Arch. Pol. Fish. (2009) 17: 95-98
DOI 10.2478/v10086-009-0008-x

SHORT COMMUNICATION

Artificial off-season spawning of Eurasian perch *Perca fluviatilis* L.

Andrzej Szczerbowski, Dariusz Kucharczyk, Andrzej Mamcarz, Marek J. Łuczyński, Katarzyna Targońska, Roman Kujawa

Received – 31 July 2008/Accepted – 20 March 2009;

Abstract. The aim of the study was to conduct off-season spawning of perch, *Perca fluviatilis* L. Spawners were obtained in late September from Lake Kortowskie. The fish were transported to the hatchery and divided into two size groups: G1 – small fish (30-70 g), and G2 – large fish (200-400 g). All males from G1 group spermiated after a two-month period of photo-thermal stimulation, but only 25% of the males from G2 group produced milt. Better results were obtained with fish that were stimulated after three months of chilling. All the stimulated males spermiated and produced higher volumes of milt. The best results, defined as ovulation success and embryo survival to the eyed-egg-stage, as well as spawner survival rate, were obtained with large females (G2-B) stimulated with a double dose of hormone (2 Ovopel pellets kg^{-1}). The egg strands obtained from females from group A (small and large fish stimulated with GnRHa and metoclopramide at 0.1 and 1 pellet kg^{-1}after 24 hr) were usually fragmented. All females responded to the hormonal injections after 4 to 5 days.

Keywords: percid culture, reproduction, off-season spawning

A. Szczerbowski [✉], M. J. Łuczyński
Department of Aquaculture
The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn
Oczapowskiego 10, 10-719 Olsztyn, Poland
Tel. +48 89 524 10 47; e-mail: aszczer@infish.com.pl

D. Kucharczyk, A. Mamcarz, K. Targońska, R. Kujawa
Department of Lake and River Fisheries
University of Warmia and Mazury in Olsztyn, Poland

Perch, *Perca fluviatilis* L., culture has been developing rapidly in recent years (Kestemont et al. 1996). Many new methods of reproduction (Kucharczyk et al. 1996, 1998, Kouril et al. 1997) and rearing larvae and juveniles in intensive culture have been reported (Melard et al. 1996, Skrzypczak et al. 1998). One of the methods of improving perch aquaculture might be to obtain gametes much earlier than in the natural spawning season. This paper presents the results of artificial spawning of perch a few months before their natural spawning season.

Perch spawners were obtained in late September from Lake Kortowskie (Olsztyn District, Poland). The fish were transported to the hatchery and divided into two size groups: G1 – small fish (30-70 g), and G2 – large fish (200-400 g). The number of females and males in each group was 50 and 30, respectively. Fish from both size groups were kept in separate 1000 l tanks under controlled photo-thermal conditions (Kujawa et al. 1999). The fish were fed a commercial trout diet (Aller Safir, Aller-Aqua, Poland). The fish that did not accept dry food were eliminated from the experiment. Approximately half of the fish were kept for two months (60 days) at a water temperature below 10°C, while the rest of them were kept under these conditions for three months (90 days) at a photoperiod of 4:20 L:D. Following this, the water temperature was raised to 12°C for two weeks, and then to 14°C for the subsequent week. Simultaneously, the photoperiod was changed to 14:10 L:D. The fish from the control group were kept

under the same conditions as those from both experimental groups. The fish were then administered hormonal injections of GnRHa and metoclopramide (Ovopel, Unic-trade, Hungary) from pellets as proposed by Horvath et al. (1997): group A - 0.1 and 1 (after 24 hr) pellet kg^{-1}; group B – 2 pellets kg^{-1}. All fish were manipulated according to the protocol described by Kucharczyk et al. (2001). The control fish were injected with a 0.9% NaCl solution. The fish from all the groups were kept for an additional two weeks after the end of the experiment to observe their survival rate. Artificial reproduction was performed in January, whereas under natural conditions perch spawn in the April – May period.

Although the fish used in the present experiment were collected from wild stock, good results were obtained. Ovopel, which usually works very well during perch reproduction in the natural spawning season, was the hormonal agent used (Kouril et al. 1997, Kucharczyk et al. 2001). All of the small males spermiated after the two-month period of photothermal stimulation (Table 1).

Table 1

Results (mean ± SD) obtained after hormonal stimulation of perch outside of their natural spawning season. Fish were kept for 60 days at a water temperature below 10°C

	Group				
Parameter	Control	G1-A	G1-B	G2-A	G2-B
Spermation (%)	0	100^a	100^a	27^b	25^b
Sperm motility (%)	-	90	90	80-90	90
Sperm concentration (x 10^9 cm^{-3})	-	22 ± 2	24 ± 2	23 ± 3	21 ± 2
Quantity of milt (ml kg^{-1})	-	36^a ± 4	33^a ± 5	14^b ± 3	15^b ± 4
Ovulation (%)	0	0	0	0	0
Mortality (%)	29	30	42	57	62

Values with different letter indices in the same row differ significantly statistically ($P < 0.05$).

