PANNON PIKEPERCH: PIKEPERCH HYBRID *SANDER LUCIOPERCA* × *SANDER VOLGENSIS*

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Due to the geographical and climatic conditions of the Carpathian basin, the dominant fish species of standard fish farms is the common carp. According to last year's statistical summary of fish production of pond culture, 75% of the total harvested market-size fish (14,282 tons) is common carp and 1,26% is the rate of carnivorous species (catfish, pikeperch, pike). The amount of pikeperch (*Sander lucioperca*) was only 27,1 tons (0,19%!) (Statisztikai Jelentések, lehalászás Jelentés, 2015, in Hungarian). Because of a market demand for better meat quality and less fattening products the production rate of Hungarian carnivorous fish should be increased. A significant increase of pikeperch production can be achieved only by developing new technologies, similar to intensive trout rearing with pellet feeding. Originally, pikeperch consumes live food, thus, this species require a specific diet.

The lack of knowledge on (pond) culture conditions inhibited evaluation of intensive rearing methods so far. In the last 15 years, research on percids has accelerated. Pikeperch rearing on formulated feeds is a new alternative way for the intensification of its production (Bódis et al. 2007, Kestemont et al. 2007). However, there is another possible way to increase the production of percids. Instead of technology improvement, a new product shall be created which can be implemented and used in a production of pond culture. This way, there is no need for an expensive farm construction. Another species of the European *Sander* genus is the Volga pikeperch (*S. volgensis*) which has perfect meat quality, as well. Although its growth is slower

Table 1. Some differences between the *S. lucioperca* and *S. volgensis* (summarised data from Balon et al., 1977; Specziár & Bíró, 2002; Specziár & Bíró, 2003; Specziár, 2005).

	S. lucioperca	S. volgensis
Duration of the reproductive season in Lake Balaton	first half of April	from mid-April to the end of May, in some years to mid June
Spawning	synchronised, one spawning within a two weeks period (see fig 1.)	non-synchronised, multiple spawnings (see fig 1.)
Reproductive guild	guarders, nesters, fitophyl	nonguarders, open substratum egg scatterers, lito-fitophyl
Distribution	large area in Europe (also occurs outside the distribution range of S. volgensis)	restricted to some river basins of the Black Sea and Caspian Sea (always sympatric with S. lucioperca)
Habitat	rivers, lakes and brackish waters (also occurs outside the distribution range of S. volgensis)	rivers and only some large lakes (always sympatric with S. lucioperca)
Ontogenetic shifting to piscivory	generally it is crucial during the first season, but at latest in the second spring	may be delayed even to third or fourth year of life
Maximum prey size during the first year	often feeds on preys close to the mouth gape width	maximum prey size is less than half of the mouth gape width
Cannibalism	occurs from 14 mm S_L	occurs only from the second year of life

Figure 1. Pikeperch (left) and Volga pikeperch (right) egg stripping

than that of the pikeperch (*Sander lucioperca)*, the Volga pikeperch starts its predatory activity later.

Due to its feeding characteristics, compared to *S. lucioperca* Volga pikeperch can be weaned to accept inanimate feed much more easily, and more efficiently even at older ages and at larger body size (own observation). This transition period was found to be at least two weeks for the pikeperch fry. Weaning of Volga perch fry from zooplankton to pellet demands only 8 to 10 days.

Survival of pellet fed pikeperch is between 44% and 49%, in which cannibalism plays a significant role, while "natural" causes of losses have a ratio of 3% to 14%. No cannibalism was observed in case of *S. volgensis* (Molnár et al., 2006).

It is a very important fact that the western limit of the distribution area of Volga pikeperch is Hungary. For this reason, Western European researchers had no interest in this species, so far.

One possible solution for increasing pikeperch production is to produce a less demanding hybrid of Volga pikeperch and a pikeperch that has a late food training. But the first objective is to assess the characteristics of hybrids.

Inter-specific hybrids have been produced for aquaculture to increase growth rate, combine desirable traits of the two species, to reduce unwanted reproduction through production of sterile or monosex stocks, to take advantage of sexual dimorphism, to increase harvest survival and to increase environmental tolerance (Bartley et al. 2000). Hybridization among species of the genus Sander has been described. The saugeye (*S. vitreus* × *S. canadensis*) has been widely used in North-American aquaculture and stocked for angling purposes to natural waters due to its better growth ability and lower sensitivity to environmental conditions (Tew et al., 2006). Its biological function as a predator was to reduce recruitment and improve growth and size structure of overabundant crappie (*Pomoxis* spp.) populations (Galinat et al., 2002). Growth of Volga pikeperch (*S. volgensis)* is slower than that of the *S. lucioperca* in nature, but the first attempts on feeding Volga pikeperch with dry feed showed that its intensive culture is easier than pikeperch (Bercsényi et al., 2001). The natural hybridization of *S. lucioperca* and *S. volgensis* is rare (Müller et al., 2010), probably because of the differences in their reproductive ethology. Cross-breeding of the two species (*S. lucioperca* female × *S. volgensis* male) could

