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Preliminary results of investigations on intraspecific
groupings of roundnose grenadier in the North Atlantic

by

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Abstract

The distribution of phenotypes of polymorphic locus $E_s - I$ testing the "fast" esterase zone on muscles phoregrams was investigated in polyacrilamide gel of roundnose grenadier of the Northeast Atlantic by electrophoresis method. The adequacy between practical and theoretical phenotypes distributions and also the lack of reliable fluctuations of their frequencies in relation to sizes, that noticeably differs the grenadier of this area from that of the other groupings investigated was observed in most samples. (Nefyodov et al., 1976; Alekseev et al., 1978). On the basis of reliable difference in phenotypical frequencies it is supposed to consider the populations of the Bill-Baileys Bank and Hatton Plateau to be independent ones. A considerable role of eggs and larvae transport in formation of genofond of local groupings of grenadier is supposed.

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Résumé

La distribution des phénotypes du locus polymorphe Es-1 qui contrôle la zone "rapide", est érasée sur les phoregrammes des muscles a été étudiée dans le corps polyacrylamide du grenadier (*Macrurus rupestris*) habitant l'Atlantique Nord-Est. Dans la plupart des échantillons la distribution pratique des phénotypes correspondait à celle théorique; de même, on observait l'absence de variations incontestables de leurs fréquences selon les dimensions, ce qui est une caractéristique typique du grenadier de cette région par rapport aux autres groupements étudiés (Nefedov et autres, 1976; Alekseev et autres, 1978).

On a proposé de considérer les populations du banc Bill-Bailys du plateau Hatton comme indépendantes vu la différence incontestable dans les fréquences phénotypiques. On suppose que le transfert des oeufs et des larves joue un rôle considérable dans la formation du fonds génétique des groupements locaux du grenadier.

The area of roundnose grenadier (*Macrurus rupestris*) practically covered the whole North Atlantic (Savvatimsky, 1969). However, in spite of the long-term fishery and a set of investigations devoted to this species, many important fields of biology of grenadier retain not to be studied. These omissions, particularly, concerning the reproduction and migrations caused the mutually exclusive hypotheses relative to its intraspecific structure. Due to one of them (Zakharov, Mokanu, 1969) the eggs and larvae of grenadier are transported by oceanic currents from spawning grounds off Iceland to the Canadian continental shelf, that is the feeding part of the area. There the fry transfers to the bathypelagic manner of behaviour, and while reached maturity the adult fishes have the inverse spawning migration.

However, Savvatimsky (1972) while considering the body structure of grenadier concluded, that it was a bad swimmer and was not able to get over such great distances. Marshall (1965) also thought, that the migrations of grenadiers across the continental slope do not exceed 100 miles. Some researchers acknowledged the possibility of grenadier spawning of the northwest Atlantic at great depths beyond the limits of continental slope (Zilanov et al., 1970; Grigoryev, 1972; Savvatimsky, 1972). It should be noted that no one of views listed had no sufficient arguments, mainly, because of small adequacy of traditional methods of fishery ichthyology for solving the given problems. Nefyodov et al. (1976) was one of the first to use the methods of biochemical genetics to reveal the population structure of grenadier, and

to investigate phenotypical and allelic frequencies of locus $E_s - I$, testing the "fast" esterase zone on phoregrams of muscles in 4 samples collected in southwest of Iceland. The differences observed proved to be insufficient for separation of isolated groupings. Further studying of grenadier of this area allowed to suppose the existence of three reproductively independent populations characterized with non-balance of phenotypical frequencies, and also by their fluctuations in relation to sex and size, that was (in author's opinion) indicative of selective significance of feature (Alekseev et al., 1978). No reliable difference in local values of allelic frequencies observed, although they were sufficient. The distribution of phenotypes of locus $E_s - I$ in some areas of the northeast Atlantic is considered in present paper.

Material and methods

The patterns of muscular tissue were collected in the scientific cruises on board the FRV "Artemida" on the Hatton Plateau, Rockall and some adjacent banks. The analysis was carried out both on board the vessel and ashore. Tris-glycine and tris-LDTA-borate buffer systems of pH-8.3 were used. Separation of isoferments was made in a 10-12% polyacrylamide gel. Designation of phenotypes and scheme of inheritance are similar to those suggested by Nefyodov et al. (1976). The phenotypes distribution obtained was compared to the theoretically possible one by means of conformity criterion of χ^2 . Similarity index $\varepsilon = \sum_{i=1}^m \sqrt{p_i q_i}$ was used for comparison of different samples, where p_i - frequency of phenotypes in the

first sample, q_1 - in the second one. The estimate of significance of r was made by means of identity criterion

$$J = \frac{8N_1 \cdot N_2}{2N_1 + N_2} \left(1 - r - \frac{\tilde{p} + \tilde{q}}{4}\right)$$
 with the same distribution as χ^2 with $m-1$ degrees of freedom (Zhivotovsky, 1979).

Results and discussions

The distribution of esterase phenotypes in the investigated samples is represented in Table I. Alongside with frequently occurred phenotypes B, BC and C, 6 rare phenotypes with frequencies less than 0.05 were revealed.

