SELECTION OF CARP POPULATION (CYPRINUS CARPIO CARPIO, L) BASED ON MORPHOMETRIC PATTERNS.

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Abstract:

The improved Hungarian carp populations of scaled phenotype (*Cyprinus carpio carpio* L.,1758) of two cyprinids cultivation ponds of Tapiza and Klos respectively near Fushe-Kruja and Elbasan regions were used in this study. Six indices calculated from morphometric measures are analysed. The populations age was from 0 + (from fingerling up to 11 months) and 1+(12 up to 23 months). The aim of study was to use the exterior indices in a selective breeding program for semi intensive cultivation conditions. Significant differences are noticed for body height index (1/H), head length index (1/cf) and index of body compress feature (O/*1*)at age of 0+ up to 1+ ($p>0.999$). After this age the differences were small. There was not significant differences for the index of body compress feature (O/*1*) at respective age ($P<0.95$). Condition coefficient(Kf) and zootecnic coefficient (Kz) increased in absolute values by age 0 to age 1+ and then the values reduced because of limited feeding. The proposed selection schemes dictate the inclusion of all exterior indices during the interval of age group 0+ up to 1+. At ages 1+ up to 2+ the selection scheme may include four indices. At ages of three and four years the selection must be based only on head length.

Keywords: carp, selection, morphometric measures, exterior indices

1. Introduction

The study of genetic aspects and effective selective breeding of cultivated fish, crustaceous and molluscs has lagged behind in comparisons with farm animals. In fact the farmers and specialists have not been interested to introduce improved breeds in aquaculture. This is because of preservation of genetic constitution of natural spices and avoiding of genetic pollution of natural habitats.

In general the attempts of farmers to increase fish production and reducing its cost is done more improving the production technologies and specially feeding practices than through selective breeding of cultivated ichthyic spices. In few words main attention is focused on fitting the environment to live organisms than the opposite.

In carp, morphologically different scale phenotypes develop due to the fact that the inheritance of scale pattern in carp is governed by alleles at two autosomal loci (S/s and N/n) with epistatic interaction [10, 6, 7]. Common carp with the "wild type" fully scaled phenotype carry the gene "S" and can be either homozygous (SSnn) or heterozygous for this allele (Ssnn). Mirror carp are always homozygous recessive (ssnn). Other combinations involving the "N" gene result in two other scale phenotypes (line or scattered carp: SsNn or SSNn, and naked carp: ssNn) as well as lethal combinations (SSNN, SsNN and ssNN), due to severe pleiotropic effects of the "N" gene on viability, development and fin-shape [7]. The fully scaled body type of common carp is considered as "wild type" [10, 1, 2]. Small head and high back are typical features of this breed. Among four scale pattern phenotypes scaled carp is characterized through an elongated, torpedo-shaped and fully scaled body, a smaller gape size and smaller head dimensions relative to the mirror carp, which is only partially scaled, but larger scales, and also has a more humpbacked, compact body [10, 1, 2]. The domesticated types can obviously be distinguished by the wild form, manifesting some features that can be considered as "economically adequate". Some of the imported features of domestic types are high growing dynamic, bigger body mass, larger mouth, small head, high back, higher meat beam, longer intestine and better using of plant feed resources.

The development of cyprinids cultivation on semi intensive conditions is favoured by rather simple cultivation technology, low production costs, and available market especially in rural areas.

The main objectives of selective breeding programs in aquaculture also for carp fish are as follow:

- improving the efficiently of feed conversion (IC)

- Improving the organoleptic indicators, the meat quality and increases of edible parts percentages of fish(the indicator of meat beam).
- Better survive through reduction of sensibility to the stress factors and increasing of the resistance to pathogens and unfavourable environment conditions.

Although the recently salmonids and sea fish economic boom, the traditional types will be required specially by local markets because of traditional consume and low selling prices. Carp is the main traditional spices cultivated in Albanian semi intensive conditions. The implementation of some selective actions in addition of the improvement of cultivation technologies could make more profitable this activity.

