

THE HYBRIDS CARP-CRUCIAN AS PROSPECTIVE OBJECT OF FRESHWATER AQUACULTURE

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Abstract. The comparative fish-breeding assessment under underyearlings and three-years-old fish of carp-crucian and of different carp breeds farmed in ponds and the morphofunctional characteristic of the gonads of carp-crucian hybrid females. For hybrid individuals are installed differences of left gonad oocytes from the right gonad on morphological features and on dimensional composition. The diameter of oocytes in the phase "E" of the left gonad authentically is smaller, $P > 0,95$, from sex cells of the right gonad.

Keywords: hybrids, carp-crucian, females, oocyte, gonad-somatic index.

Rezumat. Hibrizii crap-caras obiect de perspectivă al acvaculturii de apă dulce. Este prezentată evaluarea comparativă piscicolă a puietului de crap-caras de o vară și a peștilor de trei veri cu diferite rase de crap, crescute în eleștee și caracteristica morfofuncțională a gonadelor femelelor de crap-caras. La indivizii hibridi au fost stabilite diferențe ale oocitelor gonadei din stânga comparativ cu gonada din dreapta conform indicilor morfologice și compoziției dimensionale. Diametrul oocitelor în faza „E” a gonadei din stânga este veridic mai mic, $P > 0,95$, decât cel al gonadei din dreapta.

Cuvinte cheie: hibridi, crap-caras, femele, oocite, indexul gonado-somatic.

INTRODUCTION

In fisheries a great interest is represented by distant hybridization, which can be used to obtain industrial hybrids, as well as for selection of hybridogeneous rocks. Also, is very important in theory and practice, is the study of fertile hybrids of carp with crucian.

Area of distribution of *Carassius gibelio* covers a large territory - from Japan to Western Europe. In the eastern part of the area circulates mainly the bisexual populations and as we move to the West the percentage of males in the populations *C. gibelio* gradually is decreasing as a result of this species is often represented as same-sex gynogenetic form (GOLOVINSKAIA et al., 1965; KIRPICHNICOV, 1987).

A study of same-sex female's gynogenetic *C. gibelio* demonstrates that they are triploid (TCHERFAS & SHART, 1970). Bisexual forms are similar to the karyotype of carp. This species are called tetraploid ($2n \sim 100$).

Many interspecific hybrids can combine the valuable qualities of parent species. According to some authors, for the vast majority of distant hybrids are characteristic their sterility, which is caused by mismatch of chromosome sets (TCHERFAS & TSOY, 1984).

In such cases, in fish industry are used only the first hybrid generation, the so-called industrial hybrids.

The possibility of selection of hybrids appears at sufficient fecundity of females, which can be used to obtain of backcross hybrids by crossing them with males of the parental species. Increasing the share of heredity in the absorptive crossing one of the parental components can result to increase fecundity of backcross hybrids.

Interspecific hybrids of carp with *C. gibelio* are attractive as objects of fish farming through the possession of a high growth rate, resistance to deficiency of oxygen and some diseases, more complete use of natural forage of ponds – detritus (YARZHOMBEK, 1981).

The aim of our study was to comparative fish-breeding assessment under underyearlings and three-years-old fish of carp-crucian and of different carp breeds farmed in ponds and study the morphofunctional state of the gonads of female's hybrid carp-crucian.

MATERIALS AND METODS

The hybrids of carp-crucian (CC) of the first generation were obtained by artificial reproduction from cross of females of carp breed Teleneshtskiy Frame with genotype ssnn and males of *C. gibelio* (Cg). Growing under-yearlings of hybrids carp-crucian was carried out in separate nursery ponds, and two-and three-years-old fishes - in feeding ponds in policulture with carp and herbivorous fishes under continuous cultivation method.

As a control, were used pure-bred descendants of three breeds of carp: Teleneshtskiy Scaly (Ts) Teleneshtskiy Frame (Tf) and Kuboltskiy Scaly (Ks).

The test and control groups of fish were obtained at the same time. Simultaneously was conducted rearing of larvae and stocking of the similar nursery ponds at stocking density 30 thousand hectares.

During the time of cultivation of under-yearlings were fed 2 times a day of cereal forage mixture, the daily ratio was counted by dates of control catches.

