DEVELOPMENTS OF THE CNS OF STURGEON FISHES

GROWN UNDER DIFFERENT ECOLOGICAL CONDITIONS

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Conditions of the sturgeon youth fishes, growing at fish farms differ significantly from the natural ones, this influences greatly the huching viability. The factor determining adaptation properties of the youth is the Central Nervous System (CNS) development. It has been shown , that the sturgeon youth fishes grown in reservoirs and ponds (which hydrologic conditions like the natural ones) differ greatly from each other in respect to bechavioral and reflectory reactions (Kasimov, 1980; Kasimov et al., 1986).

The present work gives for the first time a thorough neuro-morpho-physiologic analysis of the brain development in star sturgeon (***Acipenser stellatus Pallas, 1771***) youth fishes 30 to 52 days after hatching (A.H.) growing on the Astrachan fish farm. The hutchlings fishes were grown in standart concrete Reservoirs (3 m in diametre, 12 to 15 sm deep, permanent water flow, abundant forage) and in Ponds. (2 to 2,5 hectares, 2 to 2,5 m deep, pronounced water flow, scanty forage, predators) The hydrologic conditions of the ponds were similar to those in the star sturgeon distribution area in the Volga River.

The main attention was paid to analysis of the changes in the Telencephalon structure as far as namely in this CNS region the centres of all principal analyzer systems are situated, and the region itself influences at the fish behaviour (Northcutt,Braford 1980, Nikonorov, 1982, Obukhov,1993).

By application of automatic imagination analysing complexes IBAS (Germany) and MAGYSKAN-2AR (United Kingdom) and original PC programms the following features of the brain structure were studied: square of telencephalon hemispheres and their zones; neurone sizes and density of the cell distribution over the zones.
R. Nieuwenhuys' classification was used for the hemispher structure description. (Nieuwenhuys & Meek, 1990)

In Actinopterygian fishes telencephalon develops in a way fundamentally differs from that found in all other vertebrates. In the early stages of the brain development lateral

walls telencephalon evaginate, that leading to the formation of hollow (everted) cerebral hemispheres (Nieuwenhuys, Meek, 1990; Andreeva, Obukhov, 1991). The sturgeon telencephalon is in accordance to the general pattern typical for all Actinopterygian fishes. It consist of twin everted hemispheres, subdivided histologically into two regions: dorsal area (**D**) - pallium, and ventral area (**V**) - subpallium, situated in the dorso-lateral and ventro-medial position respectively (Figure 1).

Figure 1. Cytoachitecture of the adult sturgeon telencephalon.

Nissl-stain transverse section through middle levels hemispheres. Abbreviations:

D- area dorsalis telencephali (pallium); D.m., D.d-l., D.c. -medial, dorsolateral,central zones dorsal area: V - area ventralis telencephali (subpallium); V.d., V.v., V.l. - dorsal,ventral, lateral zones vental area; es - ependymal surface; ms - meningeal surface;VM - ventriculus medialis; t.ch.- tela chorioidea; z.lim.- zona limitas

In the pallium it is possible to note two longitudinal zones, which extend along the ependymal surface: dorsomedial (**D.m.**) and dorsolateral (**D.d-l**). These zones surround another more interior zone - dorsocentral (**D.c**). The greater part of the D.d-l. zones contains large neurons, wich are arranged a number of layers (8-12) parallel to the ependymal surface hemispheres. In the dorsomedial zone (D.m) the neurons are less regularly arranged, that those in the other zone' s pallium. Characteristic feature of central zone (D.c) are large size of neurons and lacking of the lamellated pattern.

In the subpallium medial surface is composed of the epenymus of the medial telencephalic ventricle (VM), its lateral surface is lined by the meningeal tissue. Dorsally it is joined to the area dorsalis (the separation between these two areas in marker by cell-free strip - zona limitans (z.lim). The general pattern organization of the ventral area in sturgeon species is very similar, is the results of the lack of an inversion in this regions. In subpallium three nuclei present: dorsal zone (**V.d**) - group larger neurons, part of its migrated a way from ependymal surface of hemispheres: ventral zone (**V.v.**)- groups of smaller cells, sittuated along ventricular surface and lateral zone (**V.l.**) - sparsely distributed cell groups in the regions, bordering the subminengeal region of telencephalon.