The study aimed to evaluate some exterior indexes of improved Hungarian Carp of scaled phenotype and using them in a selective breeding program. The exterior indexes used are characterized by a significant statistically variance [8].

2. Material and Methods

The improved Hungarian carp populations of scaled phenotype of two cyprinids cultivation ponds of Tapiza and Klos respectively near Fushe-Kruja and Elbasan regions were used in this study. Various body measurements were carried out according to Munshi and Srivastava, [9], with certain modifications. The populations age was from 0 + (from fingerling up to 11 months) and 1+(12 up to 23 months).

2.1 Measurement of morphometric characteristics.

Total length (L cm).

It was measured from the tip of the snout to the tip of the caudal fin, i.e. the greatest distance between the most anterior projecting parts of the head to the posterior most tip of the caudal fin. The measurement was a straight line.

Standard length (*l* cm).

It was measured from the tip of the snout to the base of the caudal fin. It was straight distance from the anterior most part of the head to the end of the vertebral column/caudal peduncle.

Height or depth of body (H cm)

It was measured along the vertical line at the deepest part. It was the vertical measurement from a point on the body of the fish on its back when its height was

Greatest to a straight line to the ventral most surface or profile. It needs not necessarily to be in the middle of the fish.

Head length (cf.cm).

It was a straight measurement of the distance from the tip of the mouth or snout to the most distant point on the opercula membrane.

Length of pectoral (*girth*) (O cm)

It was the measurement of the length from the highest point of the back going round the ventral body up to the starting point of measuring. (Figure 1)

The total weight (W g)

The morphometric measures are done with a metal meter strip . The fish weighing is done with Sartorius electronic balance with accuracy of 0.01g. The height measurements were taken with Vernier callipers to the nearest 0.05 mm. The measurements are done in live fish in cultivation farms environment.

.2.2 Exterior indices used in selective breeding.

Ass suggested previously [4, 5] four indices are used for mass selection of cultivated fish:

- Index of back height or index of body length [5] or L/H). We have used 1/H ratio that means we were based on industrial length.
- index of head length (*l*/cf)
- index of body mass feature (O/H)
- index of body compress feature (O/*1*)

In this category of indices we have classified two other parameters:- condition coefficient –according to Fullton (Kf) according to Barnaham and Baxter [3]:

$Kf = W/l^3 \times 100$

- zootecnic coefficient (Kz):

$Kz = W/1.H.O \times 100$

The data of morphometric patterns were elaborated to calculate the exterior indices and using these last parameters for carp selection in different ages. The data were elaborate according to ANOVA procedures to determine the differences criteria (tD) and probability level(p).

