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The Influence of Hydrological Factors upon the Orientation of European Eel (Anguilla anguilla (L))

by

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This investigation of eel orientation was made in July-September 1969-1970 according to the method proposed by Hasler (1962). Forty-five specimens of eels with characteristic yellow colour, 160 - 170 cm in length and weighing 600 - 800 g were used in these experiments. All fish appeared to be females in the second stage of gonad development. The specimens were taken from the Kurish Bight of the Baltic Sea by traps and investigated at the fishing ground (Lesnoye, Kaliningradskaya oblast).

The direction of plastic floats attached to a dorsal fin by nylon thread was determined with a compass. The points of changes in direction were studied by hydrographical stations where we measured depth, velocity and direction of water current in near-bottom layers. Water temperature and transparency were also measured. Oxygen content and salinity were determined in the laboratory. Weather observations included the determination of wind direction and strength, cloudiness and state of the water surface.

The period of observations was characterised by relatively stable climate conditions. Wind strength of north and northeastern bearing did not exceed 4 balls, cloudiness 0.5 balls, roughness 0 - 3 balls.

Theoretically the experiments were based upon the idea that the navigation complex of fish could include orientation to temperature gradients, salinity, currents and the transparency of water (Poddubny, 1965).

The following assumption was used for mathematical treatment of the material : one or another hydrographical factor was considered to be orienting if the variation of the absolute value of this factor was followed by a change of fish course.

The experiments resulted in 72 moments of orientation (Table 1). According to Laplacian's function estimated with reliability of 80%, we have found that natural frequency of the moments of orientation was 10.2. Thus, among the factors considered, only water transparency ($8 < 10.2$) can be attributed to accidental factors.

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TABLE 1. Number of orientation moments of eels according to the hydrographical factors in the Kurish Bight of the Baltic

Factor	Moments of Orientation
Against the current	21
Salinity	16
Depth	14
Temperature	13
Transparency	8

The most intensive factor influencing the orientation of eels is the current, against the vector of which the migration of this fish takes place. The chemistry of the water current will undoubtedly be of great importance in orientation. In particular, in the areas of non-homogeneous water masses, the eels were observed to move in the direction of the minimum positive gradients of oxygen and salinity. The sharpest change in migratory course of two eels was observed in the area where two water masses were characterised by directions of 40° and 130°. Gradients of the indices of these two water masses appeared to be different (Table 2).

TABLE 2 Gradients of water masses on the path of eel movement

The direction of current	Gradients/mg/m		Difference/mg/n	
	oxygen	salinity	oxygen	salinity
40°	9.8×10^{-3}	8.0×10^{-3}	1.8×10^{-3}	7.6×10^{-3}
130°	8.0×10^{-3}	0.4×10^{-3}		

As can be seen from the data (Table 2), the values of eel sensibility to oxygen and salinity estimated as the difference between the gradients of the two water masses were 1.8×10^{-3} and 7.6×10^{-3} respectively.

Water temperature and transparency as factors of orientation are directly connected with the depth of the water basin where the migration takes place.

The depth of the basin should be considered as the most substantial factor determining eel orientation. In spite of the great influence of current as the basis of the orientation complex, eels perform migration towards depth gradients up to a certain optimum value. In particular, the bulk of the fish investigated chose the course along 4.5 - 5 m isobaths in a northeastern direction. This course corresponds to the shortest direction to reach the Baltic Sea, that is to continue the spawning migration.

References

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