Intra-day ecological operation mode of hydraulic units

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Abstract: *The fish productivity of water bodies is determined by the intensity of reproduction of sustainable replenishment, feed base, consumption, including fishing, and pollution. Under conditions of controlled runoff, hydrobionts are not evolutionarily adapted to daily changes in water level. Deposited caviar, larvae and fish dry in the floodplain and beyond the brow of the coast due to daily variability in water level - omissions. Peak omissions from coastal hydroelectric power stations lead to a premature spill of young semi-passable fish into brackish water that is disastrous for them. One of the food chains in the reservoirs begins with benthos. The development of benthos and young fish is limited by methane, the concentration of which increases to critical for them during earthquakes and floods (mass inflow from floodplains of waters and silts rich in biogas-methane).*

In order to preserve the fish productivity of reservoirs, it is advisable to dampen the level by separating energy, sluice and ecological passages by the time of day, prohibit explosions at reservoirs m on regional faults of the earth's crust, otherwise deduct funds for fish breeding plants, arrangement of spawning grounds and bulk reservoirs.

Significant changes in the water level at high pressure dams lead to local earthquakes, massive methane emissions to reservoirs.

These negative factors lead to the fact that the fish productivity of regulated reservoirs does not even go to the 20÷50% from the expected-planned level, a significant part of the population at rivers and river deltas loses food and work.

Keywords: *dams, hydrobionts, unevenness of passes, methane.*

1. Introduction. Description of the problem under investigation

The fish productivity of water areas is largely determined by the intensity of reproduction of sustainable replenishment, feed base, consumption, including predators and fishing, and pollution. Under conditions of controlled runoff, hydrobionts are not evolutionarily adapted to daily changes in water level. Deposited caviar, larvae and fish dry in the floodplain and beyond the brow of the coast due to daily variability in water level - passages. A similar decline in the reproduction of juveniles and the death of part of sexually mature individuals occurs in the tidal rivers [1,15,17].

Peak passes from coastal hydroelectric power stations lead to changes in salinity incompatible with the vital activities of a significant part of the hydrobionts, premature spilling of young semi-passable fish into brackish water [3].

One of the food chains in the reservoirs begins with benthos. The development of benthos and young fish is limited by methane, the concentration of which increases to destructive levels for their life during earthquakes and floods [13]. Significant changes in the water level at high pressure dams lead to local earthquakes, mass methane emissions to reservoirs [9]

These negative factors lead to the fact that the fish productivity of regulated reservoirs does not even go to the 20 50% from the expected-planned level, a significant part of the population at rivers and deltas of rivers loses food and work [6, 7].

1. River runoff regulation

It is well known that a tsunami (harbour wave) leads to sharp reductions in the biomass of hydrobionts as a result of fish spilling ashore. Even tides, up to 1 m high, cause a splash over the edge of the coast up to a third of salmon and their caviar. When spawning of White Sea herring and cod occurs on a sisigic tide, over 30÷80% dies from drying on a herbal substrate. The mode of operation of the hydroelectric power station allows daily and weekly unevenness of energy passages that cause fluctuations in the water level below the dam to several meters, an increase in the flow rate, agitation of bottom silts, as well as sharp variations in the salinity of water at sea incompatible with the life of biota (Fig. 1).

The daily and weekly unevenness of river flow due to the cyclical loading of power networks (tsunami simulation) leads to drying of caviar, splashes over the brow of the fish shore (Fig. 1,2). For example, up to 50% of Kurinsky bream juveniles spill out below the Kurinsky hydroelectric power station into the Caspian Sea, up to 30% of red fish spill out in tidal seas [1, 15]), over 30% of White Sea herring and cod in the Kandalaksha Bay can die from drying on a herbal substrate in a sisigic cast [17].

The characteristic inside daily change in water level beyond the Volgograd dam is up to 0,5 m, on Mondays ≈1m. In 3-4 days, the flattened wave reaches the delta, its height decreases by 3-5 times. After the

holidays, especially in winter, the water level behind the dam sometimes rises to 4 m by evening, in the delta the corresponding interstitial fluctuations of the level exceed 10÷50cm, the water speed on the ridge increases from 1 m/s to 1,5 m/s, which leads to agitation of biogas-rich silts, erosion of the coast due to extreme wet and drying, an increase in biofilter of the delta splash out into the sea. In closed sea mouths, man-made level variations lead to changes in water salinity incompatible with the vital activities of a significant part of the biota, including benthos (Fig. 3,4) [3, 4, 7, 16].

