Underwater tagging of deep sea redfish

A new tool for fish management

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Introduction

Tagging methods have generally involved the bringing fish to the surface by some fishing gear, hauling them onto deck of a fishing boat or research vessel where the live fish are transferred into containers with seawater and those that survive are tagged and released. Although some improvements have been made in the capture and handling of the fish many species are very sensitive to this type of handling. Some fish, like plaice, are very hardy, (*Pleuronectes platessa*) and seem to survive pretty well. Most fish species, however, suffer a great mortality in the capture process and many, such as the various redfish species, suffer a total mortality when brought to surface.

The redfish species have been considered impossible to tag by the conventional methods. The main reason is that the fish is unable to release the air of the swimbladder fast enough when the fish goes from the high pressure deep waters to lesser depths. As result the swimbladder may expand and rupture but if the air does not escape, its expansion can push the internal organs out through the oesophagus and the mouth killing the fish. Traditional tagging technique have therefore not succeeded for the redfish, despite numerous trials.

Sebastes mentella is the most important redfish species exploited in north Atlantic. In an area extending from the Labrador Sea in the West to the Fareos in the East extensive fishery of deep-sea redfish is carried out (Figure 1) with an annual catch of more than 150 thousand tonnes. The fishery is conducted on the shelf and slope of Greenland, Iceland and the Fareos as well as in the International waters extending from the Canadian EEZ and all the way to the south-west part of the Icelandic EEZ. More than 15 nations have participated in this fishery in recent years with at least 70-80 vessels involved in the fishery.

For several years, there has been a debate about the stock structure of deep-sea redfish in the Irminger Sea and adjacent waters and how to manage different components of the resource. Among the questions raised is to what extend the fish caught with pelagic trawls in the Irminger Sea is connected to the fish that is caught along the shelf with bottom trawls. The International Council for the Exploration of the Sea (ICES) has advised to mange them as separate stocks (Anon, 2003). As long as the stock structure and connections between possible stock components are unknown, it will always be difficult to assess the status of the stock/stocks and to give reliable advice on how to manage this importance resource.

