ACCELEROMETRY OF SEABREAM IN A SEACAGE: EFFECTS OF FLOW CONDITIONING ON ACTIVITY PATTERNS, GROWTH AND ROBUSTNESS

Arjan P. Palstra [a*], Pablo Arechavala-Lopez [b], Ana Roque [c]

[a] Wageningen University & Research Animal Breeding and Genomics, Wageningen Livestock Research, PO Box 338, 6700 AH Wageningen, The Netherlands. Email: arjan.palstra@wur.nl.
[b] Fish Ecology Group, Mediterranean Institute of Advanced Studies (IMEDEA-CSIC/UIB), 07190 Esporles, Balearic Islands, Spain.
[c] IRTA- SCR. C/ al Poblenou SN Km 5.5 43540 Sant Carles de la Rapita. Spain.

Introduction

The flow regime can have great physiological impact resulting in enhanced growth and increased robustness (Palstra and Planas, 2013). By holding juvenile Gilthead seabream (*Sparus aurata*) on-land to sizes of ~20 g, and with a future perspective of holding them on-land even longer, farmers can benefit from applying an optimal flow regime. In a first study in RAS tanks (IRTA facilities, Sant Carles de la Ràpita), experimental fish were conditioned to flow regimes inducing swimming exercise at 0, 1 and 2 Body Length (BL) s^{-1} for a period of 8 months (Feb.-Oct.). Subsamples of these fish (N=100 per treatment) were then transferred to an experimental seacage in Mallorca (LIMIA facilities, Port d'Andratx) of which ten PIT tagged fish per treatment were implanted with accelerometer tags to investigate activity patterns. Activity will then be related to growth and robustness parameters of seabream in a cage in general, and to the effects of flow conditioning in particular. Accelerometry has been performed on Atlantic salmon in floating sea-cages (Føre et al., 2011, 2018), this is the first study investigating the activity of seabream in an experimental seacage.

Materials and methods

Sizes of the experimental fish that were used for accelerometry were BL 174 ± 10 mm, BW 157 ± 28 g for fish conditioned at a flow of 0 BL s^{-1}; BL 185 ± 12 mm, BW 173 ± 36 g for fish conditioned at a flow of 1 BL s^{-1}, and BL 188 ± 24 mm, BW 189 ± 47 g for fish conditioned at a flow of 2 BL s^{-1}, indicating the exercise-enhanced growth that had occurred during flow conditioning in the RAS tanks. These fish were anaesthetized and then accelerometer tags (AccelTag AT-LP7; 21 x 7.3 mm, 1.9 g in air, 1 g in water; Thelmabiotel, Trondheim, Norway; Fig. 1) were implanted by a surgical incision on the ventral side in the body cavity and then sutured (Arechavala-Lopez et al. 2012). The accelerometers record every 60 s the gravity forces and movement along the three axes which can be converted to acceleration in m s^{-2} which is then used as a proxy for activity. Recordings were monitored by one receiver (TBR700; Thelmabiotel) placed at the bottom of the cage. Activity patterns were monitored for a period of 6 weeks (Nov.-Dec., with decreasing temperatures from max. 17.9 to min. 15.5 ºC) in a 2 x 2 x 2 m experimental sea-cage (fish density ~10 kg m^{-3}). Fish were fed manually once per day *ad libitum* in the morning at 11 h. After the 6 weeks period, fish were collected measured, weighed, and heart, liver, intestine, spleen, intestinal fat and fillet were dissected and weighed.

Results and discussion

Day/night rhythms in swimming activity under the experimental conditions were characterised by more active periods from 6 to 14 h and 18 to 0 h and less active periods from 0 to 6 h and 14 to 18 h. The peak in activity was not during but just before feeding indicating that experimental fish may have good ability to predict and time a re-occurring event such as feeding.