Samples of sexual cells were fixed in Bouin liquid and filled in paraffin-wax with further histological processing by the standard technique. All the studied of females are subjected to the general biological analysis with calculation of gonad-somatic index (GSI). The stages of gonad maturity were determined according to the recommendation of SAKUN &

BUTSKAIA (1963), and development degree of oocytes – after classification of KAZANSKII (1949) with additions proposed by MAKEEVA & EMELIANOVA (1989). Cuts of gonads were colored after Mallory's method (ROSKIN & LIVENSON, 1957). Diameter of oocytes was determined using the ocular-micrometer. All data were processed statistically (LAKIN, 1980). Microphotos were made with the help of the microscope with videocamera "Lomo, Mikmed-2".

RESULTS AND DISCUSSIONS

Comparative growing of pure-bred under-yearlings of carp three breeds and of carp-crucian the first generation showed, that hybrids during the cultivation season had good growth rates, but somewhat inferior to the carp.

All hybrid individuals had completely scaly covering.

At the late growing season the temp growth of carp-crucian hybrids and Kuboltskiy Scaly carp was higher with respect to Teleneshtskiy Scaly and Teleneshtskiy Frame carps (Fig. 1).

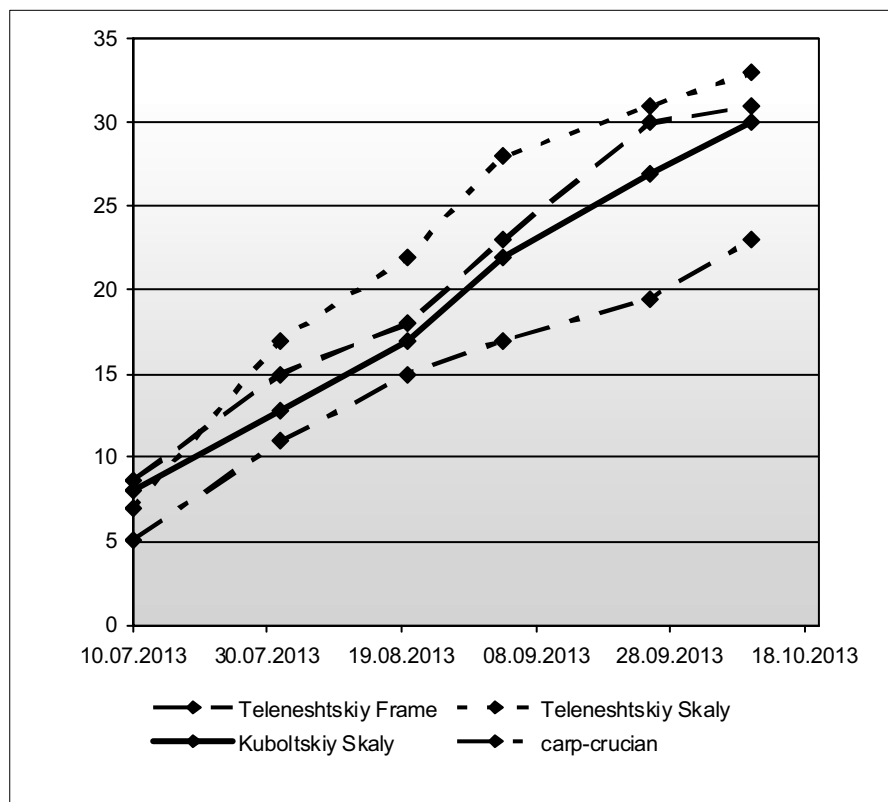


Figure 1. The growth rate under-yearlings of carp-crucian hybrids and of carp three breeds.

Despite the fact that hybrid underyearlings are somewhat inferior to the average weight of carp breeds, but at the expense to their substantial survival (82%), they had a high fish productivity - 570 kg / ha. On forage costs the carp-crucian hybrids are inferior by carp breeds (Table 1).

Table 1. Results of growing under-yearlings of carp and of carp-crucian hybrids.

Fish breeds, hybrid	Were caught			Fish productivity, kg/hectare	Food costs, kg/hectare
	Thousand units	Average body weight, g	Yield, %		
Ts	22.5	33.0	75.0	740.0	2.43
Tf	22.0	31.2	73.0	680.0	2.64
Ks	23.2	30.3	76.0	700.0	2.57
CC	24.6	23.0	82.0	570.0	3.15

Legend: Teleneshtskiy Scaly - (Ts), Teleneshtskiy Frame - (Tf), Kuboltskiy Scaly - (Ks), Carp-crucian - (CC).