This contrasts with the larger fish, as only about 25% of these males produced milt. Generally, small males produced significantly more milt than did the larger fish. The parameters of the milt obtained, such as spermatozoa motility and concentration, were similar. The females did not ovulate after the two-month chilling period. A similar situation was noted during off-season perch spawning when the females were kept for only one or two months in the altered environment (Miguad et al. 2004a). The best results were also obtained with the smaller fish. The mortality noted during the present work was high, and was observed between days 7 and 10 following the last hormonal injection.

Relatively better results were obtained from the group that was stimulated after three months of chilling. All of the males stimulated males spermiated and produced higher volumes of milt (Table 2).

Table 2

Results (mean ± SD) obtained after hormonal stimulation of perch outside of their natural spawning season. Fish were kept for 90 days at a water temperature below 10 °C. Survival to the eyed-egg-stage

	Group				
Parameter	Control	G1- A	G1-B	G2-A	G2-B
Spermation	0	100	100	100	100
Sperm motility (%)	-	80-90	80-90	80-90	80-90
Sperm concentration (x 10^9 cm^{-3})	-	25 ± 3	28 ± 4	27 ± 3	26 ± 3
Quantity of milt (ml kg^{-1})	-	47^a ± 5	52^a ± 6	17^b ± 3	20^b ± 4
Ovulation	0	0	0	95	100
Latency (days)	-	-	-	5-6	4-5
Embryos Survival to the eyed-egg stage (%)		-	-	36^b ± 14	62^a ± 11
Mortality (%)		45	51	41	18

Values with different letter indices in the same row differ significantly statistically ($P < 0.05$).

Significant differences were observed in the percentage of ovulating females between the small (groups: G1-A and G1-B) and large fish (groups: G2-A and G2-B). Females from group G1 did not spawn (Tables 1, 2). The best results in terms of ovulation success and embryo survival to the eyed-egg-stage, as well as the highest spawner survival rate, were obtained with large females stimulated with a double dose of hormone (2 Ovopel pellets kg^{-1}) after three months of chilling (Table 2).

The egg strands obtained from females from group G2-A were usually fragmented. All females responded to the hormonal injection after 4 to 6 days. The latency times were longer than those reported in earlier experiments during the natural spawning season (Kucharczyk et al. 2001); however, they were similar to data obtained by Kouril et al. (1997). The other parameters recorded were quite similar to those obtained during the natural spawning season, with the exception of survival rate. Mortality in the present work was high and was observed between days 7 and 10 following the last hormonal injection.

Temperature and photoperiod are the two main factors that strongly influence spawning success in perch (Kucharczyk et al. 1996, 2001, Wang et al. 2006). The data reported by Miguad et al. (2004b) showed that photoperiod is important in perch gonadogenesis. Variations in day length that imitate those in nature trigger this process. In the present work, the fish were manipulated with both temperature and photoperiod.

The fish that were stimulated after three months of chilling produced much better results. This was also noted by Miguad et al. (2002). The longer chilling period also influenced the results of off-season spawning of Eurasian perch. In the present work, all of the males stimulated spermiated and produced higher volumes of milt (Table 2). The greatest differences were observed in the percentage of ovulation between small (groups: G1-A and G1-B) and large female fish (groups: G2-A and G2-B). While females from group G1 did not spawn, the best results in terms of ovulation success and embryo survival to the eyed-egg-stage, as well as spawner survival rate, were noted in the large females stimulated with a double dose of hormone (2 Ovopel pellets per kg^{-1}). The egg strands obtained from the group A females were usually fragmented. All females responded to hormonal injections after 4 to 5 days. This is later than in other research conducted during the natural reproduction season (Kucharczyk et al. 2001), but quite similar to data obtained by Kouril et al. (1997). The other parameters noted are also similar to those obtained during the spawning season (except breeder survival). Spawner mortality was higher than that noted during the natural spawning season (Kucharczyk et al. 1996, 1998, 2001). Possible contributing factors to this might have been the much longer time that the wild fish were kept under controlled conditions, and the greater number of manipulations the spawners were subjected to. As was shown in the present work, males and females require different periods for successful reproduction during off-season spawning. Males need a shorter period (two months of chilling) than do females (three months). This difference is linked to the phenology of spawning. During the natural spawning season, when the reproductors are collected from natural waters, the males are usually ready to spawn earlier, and many papers report that males were beginning to spermiate during collection (Kucharczyk et al. 1996, 1998, 2001).

The presented data indicate it is possible to obtain juvenile perch during winter a few months before the natural spawning season. This could contribute to the development of new techniques for producing stocking material of this species.

Acknowledgments. The study was financally supported by Inland Fisheries Institute research project S-007 and Polish Ministry of Sciencific Research and Information Technology project No. NN311 2453 33.

References

Horvath L., Szabo T., Burke J. 1997 – Hatchery testing of GnRH analogue-containing pellets on ovulation in four cyprinid species – Pol. Arch. Hydrobiol. 44: 221-226.