The specific functional role of earch of these areas and zones unknown, however physiological experiments have shown that in Actinopterygian specific telencephalic areas bind with the specific types of their behaviour At present time attempts to compare parts of the everted telencephalon Actinopterygian fishes with the same areas of the telencephalon of other vertebrates groups have been made, however this problem do not solve now. (Northcutt,Braford, 1980; Nieuwenhuys, Meek, 1990; Andreeva, Obukhov, 1991).

Tiny fishes (30 - 32 days old)

Tiny fishes of this age, grown in reservoirs possess extremely poor-developed telencephalon. The hemisphere square makes up 400 $\pm$12 of square units. The main bulk of neurones is recorded by the hemisphere surface, differentiation into zones is practically absent. (Figure 2.A). Small neurones predominate (Table 1.).

Table 1. Telencephalic neurone sizes (mcm ^{2}) in star sturgeons Acipenser stellatus grown under different conditions.

Age (days)	Growth conditions	Pallium zones D.m.	D.d-l.	D.c.
30-32	reservoir	22.6 $\pm$ 1.4	23.9 $\pm$ 0.9	53.1 $\pm$ 2.1
	pond	48.4 $\pm$ 2.1	41.7 $\pm$ 1.8	77.2 $\pm$ 2.4
50-52	reservoir	28.9 $\pm$ 1.8	38.5 $\pm$ 2.1	78.9 $\pm$ 3.7
	pond	57.0 $\pm$ 2.1	53.7 $\pm$ 1.8	92.9 $\pm$ 3.0

In the tiny fishes of the same age, grown in pond, the similar hemisphere size (390 $\pm$111 square units) is accompained with the apparent migration of neurones into telencephalon

wall. Neurones sizes in the respective zones increase significantly (Table 1)The zonal differentiation of hemisphere is more distinct (Figure 2C, 3C)

Figure 2. Cytoachitecture of the telencephalon of tiny star sturgeon (Acipenser stellatus P grown in reservoirs (A,B) and ponds (C,D). Nissl-stain transverse sections. A,C - 30-32 days A.H.; B,D - 50-52 days A.H., abbreviations as on Fig.1.

