examined using the method of complete parasitological dissection. Three coastal areas off North Morocco (NM, 32-26°N), Southern Morocco (SM, 26-20°N) and Mauritania (M, 20-17°N), corresponding to three latitudinal natural zones with different neritic ichthyofaunas (Domanevskiy, 1998) were identified for analysis of geographic variability of fish infestation. Three options of parasitological data analysis were used for three above areas: 1) analysis of parasitofauna geographic variability on the basis of the mathematical set theory (Andreev, Reshetnikov, 1978); 2) analysis of ontogenetic dynamics of fish infestation; 3) variance of indices of invasion with parasites-markers (MacKenzie, 2002).

RESULTS

In sardine 16 species of parasites were found, including Coccidia (2 species), Myxosporea (4), Monogenea (1), Cestoda (1), Trematoda (5), Nematoda (2) and Acanthocephala (1). Parasites with simple life cycle occurred in 25.2 % of fishes, while helminthes with a complex life cycle were found in 48%. The highest indices of infestation were recorded for trematode Bacciger bacciger (Prevalence, P=14.9%; Intensity, I=1-52 ind.) and larvae of nematode Hysterothylacium sp. (P=18.3%; I=1-11 ind.). The ontogenetic variability of parasite fauna exhibited similar trends in NM and SM areas: the infestation indices for mixosporeans and trematodes decreased with fish size increase, while invasion with nematodes increased. However, some differences in sardine infestation in these areas have been revealed: trematodes were the basic parasites of sardine in NM area, while mixosporeans occurred more frequently in fish from SM area. The results of geographic variability of sardine infestation during different seasons (spring spawning and summer feeding periods) confirmed the assumption of «Moroccan» (36°-26° N) and «Saharan» (29°-16° N) sardine populations which can mix in the boundary area (28°-26° N) (Domanevskiy, 1998; Shukhgalter, 1998; Barkova et al, 2001).

In horse mackerel 22 species of parasites were found, including Coccidia (1), Myxosporea (4), Monogenea (3), Cestoda (3), Trematoda (5), Nematoda (3), Acanthocephala (2) and Copepoda (1). The parasites with a complex life cycle predominated (77%), while 36% of helminthes were observed in horse mackerel at the larvae stage. In horse mackerel 19 species of parasites were found in NM area, 8 species - in SM, 7 species - in M, 7 species - in the Azores banks. The differences in parasite fauna of horse mackerel from the Azores banks and the neritic zone of the Northern Africa were revealed. It was found that parasite fauna of horse mackerel from NM area was most original and included parasites of horse mackerel from SM, M areas and the Hyeres Bank (100%) and the Meteor Bank (80%). The fish parasite fauna was similarity in SM and M areas as well as in the Meteor and the Irving Banks (50% common species). The analysis of ontogenetic, seasonal and long-term variability of fish infestation in NM, SM and M areas allowed stating that nematodes Anisakis simplex l. and Hysterothylacium sp.l. could be used in horse mackerel population analysis. These species are characterized with high indices of invasion, positive length-age dynamics of infestation and low seasonal variability of invasion indices. The analysis of variance of mean abundance indices for these two nematodes species in three neritic areas (Fig. 1) indicated that horse mackerel infestation in NM and SM areas considerably differed from fish infestation in M area. This confirms the ichthyologists’ opinion (Domanevskiy, 1998) on availability of two populations of horse mackerel: «Sahara-Moroccan» and «Senegal-Mauritanian».

In chub mackerel 28 species of parasites were found, including Coccidia (1), Microspora (1), Myxosporea (4), Monogenea (4), Cestoda (5), Trematoda (5), Nematoda (6) and Acanthocephala (2). The total infestation was 82%. Parasites with a complex life cycle constituted 64% of the total fauna of parasites, including 36% of species at the larval stage. Ichthyologists assumed
(Domanevskiy, 1998; Bernikov et al, 2002) that in the neritic zone of CEA the «Sahara-Moroccan» (the area northwards of 18º N) and «Senegal-Mauritanian» (the area between 10 and 20º N) chub mackerel populations are feeding. This is confirmed with the differences in fish infestation in NM and SM areas («Sahara-Moroccan» population), on the one hand, and M area («Senegal-Mauritanian» population), on the other hand (Shukhgalter, 2004). The indices of invasion with Rhadinorhynchus cadenati and A. simplex in fish of the «Sahara-Moroccan» population were much higher than in the «Senegal-Mauritanian» population. At the same time, Goussia clupearum and Opechona bacillaris were found only in mackerel of the «Senegal-Mauritanian» population. Parasite fauna of chub mackerel from Azores banks area considerably differed from that of the neritic zone. In fish from the Azores banks area mixosporeans were absent but several helminthes were present, including of Nybelinia linqualis l., Bolbosoma sp. l. and Camallanus sp. which were not found in the neritic zone. Besides, in each bank area surveyed the species composition and invasion indices of parasites in chub mackerel were different. The analysis of geographic variability of chub mackerel infestation indicated that NM and SM areas (the «Sahara-Moroccan» population feeding area) appeared most original in the neritic zone, as well as the Irving Bank in the Azores banks area (Fig. 2). The most «banal» parasite fauna of chub mackerel occurred on the Hyeres Bank, which totally included parasites of fish from the Irving Bank. Parasite fauna of chub mackerel from the Meteor Bank was most similar to that of the «Sahara-Moroccan» population (70% of common species) (Fig. 3). Parasite fauna of fish from the Hyeres Bank and the Irving Bank considerably differed from that from the Meteor Bank and the neritic zone. The highest similarity of parasite fauna (85% of common species) was found in fishes feeding in the neritic zone of NM, SM and M areas, i.e. in the «Sahara-Moroccan» and «Senegal-Mauritanian» populations of chub mackerel. The analysis of length-age variability of chub mackerel infestation in NM and M areas revealed the differences in the ontogenetic dynamics of parasite fauna formation, caused by the geographical specificity of trophic and parasitic relations.

CONCLUSIONS

All above considered options of parasitological data analysis can be used in the complex research for stock discrimination of sardine, horse mackerel and chub mackerel in the Central-Eastern Atlantic Ocean.

REFERENCES


**FIGURES**

Fig.1. Dispersion of mean abundance indices of *Anisakis simplex* l. and *Hysterothylacium sp.* l. in horse mackerel from the study areas: Northern Morocco (1) Southern Morocco (2) and Mauritania (3).

Fig.2. Directed graph of inclusion measures for parasite fauna of the chub mackerel in the study areas (τ = 85%): 1 – NM; 2 – SM; 3 – M; 4 – the Irving Bank; 5 – the Hyeres Bank; 6 – The Great Meteor Bank.
Fig. 3. Non-directed graph of similarity measures of parasite fauna of chub mackerel from the study areas: 1 – NM; 2 – SM; 3 – M; 4 – the Irving Bank; 5 – the Hyeres Bank; 6 – The Great Meteor Bank. Double lines indicate relationships at $\tau = 85\%$, single lines indicate relationships at $\tau = 70\%$. 