ZARAFSHON VOHASINI KOMPLEKS INNOVATSION RIVOJLANTIRISH YUTUQLARI, MUAMMOLARI VA ISTIQBOLLARI MAVZUIDAGI XALQARO ILMIY-AMALIY ANJUMANI

MATERIALLARI

PROCEEDINGS

OF THE INTERNATIONAL CONFERENCE ON INTEGRATED INNOVATIVE DEVELOPMENT OF ZARAFSHAN REGION: ACHIEVEMENTS, CHALLENGES AND PROSPECTS

Volume II

26-27 October, 2017. Navoi, Uzbekistan

Such measures create a precondition for improving the ecological status and sustainable development of all ecosystems in Djizak region.

Summarizing, it can be said that the disappearance or decrease in the number of a plant on the territory of the region creates inconvenience for the development of other species, since species always develop in close interrelation.

Protection and reproduction of the above plant species, which are rare and endangered plant species is important in ensuring the sustainable development of the Djizak region.

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DISTRIBUTION OF CRAYFISH (CRUSTACEA) IN THE ZARAFSHANRIVER BASIN AND THEIR SUITABILITY FOR AQUACULTURE

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Abstract. For the current population of Zarafshan river Basin (ZRB) an estimated minimum of 45 000 tonnes of fish would be needed annually and since the fish sector produces some 7 000 t at present, a production-demand gap of about 38 000 tonnes exists in order to increase per capita fish consumption rate up to 7.3 kg/y. By presenting this work authors are going to render affordable assistance in aquaculture enhancement by analyzing distribution of crayfish species (Crustacea) in the ZRB waterbodies and discuss their suitability and opportunities for introduction to aquaculture. The need for fish and other aquatic food, water resources and aquatic ecosystems conditions available in ZRB for fisheries and aquaculture sector development, suitable for aquaculture Crayfish species (Crustacea) in the ZRB and their biology and the ways forward to develop proposed measures are discussed.

Keywords: Zarafshan river Basin, water quality, capture fishery, aquaculture, Crayfish species, Shrimp culture.

Introduction: The need for fish and other aquatic food

The Zarafshan river Basin (ZRB) is the center of urban, political and agricultural civilization in the whole Central Asia since ancient times. The ZRB in Uzbekistan is like many areas in arid climate zone mainly farming-oriented, while the industrial zones are found more in adjacent desert like zones. Agriculture is largely confined to the industrial production of cotton to a lesser extend to wheat and vegetables. This intensive production can only be sustained with artificial irrigation in the present context. As a result, the production of other agricultural goods as husbandry is secondary. The population suffers often from a shortage in food protein supply, which to a major part consists of fish meat from capture fishery and aquaculture. In order to improve especially the fish rising in aquaculture, the government has intensified its support for fish farming in recent years to improve the supply of fish.

The population of the ZRB in 2014 was about 6 million people (State statistical Committee of Uzbekistan). According to fish production statistics, during the years 2011-2014 estimated 2516-

726 t food fish was produced consequently both from capture fishery and aquaculture in the ZRB table 1). Thus, per capita fish consumption in the region is equal to about 1.1 kg/y, which is very low comparing to worlds average – 19 kg/y [1].

Table 1. *Fish production dynamics in different regions of Zarafshan river basin.*

Region	2011	2012	2013	2014
Navoi	1434	1664	3109	3771
Samarkand	513	594	1124	1384
Bukhara	569	870	1321	1571
Total	2516	3128	5554	6726

According to information available (www.mtm.buxdu.uz) there are plans to increase fish roduction in Navoi region up to 8500 tons in nearest future. However, this anticipated amount will e still insufficient to meet the values recommended by medicine. During soviet time per capita fish roduction and consumption in the region was about 5 kg per person.

So, what is the amount of additional fish production volume necessary for satisfaction of inimal requirements to meet food safety recommendations? For comparison – in USA many tates use established by EPA's 6.5–20 g/day standard fish consumption (appr. 7.3 kg/capita) value http://water.epa.gov/scitech/swguidance/standards/handbook/). Using these figures it is easy to alculate that for the current population of ZRB an estimated minimum of 45 000 tonnes of fish ould be needed annually and since fish sector already produces some 7 000 t, a production-emand gap of about 38 000 tonnes exists.