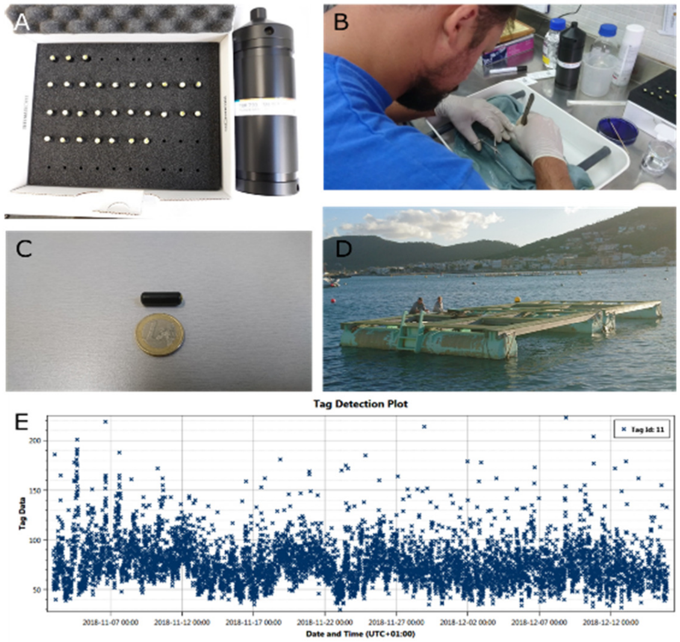

Fig. 1. (A) 30 accelerometer tags and 1 receiver, (B) seabream surgery to implant the tag, (C) tag size, (D) the experimental seacage, (E) recordings for one fish over the monitoring period of 6 weeks.

Growth performance was similar between fish of all three treatments. The initial differences that were due to exercise-enhanced growth therefore remained similar. Significant differences were found in overall activity patterns between flow-conditioned groups. Exercised fish conditioned at 1 BL s^{-1} were more active than the 0 BL s^{-1} controls. This group of exercised fish also showed the largest relative heart size. Exercised fish conditioned at 2 BL s^{-1} were less active than the exercised fish at 1 BL s^{-1} and the 0 BL s^{-1} controls. These fish had the lower relative spleen size. These results indicate that the flow conditioning at 1 BL s^{-1} was optimal for robust juvenile seabream, a conclusion that was also supported by the results of the first study in RAS tanks.
Activity patterning can be useful for timing feeding events. Under these conditions it may be advisable to feed seabream at the start of active periods; for example from 6 to 11 h and from 18 to 22 h, to favour muscle building at the cost of intestinal fat deposition. During the on-land phase in tanks, fish and farmer can benefit from applying flow enhancing swimming exercise at 1 BL s^{-1}.

Acknowledgements: This study was funded by the EU H2020 RIA MedAID (grant agreement number 727315). The authors thank A. Leon Delgado (LIMIA/IMEDEA) for feeding, animal care and data collection; E. Høy and A. Haugsdal (Thelmabiotel) for their valuable help with starting up the AccelTags; P. Jéhannet and L. Kruijt for lab analyses (WUR) and zootechnicians, students and research assistants at IRTA, LIMIA/IMEDEA and CARUS. More info on swimming fish @ www.fitfish.eu.

References

Arechavala-Lopez P, Uglem I, Fernandez-Jover D, Bayle-Sempere JT, Sanchez-Jerez P (2012) Post-escape dispersion of farmed seabream (*Sparus aurata* L.) and recaptures by local fisheries in the Western Mediterranean Sea. Fish. Res. 121: 126-135.

Føre M, Alfredsen JA, Gronningsater A (2011) Development of two telemetry-based systems for monitoring the feeding behaviour of Atlantic salmon (*Salmo salar* L.) in aquaculture sea-cages. Comput. Electron. Agric. 76: 240-251.

Føre M, Svendsen E, Alfredsen JA, Uglem I, Bloecher N, Sveier H, Sunde LM, Frank K (2018) Using acoustic telemetry to monitor the effects of crowding and delousing procedures on farmed Atlantic salmon (*Salmo salar*). Aquaculture 495: 757- 765.

Palstra AP, Planas JV (2013) Swimming Physiology of Fish. Towards Using Exercise to Farm a Fit Fish in Sustainable Aquaculture. Heidelberg: Springer.