Migration pattern of Atlantic wolffish (*Anarhichas lupus* L.) in Iceland using Data Storage Tags

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Background

From 1966 to 1975 the Marine Institute in Reykjavik (MRI) tagged nearly 13,000 Atlantic wolffish with athena tags. The results demonstrated the location of the main spawning area and patterns of feeding migration of Atlantic wolffish at West Iceland (Fig. 1). In August the Atlantic wolffish migrate from its feeding grounds to deeper water where its spawning grounds are located and in January it migrates back to its shallow-water feeding grounds (Jónsson, 1982).

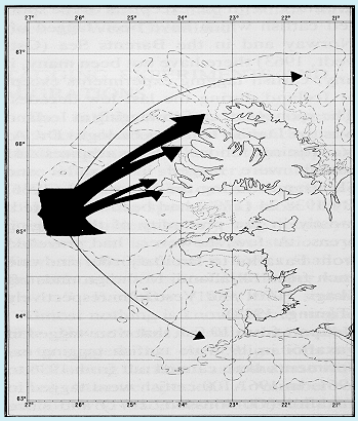


Fig. 1. Feeding migration from Látragrunn the main spawning ground of Atlantic wolffish at Iceland (Jónsson, 1982).

In the years 2010-2011 eleven Atlantic wolffish were tagged with ultrasonic transmitters tags. This approach demonstrated fidelity of Atlantic wolffish at feeding grounds (Sturlaugsson *et.al.*, 2012).
From 1999-onwards, catch (bottom trawl) of Atlantic wolffish from its main spawning ground at Látragrunn increased considerably. Today an area of 1,000 km^2 of this site is closed (protected) during spawning and incubation time of Atlantic wolffish (Fig. 3).

This study

The MRI in cooperation with Star-Oddi tagged 303 Atlantic wolffish with floy-and electronic data storage (DST) tags in the years 2012-2013 (Fig. 2). The DSTs measure depth and temperature and register time regularly. While the fish is still at the bottom the depth changes in rhythm with the tide. By comparing the depth trajectory registered in the DST with the tide which is different each time by locations, it will be possible to estimate the locations of the fish at any time via Tidal location method.

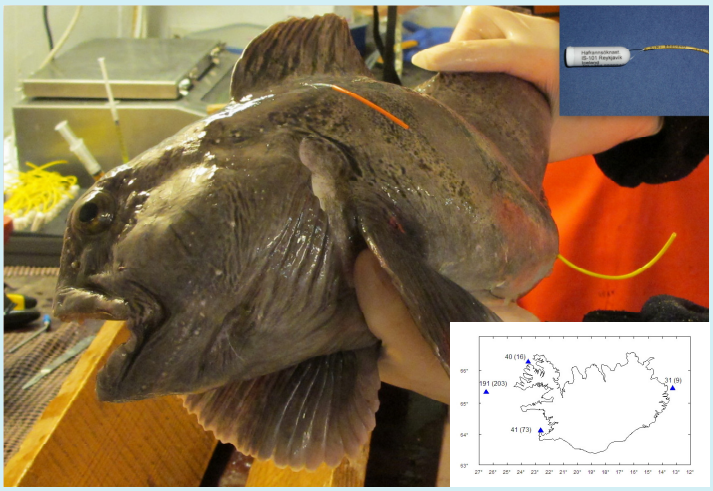
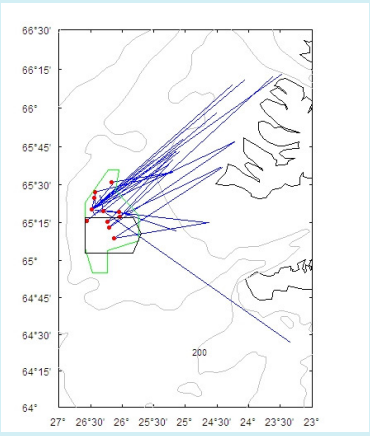


Fig. 2. Atlantic wolffish tagged with DST- and floy tags. The DST is located in the abdomen of the fish and the yellow tube sticks out. The picture in the top right corner is of DST with yellow tube attached to it. The picture in low right corner shows the location of the tagging, the numbers of DST tagged fish and the number of fishes tagged only with floy tags (between brackets).