Taking into account the singularity of fish deficiency figures for the whole republic of Izbekistan, the Resolution of the President No. PK – 2939 from May 1, 2017: "On the measures on mprovement of fisheries sector management" was issued, which is primarily directed to sharp ncrease of fish production in the republic. Obviously that fulfilment of the tasks indicated in this Resolution requires availability of all necessary natural, technological, workforce capacity, etc. onditions and resources. Although the ZFB region has large water surface area of lakes and water eservoirs – more than 275000 ha (table 2), possible contribution of capture fishery in this regard is ery limited due to very low productivity of overwhelming waterbodies – from 3-7 kg/ha [2] to 10 g/ha [3].

One internationally well recognized way is to diversify aquaculture both in terms of reared nimals/plants and new progressive technologies if above stated conditions are provided. Some ttempts in this direction already on the way in ZRB, e.g. fish-farm JV "Aqua-Todakul" recently as imported African catfish and tilapia from Vietnam for the aquaculture purposes. Another lternative for diversification and improvement of aquaculture is the rearing of crayfish and hrimps.

The aim of present work is to render affordable assistance in implementation of above stated residential Regulation by analyzing distribution of crayfish species (Crustacea) in the ZRB aterbodies and discuss their suitability and opportunities for introduction to aquaculture.

Water resources available in ZRB for fisheries sector development

The development of agriculture, including aquaculture and capture fisheries in arid lands in entral Asia (CA), has one very common problem, namely– deficit of river freshwater because of rational and inefficient use of water for irrigation. At the same time there are huge volumes of nconventional mineralized return water resources of agricultural origin which are classified by any people as useless waste because of expected low quality [4].

At the same time water resources of the river was used very intensely. Irrational and neffective agriculture especially flourished during the Soviet Union has lead to 100% use of vailable water resources of ZRB and even uses additional water diversion from the mudaryaRiver via Amu-Bukhara machine canal. Improperly managed agricultural practices and outdated drainage systems as well as diversion of untreated domestic and industrial sewage water has lead to salinization and contamination of surface waters [5]. According to studies from 15 to 40 t salts/ha from the irrigated land are diverted to natural aquatic ecosystems via drainage systems. Within the entire Amudarya river basin annually more than 100 mln t of salts are diverted to rivers and natural depressions causing salinization of downstream lands, waters and peripheral lakes of anthropogenic origin [6].

As a result, in the Zarafshan river itself the salinity of water increases from 0.3 g/L in upstream to 1.6–2.8 g/L in downstream which makes it unsuitable for drinking and irrigation purposes. The levels of industrial pollutants such as ammonium and some of heavy metals exceed the guideline levels proposed by World Health Organization and FAO [7].

Thus it can be expected that the water quality of most peripheral lakes of anthropogenic origin, as well as some reservoirs lakeTodakul and Shorkul still does not correspond recommended international and national guidelines. However, namely these waterbodies (table 2 and 3) were and still compile main fishery waterbodies of the region.

Table 2. Waterbodies (lakes) of the ZRB.

Waterbody	Water surface area, ha	Depth, *m*		Transparency, *cm* (Secchi disk)
		average	Max.	
Ayakagitma	14,200	8–10	40	≤300
Dengizkul	35,500	8–10	30	≤220
Karakyr	26,200	1.5–2	5	≤300
Tugkan	7,900	1–2	8	≤270
Khadicha	12,300	2–3	6–8	≤200
Shorkul reservoir	5000	3–4	10–15	≤ 180
Todakul	22700	5–7	17	≤180
Western Aydarkul	151000	12.5	33.6	≤500

Table 3. Water quality of the (lakes) of the ZRB.

Waterbody	Salinity, g/L	pH	Dissolved oxygen, mg/L	Chemical oxygen demand, mgO/L
Ayakagitma	7.31–9.23	7.0–8.6	6.2–7.6	48.7
Dengizkul	17.0–20.58	8.2–8.8	5.0–6.8	15.5
Karakyr	10.69	8.0	3.6–5.8	41.5
Tugkan	2.66–4.30	7.9–8.2	5.8–6.2	24.4
Khadicha	4.15–22.00	8.1–8.6	2.0–8.6	43.5
Shorkul reservoir	1.70	7.6–7.8	5.2–8.8	23.9
Todakul	1.5–4.0*			
Western Aydarkul	8.10–10.30	6.60–8.13		21.4–56.1

* [8]

However, the waters used for fish farming are limited and very dependent on the quantities of water not used for irrigation. The excess water from the irrigated fields is often not led back into the river, usually to avoid contamination and salinization. It is gathered in so-called collectors and parallel to the river into sometimes huge lakes (for example, TudakulLake, Kuyimazarskoje reservoir, Solyonoye lake) to evaporate there. Many of these collectors bring the water directly into the desert and it evaporates there. Fish ponds are not filled with this water, since the salt content is usually 3–7 g/L, which is too high for the offspring of almost exclusively bred carp.