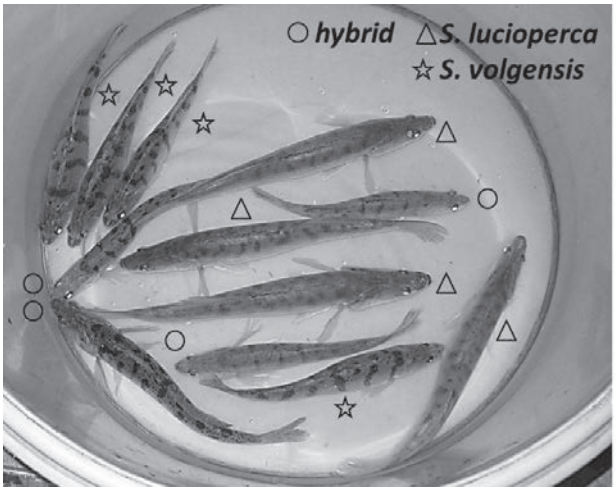

Figure 3. *S. lucioperca, S. volgensis* and its hybrid

be induced in a laboratory with a common propagation technique (Müller et al., 2004; Müller et al., 2006; Müller et al., 2009a).

The newly hatched larvae of *S. volgensis* are smaller (3.25 ± 0.17 mm, Müller et al., 2009b) than those of *S. lucioperca* (5.04 ± 0.05 mm, Ostaszewska, 2005). The growth rate and final size of pikeperch also exceeds those of the Volga pikeperch in natural waters. *S. lucioperca* grows to 145-213 mm at age 1+ (Bíró, 1970; Bíró, 1985; Bíró et al., 1998), while this same size was reached by *S. volgensis* (196 mm) at age 3+ (Specziár and Bíró 2003) in Lake Balaton, Hungary. The potentially more valuable hybrid, (*S. lucioperca* female × *S. volgensis* male) was chosen due to the considerations mentioned above in our studies.

Our recent knowledge on the important features of the hybrid are summarised as follows (Müller et al., 2004; 2006; 2009; 2010; 2011; 2012):

- The first feeding fry of the hybrid can be reared easier and more effectively than the larvae of pikeperch in laboratory conditions. There was a non-experimental observation that the hybrid larvae were not as sensitive to *Costia* infections as pikeperch larvae.
- Weaning of the hybrid juveniles to artificial food was much easier than that of the pikeperch. Volga pikeperch could be weaned to dry feed at a survival rate of 100%. In our case the survival rate of the hybrid was about 90-95%, while in the case of pikeperch the weaning losses varied between 31-88 %.
- The growth rate of hybrid was lower than the growth of the pikeperch but higher than the growth of the perch (*Perca fluviatilis*).
- Hybrids found it difficult to tolerate disturbances during the experimental period. In the mixed group interactions were observed. Hybrids in mixed groups were not as stressed as those in hybrids-only groups.
- According to laboratory experiments, F1 hybrids are fertile. The following fertilisation tests were performed: pikeperch × pikeperch (P), pikeperch × Volga pikeperch (PV) as well as pikeperch × hybrid (PH). There was no significant difference in fertilisation rates: P-86%, PV-85.6%, PH-73.6%.
- According to the three experiments done on the comparative oxygen tolerance of pikeperch and hybrid juveniles, the hybrid performed better than pikeperch in two events. In these experiments, significantly higher oxygen tolerance has been shown in the PH and PV than in purebred pikeperch. In a previous report, hybrid oxygen tolerance was closer to that of the pikeperch, not differing in the value expressed in mg/L, however, the pikeperch tolerated low oxygen concentrations for a longer period of time (Müller et al., 2006). In this experiment, hybrid and PH and PV showed longer oxygen tolerance than the pikeperch.
- Morphological keys for *S. lucioperca* ♀ × *S. volgensis* ♂ hybrid were described. Results of the genetical analyses definitely proved the hybrid status of the investigated fish.
- The natural hybridization of *S. lucioperca* and *S. volgensis* is rare, probably because of the differences in their reproductive ethology. In November 2008 a presumed hybrid was caught from Lake Balaton by fishermen. Results of the morphological and genetic analysis definitely proved the hybrid status of that fish, and mitochondrial sequence analyses showed that the female parent was a *S. lucioperca*. The captured hybrid is definitely a wild born hybrid. Based on scale readings the captured hybrid was aged to 6+ old, therefore it was born one year before the first artificial hybridization attempt (Müller et al., 2004). *S. lucioperca,S. volgensis* and their F1 hybrids can clearly be separated based on multivariate analysis of meristic and morphometric characters. Lateral line, which proved to be the most decisive character in juveniles, supported the hybrid status of the investigated putative natural hybrid.

Further investigations are needed to reveal the quantity traits of hybrids and to compare the hybrid to Volga pikeperch as well as to investigate the possibility of cross hybridization.

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