

IMPACT OF TELEMETRY TRANSMITTER IMPLANTATION ON GROWTH OF JUVENILE EUROPEAN CATFISH*

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In the present study, we aimed to evaluate the effects of intraperitoneal tagging with dummy transmitters on growth of juvenile European catfish (*Silurus glanis* L.) within a period of 75 days kept in indoor condition. The initial mass of juveniles (mean \pm SD) was 236.5 ± 21.2 g. We compared growth by analysing specific growth rate (SGR) and the slopes of the growth curves between control individuals and those of experimentally tagged ($n = 6$ per group). Body mass was increased in both control and experimentally tagged fish. There was no significant difference in SGR between tagged and untagged fish; 0.26 ± 0.11 % day⁻¹ vs. 0.38 ± 0.12 % day⁻¹ respectively. These results suggest that the telemetry studies of juvenile European catfish to be relevant and unbiased.

SGR, intraperitoneal tagging, ichthyology, fish, *Silurus glanis*

INTRODUCTION

Telemetry is a useful method for both field and laboratory studies, which provides researchers with a valuable approach to consider spatial and temporal distribution of a particular individual. Identification of individual with telemetry technique help us with better understating of moving activity, home range and habitat preferences as well as physiological information that could not be obtained easily by another approach (Baras, 1991; Jadot et al., 2005).

Surgical tag attachment has become the most popular and efficient for long term telemetry studies (Lucas, Baras, 2000; Bégout Anras et al., 2003). However, the transmitter attachment may influence various life functions of the fish (Lewis, Muntz, 1984; Mellas, Haynes, 1985). Moreover, the impact of implantation seems to differ among species; exhibiting a species-dependent effect (Bridger, Booth, 2003). Therefore, it is recommendable to examine the impact of transmitter implantation, particularly when there is a complete confidence in the results of telemetry studies. The potential negative effects of telemetry remain unclear for a number of species in which telemetric data are available.

European catfish (*Silurus glanis* L.) received high consideration to be studied by a telemetry, because its at top concerns for aquaculture and recreational fisheries (Linhart et al., 2002; Arlinghaus et

al. 2007; Copp et al., 2009). In addition, this fish is known as an invasive species in many countries having an impact on native biota (Martino et al. 2011, Bevacqua et al. 2011; Copp et al. 2007). For better understanding of the biology of European catfish, it is therefore critical to determine the potential risks of its introduction to a new environment (Copp et al., 2007). Overall, information obtained from telemetry on European catfish might be helpful in these issues. Although former studies have used telemetry approach in the European catfish (Carol et al. 2007; Slavík et al. 2007, 2011; Slavík, Horký, 2012), but none of them evaluated the impact(s) of radio-transmitter implantations on its life. The present study was conducted to investigate medium-term effect of internal tagging on growth of juvenile European catfish under restricted feeding.

MATERIALS AND METHODS

Animals and housing

The individuals used in the experiment originated from hatchery-reared European catfish (1-year old), obtained from the indoor rearing facility of the aquaculture farm of Jaroslav Švarc, Velká Bystřice (Czech Republic) in February 2011. Three aquaria (à 240 L)

* Supported by the Ministry of Education, Youth and Sports of the Czech Republic (S grant) and partially by the Internal Grant Agency of the Czech University of Life Sciences Prague (CIGA), Project No. 20132016.

were divided into four equal compartments by plastic perforated partitions. After transportation one individual was placed into each compartment (bottom area 20 x 62 cm) equipped with non-transparent plastic tube as shelter. Fish were acclimated for over one month. Aquaria were equipped with a filters and aerators. Cleaning and partial water exchange was provided once per week. Water temperature was maintained at 22°C. Water was supplied from tap water from the city of Prague, and the infrastructure was deemed to be pathogen-free.

Experimental design

Fish were reared and manipulated following the Animal Protection Law of the Czech Republic and corresponding EU legislation. Experimental protocol was issued by Animal Care and Use Committee of the Czech University of Life Sciences Prague and approved by the Ministry of Education, Youth and Sports of the Czech Republic under Permit No. 22103/2010-30.

Prior starting the implantation, the fish were fasted for four days. On March 7 (day 0; D0) fish were weighted (mean mass \pm standard deviation: 236.5g \pm 21.2; n = 12) and randomly divided into two groups of 6 individuals each. Fish in a first group were tagged with dummy radio transmitters MST - 930, 4 g in air, 9.5 x 26 mm (Lotek Engineering Inc., New market, Ontario, Canada) while the fish in a second group stayed untagged. Starting weights of catfish were identical between groups (t = 0.96, P = 0.36) as well as their division into experimental aquaria (t = - 0.25, P = 0.81). The feeding of fish was started 24 hours after surgery, day D1 of the experiment. The fish were fed by a piece of raw beef heart twice a week with dose of 3 % of the individual body weight per feeding. The feed dose was rounded up to the nearest gram. Remaining feed, if any, was removed from the aquaria 24 hours after feeding.