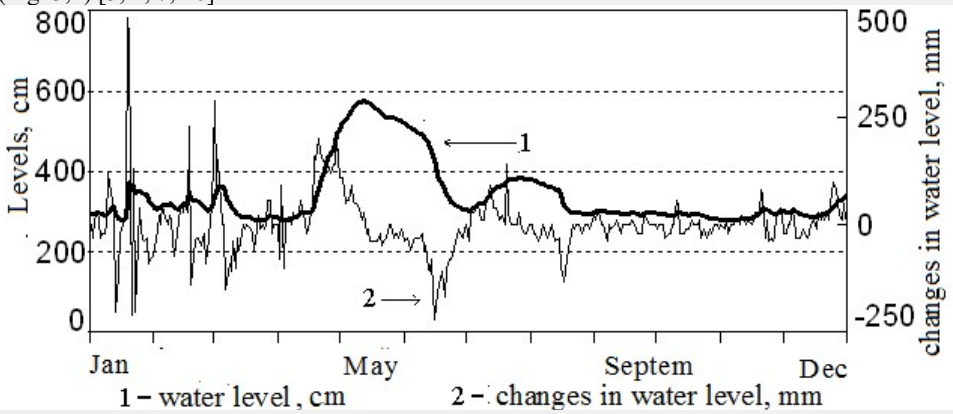

Fig. 1. Water level on Astrakhan in 2004

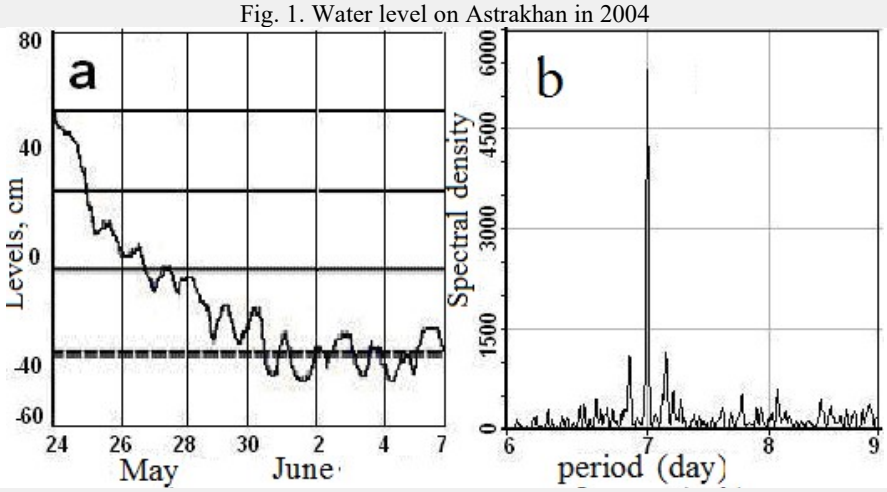

Fig. 2. Recording of the level on the railway station Astrakhan from 24.05 to 07.06.1992 (*a*) [14] spectral density of water level fluctuations on the Lower Volga in 1992-2003 (*b*) [8].

