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ASSESSMENT OF THE BIO-ECOLOGICAL STATUS AND ECONOMIC SIGNIFICANCE OF SILVER CARP (HYPOPHTHALMICHTHYS MOLITRIX VAL.) IN NATURAL WATER BODIES OF KARAKALPAKSTAN BASED ON GROWTH PARAMETERS

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Abstract: This paper assesses the bio-ecological status of silver carp populations in Sudoche, Jiltirbas and Muynak (Mo‘ynoq) Lakes of the Republic of Karakalpakstan through growth parameters and evaluates the ecological and economic significance of the species for the region. Mean body weights obtained from control catches in 2023–2025 were compared with the length–weight equation and age–weight values published for water bodies of Uzbekistan. In all three lakes, the mean weight of fish corresponded to age group III, with estimated total length ranging from 65.4 to 69.2 cm. The relative growth index was 98.5 % in Sudoche Lake, 89.1 % in Jiltirbas Lake and 82.1 % in Muynak Lakes. The results indicate that the populations are stable, but growth is markedly slower in water bodies with higher mineralization.

Keywords: silver carp, *Hypophthalmichthys molitrix*, bio-ecological status, length–weight relationship, age group, relative growth index, mineralization, Amu Darya delta, Karakalpakstan, fishery significance.

Introduction (literature review)

The desiccation of the Aral Sea has fundamentally altered the hydrological regime, water quality and fish fauna of the lake systems in the lower Amu Darya [1]. According to L.P. Pavlovskaya, fish catches in the lower Amu Darya declined from 7,000–8,000 tonnes in the early 1970s to 1,000–3,000 tonnes in the early 1990s. The share of the native Aral barbel in the drifting eggs and larvae fell from 80 % in the 1960s to 0.04 %, while silver carp came to account for 85–90 % [2]. This indicates that the introduced species has replaced native fishes in the river system.

Silver carp was brought to Uzbekistan after 1960. In 1961, approximately 400,000 yearlings of grass carp, silver carp and bighead carp were released into the Amu Darya. Today the species reproduces naturally in some rivers, and its juveniles are found in large numbers in collectors, canals, lakes and rice fields in August and September [3]. B.G. Kamilov studied the age and growth of silver carp in Tudakul Reservoir and established a length–weight equation and mean weights by age group for conditions in Uzbekistan [4]. Methods for assessing population status from length–weight relationships were reviewed by R. Froese [5].

At the same time, as a non-native (invasive) species, silver carp may compete for food with native planktivorous fishes and alter ecosystem structure [6]. Studies of lakes in Khorezm have

shown that salinity and water scarcity are the main factors limiting fish farming potential [7]. Recent work on the ichthyofauna of Karakalpakstan lists silver carp among the principal commercial species of the region [8]; however, assessments of its growth status in natural lakes compared with other populations in the country are virtually absent.

The aim of the study is to assess the bio-ecological status of silver carp populations in natural water bodies of Karakalpakstan based on growth parameters and to substantiate the significance of the species for the region.

Objectives: 1) to determine the estimated length and age group of fish in the studied lakes; 2) to compare growth parameters with a reference population in Uzbekistan; 3) to relate differences in growth to ecological factors; 4) to evaluate the ecological, fishery and socio-economic significance of the species.

Materials and methods

The study sites were three natural water bodies in the Amu Darya delta: Sudoche Lake, Jiltirbas Lake and Muynak Lakes. Field material was collected during control catches in spring, summer and autumn of 2023–2025 using gillnets of various mesh sizes (20–60 mm). At least 30 fish were weighed per lake per season. Measurements and biological analysis followed I.F. Pravdin [9], and age determination followed the recommendations of N.I. Chugunova [10]. Water mineralization was measured in situ with a conductivity meter.

Mean total length (TL, cm) was calculated from mean body weight (W, g) using the inverse length–weight equation: $TL = (W / a)^{1/b}$, where a = 0.0065 and b = 3.1572 are the coefficients established for the Tudakul Reservoir population (n = 142, $R^2 = 0.995$) [4]. Age group was assigned by comparing mean weight with the age–weight series of the reference population (I – 187.5 g; II – 1548.6 g; III – 4264.8 g; IV – 9646.8 g) [4]. The relative growth index was calculated as $RGI = (W / W_s) \times 100$ %, where W_s is the mean weight of the same age group in the reference population. Growth lag was defined as 100 – RGI (%). Calculations were performed in MS Excel.

Results

The results are presented in Table 1. In all three lakes, the mean weight (3.5–4.2 kg) and estimated length (65.4–69.2 cm) of fish correspond to age group III of the reference population (length range 51–78 cm). Thus, catches are dominated by three-year-old fish approaching sexual maturity.

Table 1. Growth parameters of silver carp (2023–2025)

Lake	Mineralization, g/L	Mean weight, kg	Estimated TL, cm	Age group	RGI, %	Growth lag, %
Sudoche	8.5	4.2	69.2	III	98.5	1.5
Jiltirbas	6.2	3.8	67.1	III	89.1	10.9
Muynak	10.4	3.5	65.4	III	82.1	17.9

Note: RGI – relative growth index; reference population – Tudakul Reservoir (age III, 4264.8 g) [4].

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In Sudoche Lake, growth is at the level of the reference population (RGI = 98.5 %). Relatively stable water exchange and favourable summer temperatures create good conditions for the species here. In Jiltirbas Lake, despite the lowest mineralization (6.2 g/L), growth lags by 10.9 %. This may be related not only to salinity but also to intraspecific competition for food under high population density. This hypothesis will be tested at the next stage by studying the feeding spectrum and density.

The greatest growth lag (17.9 %) was observed in Muynak Lakes. At a mineralization of 10.4 g/L, fish spend a substantial part of their energy on osmoregulation, which slows somatic growth. Nevertheless, the population has persisted, indicating that the species has adapted to these conditions. From an economic point of view the difference is significant: at the same age, each fish in Muynak Lakes is on average 0.7 kg lighter than in Sudoche Lake. This means 0.7 tonnes less product for every 1,000 fish caught.

Significance of the species. Based on the results obtained and published data, the significance of silver carp for the region is summarized in Table 2.

Table 2. Significance of silver carp for water bodies of Karakalpakstan

Aspect	Main content
Ecological	Directly consumes phytoplankton, reducing algal blooms in lakes; as a primary consumer it assimilates energy efficiently within the food chain
Fishery	Reproduces naturally in the Amu Darya, accounting for 85–90 % of drifting pelagic eggs [2, 3]; stocks are partly self-sustaining without artificial propagation
Socio-economic	A low-cost protein source for the Aral Sea region population; a source of income for local fishers; one of the few commercial species caught in salinized lakes
Risk factor	As a non-native species it competes with native planktivorous fishes [6]; density control is required

Conclusions and recommendations

1. Silver carp has formed stable populations in three natural lakes of Karakalpakstan. Catches consist mainly of age group III fish with an estimated length of 65–69 cm.

2. The bio-ecological status of the population varies among water bodies: in Sudoche Lake growth is at the national reference level (98.5 %), whereas in Muynak Lakes it lags by 17.9 %. In addition to mineralization, water exchange and population density influence growth.

3. Silver carp has both ecological (reduction of phytoplankton) and economic (naturally reproducing commercial fish, low-cost protein source) significance for the region. However, as a non-native species, its abundance should be kept under control.

4. **Recommendations:** give priority to Sudoche Lake, where growth performance is highest, when stocking juveniles; take measures to increase water inflow to Muynak Lakes in order to reduce mineralization; continue individual

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measurements and scale-based age determination to develop a region-specific length–weight equation.

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