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Spy elimination: note on expulsion of telemetry transmitter from the body of juvenile *Silurus glanis* (Siluriformes: Siluridae)

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Abstract. The effect of radio transmitters implanted in juvenile European catfish – *Silurus glanis* Linnaeus, 1758 (Siluriformes: Siluridae) – was studied under controlled conditions. A dummy transmitter was expelled from one individual during an experiment. It was expelled 37 days after implantation from a different place in the body wall from that in which it was implanted. This finding clearly suggests that not every non-moving transmitter in a field study indicates the death of the fish in which it was implanted.

Key words. Ichthyology, expulsion, telemetry, transmitter, European catfish, encapsulation.

INTRODUCTION

Biotelemetry is increasingly being used to study animal behaviour, including that of fish, in their natural environment (Cooke et al. 2011). For the purpose of tracking fish, there are three main ways of positioning a transmitter in or on a fish. These are: i) it can be attached externally, which is not often used, ii) inserted intragastrically or iii) implanted surgically, which is the preferred option (Bridger & Booth 2003). Despite many advantages, surgical implantation has a number of disadvantages: the necessary anaesthesia, impact of implantation on the behaviour of fish during the post-surgical healing process and the implantation wound may become infected (Jepsen et al. 2002, Bridger & Booth 2003). A little known complication is the ability of some species to expel implanted transmitters.

There are three ways in which a transmitter is expelled; through the incision, through an intact part of the body wall and via the intestine. The ability to expel a transmitter is considered to be species-dependent. While in some species it has never been recorded there are other species for which there are many records (Jepsen et al. 2002). The expulsion of transmitters has been recorded for the following species: rainbow trout – *Oncorhynchus mykiss* Walbaum, 1792 (Salmonidae) (Ivasauskas et al. 2012, Christholm & Hubert 1985), Atlantic salmon – *Salmo salar* Linnaeus, 1758 (Salmonidae) (Moore et al. 1990), blue catfish – *Ictalurus furcatus* Valenciennes, 1840 (Ictaluridae) (Holbrook et al. 2012), channel catfish – *Ictalurus punctatus* Rafinesque, 1818 (Ictaluridae) (Summerfelt & Mosier 1984, Marty & Summerfelt 1986), vundu – *Heterobranchus longifilis* Valenciennes, 1840 (Clariidae) (Baras and Westerloppe 1999), grass carp – *Ctenopharyngodon idella* Valenciennes, 1844 (Cyprinidae) (Schramm & Black 1984) and bluegill – *Lepomis macrochirus* Rafinesque, 1819 (Centrarchidae) (Knights & Lasee 1996).

The expulsion via the incision often happens shortly after surgery and it is disputable if it is an active biological process (Baras & Westerloppe 1999, Schramm & Black 1984). Expulsion within a few days of implantation may indicate that the wound did not heal and as a consequence the transmitter simply fell out of an open wound. During a biological expulsion, there is an

active proliferation of fibro-granulation tissue containing myo-fibroblasts that are forcing the transmitter through a route of least resistance (Marty & Summerfelt 1986). Expulsion via the intestine is recorded for rainbow trout and catfish of the genera *Ictalurus* and *Heterobranchus* (Christholm & Hubert 1985, Marty & Summerfelt 1986, Baras & Westerloppe 1999). The last route is expulsion of the transmitter through an intact part of the body wall, which is recorded for, e.g. Atlantic salmon (Moore et al. 1990). Here we report the first expulsion of a dummy transmitter by European catfish (*Silurus glanis*).

