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DETERMINATIVE ROLE OF CENTRAL SPECIES IN CONSORTIUM (WITH REED SWEETGRASS CONSORTIUM AS MODEL)

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UDC 574.58

It has been shown that sweet-grass shoots play the determinative role in their colonization by chironomid larvae, which makes it possible to speak of a determinately organized biocenotic coordination system, i.e., a reed sweetgrass consortium. Only the population consortium associated with the determinant cenopopulation corresponds to the biocenotic level of vegetation study.

The theory of identification of consortia and establishment of their organization has been subject of extensive literature (Beklemishev, 1951; Ramenskii, 1952; Rabotnov, 1969, 1973; Selivanov, 1976; Voronov, 1974; Mazing, 1976). The inconsistencies in interpretation of even foundational principles is due to the fact that members of different ecological schools took part in their development, considering consortial problems in relation to their specific research subjects.

The theoretical studies were followed by publications in which various aspects of consortium structure and intraconsortial relationships were investigated at the practical level (Emel'yanov, (1965). However, the questions of whether a given combination of organisms reflects the specific character of the relations among them through determination of structure and function by the central species (determinant) and whether one can in general speak of a consortium as a specific natural formation having ecological status have generally been ignored.

We undertook a study of chironomid colonization of a community of aerial-aquatic vegetation absolutely dominated by reed sweet-grass (*Glyceria maxima*) in two lake-type bodies of water in the underflooding zone of Kievskoe Reservoir (Mal'tsev, 1985) in order to resolve these questions.
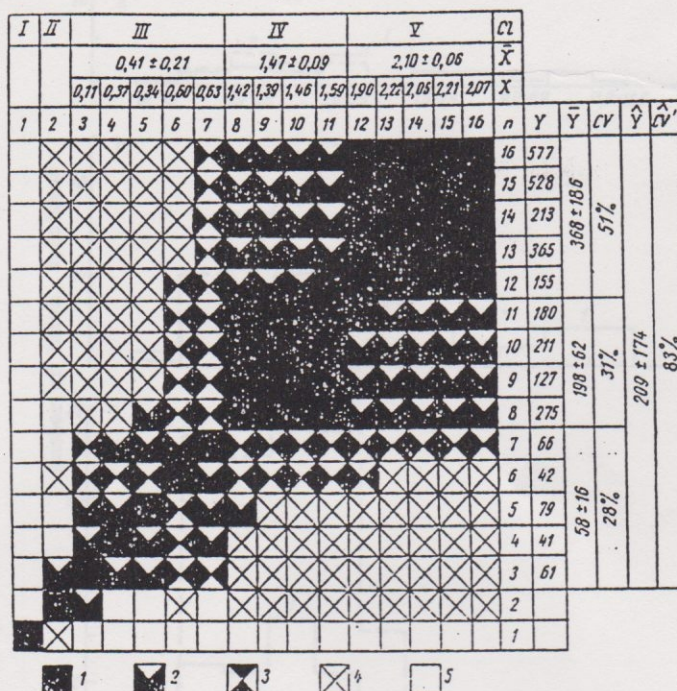
Fig. 1. Identification of groups by Makarevich's method on basis of Orlocci index. Orlocci index values: 1) 0.1–1.0; 2) 1.1–3.0; 3) 3.1–6.0; 4) 6.1–10.0; 5) 10.0; n) number of shoots; Cl) cluster number; X) ratio of total P. sordens and G. glaucus populations on individual shoots; X̄) average values of X for clusters; Y) total chironomid population on individual shoots; Ȳ) average values of Y for clusters; Ŷ) average values of Y for clusters III, IV, and V; CV) coefficient of variation for Y in individual clusters; ĈV') the same, for clusters III, IV, and V combined.

Samples were collected in June, 1983. The sweet-grass shoots were removed one by one, with all their leaves (including dead ones), and placed in polyethylene sleeves (each in a separate sleeve). All the animals were then carefully washed from each shoot, collected in a separate jar, and fixed with 4% formalin. Each sweet-grass shoot was weighed. The population of each animal species found in a sample was calculated in the laboratory, and its mass was determined (by weighing on a torsion balance). Length measurements were also made (to within 0.5 mm) for those chironomid species present in large numbers (examining each individual). A total of 16 samples were collected in this manner. The data were subjected to statistical analysis.

The masses of individual sweet-grass shoots differed only slightly, amounting to 80–100 g. A total of 21 species of chironomid larvae (Diptera, Chironomidae) was detected for the sweet-grass phytocenoses in the lakes in the Kiev Reservoir underflooding zone, with Pentapedilum sordens and Glyptotendipes glaucus predominating; the populations of these chironomids colonizing the sweet-grass shoots differed by two orders of magnitude (See Table 1).

The points corresponding to the samples in the coordinate system P. sordens population (x) versus G. glaucus population (y) was approximated by a straight line with a correlation coefficient $r = 0.72$ for $P = 0.99$ and $K = 0.40$. The points corresponding to the samples in the "P. sordens population" (x) versus "number of other chironomid species" (y) ($r = 0.57$, $P = 0.95$, $K = 0.013$) and "P. sordens population" (x) versus "total population of other chironomids" (y) ($r = 0.49$, $P = 0.95$, $K = 0.045$) coordinate systems were also approximated by straight lines.