Surgery and weighing

Each individual was anaesthetised in a solution of 0.2 ml.l⁻¹ 2-phenoxy-ethanol before the surgery. Dummy radio transmitters were implanted into the fish body through the lateral incision of about 1 cm long. The wound were closed with two separate stitches using sterile braided absorbable suture (Ethicon Coated Vicryl W9113, Johnson & Johnson, St. Stevens Woluwe, Belgium). The local antiseptic solution (iodised polyvidone - 'Alfadin') with penicillin antibiotics ('Norocilin LA') and antihemorrhagic agent (P-Aminomethylbenzoic acid - 'PAMBA') were applied to the wounds and the fish were transferred back into aquaria.

The fish were checked every day through the experiment with the observations made on the external

lesion and healing of the tagging wounds. The weighing at precision to nearest gram took place on days: D4, D21, D34, D39, D47, D55, D70, and D75. The experiment was ended on June 21 (day D75), when the fish were deeply anaesthetised until death; the final weigh was recorded.

Data analysis

Specific growth rates were calculated using the formula: $SGR (\%day^{-1}) = 100 [(Ln WF - Ln WI) \Delta T^{-1}]$ with ΔT = experimental period (days) and WF and WI = final and initial individual body weight (Stejšek et al, 2009).

Differences in final weight (based on SGR) of catfish were determined using GLM with tagged/untagged fish and initial weight of individual as a continuous variable. Trends in growth rates (based on specific mass weights of all individuals) were tested using GLM on longitudinal data with fixed factors: tagged /untagged as categorical variable and day of weighing as continual variable. The best fitting linear model was chosen by comparison of marginal model (weight~tag*day) with more complex models including: autoregressive correlation structure (corCAR1) and heteroscedasticity (varIdent) in time and also between tagged and untagged individuals (Crawley 2007, Pekár, Brabec, 2012).

Models were compared using Akaike's information criterion (AIC). Statistical significance was set at $\alpha = 0.05$. Tests were computed using lm and nlme functions of R statistical software, version 2.15.1 (R Development Core Team, 2012)

RESULTS

No mortality was observed among the juveniles of European catfish during the experiment period.

The calculated SGR was 0.26 \pm 0.11 % day⁻¹ for tagged fish and 0.38 \pm 0.12 % day⁻¹ for untagged fish. The SGR was not connected with any of studied factors (Table 1) therefore only main factor – tagged/untagged was considered in the subsequent analysis of growth trends.

Based on best fitting and most parsimonious linear model, it seems that the implantation of dummy transmitter did not significantly influence the growth of fish during the period of the experiment (Table. 2). This finding is visible also from the growth curve (Fig. 1). Average daily gain of fish derived from the model was estimated to be 0.82 g (\pm 0.26 SE) and 1.16 g (\pm 0.19 SE) for tagged and untagged fish, respectively. Series of measurements of same individual exhibit strong autocorrelation (Phi = 0.993) as well as reversible heteroscedasticity ($\delta = - 0.007$) over the time (days) of experiment. However heteroscedascity was not different between the experimental groups.

Table 1. Influence of factors on the SGR of studied juvenile European catfish from the GLM model

	df	F	P
Initial weight	1	0.61	0.45
Implantation	1	1.83	0.21

Approximately 21 days post-implantation, the incision wound got completely healed although small inflammation stayed in place where the antenna passed through the body wall. One fish expelled the tag by D37.

DISCUSSION

Analysis of growth is a common parameter to evaluate tagging procedure and its effects on fish (Martin et al., 1995; Cooke et al., 2011; Lacroix et al., 2004). The growth could be based on measurement of length or mass since mass measurement seems to be more sensitive index of medium-term growth analysis (Bégout Arnas et al., 2003).

