

NEW, INOVATIVE METHODS AND TECHNOLOGIES FOR PRODUCING VALUABLE CARNIVOROUS FISH SPECIES: THE NORTHERN PIKE (*ESOX LUCIUS*) AND THE PIKEPERCH (*SANDER LUCIOPERCA*)

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The pikeperch (*Sander lucioperca*) and the Northern pike (*Esox lucius*) are one of the most valuable freshwater carnivorous fish species in Europe. The pikeperch has a high importance for human consumption, due to its white, boneless flesh. The pike is one of the predatory fish species most preferred by anglers in Europe.

Pikeperch for human consumption are mostly originating from natural catches, but the yields are decreasing. The traditional production of different age (size) of carnivorous fish (for human consumption, for restocking of natural waters and angling ponds etc.) takes place in pond culture. Here, the success is strongly depending on the weather and the quantity and the size of the prey fish. The most critical period for pike and pikeperch is the transition to carnivorous habit – if the juveniles cannot find enough food organisms at the appropriate size their variance of body weights will increase and this will lead to the onset of cannibalism. The first year, especially the first winter determines the success of producing “up to one-summer old fish”. In a pond culture, the common carp (*Cyprinus carpio*) is the main cultured species. Carnivorous species are additional fish, requiring different conditions like carp. Because of the extant difficulties, the production of carnivorous fish is yearly altering and hard to predict. Market exists all life stages of pike and pikeperch, constantly and at a high quality. There is a high demand and a low production. To supply market demands - besides the traditional (extensive) way - new technologies and methods (intensive rearing and artificial propagation with hormone injection) are required.

The widely used propagation technique for pike is to capture the spawners during the act of natural spawning (in Central Europe it is at the end of February, start of March). There used to be a wide range of fertilization rates, because the oocytes could be overmatured. The improvement of artificial propagation leads to higher fertilization rates and the better quality of the yolk-sac fry.

Pikeperch is a fish with high productivity (the number of 1 kg of dry eggs is 1,5 million – the average GSI of the females is 10 %). The traditional propagation method for

this species employs a special spawning material, the spawning nest, made from various natural and/or artificial materials. Such a nest may be used for collecting eggs either in natural waters or in the hatchery. Using spawning nest requires less work, it is simple, but there are more losses of the eggs. It is unpredictable, and hatching rates are strongly depending on the incubation technique. The artificial propagation of pikeperch, using hormonal treatment is a new technology in the case of this species. The ovulation time differs individually making the propagation difficult - more and special work is needed. This method has the highest efficiency, it is predictable (correct numbers, regarding egg quantity, fertilization and hatching rates), safe incubation (treatment against pathogens). and large scale propagation could be done.

For both species, artificial propagation using hormonal treatment leads to the possibility of out-of-season spawning, which is a crucial step of the intensive rearing in closed conditions.

The using of dry feeds to produce pike and pikeperch is the most predictable way to rear these fish and it is the only way to produce market size fish during the whole year in recirculation systems at high stocking densities.

The weaning process (habituating the fish to consume commercially available dry feeds) is a sensitive and decisive part of the rearing. It's important to reduce the starving of the fish or to get the water fouled due to degradation processes of excessive feed supply.

There are two possibilities to get pikeperch consuming dry feed: weaning pond nursed fish

or weaning the first feeding fry.

The intensive rearing of pikeperch could be done indoor (recirculation system) or outdoor (lake cages) fish farms. With an intensive technology and keeping the fish in closed systems (under controlled conditions, stable water temperature and oxygen content) growing time would be shortened (13-15 months). In lake cages, one-summer old fish could be produced with dry feed to produce large size fingerlings, strong enough to survive wintering.

Pike fry could be grown exclusively with dry feed and to produce nursed fish (3-5 cm) or large size (10-15 cm) fingerlings. Intensively reared pike fingerlings can similarly suitable for stocking purposes.

NOVE, INOVATIVNE METODE I TEHNOLOGIJE ZA PROIZVODNJU PLEMENITIH KARNIVORNIH VRSTA RIBA: ŠTUKE (*ESOX LUCIUS*) I SMUĐA (*SANDER LUCIOPERCA*)