The aim of this study was to locate more precisely the spawning grounds of Atlantic wolffish for further protection during the breeding period, but also to collect more information on the migration pattern from breeding to feeding ground and vice-versa, on its possible consistency and on timing of migration.

Potential differential vertical movement and possible difference in migration between sexes will also be investigated due to the peculiar life cycle of this fish. Finally, genetic samples were taken from all fish that were DST tagged to investigate relationship between genetic and migration.

Fig. 3. The red points indicate the tagging locations and the ends of the blue lines the locations of recapture. The tagging was done in 25 locations in the area defined with the green shape. The area that is defined with the black lines represents the current protected breeding area.



Result and discussion

So far 34 Atlantic wolffish tagged at Látragrunn have been recaptured. Preliminary analysis reveals that current migration patterns of Atlantic wolffish is quite similar to the migration pattern observed in the seventies (Fig. 1 and Fig. 3), despite environmental changes (rising of the sea temperature). This perhaps indicate the importance of Látragrunn as a spawning area for Atlantic wolffish. The results have also demonstrated that the Atlantic wolffish in the protected area at Látragrunn seems to migrate later from its spawning grounds than Atlantic wolffish in nearby areas, potentially indicating a relationship between migration and fishing mortality.

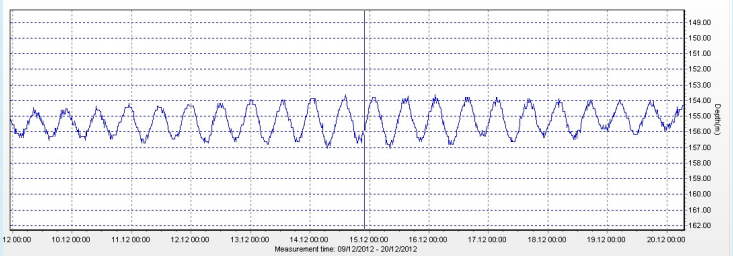


Fig. 4. Depth trajectory from DST, the measurements interval was 15 minutes. The fish was recaptured two weeks after tagging and was a spawning female.

The result hitherto have shown that Atlantic wolffish is rather sedentary (Fig. 4), which will facilitate location estimates via Tidal location method. However Atlantic wolffish also appear to have occasional vertical migrations (Fig. 5).

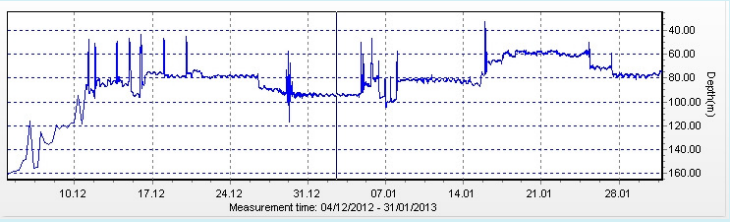


Fig. 5. Depth trajectory from DST, the measurements interval was 15 minutes. The fish was recaptured two months after tagging. As seen from this trajectory Atlantic wolffish have occasional vertical migrations.

This tagging experiment with DSTs is still ongoing. It is forecasted that 40 Atlantic wolffish will be tagged south east of Iceland in autumn and another 40 in late winter north west of Iceland. Although we have only data from DSTs from fish that were recaptured shortly after tagging, the result have already demonstrated some new aspects on migration of Atlantic wolffish, e.g. occasional vertical movements and possible relationship of migration and fishing mortality. In the future data from DSTs will be analysed with Tidal location method including fish that have been longer at sea or tagged in other areas than Látragrunn. This project is likely to reveal some other unknown aspect of migration of Atlantic wolffish relevant to fisheries management issues.

Jónsson (1982). Contribution to the Biology of Catfish (*Anarhichas lupus*) at Iceland. *Journal of The Marine Research Institute,Reykjavik* **4**, 3-26.

Sturlaugsson, J., Geirdal, E. & Geirdal, G. (2012). Migration behaviour of wolffish (Anarhichas lupus). p. 48. Reykjavík: Laxfiskar.

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