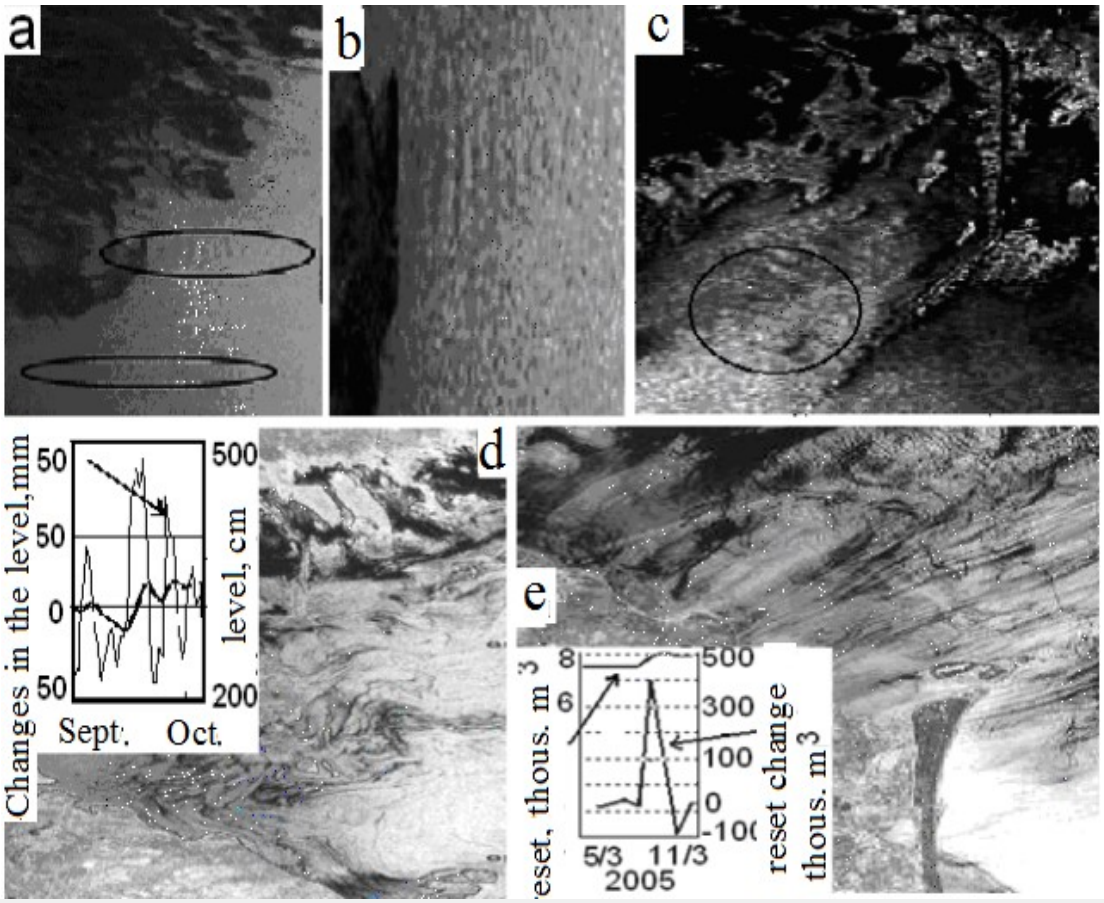

Fig. 3. R/L (radar) images of 21.01.2005 (a-b) and 14.07.2003 (c), in ellipses of wave tsugi from Volga sleeves and channels. A photograph of wave structures 29.09.1999 on the tie-in the water level and daily changes in the level from 01.09 to 01.10, the arrow shows a drain wave that passed through Astrakhan 25-27.09.1999 (d). R/L snapshot 16.03.2005 (e). On the tie-in of water bypass from hydroelectric power station 05-13.03.2005, arrow - bypass 10-11.03.2005.