Increased viability of carp-crucian hybrids compared to the carp manifested during winter: the yield was 93.4%, with less weight loss body – 5.8%.

In order to estimate the consumption of natural food base of ponds, growing of carp-crucian hybrids was held with carps, *C. gibelio* and the *Silver carp* in fattening ponds with continuous process for two growing season without feeding.

The total stocking density yearlings equaled 2400 units/hectare (Table 2).

Table 2. Results of growing in continuous process of the carp fishes.

Fish breeds, hibrid, species	Were stocked of yearlings		Average body weight of three-year-olds, g	Yield, %	Gain of weight, g	Fish productivity, kg/hectare
	Units/hectare	Average body weight, g				
Ts, Tf, Ks	500	27.0	$\frac{758}{510-940}$	61.0	731.0	230.0
CC	400	22.0	$\frac{567}{350-830}$	62.5	545.0	140.0
Cg	300	25.0	$\frac{318}{170-480}$	65.0	293.0	60.0
SC	1200	36.0	$\frac{1170}{1050-1390}$	58.3	1134	810.0

Legend: Teleneshtskiy Scaly - (Ts), Teleneshtskiy Frame - (Tf), Kuboltskiy Scaly - (Ks), Carp-crucian - (CC), *C. gibelio* - (Cg), *Silver carp* - (SC).

The results of co-cultivation in polyculture of three-years-old carp fishes showed that the level of the trophic utilization of ponds was high. Natural productivity of the ponds was 430 kg / hectare, excluding herbivorous fish. The best gain of body weight that is characterized by the three-years old carp - 731 g, intermediate held carp-crucian hybrids - 545 g, *C. gibelio* increase weight by 293 g.

The share of productivity of carp-crucian hybrids was 32.6% or 140 kg / ha.

Thus, you can use the carp-crucian hybrids when organize the pasture of fish farming for the effective use of natural forage, excluding the costs for concentrated feed, which will increase the productivity of water bodies and decrease costs of farmed commercial fish.

Very often a wide hybrids in the first generation of fish is detected phenomenon of same-sex male sterility.

According to some authors (TCHERFAS, 1971) when crossed females unisexual forms of *C. gibelio* with a males bisexual forms, or with males closely related species, obtain the posterities inherit only maternal characteristics and preserve the natural fecundity.

We investigated the females of carp-crucian hybrids and *C. gibelio* for the duration of works on reproduction

The females *C. gibelio* in the period were of the spawning process and in the pre-spawning state. And right and left gonads in both females hardly differed by their weight (Table 3).

Table 3. Biological characteristic of females *C. gibelio* and hybrid of carp-crucian.

Fish species, hybrid	Body length cm	Body weight, g	Gonad weight, g		Weight of all gonads, g
			Right	Left	
<i>Carassius gibelio</i> ♀	20,0	242	23,0	18,0	41,0
<i>Carassius gibelio</i> ♀	26,0	566	22,0	20,0	42,0
<i>Carp-crucian</i> ♀	32,0	820	11,0	143,0	154

In the gonads of females spawning finishes *C. gibelio* are present follicular emptied membranes, yolk oocytes not spawned in a state of resorption and sex cells of period trophy-plasmatic growth of the new generation, which is also touched upon process of degeneration. In the oocytes in the intensive phase of vitellogenesis, there is a process of destruction of cortical vacuoles, swelling of your own membrane with the release of the content of the oocyte under follicular epithelium (Fig. 2).

Gonad-somatic index (GSI) of females spawning finished *C. gibelio* is 8.71%. As at the given individual is a total resorption of oocytes of the next generation, her spawning in the current season is finished.

Females with a smaller body or weight are in the process of spawning, and their gonads correspond V stages maturity. Shedding of eggs occurs in the small portions, as at the time of catch of females, in the gonads contain a small amount of empty follicles, oocytes are in maturing phases (phase F), and finished vitellogenesis (phase E), the size of which is an average of $886 \pm 9,0 \mu\text{m}$, as well as younger cells in all phases of vacuolization. The Gonad-somatic index rather high also makes 23; 29%.

