
© VLADIMIR M. ANDREYENKO, GALINA S. KOSHCHEYEVA,
LARISA V. GUBANOVA

karabanova_l@mail.ru, gala-s-k@yandex.ru

UDC 57

**THE ASSESSMENT OF FRESH RESERVOIRS BIOPRODUCTIVITY
OF BERDJUZHSKIY AND KAZANSKIY AREAS ON THE BASIS
OF HYDROLOGICAL AND ECOLOGICAL CHARACTERISTICS**

SUMMARY. The survey results of 24 lakes of Kazanskiy and Berdjuzhskiy areas of the Tyumen region are presented. The fishery value of the lakes is analyzed. The recommendations for the further operation of reservoirs in the modern world are given.

KEY WORDS. Fish breeding, lakes, the Berdjuzhskiy region, the Kazanskiy region.

More than 100 thousand hectares of water areas of the Tyumen region are suitable for fish breeding. This significant natural reserve is not used in full and requires state support for the development of lake fisheries through the use of natural food resources of reservoirs.

Currently, the regional budget compensates 50% of the actual cost of the construction of the fishery objects and 70% for the purchase of specialized equipment. Subsidies for the purchase of high quality fish formula feed are given. Research funding from the budget is not provided.

According to the Institute Gidroybproekt (Hydrofishproject) [1], there are 262 lakes in Berdyuzhskiy area, 292 lakes of fishery value in Kazanskiy area. Their total area is of over 309 km² and 110 km² respectively. Most of these are small, overgrown ponds with an area less than 1 km².

For detection of fishery productivity, the authors made a research of hydrological and ecological conditions of 15 large reservoirs of Berdyuzhskiy and Kazanskiy districts of the Tyumen region.

Research methods. The complex study of reservoirs included: establishing the administrative position according to standardized passport municipality, identifying the geographical location of reservoirs on guides, physical and geographical description of the site, the study of the hydrological regime by analyzing the dynamics of the levels (according to the ITF, direct observations on the pond and collecting data from local population).

The state of hydraulic structures, the presence of inflow and outflow of water was characterized.

The procedures which were carried out: soundings on target, the description of the nature of coastline, charting lakes considering current changes, water samples for microbiological analysis, the measurement of water clarity, the nature of bottom

sediments; hydrobotanical study of lakes and their coasts, net fishing — for the study of ichthyofauna composition, determining morphometric characters and age structure.

Before the work was carried out, a reconnaissance tour of the reservoir along the bank by car and motorcycle and on the water along the shoreline by rowboat was made. The aim was to view the nature of the coastal zone. The wetland conditions of the territory, the presence of tributaries, buildings, water intake, and the sources of lakes pollution were noticed. The places for further, more detailed studies were allocated.

Depth measurements were taken at two intersecting targets from coast to coast (on the reservoirs of complex shape — three targets). The depth measurement was carried out by a marked pole. Depth marks were recorded every 3 minutes while moving.

The hydrobotanical materials were collected and processed according to conventional methods [2]. A general scheme of overgrown pond with separation of individual groups of plant communities was constituted. As a topographic base, the maps at a scale of 1:25000 were used.

While describing the plant communities, all present species were observed. For example, their abundance, distribution and substages according to occupied areas, vitality, phenological condition, the type of bottom sediments. The refined composition of water and coastal aquatic flora was specified. Hydrobiological samples were taken and processed according to conventional methods [3], [4]. Zooplankton samples were collected at each reservoir by a plankton net of Apshteyn. The cameralistic processing of the material was carried out through the counting method based on a number of common species of zooplankton according to their size-age groups. Zooplankton biomass was determined by the size and weight of organisms of various size and age groups. Zoobenthos samples were collected at the same points — two grabs each.

Research results. The form of the lakes surveyed in terms is usually simple — almost round or oval. The lakes formed in the bottoms of ancient ravines flow are oblong. Also, there are reservoirs of complex configuration: with many capes and bays, as individual reaches, connecting by wide channels. The banks of lakes are generally slightly rugged, low-lying, often swampy, and inexplicit. Indigenous shore waters of several reservoirs are steep (up to 2-5 m), now back away from the water's edge to 10-60 m. Valley floodplain lakes are located in the valleys of the modern rivers and form as a result of river valleys expansion. For example, the chain of lakes in the area of Kazanskiy area — Mal. Kabanye, Bol. Kabanye, Polkovnikovo, Bezrybnoe, Mal. Setovo, Bol. Setovo, Yarovskoe, Zarosloe, Sladkoe, Ubiennoe. These water bodies in wet years remain the periodic connection to the Ishim River.

Most often, the hollows of a cup and saucer-shaped form with a gradual increase of depths from coast to the central part are met. Only at some reservoirs, sharp depths are observed. The bed is equal, occasionally wavy, with small holes and furrows. In two reservoirs hollows are noted.

The water surface area of the vast majority of the surveyed water bodies (92%) is less than 10 km². According to the classification of P.V. Ivanov [5], these are small and very small lakes.

