Arch. Pol. Fish.	Archives of Polish Fisheries	Vol. 15	Fasc. 2	165-170	2007

Short cmmunications

EVALUATION OF THE SUITABILITY OF SAMPLES COLLECTED IN VIVO FOR INVESTIGATIONS OF JUVENILE STURGEON STOMACH CONTENTS

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ABSTRACT. The aim of the experiment was to determine the capabilities of artificially spawned sturgeon that had been previously fed commercial feed to adapt to feeding on natural food. The gastric lavage method was also evaluated to determine its usefulness in studies of sturgeon food composition. The investigations of sturgeon and sterlet, *Acipenser ruthenus* L., hybrids were conducted in experimental ponds. The effectiveness of gastric lavage was determined to be 65%. A total of 97% of the fish fed on natural feed. The basic components of natural feed were Chironomidae and Ephemeroptera larvae and planktonic crustaceans.

Key words: STURGEON, GASTRIC LAVAGE, STOMACH CONTENTS, FEEDING EXPERIMENTS, INVERTEBRATE FAUNA

Most sturgeon species are currently threatened with extinction, and many countries have initiated programs to protect and restore these species to their former regions of occurrence (Kirschbaum and Gessner 2000, Waldman 2000). With the proposed methods of restoration, it is critical to analyze in detail the capabilities of fish reared under controlled conditions to adapt to natural conditions. As a typical euryphagous species, sturgeon are capable of adapting to existing resources in the aquatic environment; nevertheless, the necessity of changing the type of feed from commercial to natural may occur to be a significant problem that could decrease stocking effectiveness. Traditional methods for investigating stomach content are based on the analysis of pre-

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viously prepared digestive tracts (Hyslop 1980). Since sturgeon stocking material is of such a high value, this method is of limited use. The current investigation applied the in vivo method of collecting stomach contents with gastric lavage, which eliminated the need to sacrifice the fish. Although this method has already been applied in studies of the diet composition of sturgeon (Brosse et al. 2002) and other fish species (Kamler and Pope 2001), the effectiveness of it remains unclear.

The aim of the experiment was to observe the ability of sturgeon from controlled spawning that had been fed formulated feed to adapt to feeding on natural feed as well as to evaluate the effectiveness of gastric lavage as a method to study fish stomach contents.

Two-year-old sterlet, *Acipenser ruthenus* (L.), and Siberian sturgeon, *A. baerii* Brandt, Russian sturgeon, *A. gueldenstaedtii* Brandt & Ratzeburg, and Green sturgeon, *A. medirostris* Ayres, hybrids were studied, and the material used in the investigsation was collected in 2006. The size (total length and individual weight) were recorded when the fish were stocked into the ponds and at the end of the investigation (Table 1). The condition of the fish was described with the Fulton K coefficient. The fish under investigation were stocked into two ponds. In one, the sturgeon were fed extensively with small amounts of commercial pellet feed throughout the investigated period, while in the second the sterlets fed only on the food organisms that occurred naturally in the pond. The first experimental gastric lavage was performed on ten specimens six weeks after they had been stocked into the pond, and then it was repeated twice at monthly intervals. Before the stomach content was collected the fish were anesthetized with a solution of Propiscin (Kazuń and Siwicki 2001) applied directly to the gills through immersion. Stomach content analysis was performed on 32 individuals. The stomach contents of five fish was collected with the traditional method of sacrificing the specimens and then preparing and conserving the entire digestive tract. In another five specimens, gastric lavage was performed followed by specimen sacrifice, removal and preservation of the digestive tract. This provided a basis for determining precisely the effectiveness of the method applied. The largest group (22 specimens) was comprised of fish from which the stomach contents was sampled with the in vivo method. This entailed inserting a set of two plastic tubes into the digestive tract and pumping water through to rinse out the stomach content. The sample obtained was preserved with a 4% formaldehyde solution.

TABLE 1

Size and condition of fish (mean±SD) at the beginning and end of the experiment

Date	N	Body length	Body weight	Condition
hybrids				
31.05.2006	10	33.2±3.0[a]	279.8±73.7[a]	0.747±0.061[a]
16.10.2006	10	56.1±2.1[b]	601.0±88.9[b]	0.338±0.032[b]
sterlets				
31.05.2006	10	38.7±2.6[a]	424.7±113.1[a]	0.717±0.070[a]
16.10.2006	20	41.7±2.3[b]	463.0±103.2[a]	0.630±0.075[b]

Values in the same column with different letter indexes (respectively for the hybrids and sterlets) differ significantly statistically (Mann-Whitney U test, P < 0.05)

The comparison of the traditional and in vivo methods for obtaining stomach contents permitted evaluating the effectiveness of the former method. In the current investigation, the effectiveness of the in vivo method was satisfactory (Table 2). Gastric lavage permitted determining an average of 65% of the diet composition; however, the substantial range of the results (from 39 to 99% in individual specimens) indicates that the precision of this method is varied and, consequently, is loaded with significant error. Brosse et al. (2002) applied gastric lavage and recovered 50% of small-sized prey (Chironomidae, Oligochaeta) and 75% of the larger prey (fish, shrimp) that had been fed previously to sturgeon.