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Smuđ (*Sander lucioperca*) i štika (*Esox lucius*) pripadaju najvrednijim slatkovodnim karnivornim vrstama riba u Evropi. Smuđ je veoma važan u ljudskoj ishrani, zbog svog belog mesa bez kostiju. Štika je predatorska vrsta ribe koju Evropski ribolovci najviše vole. Smuđ, kojim se ljudi hrane, uglavnom potiče iz otvorenih voda, ali ulov opada. Tradicionalna proizvodnja karnivornih riba različitog uzrasta (veličine) za ljudsku ishranu, nasadjivanje otvorenih voda i jezera za pecanje se odigrava u ribn-

jacima. U ovim slučajevima, uspeh uzgoja veoma zavisi od vremenskih prilika i od količine i veličine plena. Najkritičniji period za štku i smuđa je prelaz na mesožderski način života - ako mlađ ne može da pronađe dovoljno hrane, organizama odgovarajuće veličine, variranje telesne mase se povećava i to vodi do početnih stadijuma kanibalizma. Prva godina života, naročito prva zima određuje uspeh proizvodnje „ribe koja je stara do jedne godine“. U ribnjacima, šaran (*Cyprinus carpio*) je najčešće gajena vrsta riba. Karnivorne vrste su dodatna vrsta riba koja zahteva različite uslove gajenja. Zbog postojećih teškoća, proizvodnja mesoždernih vrsta godišnje varira i teško ju je predvideti. Na tržištu stalno postoje štuka i smuđ svih uzrasta visokog kvaliteta. Postoji velika potražnja za ovim vrstama ali je proizvodnja mala. Da bi se zadovoljile potrebe tržišta - osim tradicionalnog (ekstenzivnog) načina uzgajanja - potrebne su i nove tehnologije i metode (intenzivno uzgajanje i veštački mrest sa hormonskim injekcijama).

Naširoko korišćena tehnika oplodnje za štku je hvatanje matica tokom prirodnog mresta (u centralnoj Evropi to je kraj februara i početak marta). Step en oplodnje veoma varira jer jajne ćelije mogu biti prezrele. Napredak veštačkog mresta vodi do boljeg procenta oplodjenja i boljeg kvaliteta mlađi u stadijumu žumancetne kesice.

Smuđ je riba koja ima veliku produktivnost (1,5 miliona jaja u 1 kg suve težine) U tradicionalni metod oplodnje za ovu vrstu spadaju gnezda za mrest napravljena od raznih prirodnih i/ili veštačkih materijala. Ova gnezda mogu da se koriste za sakupljanje jaja i u otvorenim vodama, i u mrestilištima. Korišćenje gnezda za mrest zahteva manje posla, jednostavno je, ali dolazi do većeg gubitka jaja. Ova tehnika je nepredvidiva, a ishod mresta veoma zavisi od tehnike inkubacije. Veštački mrest smuđa, pomoću hormona je nova tehnologija koja se koristi za ovu vrstu ribe. Period ovulacije se razlikuje od jedinke do jedinke, što mrest čini teškim - potrebno je više rada i to na poseban način. Ovaj metod je najefektivniji, predvidiv je (brojke vezane za količinu jaja, fertilizacije i mresta su tačne), inkubacija je bezbedna (tretman protiv patogena) i izvodljiva je oplodnja veće količine jajnih ćelija.

Za obe vrste, veštačka oplodnja pomoću hormonske terapije omogućava mrest van sezone, što je veoma bitan korak ka intenzivnom gajenju u zatvorenim uslovima. Upotreba suvih hraniva za proizvodnju smuđa i štuke je najpredvidiviji način gajenja ovih vrsta. To je ujedno i jedini način za proizvodnju ribe tržišne veličine tokom cele godine u recirkulacionim sistemima sa velikom gustom nasada.

Proces navikavanja (navikavanje ribe da konzumira suhu hranu dostupnu na tržištu) je osetljiv i odlučujući deo uzgoja. Važno je smanjiti izgladnjivanje riba ali i zagađenje vode usled procesa degradacije preterane količine hraniva.

Postoje dva načina za navikavanje smuđa na konzumiranje suvog hraniva: navikavanje ribe odgajene u ribnjaku i navikavanje mlađi pri prvom hranjenju.

Intenzivno gajenje smuđa se može sprovesti u zatvorenim (recirkulacioni sistemi) ili u otvorenim (kavezi u jezeru) farmama riba. Period rasta će biti skraćen (13-15 meseci) zahvaljujući intenzivnoj tehnologiji i gajenju ribe u zatvorenim sistemima (u kontrolisanim uslovima, sa stabilnom temperaturom vode i stabilnim sadržajem kiseonika). U kaveznim sistemima, riba stara jedno leto može da se hrani suvim hranivom i proizvede krupnu mlađ. Ta mlađ je dovoljno jaka da preživi zimu.

Mlađ štuke se može gajiti isključivo suvim hranivom i proizveće najsitniju mlađ (3-5 cm) ili krupnu mlađ (10-15 cm). Intenzivno gajena mlađ štuke može takođe da bude dobra za nasad odnosno poribljavanje.