Larger ponds are few. In Berdyuzhskiy district, there are only 7 middle size lakes, and in Kazanskiy district — 2: Yarkovskoe and Yakush. The maximum area of a reservoir was 14.98 km², the minimum — 0.35 km².

The average depth of lakes is from 1 to 3.7 m and in most cases (68.1%) is in the range of 2 to 3 m. Maximum depths for different water bodies range from 1.3 to 4.5 m. The deepest lakes are Matyushkino — 4.1 m, Bol. Mishino — 4.1 m, B. Karkovo — 4.3 m. in Berdyuzhskiy area; Sladkoe — 4.0 m, Yarovskoe — 4.0 m, Bolshoe — 4.4 m., Maloe — 4.5 m. in Kazanskiy area. The basic amount of water bodies have maximum depth of 2.5 to 3.5 m

The composition of bottom sediments and their distribution are caused by the landscape features of catchment basins, the genesis of foundation pits, the relief of bottom bed. In a coastal zone of forest-steppe lakes, sandy, oozy and sand soil is often noted. The bulk of a ground precipitation is presented by sapropels of dark gray, black color. In intensively growing reservoirs, the top layer of silt is covered with a thick layer of the vegetative remains.

The water balance of lakes consists of a credit (precipitation falling on the mirror surface and groundwater runoff from the catchment area) and expenditures (evaporation and runoff) parts. By the nature of water balance, lakes are divided into stagnant and waste. The bulk of the inland lakes of the south of the Tyumen region (in the forest steppe — more than 95%) consists of stagnant water. The predominance of inland lakes in the steppe regions is the cause of the dry climate and a negative water balance, the lack of the expressed hydrographic network. The main sources of lakes supply are surface inflow from the catchment area and rainfall in the mirror. The expenditure of the balance of evaporation plays a major role, and sometimes runoff.

Level regime of lakes is subject to seasonal and long-term fluctuations, caused by the change of the precipitation, summer air temperatures and alternating periods of varying degrees of moisture in Western Siberia. The change of water level depends on the location of reservoir, shape and structure of the banks, the share index of the catchment and the most pronounced in the shallow drainage lakes.

The annual variation is characterized by spring tide levels, beginning in the steppe regions on average in the second half of April. The height of the spring rise of water mostly is 0.2-0.4 m (0.4-0.6 m. and more). In summer, the decline of water begins. It occurs with particular intensity in July, suspending or slowing down during heavy rains and ending in steppe lakes before freezing over.

Aquatic flora. In the composition of aquatic lakes surveyed, 56 species belonging to 37 genera and 26 families were registered. The highest species diversity was observed in the families Rdestovye (Potamogetonaceae) — 14 species and Sedge (Sureraseae) — 12 species. The remaining families are represented by 1-3 species. The list of coastal aquatic plants includes over 50 species, listed in the description of plant hydrophytes.

The aquatic flora of lakes is represented mainly by helophyte — 27 species and hydratophiyte — 19 species. Pleystophytes are marked in smaller quantities — 10 species.

The highest species diversity of plants is observed in freshwater lakes. With the increase in water salinity, the number of species of hydrophytes is drastically reduced. There are only halophilic plants and species with wide ecological amplitude.

The overgrowth of lakes. Special hydrobotanical work at implementation of earlier cadastral descriptions was not carried out, therefore it is possible to judge about the change of reservoirs overgrow only roughly. For the last decades, the gradual overgrowth of lakes (by Tab. 1, 2) that was promoted by the long shallow periods is observed. In addition, reclamation work (mowing the air-water vegetation, stocking of herbivorous fishes) almost ceased to be done. The overgrowth of lakes was determined visually.

Table 1

The dynamics of lakes overgrowth in Berdyuzhskiy area

Lake	General degree of overgrowing, %		
	1968	1985	2009
Okunevo	5	5	25
Bezguskovo	10	10	15
Zayache			20
Chistoe			15
Polovinnoye	15	50	35
Travnoye		30	10
Glubokoe	10		5
Krivoje			10
M. Uktuzkoye	5	20	25
Krutoje	10		15
B. Krasnoje			5
Sorochie	10		10

Table 2

The dynamics of lakes overgrowth in Kazanskiy area

Lake	General degree of overgrowing, %		
	1962	1985	2009
Pesyanoje	insignificant		10
Travnoje	2		20
Bol. Kabanye	34	15-20	25-30
Polkovnikovo	insignificant		10-15
Bezrybnoje	10	25-30	15
M. Kabanye	14		15
Sladkoe	20		20
Zarosloye			15
Yarovskoe	10	15-18	10-15
Bol. Setovo	23		25-30
Ubiennoe	insignificant	10	10
Yakush			15

It was found out that with increasing salinity, a sharp decrease in species diversity takes place. In combination with unfavorable hydrological factors, it can significantly affect the degree of fouling of the reservoir.

In general, most of the overgrown lakes are assessed as moderate, not interfering with fishing activities.