Alternatively, the rising of crayfish and shrimps should be even promoted by a higher salinity of the water. For a higher salinity foster the fertilisation of eggs and the rise of juveniles probably by facilitating the process of moulting in such an environment [9].

Suitable for aquaculture Shrimp and Crayfish species (Crustacea) in the ZRB and their biology

The technology and culture systems Crustaceans are already an integral part of the agricultural value chain in many countries. A possible protein supplier, already successfully cultured and even exported in many neighboring countries (Turkey, Iran, Armenia), is Galician crayfish (*Astacus leptodactylus* Eschscholtz, 1823). This can tolerate up to 14 g/L salt content. Turkey supplies about 90% of its crayfish production to Western Europe. The next installations are in Armenia, Azerbaijan, Iran and possibly in Turkmenistan (not known), also Kazakhstan has not such an industry yet. In Central Asia, crayfish breeding has not yet been established.

Also the freshwater shrimp *Macrobrachium nipponense* De Haan, 1849 (fig. 1) is a possible aspirant for aquaculture. Farmed production of this freshwater prawn in China was in 2007 192397 t, almost none was reported a decade earlier [10, 11, 12].

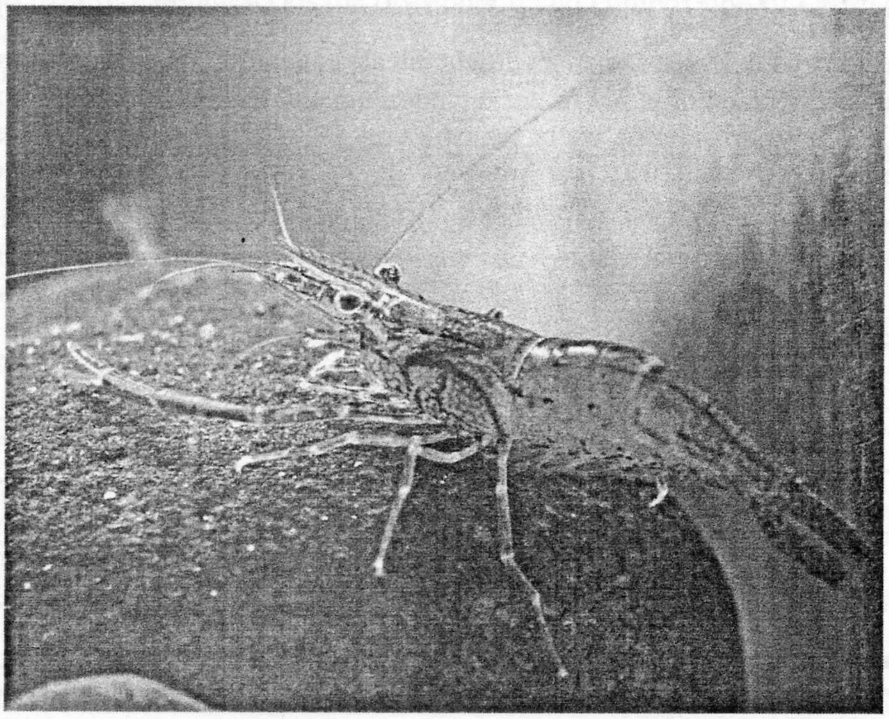

Fig. 1. The freshwater shrimp Macrobrachium nipponense De Haan, 1849 (CC BY-SA 2.5, https://commons.wikimedia.org/w/index.php?curid=16852541).

Pacific white shrimp are among the most widely cultivated shrimp in the world. In shrimp farms situated on Sonora Desert, Mexico, e.g. Pacific white shrimp *Penaeus vannamei* Boone, 1931 is cultivated by direct using pumped seawater (salinity 35 g/L) from the Gulf of California (fig. 2). We have visited this farm in 2010 and were told that this is due mainly to ease of cultivation and rapid growth rate; harvesting begins after 120 days. The shrimp grew from 1.2 g to about 20 g in 120 days. Quality of pond-raised shrimp is normally high, owing to strict controls and the lack of at-sea time that accompanies shrimp harvested from the wild.The species is found in waters with a wide salinity range (1 to 40 ppt). The high tolerance of *P. vannamei* to low salinity and the year-round availability of healthy post-larvae (PL) make this species an excellent candidate for inland farming [13].