In most cases there is a good agreement between the observed distribution of phenotypes and theoretically possible one. Only the sample from the Outer-Bailey Bank, where the probability of divergence was more than 95% made up an exclusion.

In comparison by pairs, no reliable differences between the samples from the Hatton Plateau, Rockall and George-Bligh Banks were observed. All these samples are balanced and have the analogous distribution of phenotypical frequencies and although the distance between the extreme positions of collections was about 400 miles, and they perhaps are one reproductive grouping. The sample from the Bill-Baileys Bank, where the decrease of phenotype B percentage with corresponding increase of C frequency was observed, most greatly differs from the grenadier population from the Hatton Plateau. This allowed to ascertain with a 95% probability the difference of grenadier inhabited on this bank from that of the groupings on the Hatton Plateau and Outer-Bailey Bank.

At the same time in spite of the similarity of phenotypic frequencies the belonging of grenadier from the Hatton Blateau, Rockall and George Bligh Banks to one population cannot be considered to be proved. Primarily, opposed to this are the results of analysis of phenotypes distribution in relation to sex and size. If no deviations are observed on the Bill-Baileys, Outer-Bailey and Rockall Plateau, then in the northern part of the Hatton Plateau the males have reliably higher frequency of B phenotype than females (0.302 and 0.169, respectively). In the southern part of the area the differences between the sexes disappeared, but reliable differences between size groups appeared. The frequency of B phenotype for males up to 60 cm long was equal to 0.405 and of 61-80 cm long decreased up to 0.148.

An analogous phenomenon, probably even on a larger scale was observed and for grenadier populations, inhabited in the southwest of Iceland. Non-balancing of samples majority is typical for the same area in contrast to the Northeast Atlantic (Nefyodov et al., 1976; Alekseev et al., 1978).

If we assume an intensive influence of selection, then the similarity of local values of allelic frequencies of the roundnose grenadier populations observed up to the West Atlantic retained to be not clear (Nefyodov et al., 1976; author's data). Therefore, it seems to be possible that together with selection there exists some more factor, partially levelled its influence. Migration can be this factor. And, this is the migration of not adult fishes, but the transport of eggs and larvae by the oceanic currents.

Even Johnsen in 1927 informed about the capture of Macrouridae larvae in offshore waters beyond the limits of shelf waters at depths of 650-850 m. Marshall (1965) supposed that the extrusion of eggs of grenadiers and their fertilization took place near the bottom, and then the eggs, developing, lift into the upper water layers. Merrett (1978) confirmed this view. Larvae of grenadier were found by Merrett at depths of 25-500 m and deeper in relation to stages of development at a distance from shore and continental slopes.

Apparently, that eggs and larvae of grenadier can be transported at a distance of hundreds of miles, and the distance, as Marshall marked, can relate to their position concerning thermocline and circulation features of water masses in a given area. Assuming this hypothesis the development of eggs and larvae of Macrouridae in pelagic waters should be considered as species adaptation, directed to extension of the area, by which a slow migration of adult species is compensated.

Conclusions

1. On the basis of differences in frequencies of phenotypes of esterase locus E_s-I , the populations of roundnose grenadier on the Bill-Baileys Bank and Hatton Plateau are considered as independent.

2. The similarity of frequencies of phenotypes of esterase in populations from the Northeast Atlantic and southwest area of Iceland is stated. At the same time in the second area the non-balanced samples are occurred more often, and more considerable differences in phenotypes distribution in separate

size groups were observed.

3. A considerable influence of transport of eggs and larvae of this species by oceanic currents upon the formation of genofond of local populations of roundnose grenadier is supposed.

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Table I

Distribution of phenotypes of polymorphic locus $E_S - I$ of roundnose grenadier
in the Northeast Atlantic

Area	Phenotypes									N	
	A	AB	AC	B	BC	BA	C	CA	A		
1. Bill-Baileys	n	-	I	I	I7	39	-	40	I	-	99
	p	-	0,010	0,010	0,172	0,314	-	0,404	0,010	-	
2. George-Bligh	n	-	3	2	24	42	-	21	I	-	93
	p	-	0,032	0,021	0,258	0,452	-	0,226	0,011	-	
3. George-Bligh	n	-	I	I	31	37	I	22	-	-	93
	p	-	0,011	0,011	0,333	0,398	0,011	0,237	-	-	
4. Outer-Bailey	n	-	I	5	49	49	I	38	I	I	145
	p	-	0,007	0,034	0,338	0,338	0,007	0,262	0,007	0,007	
5. Hatton, north	n	-	I	I	19	51	-	21	-	-	93
	p	-	0,011	0,011	0,204	0,548	-	0,226	-	-	
6. Hatton, north	n	I	3	3	22	37	I	20	-	-	87
	p	0,011	0,035	0,035	0,253	0,425	0,011	0,230	-	-	
7. Hatton, south	n	I	6	-	47	89	I	46	I	-	191
	p	0,005	0,031	-	0,246	0,466	0,005	0,241	0,005	-	
8. Rockall, south	n	-	5	2	62	82	2	40	-	2	195
	p	-	0,026	0,010	0,318	0,421	0,010	0,205	-	0,010	