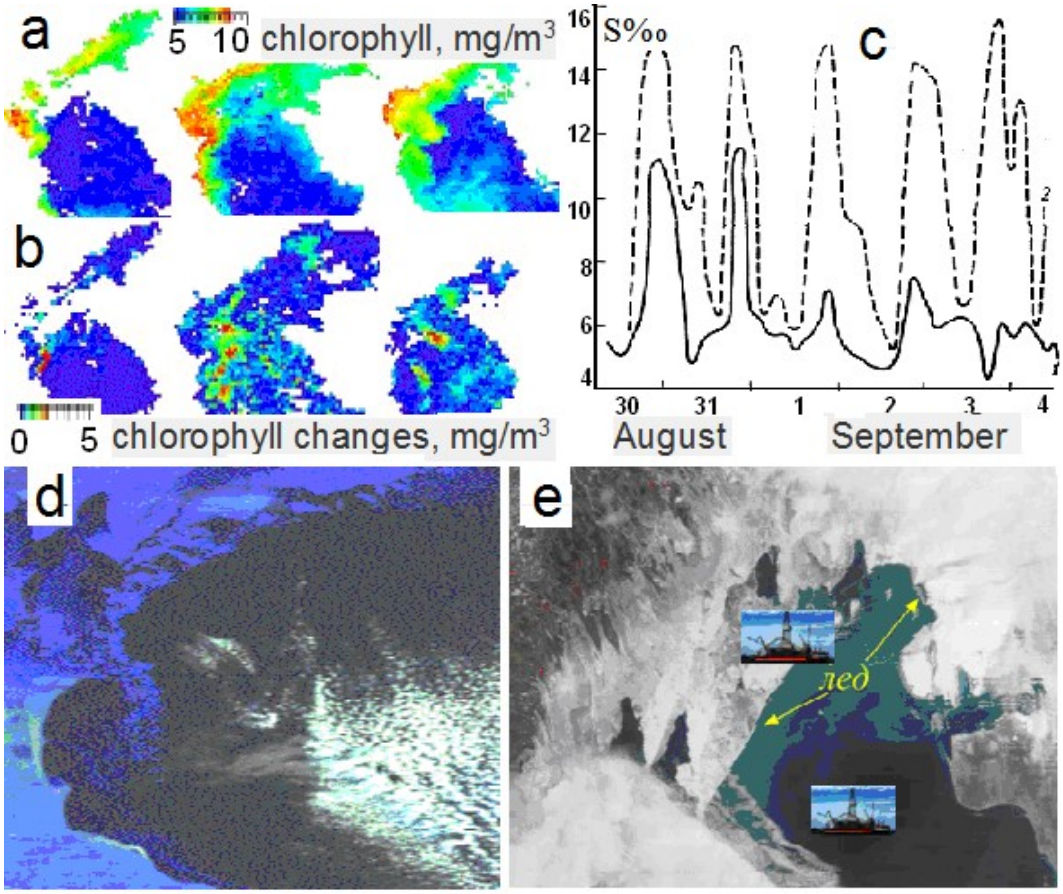

Fig. 4. Chlorophyll content when passing drain waves 25.03.1999, 25.09.1999 and 26.04.2000 from left to right (a). Difference between max. and min. Chlorophyll content at passage of drain wave with Fig. a (b). Changes in the salinity of water on the sea of the river Dnieper in August-September (line - surface, dotted - bottom) (c). Pictures of ice in the Caspian Sea 10.02.2005 (d) and 06.03.2003 (c).

The yields of the Volga wobble and bream largely depend on the duration of the flood. One of the conditions of high yield of these fish (over 200 thousand copies/hour of trawl) both before and after regulation of Volga runoff is achieved only with a flood duration of more than 45 days [7]. Before the regulation of the Volga runoff, bream catches were quite efficiently predicted by its yield five years earlier (R>0.7) (Fig. 5). After regulation, the connection disappeared.

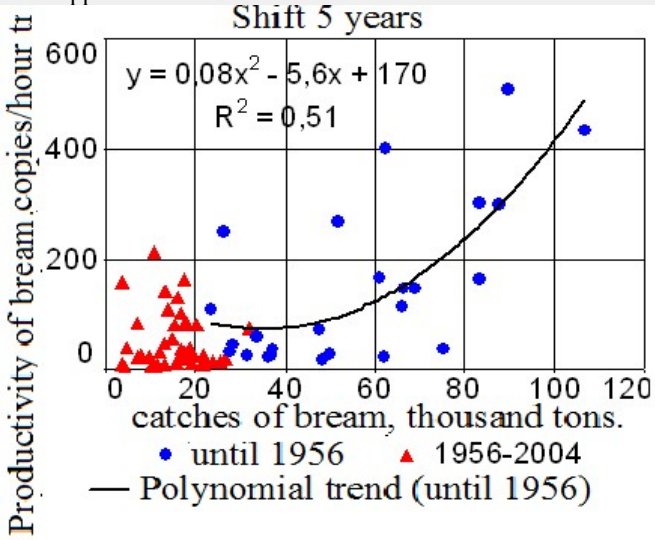

Fig. 5. The ratio between bream yield and its catches after 5 years in the Northern Caspian.