Its important to mention be noted that some of the oocytes in the phase of "E" have been subjected to degenerative changes (Fig. 3).



Figure 2. Resorption of the oocyte *C. gibelio*. Plot of follicular epithelium in the process phagocytosis of yolks granules (original).



Figure 3. Degenerative changes of the oocyte *C. gibelio* in a phase "E".
Destruction of cortical vacuoles (original).

By references of GOLOVINSKAIA et al., (1965) sexual maturation of *C. gibelio* in ponds of Moldova there comes at the age of 1+ and 2+ with a length of 12.6; 17.0 cm and average weight of 58; 160g, respectively. Investigated by us individuals are re-maturing fishes. According to the GOLOVINSKAIA et al., (1965) at the beginning of June, at such females happens shedding the third portion of eggs.

In the same time hybrid females of carp-crucian, which also participate in spawning are investigated. The process of spawning at females of carp-crucian at the time of the study is not finished. The presence in an ovary the emptied follicular membranes indicates the ovulation and spawning matured oocytes (Fig. 4).

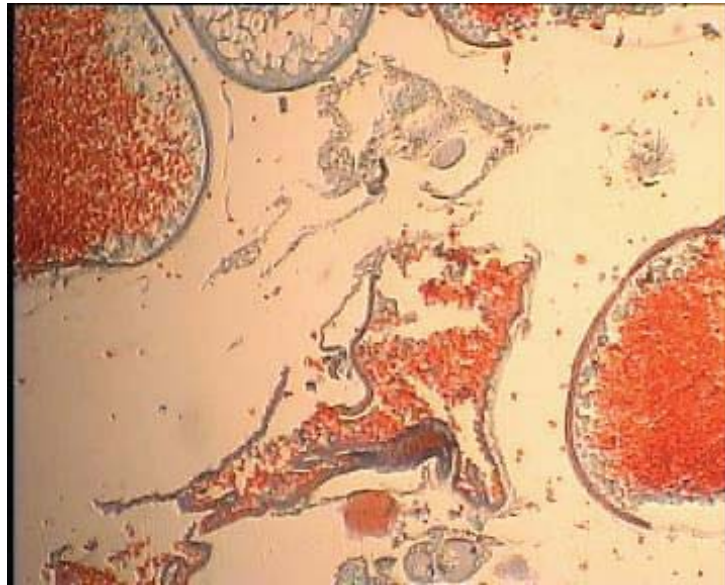


Figure 4. The fragment of ovarie of hybrid female in the process spawning. One can see the empty follicular membranes and not ovulated oocyte in the process resorption (original).

The morphometric analysis the gonads of hybrid females showed the different dimensions of gonads. The histological analysis revealed differences of oocytes left gonad from right by morphological characters and dimensional structure (Table 4).

Table 4. Reproductive ability of *C. gibelio* and hybrid of carp-crucian.

Fish species, hybrid	Body weight, g	Gonad-somatic index (GSI),%			Oocyte dimension, μm	
		Right gonad	Left gonad	all gonads	Right gonad	Left gonad
<i>Carassius gibelio</i> ♀	242	13.06	10.23	23.29	886±9.0	
Carp-crucian ♀	820	1.86	24.20	26.06	858±10.3	818±7.5

Analysis of oocytes right gonad revealed similarities with oocytes of *C. gibelio* on dimensional composition. Their diameters are in the phase of "E" authentically are not different (Table 4). At the same time is traced their similarities by morphological characters (Fig. 5).



Figure 5. The oocyte in a phase "E" at hybrid female of carp-crucian in right gonad (original).

And when we compare the size of oocytes left gonad of hybrid female with oocytes of *C. gibelio* noted their reliable difference $P > 0.999$. The diameter and morphology of oocytes left gonad of hybrid female differed from oocytes the right: oocytes of left gonad next generation were in a phase of intensive vitellogenesis (D6) and has a smaller diameter. We believe that the structure of the sex cells in the left gonad similar to that of carp oocytes (Fig. 6).