The biomass of lakes. The basis of biomass is high-calorie and high-crustaceans — daphnia, the main representatives of which were *Daphnia longispina* and *D. pulex*. The samples of oviparous and juvenile of these crustaceans were presented, which shows the intensity of their reproduction. Almost in all lakes there was *Daphnia longispina*, rarer *D. pulex* and once — *D. magna*. Of copepods occurred mainly large-filter-diatomid (as an adult form and nauplii of different stages of development).

Rotifera plankton, although its quite diverse species composition, was insignificant because of the small size of the animals, and an essential role of zooplankton in lakes did not play.

In the surveyed lakes, the formation of plankton zoocenoses in summer is due to the production of thermophilic forms of cladocerans filter feeders and diatomid.

On biomass size, the bigger quantity of reservoirs belongs to lackfeeding with a biomass to 5 g/m³. Middlefeeding lakes are fewer, the biomass in which doesn't exceed 10 g/m³. A part of lakes belongs to highly productive with a zooplankton biomass over 10 g/m³. It is necessary to note that the number of lackfeeding reservoirs (on biomass size) included lakes which were fished larvae of the white fishes eating zooplanktons.

Fish fauna. The basis of the fish population of lakes was made up by widespread in the south of the Tyumen region species: crucian silver, crucian gold and minnow lake. The perch (Bezguskovo, M. Uktuzskoye, Okunevo, Polovinnoe in Berdyuzhskiy district) inhabits in un-asphyxaty and periodically asphyxiaty reservoirs, and this species is mainly spread in Bezguskovo lake. At the same reservoir there is a motley silver carp from fish-farming of previous years (no commercial value). A gudgeon and a verkhovka were noted in 3 lakes of the Berdyuzhskiy district (Krivoe, Okunevo, Polovinnoe) and in so many in the Kazanskiy district. These types are the most undesirable for maintaining commodity fish breeding.

Verhovka takes the deficit of dissolved in the water oxygen more resistantly than the other. And therefore, for a short time period, it is the leader in number of fish. In lake Sladkoe, in Kazanskiy district, roach, bream, ruff, pike, nine-spined stickleback and spotted sloth (trout) were found.

A survey of 12 reservoirs of Kazanskiy district demonstrated that depending on the current state of the hydrological and hydrochemical conditions, the level of aquatic vegetation, zooplankton, zoobenthos and composition of the fish population, the following fish species can be grown in them: herbivores (11 lakes), carp (10 lakes), whitefish (11 lakes) and sturgeon (1 lake). Taking into account the varying degrees of oxygen deficiency in the water of lakes in winter, five of them will be used for many years, and 7 — for one-year feeding.

In Berdyuzhskiy district, grown white fishes are presented by small white fish (pelyad) (lake Bolshoe, Chistoe) and tugun (lake Chistoe). The carp from fish-breeding of the previous years is presented in lakes Bezguskovo and Chistoe. The trade value is insignificant.

In lakes Bezguskovo, Bolshoe Krasnoe, Krivoe the growth rate of silver crucian is below the average measures, observed for this species in 2007. The similar phenomenon concerning a gold crucian is characteristic for lake Travnoe. However, it should be noted that in the studied reservoirs a badly-growing carp is not recorded.

The growth rate of invasive species (whitefish) in 2007 was quite intense. This may indicate a favorable environmental conditions for the growth of the species.

Lakes fishery and recommendations for further use.

The research of the materials inventory of 2008-2010 found that, depending on the oxygen conditions in winter, in five surveyed lakes, a long-term feeding of valuable fish is possible (Lake Bezguskovo, Glubokoe, Okunevo, Polovinnoe, Chistoe), in three lakes — one-year feeding (Zayachie, Krivoe, Travnoe). In the four reservoirs, the operating mode will depend on the hydrological regime: in wet years long feeding is possible, in dry years — one year old (Lakes B. Krasnoe, Krutoe, M. Uktuzskoe, Sorochie,). In many lakes (Volkovo, Sosnoe, Tarasovo) the growing of valuable species of fish is not possible due to the strong overgrowing of reservoirs. The prey of only native fish species by means of passive gear is possible here.

REFERENCES

1. The general scheme of the fish breeding development in the Tyumen region. Book 2. The development of fish depots. // A report Hydro-fish-project. M., 1962.
2. Ivanov, P.V. Classification of lakes of the world according to their size and average depth. Newsletter LSU. 1948. № 21. P. 78-90.
3. Polymskiy, V.N. Zonal biolimnological peculiarities of the Tyumen region lakes. // Biological bases of fish practical usage of Siberian and Ural lake systems. Tyumen. 1971. P. 20-26.
4. Katanskaya, V.M., Raspopov, I.M. Methods of studying the highest aquatic vegetation // The manual on the methods of hydrobiological analysis of surface waters and bottom sediments. L.: Science, 1983. P. 129-175.
5. The manual on collecting and processing materials when carrying out hydrobiological research in terms of fresh water reservoirs. Zooplankton and its production. L.: GosNIORH, 1982. 33 p.