Kestemont P., Melard C., Fiogbe E., Vlavonou R., Masson G. 1996 – Nutritional and animal husbandry aspects of rearing early life stages of Eurasian perch *Perca fluviatilis* – J. Appl. Ichthyol. 12: 157-165.

Kouril J., Linhart O., Reiot P. 1997 – Induced spawning of perch by means of a GnRH analogue – Aquacult. Int. 5: 375-377.

Kucharczyk D., Kujawa R., Mamcarz A., Skrzypczak A., Wyszomirska E. 1996 – Induced spawning in perch, *Perca fluviatilis* L. using carp pituitary extract and hCG – Aquacult. Res. 27: 847-852.

Kucharczyk D., Kujawa R., Mamcarz A., Skrzypczak A., Wyszomirska E. 1998 – Induced spawning in perch,

Perca fluviatilis L. using FSH+LH with pimozide or metoclopramide – Aquacult. Res. 29: 131-136.

Kucharczyk D., Szczerbowski A., Łuczyński M.J., Kujawa R., Mamcarz A., Wyszomirska E., Szabo T., Ratajski S. 2001 – Artificial spawning of Eurasian perch, *Perca fluviatilis* L. using Ovopel – Arch. Pol. Fish. 9: 39-49.

Kujawa R., Kucharczyk D., Mamcarz A. 1999 – A model system for keeping spawners of wild and domestic fish before artificial spawning – Aquacult. Eng. 20: 85-89.

Melard C., Kestemont P., Grignard J.C. 1996 – Intensive culture of juvenile and adult Eurasian perch (*Perca fluviatilis*): effect of major biotic factors on growth – J. Appl. Ichthyol. 12: 175-180.

Miguad H., Fontaine P., Sulistyo I., Kestemont P., Gardeur J.-N. 2002 – Induction of out-of-season spawning in Eurasian perch *Perca fluviatilis*: effects of rates of cooling and cooling durations on female gametogenesis and spawning – Aquaculture 205: 253-267.

Miguad H., Gardeur J.-N., Kestemont P., Fontaine P. 2004a – Off-season spawning of Eurasian perch *Perca fluviatilis* – Aquacult. Int. 12: 87-102.

Miguad H., Fontaine P., Kestemont P., Wang N., Brun-Bellut J. 2004b – Influence of photoperiod on the onset of gonadogenesis in Eurasian perch *Perca fluviatilis* – Aquaculture 241: 561-574.

Skrzypczak A., Mamcarz A., Kucharczyk D., Kujawa R. 1998 – The use of a floating pump to collect and transfer live zooplankton as food for percid larvae (Percidae) reared in net cages – Progr. Fish-Cult. 60: 239-241.

Wang N., Gardeuer J.-N., Henrotte E., Marie M. Kestemont P., Fontaine P. 2006 – Determinism of the induction of the reproductive cycle in female Eurasian perch, *Perca fluviatilis*: Identification of environmental cues and permissive factors – Aquaculture 261: 706-714.

Streszczenie

Pozasezonowy rozród sztuczny okonia europejskiego *Perca fluviatilis* L.

Badania miały na celu przeprowadzenie pozasezonowego rozrodu okonia w warunkach eksperymentalnych. Tarlaki pozyskano pod koniec września z Jeziora Kortowskiego i po przetransportowaniu do podchowalni umieszczono w 1000 l zbiornikach, pracujących w systemie obiegu zamkniętego z możliwością modyfikowania warunków termicznych wody oraz warunków świetlnych. Pozyskane tarlaki podzielono na dwie grupy wielkościowe: G1- ryby małe (30-70 g) i G2 – ryby duże (200-400 g). Około 50% ryb przetrzymywano przez 60 dni w wodzie o temperaturze poniżej 10°C, natomiast pozostałe ryby przetrzymywano w tych samych warunkach przez 90 dni. W okresie fazy schładzania długość cyklu świetlnego (światło : ciemność – L : D) ustawiono na 4:20. Po tym okresie przez 3 tygodnie podnoszono temperaturę wody do 14°C, jednocześnie stopniowo zmieniając cykl świetlny na 14:10 L:D. Po zakończeniu cyklu stymulacji foto-termicznej, w celu przyspieszenia dojrzewania płciowego, zastosowano iniekcję hormonalną przy użyciu preparatu hormonalnego Ovopel, stosując dwie dawki (A – 0,1 i 1 granulka kg^{-1}; czas letencji 24 h; B – 2 granulki kg^{-1}).

Najlepsze efekty rozrodu uzyskano w grupie tarlaków okonia przetrzymywanych w wodzie o temperaturze poniżej 10°C przez 90 dni. W tym wariancie doświadczenia pozyskano nasienie od wszystkich stymulowanych samców, natomiast w przypadku samic najlepsze wyniki zanotowano w grupie G2-B, gdzie od 100% samic pozyskano ikrę, a przeżywalność embrionów do zaoczkowania wyniosła około 65%.