Cluster analysis by Chekanovskii's method (Makarevich, 1971) was employed to identify homogeneous groups. The convergence criterion for the input data was the Orlocci index (Vasilevich, 1972), which was calculated in two stages: the norming vector was first computed
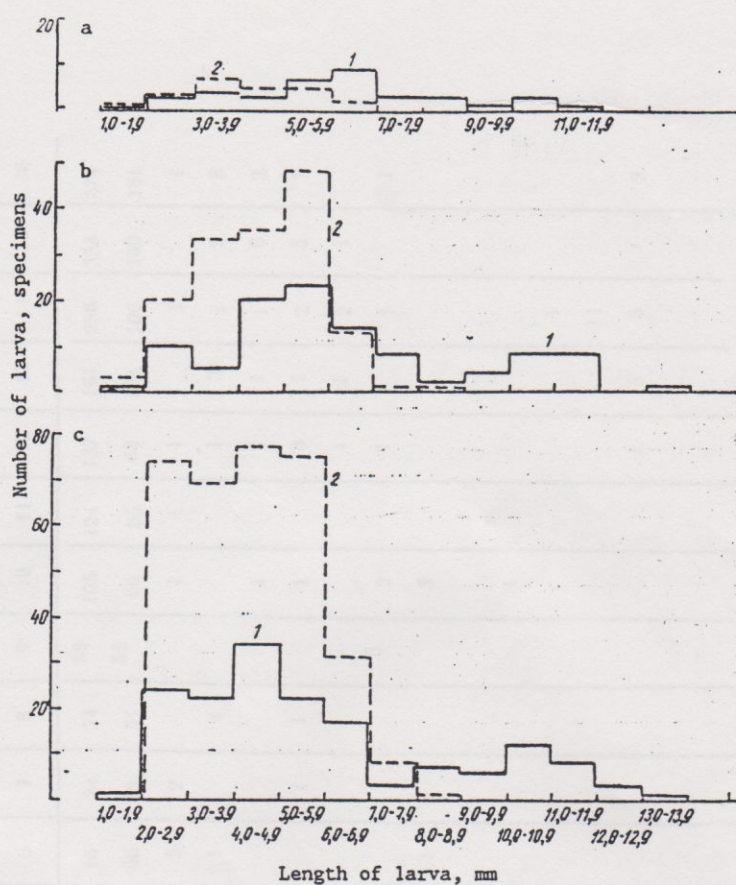
Fig. 2. Distribution of dominant chironomid species by size class. a) Cluster III, shoot 7; b) cluster IV, shoot 8; c) cluster V, shoot 15; 1) *Glyptotendipes glaucus*; 2) *Pentapedilum sordens*.

$$V_{j,\,h} = \left(\sum X^2_{ej,\,h} \right)^{1/2},$$

followed by the normed distance

$$D_{j,\,h} = \left[\sum_{e=1}^{p} \left(\frac{X_{ej}}{V_j} - \frac{X_{eh}}{V_h} \right)^2 \right]^{1/2},$$

where p is the number of traits (species), and X_{ej} (X_{eh}) is the abundance of the e-th species in the j-th (h-th) sample. The input data for the cluster analysis were the numbers of chironomids colonizing each sweet-grass shoot. Five clusters were identified on the basis of Orlocci index (Fig. 1).

The first and second clusters reflected extremely low population levels on shoots with very shallow inundation (at a depth of 10 cm), which were characteristic of the narrow belt of nearshore stands with ecological conditions unsatisfactory for aquatic animal habitat. These clusters exhibited virtually no similarity to one another or to the other clusters. The low colonization level and inadequate number of samples do not enable us to make any statement regarding dominance among the chironomids (which was characteristic of the clusters described in Fig. 1).

TABLE 1. Populations of Different Chironomid Species Colonizing Individual Sweet-Grass Shoots

Type	Number of shoots															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pentapedilum sordens	2	3	6	10	12	16	24	74	98	105	124	137	161	236	354	374
Glyptotendipes glaucus		1	53	30	20	56	38	51	51	66	85	62	104	106	160	181
Polypedilum convictum	12	2				5					1					1
Parachironomus pararostratus		2					2					1	3			8
Paratanitarsus lauterborni								1				8				3
Cricotomus silvestris	5				5									1		7
Endochironomus tendens									6	2			2	2	6	
Endochironomus albipennis		3		1						3						
Pentapedilum exectum	5				1						1		3	1		
Endochironomus impar		3										1				
Polypedilum nubeculosum										1						
Chironomus plumosus		3												11		
Limnochironomus tritonus										1						
Others					1							1	3	3	2	2

The third cluster was characterized by moderate shoot colonization by the chironomids under favorable ecological conditions (a depth of 40 cm). Here there was pronounced dominance of two chironomid species: *P. sordens* (6-24 specimens) and *G. glaucus* (20-56 specimens), with the latter present in larger numbers by a factor of 2-2.5. This cluster exhibited weak similarity to the fourth and fifth clusters, which were characterized by strong colonization and marked dominance of *P. sordens* (74-161 and 98-374 specimens) and *G. glaucus* (51-104 and 51-181 respectively); *P. sordens* was present in larger numbers (by a factor of 1.5 for the fourth cluster and by a factor of 2 for the fifth). The latter two clusters were highly similar.