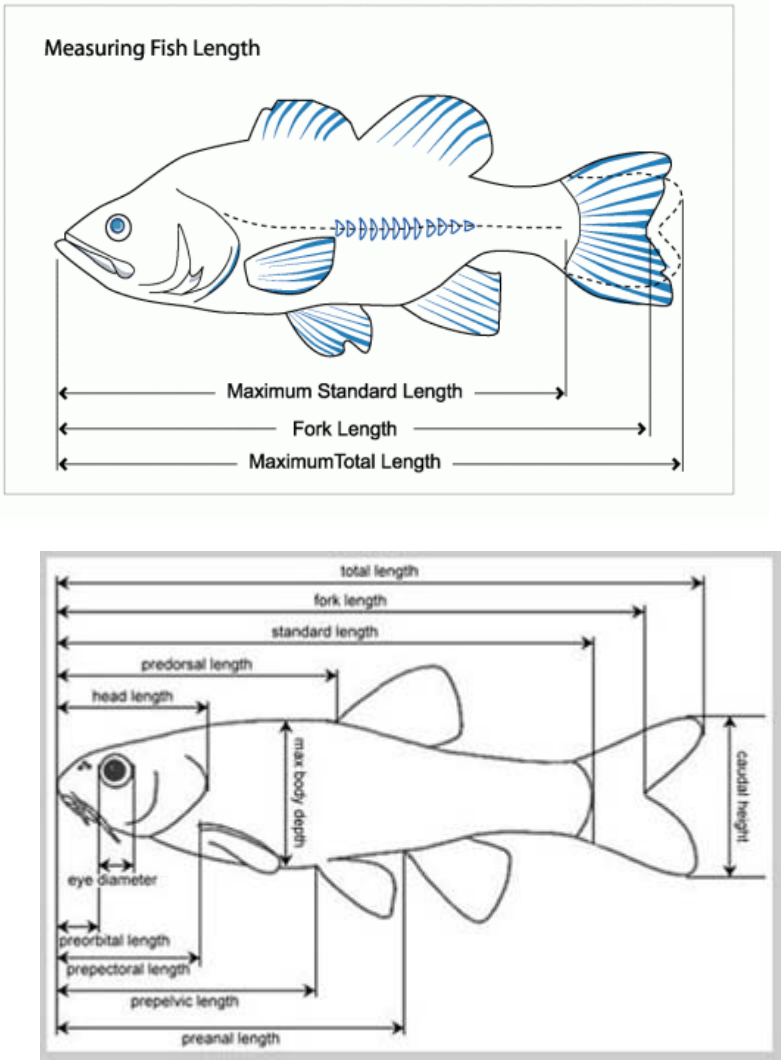

Figure 1 Measurement of morphometric features**.**

3. Results and Discussion

3.1. The dependence of exterior indices by the age of sampled individuals.

A distinguishing feature of fish is that over the ontogenesis, along quantitative changes which are expressed with the increasing mass of all body systems, morphological changes of qualitative features occur. Possible changes of exterior indices values with the advancing age of fish are shown in Table 1. The fish measured are considered as component of one population.

Body height index (1/H) :

There were significant differences between the values of this index during 0+ up to 1+ age.(tD =3.95 and p>0.999). During 1+ to 2+ age, although the differences were small they still remained statistically significant (tD=2.625 and p>0.95). They were not significant at ages of 2+ to 3+ (tD=0.733 and p<0.95). Hungarian carp of scaly pattern changed the standard length and body height ratio during the growing period of 2+ to 3+ age.

Table 1. The exterior indices values at four ages of scaly pattern Hungarian carp.

Age	Indices					
	1/H	O/1	O/H	1/cf	Kf	Kz
0+	2.516	0.919	2.309	2.974	2.85	8.07
1+	2.63	0.875	2.298	3.439	3.01	8.32
2+	2.541	0.876	2.221	3.324	2.54	7.78
3+	2.563	0.875	2.24	3.449	2.39	7.33

The data show that Hungarian carp of scaly type during the growing period up to the age of three years (2+) changed the ratio between the standard length and maximal height. The body height index increased rapidly during the first and second year of life and thereafter it values stabilized in characteristic breed edges.

Head length index (1/cf) :

A big difference is noticed between industrial length and head length ratio during fingerlings phase up to age of one year and few months later. The tD statistical elaborated value was 15.64 for p>0.999. The growth rate of head was slower compared with body length growth, which is after a biological phenomenon known for vertebrate's ontogenesis.

During the transition from age 1+ to age 2+ and from age 2+ to age 3+ the changing rate of head length index decreased. Corresponding values of tD were 3.026 and 2.63 for probability level of p>0.99 and p>0.95. There have not been done studies in population of older ages, but it is likely to expect the stabilization of index values at the age of 4+.

The index of body mass feature (O/H):

In the studied population there have not been observed statistically significant differences in the values of this index during the transition from age 0+1+(tD=0.478 and p<0.95). Perhaps it is necessary to repeat the study for this index with a greater number of individuals in order to be sure for the result. .

Significant differences are noticed in this index values by the age of two years up to three years(tD was 3.59 and p>0.99). There are not significant differences by the age of three years up to four years (tD=0.935 and p<0.95).

Index of body compress feature (O/*1*) :

Significant differences are noticed for this index values during the transition from age of 0+ up to age of 1+ (tD =4.19 and p>0.999). After this age the differences were small and not statistically significant. (tD from age of 1+ up to age of 2+ was 0.105 while from age of 2+ up to age of 3+ was 0.098).