One of the reasons for this decline in yields and subsequent catches is in the inter-day rise in the water level in the flood. Before the launch of the Volgograd *hydroelectric station*, the average daily water level in the delta grew over 2 cm in the summer low water no more than 2-5 times (precipitation, baric phenomena). With a stable decline in level, the number of wobla and bream fry was maximum. During the years of an unstable decline in the level of yield was many times less (fry from watercourses splashed out over the eyebrows of the coast and dried). With the launch of the Volgograd Hydroelectric Power Station, due to the instability of reducing the flooding of the steel delta, the number of fry fell 2-5 times more often.

As a result of the negative consequences of the non-ecological regime of the Volgograd hydroelectric station, tens of thousands of people lost food and work (Table 1). In other regions, for a similar reason, fish productivity has not reached the planned level. For reservoirs on the Middle Volga - less than 20%, for Upper Volga, where the impact of passages on the water level in the upper spawning grounds is less, - 40-50%.

Table 1. Indicators of economic development of Volga reservoirs

Reservoir	Planned efficiency, kg/ha		Actual produktiv-wear, kg/ha		Ratio of actual to planned,%		Number of jobs at 10 t/yr per fisherman + 4 in processing, transportation, manufacture and operation of vessels, berths, workshops, etc.	
year			1963	1973	1963	1973		
Rybinsk	16		8	6	**50**	**38**		
Uglich	35		7	17	**20**	**47**		
Ivankovskoye	30		12	12	**39**	**41**		
Kuibyshev	40		6	6	**16**	**16**	1933-1953	1983-2003
Volgograd	50		8	9	**17**	**18**	83 thous.	4 thous.
Catches of the Astrakhan region, thous. t.	1933	1943	1953	1963	**1983**	**2003**	Due to the unevenness of inter-day and inside daily passes, catches fell by **140 thousand tons/g.** Up to **80 thousand** people lost their jobs	
herring	7	68	31	6	**1**	**0**		
pike perch	42	25	15	3	**2**	**1**		
bream	23	56	21	16	**11**	**14**		
sazan	10	14	8	2	**4**	**1**		
vobla	78	61	40	20	**5**	**5**		

The mode of operation of the hydroelectric power station provides for environmental discharges through the dam - mainly the surface water of reservoirs, the migration of fish through fishing channels or using fish lifting devices. However, in bottom waters, the concentration of biogenic elements is usually several times higher by orders of magnitude than in surface waters. To pass biogens downstream, rather than burial in reservoirs, culverts with gate valves should be inserted into the body of dams, and pipes (Pitot tubes) should be thrown through previously built dams (Fig. 6). Pipe diameters shall be determined by low and flood flow rates. Clean pipes from growths - temporarily fill them with methane-enriched water. Fishing channels in the form of pipes will minimize the problem of their maintenance and poaching. If the flow rates in the pipes are insurmountable for fish, a foam scheme should be used. With sound, light signals or a moving shutter array, drive and hold fish in pipes, and then push them out. After spawning, the fish will pass down through these pipes with a stream of water.

Significant reductions in the feed base in river deltas also affect the survival of the sea beast during the puppy and feeding period [5].