TABLE 2

Efficiency of gastric lavage methods in a dietary study of juvenile sturgeon

Number of fish	Weight of food lavage from stomach (mg)	Weight of remain food removed with the traditional method (mg)	Total weight (mg)	Efficiency (%)
1	1322.48	10.11	1332.58	99.2
2	1460.03	1058.10	2518.13	58.0
3	1336.49	1525.81	2862.30	46.7
4	1716.52	2648.95	4365.47	39.3
5	60.42	13.05	73.65	82.2

Although no fish deaths were recorded during the experiment, the condition coefficient values of the fish were significantly lower at the end of the experiment (Mann-Whitney U test, P < 0.05; Table 1). A significant element of the sturgeon diet was formulated feed (95% of total food weight; Table 3); however, the stomachs of 97%

of the examined specimens contained natural food, the basic components of which were Chironomidae and Ephemeroptera larvae and planktonic crustaceans (Table 3).

TABLE 3

Frequency of occurrance, average weight, and average number of food components in the sturgeon diet (mean (min.-max.))

Food components	Frequency of occurrance (%) N=32	Weight of food components (mg)	Number of food components (indiv.)
Chaoborinae	28.13	13.44 (0.001-70.00)	15 (1-70)
Chironomidae	87.50	35.72 (0.02-343.90)	121 (1-1246)
Coleoptera	6.25	12.14 (1.78-22.50)	15 (5-24)
Culicinae	6.25	1.00 (0.80-1.20)	5 (4-6)
Ephemeroptera	59.38	78.53 (1.06-909.13)	45 (1-458)
Heleidae	9.38	0.71 (0.18-1.66)	7 (1-18)
Hydrachnidia	12.50	0.93 (0.35-1.71)	3 (1-6)
Molusca	3.13	46.66	144
Neuroptera	3.13	7.82	1
Odonata	25.00	20.38 (1.47-112.8)	5 (1-30)
Ostracoda	21.88	1.211 (0.05-5.45)	17 (1-68)
Cladocera	62.50	41.64 (0.0004-222.63)	168 (1-1071)
Copepoda	53.13	1.49 (0.002-5.18)	17 (1-34)
Rotifera	12.50	0.12 (0.003-0.56)	8 (1-17)
Pellets	77.78	132 (264-19 272)	21 (2-146)

These benthic organisms were also the most frequently occurring component of their diet. The continuity of occurrence in the sturgeon diet of Chironomidae and Ephemeroptera was 88 and 59%, respectively. Pyka and Kolman (2003) investigated the feeding intensity of much smaller Siberian sturgeon specimens in earthen ponds and determined that the most important dietary components were Diptera larvae and *Daphnia cucullata*. Under natural conditions the food of juvenile sturgeon is comprised of insect larvae (Baetidae, Diptera, Chironomidae), crustaceans, oligochaetes and polychaetes, and mollusks (Chiasson et al. 1997). The results presented in the work indicate the significant variability in the stomach content of individual specimens as is indicated, among other indicators, by the substantial number of snails (144 indiv.) found in just one sterlet. The large numerical share of zooplankton in the stomach contents of the fish examined might have resulted from a deficient benthic organism food base for juvenile sturgeon and provide an explanation of their weak growth. Despite the availability of natural food, the hybrids preferred commercial feed. Even though they were fed supplemental commercial pellets, the values of their Fulton condition coefficients at the conclusion of the experiment were substantially lower than when they were stocked into the ponds (Table 1).

Anatomical variation among fish species requires testing the effectiveness of the gastric lavage method. The results presented in this work represent the initial steps in the study of the capabilities of sturgeon reared under aquaculture conditions to adapt to feeding on natural food. Both hybrid sturgeon and sterlets fed on natural food. Gastric lavage was confirmed effective as a method for investigating the stomach content of sturgeon and can be recommended in instances when it is necessary to curtail the number of fish eliminated from investigated populations as a result of sampling.

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Received – 02 July 2007

Accepted – 24 August 2007

STRESZCZENIE

OCENA PRZYDATNOŚCI PRÓB POBIERANYCH METODĄ PRZYŻYCIOWĄ W BADANIACH SKŁADU POKARMU MŁODOCIANYCH JESIOTRÓW

Praca przedstawia wyniki badań nad odżywianiem się jesiotrów hodowanych w stawach w aspekcie ich zdolności adaptacyjnych do odżywiania się pokarmem naturalnym. W eksperymencie wykorzystano dwuletnie sterlety, *Acipenser ruthenus* L. i hybrydy jesiotrów syberyjskich, *A. baerii* Brandt, rosyjskich, *A. gueldenstaedtii* Brandt & Ratzeburg i zielonych, *A. medirostris* Ayres (tab. 1). Przedstawiona została ocena efektywności wypłukiwania zawartości przewodu pokarmowego jesiotrów jako metody pozyskiwania prób do badań nad ich odżywianiem. Dzięki zastosowaniu tej metody możliwe było określenie średnio 65% składu diety w porównaniu z tradycyjną metodą badania składu pokarmu (tab. 2). Podstawowymi składnikami naturalnymi diety jesiotrów były larwy Chironomidae i Ephemeroptera oraz skorupiaki planktonowe (tab. 3).