Condition coefficient (Kf):

Condition coefficient increased in absolute values by age 0 to age 1+and then the values reduced. There is highly probable that in other growing conditions the dynamics of this indicator should be variable. The carp of Hungarian type is very greedy fish and quite suitable to be cultivated in intensive type systems. The values of condition coefficient depend mainly by the feeding conditions. Not sufficient additional feed has been the main factor of values fall of Fullton coefficient in our population.

Zootecnic coefficient (Kz) :

This indicator followed the dynamic of condition coefficient. The same reasoning's made above are valid for this coefficient.

3.2. The effect of age on the possibility of selecting fishes, based on the implementation of exterior indices.

The results shown above have been used to determine the selection schemes during specific age. The exterior indices are used to evaluate the individuals. The results of changes of exterior indices values during different ages are given in Table 2.

Table 2. Values of exterior indices during the increasing of fish age (0+ up to 3+).

Index **Age**	**1/H** **(tD) p**	**O/1** **(tD) p**	**O/H** **(tD) p**	**1/cf** **(tD) p**	**Kf** **(tD) p**
0+ -1+	3.958>0.999	4.19>0.999	0.478<0.95	15.64>0.999	3.06>0.99
1+ -2 +	2.625>0.95	0.105>0.95	3.59>0.99	3.026>0.99	1.72<0.95
2+ -3+	0.773<0.95	0.098<0.95	0.935<0.95	2.63>0.95	1.80<0.95

Based on the results presented in Tables 1 and 2 the proposed selection scheme could be as follow (table 3). As it results from the proposed scheme, the selection performed at age 1+ includes all exterior indices. The selection carried out in the range of ages 1+ up to 2+ may include four indices. The condition coefficient can be also included despite the fact that changes in its values at these ages are not statistically proven. If the selection will be done at ages of four years it will be based only on head length indices.

Table 3: Possibility of selection in particular age group of "scaly" carp. [Selection (+): lack of selection scheme (-)].

Index	**1/H**	**O/1**	**O/H**	**1/cf**	**Kf**
Age					
0+ -1+	+	+	-	+	+
1+ -2 +	+	+	+	+	-
2+ -3+	-	-	-	+	-

Figure 2. Partial view of Tapiza farm. Ponds for Carp fingerlings treatment.

For many reasons the progress of this scheme has a relative nature. For indices whose values depends very much on farming conditions (O/1,O/H, Kf) it is obligatory to fill the schemes with such data: relevant system of cultivation, intensification level, feeding scheme and feeding values of feed rations especially their protein energy ratio, feed conversation ratio, the level of water exchange, the regime of dissolved oxygen in water, the temperatures regime, density of fish breeding etc. In case of selection which has been effected by the elevation of body height index, the tendency must be the selection of individuals who have low values of this indicator (always lower than 2.5). Regarding with the length head index the selection trend should be towards individuals that have high values of it's (as close as 3.5 values). Similarly the selection for the condition index must try to fix the population value as close to 3.0.

Three mentioned indices should be considered compulsory during the implementation of breeding improvement operations for productive features.

4. Conclusions

- Compilation and implementation of selection schemes for farmed carp (*Cyprinus carpio carpio* L.,1758) should be based on the variability level of indices during the transition from one age to another.
- During the growing period up to the age 2+ the ratio values between the industrial length and maximum height vary. The index values of head length reduced with increase of age and seem to stabilize completely at age of 4+. Regarding the reduction of condition index values (determined according to Fullton) with increase of age the main reason must have been a deficiency of added feed.
- The proposed selection schemes dictate the inclusion of all exterior indices during the interval of age group 0+ up to 1+. The selection during the interval between the ages of 1+ -2 + could include four indices and the conditions index despite of the fact that changes of its values at these ages are not confirmed statistically. At ages of three and four years the selection must be based only on head length.
- The accuracy of application of the scheme proposed in this paper is relative. For indices whose values depends very much on cultivation system (O/*1*,O/H and Kf) it is obligatory to complement the scheme with some information relevant to the cultivation system.

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