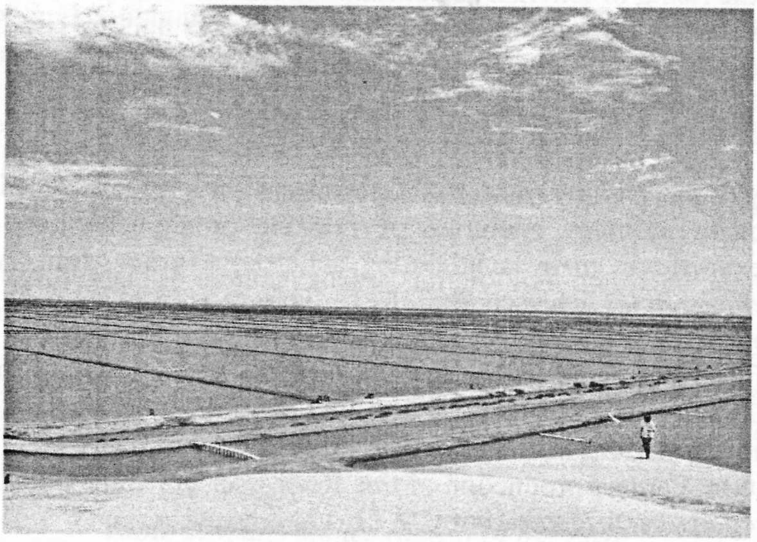

Fig. 2. Shrimp ponds fed by seawater in Sonora Desert, Mexico (Photo B. Karimov, 2010).

Analyses of hydrophysical and hydrochemical indicators of waterbodies in ZRB have revealed the suitability of salinity, pH, water temperature, etc. for the culture of Crayfish (see tables 2, 3 and fig. 3). Regarding suitable water temperatures for crayfish culture, the period of the year with temperatures higher than 10°C (see graph in fig. 3) can be accepted as active culture period i.e. from early April to late October – 7 months.

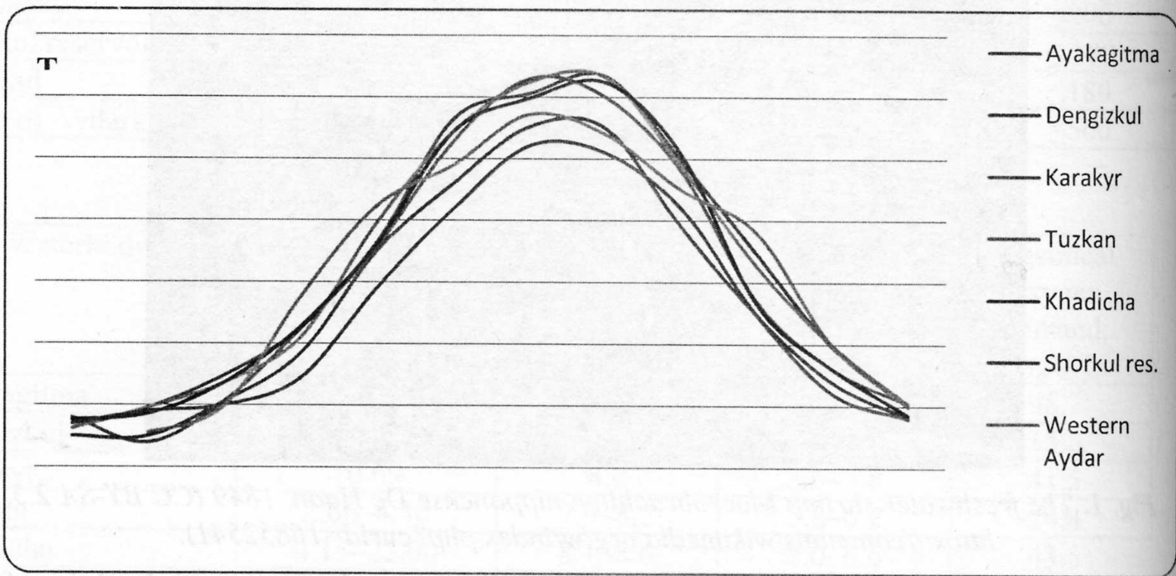

Fig. 3. Water temperature profile of main fishery waterbodies of ZRB (based on Uzhydromet data).

Above stated species have already been found several times in Uzbekistan. Wild catches are used sporadically. This shows that there is the possibility to use crustaceans in aquaculture. The following larger shrimp and crayfishes are so far known from Uzbekistan and Kazakhstan: *Macrobrachium nipponense, Caspiastacus pachypus* (Rathke, 1937), *Pontastacus leptodactylus leptodactylus* (Eschscholtz, 1834) *P. leptodactylus boreoorientalus* (Birstein and Winogradov, 1934) Turkestan crayfish – *P. kessleri* (Schimkewitsch, 1884), *P. eichwaldi eichwaldi* (Bott, 1950), Caspian crayfish – *P. eichwaldi* was accidentally introduced and is partly used commercially.