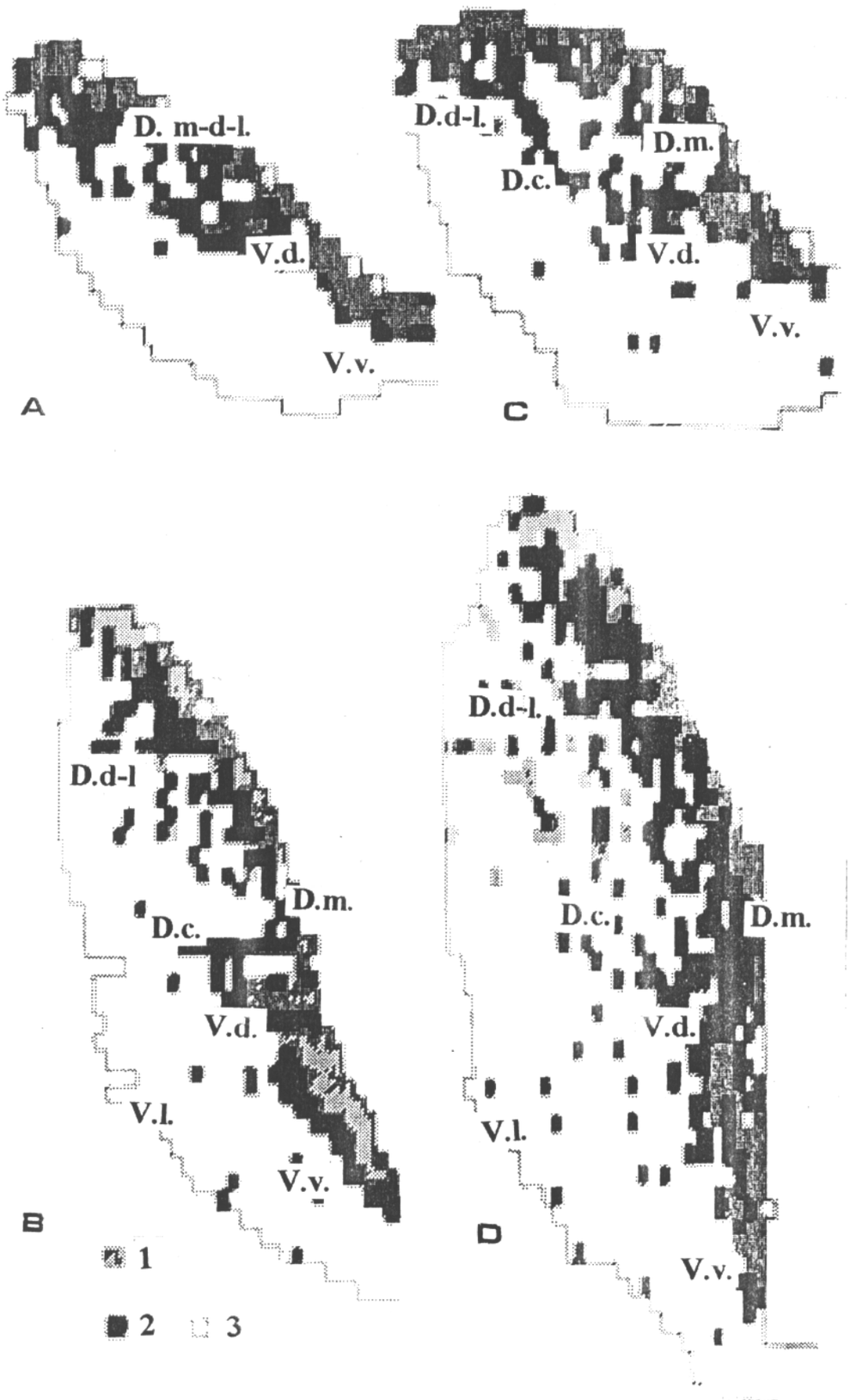

Figure 3. Computer diagrams of the same star sturgeon's brains made by automati imagination analysing system MAGYSCAN-2AR. 1,2,3 - zones of the maximum (1), middle (2) and minimum (3) cell density, other abbreviations as on figure 2.

Tiny fishes (50-52 days old)

This stage of development is of the special importance for sturgeons as far as it is marked with releasing of the youth in the natural environment (Kasimov at al., 1986). Central nervous system on this age acquires the definite structure, stabilization of conditional reflectory reactions takes place. It should be noted that growing of the youth under different ecologic conditions results in development of the steady behaviour reactions, adequate to the environmental conditions (Kasimov, 1980).
On the 50th to 52nd day A.H. in the " reservoir" youth the telencephalon features change insignificantly: the hemisphere square gets 570 ± 12 square units, the neurone sizws are given in the Table. The zonal differentiation of hemisphere has not completed yet. (Figure. 2B, 3B).

The '"pond " youth leave significantly behind the " reservoir " youth fishes in respect to growth and brain differentiation rates. Hemisphere square increases in size more than twice and gets 1250 ± 12 square units. Pallium and subpallium zones complete their differentiation, the level of their development is almost the same as in the mature brain (Figure 2D, 3D). Increasing of the average size of the neurones in the pallium zones results from the increase in number of large neurones themselves.

The obtained data coincide with the results of behaviour, biochemical and genetic studies in star sturgeon brain. So, it was shown that in the " pond " specimens even on the 30th to 35th days A.H. conditioned reflexes arise quicker, than in the " reservoir " fishes, skills exist longer and in their nervous tissue the more DNA/RNA concentrations are recorded. Later these differences become more pronounced (Nikonorov, Vitvitzkaya, 1991).

Thus, it has been shown that since the earliest stages of development, ecologic factors influence greatly on the formation of the CNS structuro-functional stereotype in the fishes. This is especially true for the " sensory starvation " under reservoir conditions, supressing the sturgeon CNS activity and , consequently, influencing the futher fortune of hutchlings after releasing in River.

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