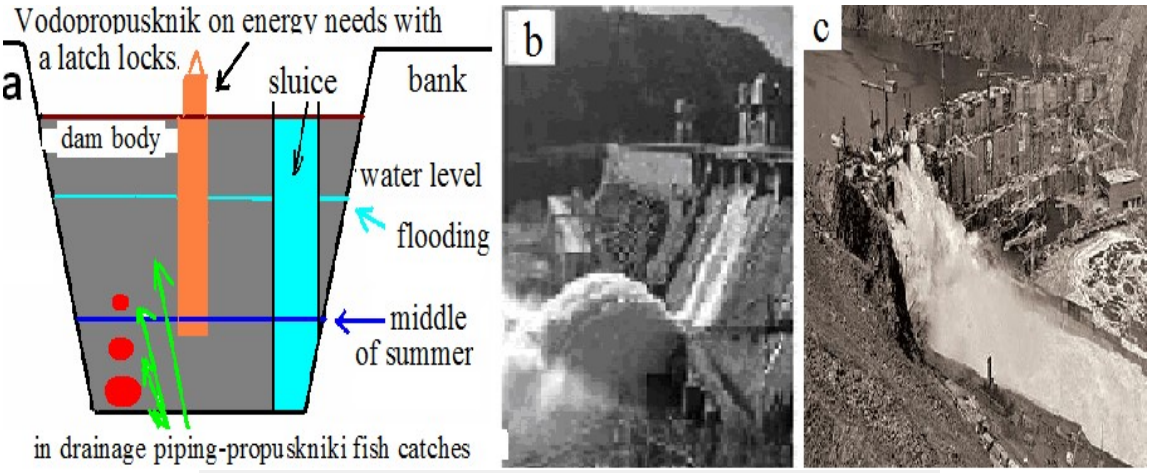

Fig. 6. Dam body diagram (*a*), photo of water discharge from dams (*b,* c).

2. **Earthquakes**

Among the negative consequences for aerobic biota from earthquakes is the mass degassing of methane (lithospheric, from destroyed gas hydrates, clay traps, agitated silts). In seismic conditions, outside the consequences of floods, the concentration of methane in water as a rule does not exceed 10^{-4} mg/l, after mass degassing and floods it reaches 10^{-1} mg/l or more, which is detrimental to a significant part of aerobic biota [7, 13].

Natural earthquakes in the Volga region are episodic, including failed karst, landslide, thunderstorm and meteorite. Waveguides caused by the decompression zones of the Volga-Caspian part of the East European platform are the reasons for the range of the Krasnovodsk and Kopetdag earthquakes, provoking local seismicity (Fig. 7.a, b), there are also echoes of the tectonic activity of the Voronezh crystal massif (Fig.7.c) [10-12]. A significant part of local earthquakes is technogenic [2].

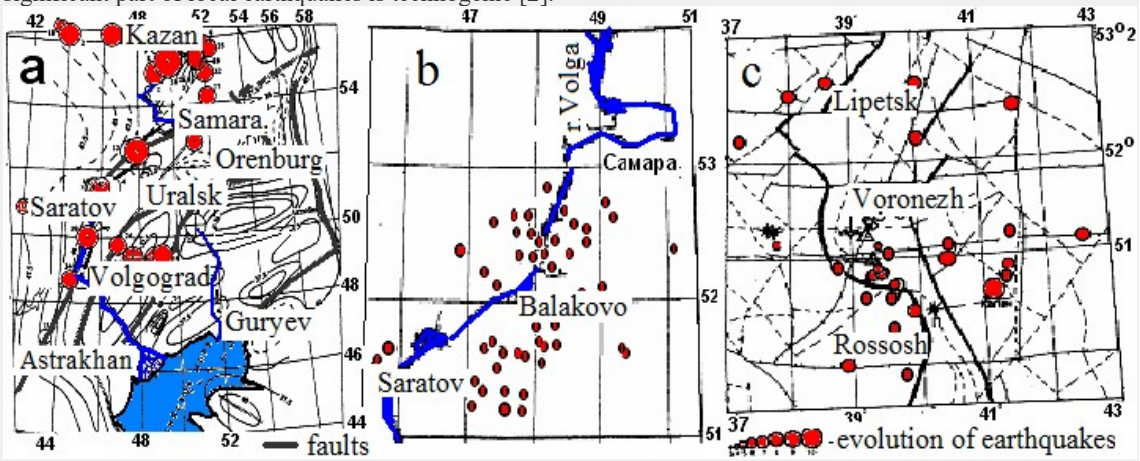

Fig. 7. Epicenters of seismic events of the Lower and Middle Volga (a), from October 1999 to December 2002 (*b*), for 2000 (*c*).

The situation of negative consequences of earthquakes is aggravated in high pressure dams, where earthquakes are predicted and occur with sharp changes in the water level at the Sulak hydroelectric power station [9].

3 Conclusions. Recommendations

It is desirable to dampen the passage of water through dams by time-of-day separation of energy, sluice and ecological passages in order to maintain the fish productivity of the water areas after regulating the river flow. Reduced flow rates will reduce coastal erosion and dredging.

For ecological passages, transfer water rich in biogenic elements from the bottom horizons of reservoirs through dams.

Prohibit explosions on faults of the Earth's crust near rivers, otherwise deduct funds for fish breeding plants, the arrangement of spawning grounds and bulk reservoirs.

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