But nevertheless the biodiversity of Crustacea in Uzbekistan is still widely unknown. There are only isolated findings that have been mentioned in the literature. In the Shorkul water reservoir e.g. *Pontastacus kessleri* and *Macrobrachium nipponense* are caught and marketed in some years. A comprehensive study of the distribution and diversity of the various species that are suitable for aquaculture is overdue. Also in view of problems of imported species for economic purposes. The effects of such neozoans on the native animal world cannot be estimated if reliable data on the local fauna are not available. Moreover, it is much more effective when native animals are used for aquaculture, since they have already adapted to the prevailing environmental conditions. To anchor these questions and work in the scientific landscape of the participating institutions is a significant step forward in a sustainable development of the country.

Way forward

Freshwater prawns are suitable candidates for inclusion in policulture systems and in integrated aquaculture-agriculture. By occupying bottom niche of fish ponds they generate additional aquatic food products in fish farming.

In order to introduce large-scale commercial aquaculture practices of Crustaceans in ZRB following measures are needed to realize taking into account world's leading experience:

- Work out the biodiversity of the Crustacea in the establishment of a network of institutions and private individuals to record crayfish populations in the country.
- Establishment of a database for the distribution and composition of Crustacean fauna in the ZRB and in whole of Uzbekistan.
- Construction of an aquaculture plant for *Pontastacus leptodactylus leptodactylus* on the selected large drainage canal or lake fed by collector water.
- System analysis of the potential risk for the biosystems and the possible breeding of other species of crayfish.
- Biodiversity research: literature study, local fishermen's survey, involvement of the relevant institutions (fish farmers associations, fishery collectives, anglers, etc.), own investigations on different types of water bodies.
- Impact of pollution of the environment, biodiversity, competition potential, degree of pollution of the targeted measures, parasites and known diseases in humans and animals, biological clarification of the waters.
- Establish a relevant information system on biodiversity for general use.

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MATHEMATICAL MODEL OF DIFFUSION OF HARMFUL SUBSTANCES IN THE ATMOSPHERIC BOUNDARY LAYER

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Abstract. This work considers the actual problem related to solving the problem of forecasting and environmental monitoring of air pool of industrial regions, where there is an imbalance of sanitary environmental standards due to the large number of emissions of harmful substances and active fine aerosol particles, and carbon dioxide gases into the atmosphere. In the article for solving the mentioned problem there is a full mathematical model developed to conduct a comprehensive study of the process of transfer and diffusion of pollutants released into the environment from production facilities, which is described by a system of differential equations in partial derivatives with appropriate initial and boundary conditions. To derive a mathematical model of the object there were used the basic laws of mechanics and hydro thermodynamic (conservation equations of mass, energy, balance of power, the state, etc..). Taking into account the main parameters that play a significant role in the process of transport and diffusion of pollutants in the atmosphere: the wind speed and its directions; terrain; absorption coefficient of harmful aerosol fine particles in the atmosphere, etc. We obtain the differential equation for calculating the rate of deposition of fine and aerosol particles, propagating in the boundary layer of the atmosphere, when the principal parameters are considered, which affect the rate of particle deposition: the mass and radius of aerosol particles, density of the atmosphere, air resistance force.

Keywords: mathematical model, transfer and diffusion of pollutants, climatic factor, mechanics, hydro thermodynamics.

Introduction

The rapid development of spheres of production, mining and development of oil, gas and ore deposits, processing of raw materials and general-purpose products, construction of production facilities and settlement blocks has set humankind acute problem – protection of the environment. As a result of a sharp increase of harmful emissions in the industrial regions, the concentration of harmful substances in the atmosphere exceeded the maximum allowable by health norms. Problems related to coal mining, nonferrous metals and other minerals have led to soil erosion and contamination of vast areas of secondary materials and waste production that are a source of pollution of the air-water areas of cities and regions.

It also should be noted that emitted by thermal power stations, factories and production facilities, gas impurities undergo complex chemical reactions, as a result of which new, more toxic substances arise, which did not exist in the original emissions. These inorganic substances are especially harmful emissions of nitrogen oxides and sulfur oxides and carbon dioxide, etc. As we know, all thrown out harmful substances from industrial production objects in the environment (the