Growth studies conducted under controlled condition are characterized by *ad libitum* or “optimal” feeding dose (Bogut et al., 2002; Linhart et al., 2002; Weimer et al., 2006; Hopko et al., 2010; Kaeming et al., 2011; Montoya et al., 2012). Such conditions are not common in the wild since the fish in experiment are not forced to search for food (Cooke et al., 2011). There is also an assumption that fish of different origin than from the locality where they are tracked after release, faced new environment, which may affect their feeding activity (Gomez-Laplaza, Morgan, 2003). Restricted feeding should therefore better imitate condition in the wild. However in these more stringent conditions our results showed that juveniles of European catfish lived and grew after surgically tag implantation and they were minimally affected. Although the mean SGR

Table 2. Components from best fitting and most parsimonious GLM model on longitudinal data on trends in growth of studied juvenile European catfish

	df	F	P
Implantation	1	0.36	0.55
Day	1	57.36	< 0.001
Implantation × day	1	1.64	0.20

of untagged fish ($0.38 \pm 0.12 \% \text{ day}^{-1}$) was higher than that of the tagged fish ($0.26 \pm 0.11 \% \text{ day}^{-1}$), but observed difference was not significant statistically. Also the growth trends were similar between groups. This finding is important because when “tagged fish” substantially reduce the growth rate, they may also change the behaviour and the telemetry data then may not be representative (Bégout Arnas et al., 2003; Bridger, Booth, 2003).

Despite of small sample size, we conclude that our trial justifies the usage of intraperitoneal tagging, which do not severely affect the growth of juvenile European catfish.

A known disadvantage to surgical implantation of tag is the potential of their lost (Schramm, Black, 1984; Baras, Westerloppe, 1999; Bridger, Booth, 2003). We recorded one expulsion of a dummy transmitter in halfway through the experiment. This special event with description of mechanisms was published by Daněk, Kalous (2013). This fish stayed in the tagged group since the object of the study was focused on impact of the implantation. It has been also reported that fish expelling their tags showed specific growth not different from those keeping their tags (Jepsen et al., 2008).

At the beginning of the experiment, a trend toward decrease in body weight was observed in both groups. This could be related to the recovery from the surgery in the group of tagged fish (Bridger, Booth, 2003; Robertson et al., 2003). Surprisingly the

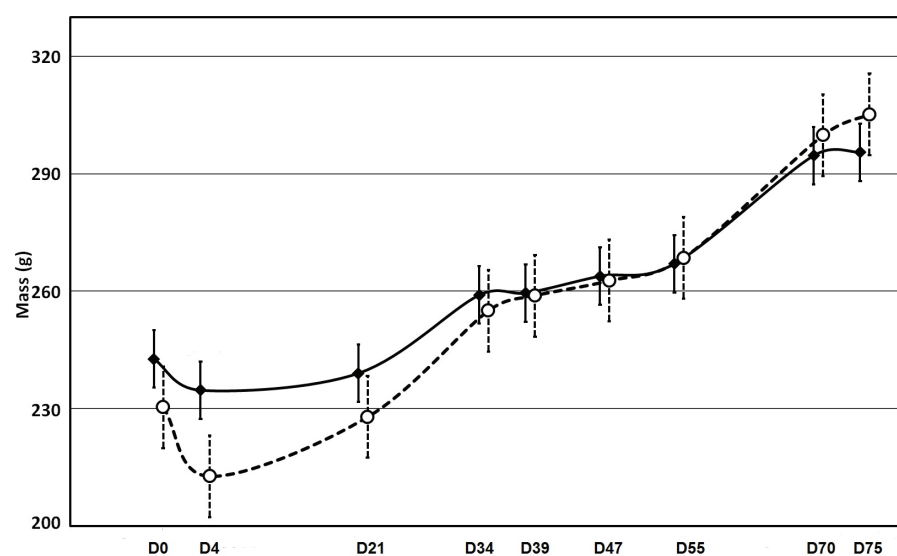


Fig. 1. The average mass of European catfish throughout the experiment (D0-D75) with confidence interval for the tagged group (black squares) and untagged group (open circles). Tagging was done on April 7, 2011 and weighing was performed on days indicated on the X-axis. Duration of experiment was 75 days (D0-D75).

decrease in body weight was higher in the group of untagged fish. It is place to speculate that this could be resulted from an influence caused by the presence of pheromones from injured fish since tagged and untagged fish shared the same water (Pfeiffer, 1977; Stensmyr, Maderspacher, 2012). It is also possible that tagged fish tried to save energy for healing process by lower movement activity but the untagged fish ranged without restriction leading also to loss of weight. However, the growth returned between D4 – D21 and stayed more or less stable till the end of the experiment (Fig. 1).

CONCLUSIONS

Although we cannot conclusively claim that there exists no effect on fish growth after intraperitoneal implantation of transmitters ($\leq 2\%$ ratio of tag mass in the air to fish mass in the air), we assume a possible effect as negligible. Based on presented data we consider the telemetry studies of European catfish (*Silurus glanis*) to be relevant and unbiased.

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Received for publication on October 3, 2013

Accepted for publication on March 6, 2014

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