Figure 2 shows the distribution of the dominant chironomid species by size classes in the samples belonging to clusters 3, 4, and 5. It can be seen that the distribution had a similar character in all cases, being distinguished by a single maximum for *P. sordens* (3.0-6.0 mm size classes) and two for *G. glaucus* (4.0-6.0 and 10.0-12.0 mm size classes).

The data given above indicate that the phytophilic invertebrate complex colonizing sweet-grass shoots is qualitatively a quite homogeneous cenotic aggregate with pronounced dominance (in terms of population) by two chironomid species, *P. sordens* and *G. glaucus*. Our samples also exhibited considerable quantitative inhomogeneity (see Table 1).

The clusters identified (see Fig. 1) could be combined into two groups on the basis of the difference in ecological conditions: the first consisted of clusters 1 and 2, representing shoots in the nearshore zone with a low level of inundation, and the second of clusters 3, 4, and 5, representing shoots with normal inundation. Because of the minimal number of shoots in the clusters of the first group, we will not analyze them.

The differences in quantitative organization within the second group of clusters cannot be attributed to a gradient for external abiotic conditions, since there was virtually none. The sole cause must therefore have been differences in the condition of the sweet-grass shoots that served as the substrate on which the community of phytophilic organisms developed. Sweet-grass produces several generations of shoots over the growing seasons (Ekzertseva, 1975). At the time of colonization by the chironomids, the sweet-grass phytocenosis consisted of shoots in different age-related physiological states, with different proportions of dying parts, which created conditions for a colonization pattern that appeared nonuniform at first glance but was actually quite regular.

The selectivity (with respect to plant species) of the larvae mining the young parts of the macrophytes, which is expressed in colonization of specimens prior to flowering in early summer (Kalugina, 1963), evidently also extends to age. Thus, there is every reason to assume that different-aged shoots are colonized at different rates, which are determined by shoot status and size, and that there is virtually no subsequent migration of the larvae from shoot to shoot, because of their low mobility. This apparently explains why sweet-grass shoots of virtually identical size at the time of collection, which were exposed to the same ecological conditions, nevertheless differed in chironomid population structure; the differences were determined by the shoots themselves. This determinative action was responsible for the quite uniform structural characteristics within the cluster (see Fig. 1), as was confirmed by the low level of variation in chironomid abundance C_v (Zimbalevskaya, 1981).

It can thus be asserted that we are dealing with a determinately organized biocenotic coordination system whose structure (and hence whose functioning) is determined by the sweet-grass shoots, i.e., a reed sweet-grass consortium.

Among all the types of consortia described at different levels of biological-system organization (Mazing, 1976), the population consortium, associated with a dominant cenopopulation, corresponds to the biocenotic level of vegetation study. From this standpoint, it is impractical to speak of an individual consortium: the latter is a component of a population consortium, i.e., a structure of lower rank.

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DIFFERENTIATION OF HIGH ALTITUDE VEGETATION ON THE BASIS

OF AERIAL PHOTOGRAPHS

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On the basis of aerial photographs a large-scale sketch map of high altitude vegetation was drawn depicting the altitudinal belts (podgoltsy, mountain-tundra, cold goltsy desert belt). The mountain-tundra belt was divided into different zones: shrub-moss, lichen-sedge tundras. The legend is in tabular form and shows the ecological characteristics and interpretation signs of the mapped subdivisions.

The Talaisko-Konzhakovsko-Serebryanskii massif where the work was carried out is situated in the axial watershed zone of the Urals range in the southern part of the Northern Urals. It is part of the much larger Kytlymskii massif and constitutes an arched range stretching from the southwest to the east for almost 20 km. Its separate peaks have their own names: the Tylaiskii Kamen' (1470 m sea level elevation), the Konzhakovskii Kamen', the highest point in the Northern Urals (1570 m sea level elevation), and the Serebryanskii Kamen' (1305 m sea level elevation). According to the composition of the geological rocks the massif is divided into two halves: the western, Tylai-Konzhakovskii (dunite-pyroxenite) and the eastern, Serebryanskii (gabbro). Thus the Tylaiskii and Konzhakovskii Kamen's have basically rounded, smooth smooth slopes while the Serebryanskii has, due to weathering, developed alpine relief forms with sharp, rocky ridges and only in the parts below the summits are altiplanatation terraces and solifluction forms observed (Efimov, and Efimova, 1967).

It is well known that the vegetation character at the upper levels of any mountain country depends on its position in the horizontal zonality system. The massif under study is situated in the boreal (taiga) zone where the belts in the high mountains are developed: podgoltsy, mountain-tundra and the belt of cold goltsy deserts (Gorchakovskii, 1975; Gorchakovskii, and Kuvaev, 1985).