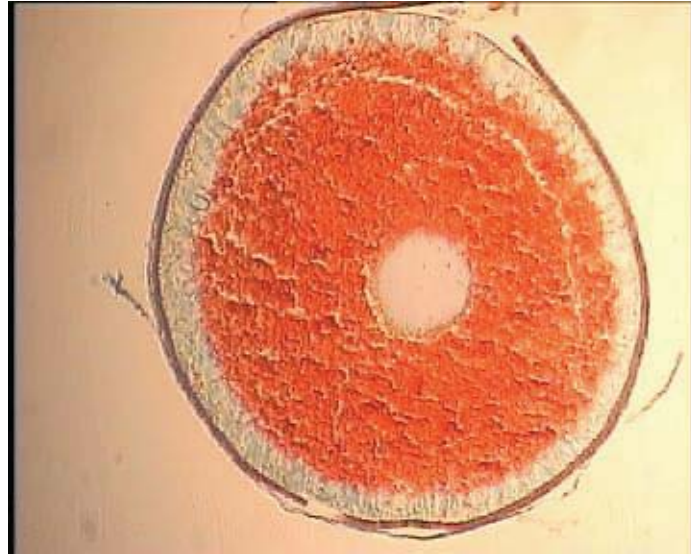


Figure 6. The oocyte of hybrid female carp-crucian in left gonad in a phase of intensive vitellogenesis "D₆" (original).

It should be noted that all oocytes in left gonad, aren't affected by how - either destructive changes, unlike sexual cells - in the right. In the latter, all the cells of tropho-plazmatic growth of the next generation affected the process of resorption.

CONCLUSIONS

After the research that was made, we can mention the main ideas. So we had revealed that:

- the under-yearlings carp-crucian hybrids have substantial survival and a high productivity;
- the carp-crucian hybrids can be effectively used for growing in continuous process of commercial fishing at the expense to natural forage, but only up to the age of three – beginning of their sexual maturity;
- there is a difference between morphofunctional state of the gonads of females *C. gibelio* and carp-crucian hybrids.

Also we had discovered the different-dimension of gonads and different-quality of oocytes in the right and left gonads of hybrid females.

REFERENCES

- GOLOVINSKAIA KLAVDIA, ROMASHOV D., TCHERFAS NINA. 1965. *Odnopolie i dvupolie formi serebreanogo carasea (Carassius auratus gibelio BL.)*. Edit. Voprosy Ihtiologii. Moskva. **5**(6): 614-629. [In Russian].
- KAZANSKII B. N. 1949. *Osobennosti funkcionirovania iaicnika i ghipofiza u rib s portionnim ikromitaniem*. Trudi Lab. Osnov ribovostva L. C. Edit. Nauka. Moskva. **2**: 64-120. [In Russian].
- KIRPICHNICOV V. 1987. *Genetika i selektia ryb*. L. Edit. Nauka. Moskva. 520 pp. [In Russian].
- LAKIN G. 1980. *Biometria* Moskva. Edit. Vishaia shkola. Moskva. 291 pp. [In Russian].
- MAKEEVA ALLA & EMELIANOVA NATALIA. 1989. *Periodizatsia oogeneza u carpovyh ryb*. Edit. Voprosy Ihtiologii. Moskva. **29**(6): 931-934. [In Russian].
- ROSKIN G. & LIVENSON L. 1957. *Microscopiceskaia tehnicia*. Edit. Sovetskaia nauka. Moskva. 487 pp. [In Russian].
- SACUN OLGA & BUTSCAIA NADEJDA. 1963. *Opređenje stadii zrelosti i izuchenie polovyh tsiclov u ryb*. Edit. Nauka. Moskva. 17 pp. [In Russian].
- TCHERFAS NINA. 1971. *Natural and artificial gynogenesis of fish*. Pep. FAO/UNDP (TA). Rome. **2926**: 274-291.
- TCHERFAS NINA & SHART LIDIA. 1970. *O triploidii v moldavskih populeatsiah serebreanogo carasea*. Prudovoe rybovodstvo. Edit. Vniiprh. Moskva. **5**: 276-283. [In Russian].
- TCHERFAS NINA & TSOY R. 1984. *Novie geneticheskie metodi selektii*. Edit. Leogkaia promishlennosti. Moskva. 101 pp. [In Russian].
- YARZHOMBEK A. 1981. *Ustoichivosti k nedostatku kisloroda carpa, serebreanogo carasea I ih gibridov*. Bolezni ryb i vodnaia toksicologia. Edit. Vniiprh. Moskva. **32**: 80-83. [In Russian].