MATERIAL AND METHODS

The expulsion of a transmitter was observed during a study in which the effect of implanting a transmitter on the growth and behaviour of fish was monitored. The fish used in the experiment were hatchery reared age-1 European catfish obtained from the indoor rearing facilities of the aquaculture farm of Jaroslav Švarc, Velká Bystřice (Czech Republic). This study was carried out at the Czech University of Life Sciences, Prague, in spring 2011. During the experiment the fish were kept indoors in three 240 l aquaria. The fish were separated from one another by perforated plastic partitions. The fish were fed pieces of raw beef heart, the water temperature maintained at 22°C and oxygen concentration never dropped below 7 $mg.l^{-1}$. Altogether 12 individuals (weight 185–257g, standart length 282–322 mm) were included into the experiment, of which 6 were tagged with dummy transmitters MST–930, which weighed 4 g in air, were 9,5×26 mm in size, coated with a biologically inert polyethylene layer and equipped with 24 cm polyethylen-coated wire antenna (Lotek Engineering Inc., New market, Ontario, Canada). Fish were anaesthetised in a solution of 0.2 $ml.l^{-1}$ 2-phenoxy-ethanol. An antiseptic solution (iodised polyvidone,"Alfadin"), a penicillin antibiotic ("Norocilin LA") and an anti-hemorrhagic agent (P-Aminomethylbenzoic acid – "PAMBA") was applied to the wound. The wound was closed by two separate stitches of a sterile braided absorbable suture (Ethicon Coated Vicryl W9113, Johnson & Johnson, St. Stevens Woluwe, Belgium). The dummy transmitter was implanted on 7 April 2011.

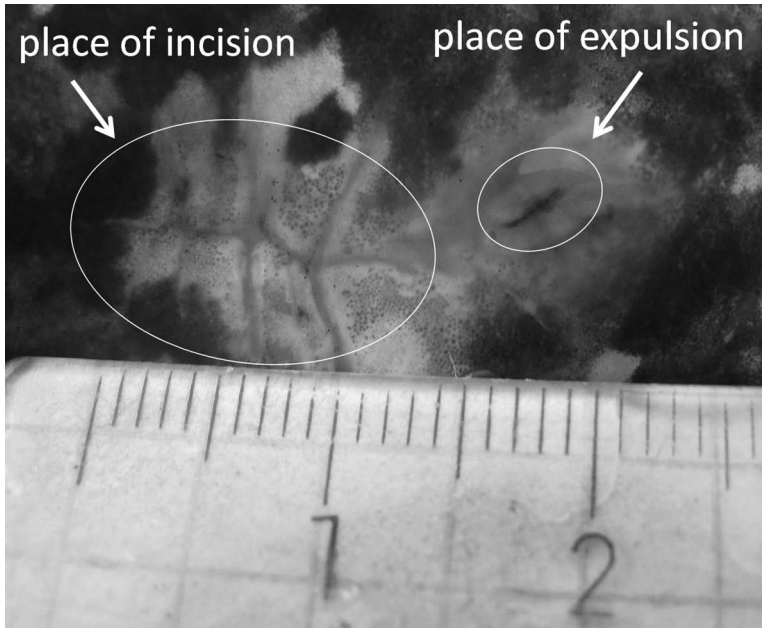

Fig.1. The expulsion of a telemetry transmitter from the body of a juvenile European catfish (*Silurus glanis*). The ellipses indicate the area of skin above left pelvic fin through which the transmitter was inserted had healed over whereas the slit in the area of skin through which the transmitter was expelled is still open.

Fig. 2. A transmitter encapsulated in myo-fibroblast tissue dissected from a juvenile European catfish (*Silurus glanis*).

RESULTS

Approximately 21 days post-implantation the incisions through which the transmitters were implanted had completely healed. The transmitter was seen being expelled from one of the fish through an intact part of its body wall on 13 May 2011, which was 37 days after implantation. The individual was caught immediately and the place of expulsion was photographed (Fig.1) after which the fish was released back into the aquarium. There were no health problems or obvious changes in behaviour prior to and after the expulsion. Three days after the transmitter was expelled, on 16 May 2011, the wound had closed and healed. The fish was alive and healthy at the end of the monitoring period.

This study was terminated on 21 June (76 days after implantation) and no other expulsions of transmitters from fish were recorded during this experiment. During the autopsy that was done on the fish at the end of the study, the encapsulation of the dummy transmitters in myo-fibroblast tissue was recorded in all cases (Fig. 2). This tissue is probably involved in the active biological expelling of foreign material as was previously noted by Marty & Summerfeld (1986).

Our finding clearly demonstrates that in the case of European catfish, the expulsion of transmitters is possible and therefore it is advisable to be careful when interpreting telemetry results, especially when they indicate that an individual has ceased moving. The above observation indicates that not every non-moving transmitter in a field study must represent the death of a tracked fish. Based on our observations, it could also be due a living individual expelling a transmitter.

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