# TRACKING OF ATLANTIC SALMON (*Salmo salar* L.) AND SEA TROUT (*Salmo trutta* L.) WITH ICELANDIC DATA STORAGE TAGS

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## Introduction

The data storage tag (DST) was developed in Iceland by the engineers at Star Oddi Ltd. in co-operation with fish biologists at the Institute of Freshwater Fisheries and the Marine Research Institute in Iceland. These tags record series of measurements from the environment of the fish. They record pressure (depth), temperature and conductivity (salinity). The small size, low weight and cylindrical shape of these data storage tags make it possible to use the tag on relatively small fish.

The Institute of Freshwater Fisheries has used the Icelandic DSTs in Icelandic waters on Atlantic salmon (*Salmo salar* L.) from 1993-1996 and on Atlantic sea trout (*Salmo trutta* L.) from 1995-1996. In addition, the Institute of Freshwater Fisheries has participated in research on Baltic salmon (*Salmo salar* L.), where these tags were used, from 1995-1996. The salmon were tagged externally, but the sea trout were tagged both externally and internally. A total of 310 salmon and 110 sea trout have now been tagged with DSTs in Icelandic waters.

In the DST tagging experiments in Icelandic waters, the main aim was to study the homing migration of salmon in coastal waters and the sea (feeding) migration pattern of sea trout. These studies were the first instances of DSTs used in research on these species. The Icelandic DSTs are both the smallest and, by far, the least costly data storage tags on the market. Therefore, the Institute of Freshwater Fisheries has been able to tag and recapture high numbers of fish of diverse sizes (39-96 cm). This was done in order to determine, as closely as possible, the common behaviour of these migrants. Different intervals between recordings were used to examine more closely the swimming behaviour (1,5 minute intervals) and diurnal rhythms (DSTs with two different measuring time series, that are repeated). In the case of salmon, different environmental circumstances were used to look at possible effects on the migration pattern. As an example, salmon were released both coastally and off-shore at varying depths. They migrated both against and along the main sea currents over distances ranging from 25-420 km (shortest sea route). Control groups of salmon were tagged with DSTs and kept in net pens in the sea, enabling comparison with the salmon migrating at that time.

The use of DSTs provided new methods of sampling series of data directly from the fish´s environment, and over longer periods of time in the sea than previously possible. For example, we have received a series of vertical movements and corresponding water temperatures, from the sea trout studies, for time periods up to 5 months. These data series were also the first instances of such measurements that included the sea phase throughout the study and the freshwater phase before and after sea migration.

## Results of migration studies on homing Atlantic salmon

A high recapture rate of tagged salmon (20-60 %) gave large series of recordings showing that the salmon spent most of their time close to the sea surface, as has been reported. But, the recordings also included much information concerning the poorly documented diving activity that occurs occasionally. This new information included dives made by the salmon down through the thermocline, and dives that were both deeper (down to 153 m) and faster (vertical speed up to 0,73 m/sec) than had been reported previously in coastal waters. The reasons for the diving activity of homing salmon are not always the same. Certain known facts or hypotheses give these reasons for dives while homing: excursions to scan the different environmental parameters as cues for orientation, selective tidal transport, thermoregulation, escape behaviour, and feeding (seldom).

The salmon experienced diversity in the temperature and salinity, and the largest changes in a short time were recorded at the same time as excursions into deep water, estuaries or rivers. Examples of extreme changes in temperature and/or salinity in a very short time are good indicators of the versatility of salmon. The salinity sensor was first used in 1996, and the first results show very interesting behaviour regarding the coastal migration, especially in relation to the estuaries. The water temperature recorded reflects the vertical, estuary or river migration pattern and also gives possibilities for tracking the horizontal location of migrating salmon, in general, close to the sea surface over large areas. By comparing temperature data from a DST to sea surface temperature data from satellite measurements, it is possible to locate the area (temperature zone) to which the fish are migrating. Because the salmon is frequently in close proximity to the surface, the sea temperature is often correlated to the air temperature in the area. Relatively high temperatures experienced by salmon, combined with their common non-feeding behaviour during spawning migration, resulted in as much weight loss as 10% within 1 month.

## Development of new generations of DSTs

The on-going development will result in a release of the new generation DST 300 in November of this year. Reduction of size and weight has been the main object.

| PARAMETER | DST200 | DST300 | |
|---|---|---|---|
| Size (diameter/length) | 18/48 | 13/46 | [mm] |
| Weight (in air/in water) | 12/0 | 8/1 | [gram] |
| Memory | 8.100* | 8.100* | [number] |
| Maximum depth | >450 | >700 | [meters] |
| Temperature range | customer specified from -25 to +50 | | [°C] |
| Depth range | customer specified from 0 to 600 | | [meter] |
| Salinity range | customer specified from 5 to 37 | | [‰] |
| Life time | >12** | target 12** | [month] |

*Increased to approx. 16.300 in near future

**Depending on temperature and number of measurements

The next steps taken in the DSTs´ development in Iceland will involve further reduction of size and weight, expansion of memory, expansion of life time, development of new sensors (5) and specification of complete customer chip solutions.

## General conclusions and future perspectives

The data storage tags will be very important research tools in fisheries research in the future. They will open new methods of studying the behaviour and environment of fishes, not the least of which will be the anadromous fish. This is due to the fact that the DSTs enable unique possibilities regarding sampling continuous series of special, behavioural, and environmental information from areas and over time periods where other sampling methods can not be used, or are both too difficult to use and too costly, which often results in limited data. This new dimension in research of fish will therefore add valuable information to our understanding of fish behaviour and their reactions to their environment. Additionally, the results from DSTs tagging can, in some instances, be useful in improving the traditional sampling methods.In the coming years, the Institute of Freshwater Fisheries will continue to use DSTs in research on salmonids in the sea. In the case of Atlantic salmon, the main activity will be in tagging experiments involving feeding migration in the sea, with a combination of tagging of kelts and large smolts/postsmolts. This will also introduce very interesting ways of comparing growth to sea temperature circumstances.

## References

- Available papers in english from tagging experiments, based on Icelandic data storage tags

Karlsson, L., Ikonen, E., Westerberg, H. and Sturlaugsson J. 1996. Use of data storage tags to study the spawning migration of Baltic salmon (*Salmo salar* L.) in The Gulf of Bothnia. -ICES. C.M. 1996/M:9. 16 p.

Sturlaugsson, J. 1995. Migration Study on Homing of Atlantic salmon (*Salmo salar* L.) in Coastal Waters W-Iceland - Depth movements and sea temperatures recorded at migration routes by data storage tags. -ICES. C. M. 1995/M:17. 13 p.

Sturlaugsson, J. and Johannsson M. 1996. Migratory pattern of wild sea trout (*Salmo trutta* L.) in SE-Iceland recorded by data storage tags. -ICES. C. M. 1996/M:5. 16 p.

Thorsteinsson, V. 1995. Tagging Experiments using Conventional tags and Electronic Data storage tags for the observations of migration, homing and habitat choice in the Icelandic spawning stock of cod. -ICES.C.M. 1995/B:19.