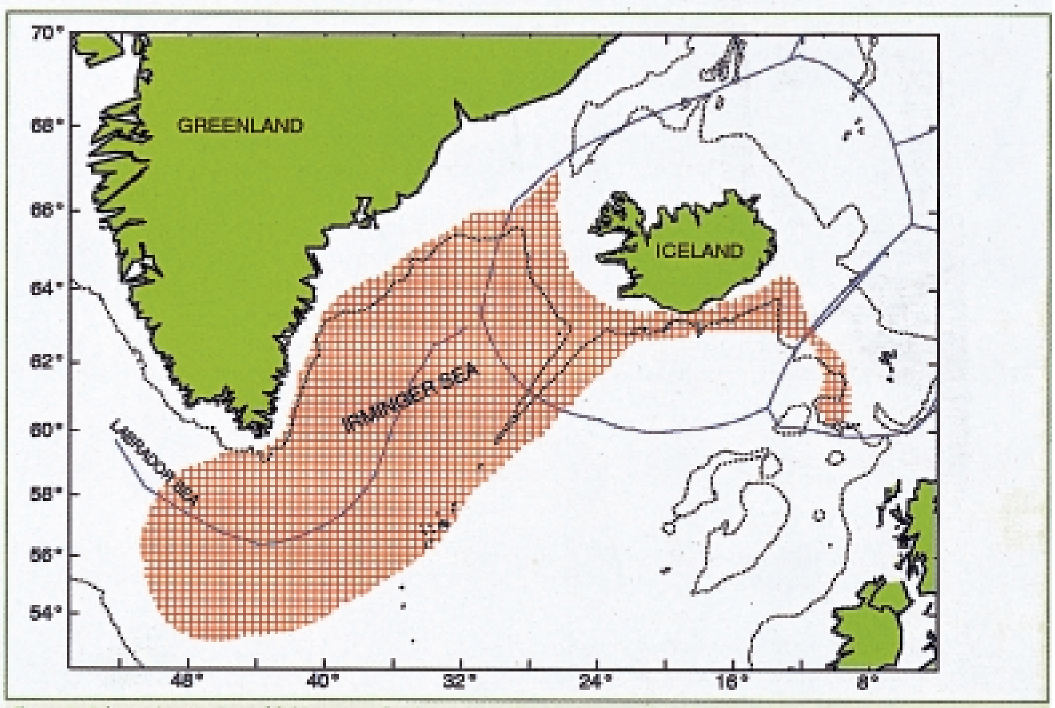

Figure 1. Schematic overview of fishing areas for deep-sea redfish from west of the Faroes to the Irminger Sea.

The Marine Research Institute in Reykjavík, Iceland (MRI) in collaboration with Star-Oddi have approached the problem of tagging redfish by constructing and building the Underwater Tagging Equipment (UTE) which makes it possible to tag redfish by a robot, in the fishes own environment, thus avoiding the hazardous trip to the surface. Based on the success of such a quest a further attempt will be made to answer some of the question raised. The main reason for MRI's interest with the UTE is therefore associated with the unknown stock structure of *deep-sea* redfish and the unknown migration pattern of the fish. The goal is to use this equipment to answer some key questions in order to improve the advice on stock management in the future. Although redfish has been the target species during this work, the equipment is capable of tagging a range of species. Although the survival of fish through capture and handling varies between species it is likely that survival rate for all species during tagging could be improved using this technique. The technology of underwater tagging is therefore likely have a great potential in its application.

Figure 2. The Underwater tagging equipment.

The equipment

In order to use the UTE (figure 2), a vessel equipped with a fishing trawl and with cable wire is required. This is a standard equipment onboard research vessels and most of the vessels that participate in the

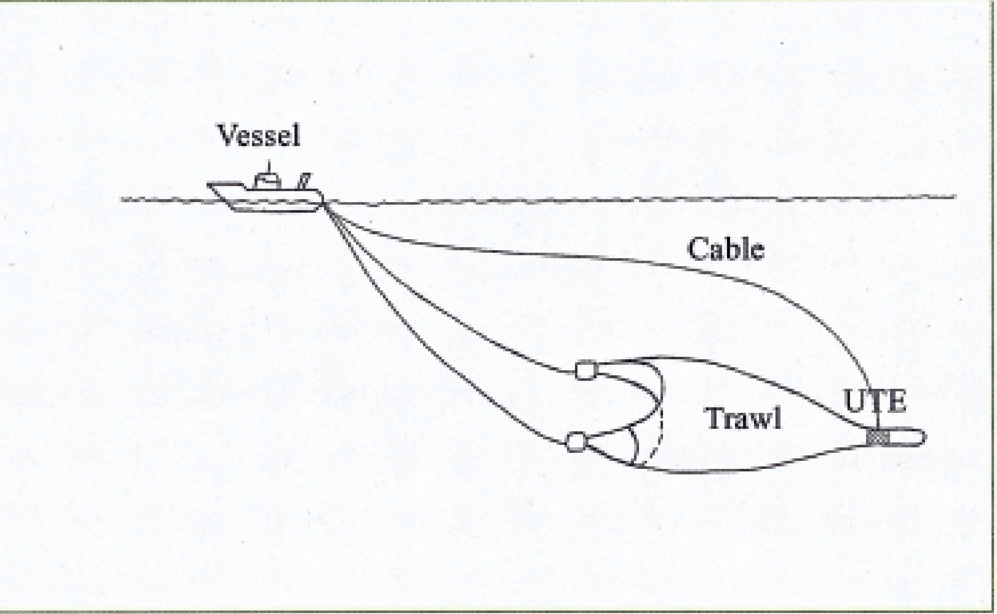

Figure 3. Placement of the device in the fishing gear.

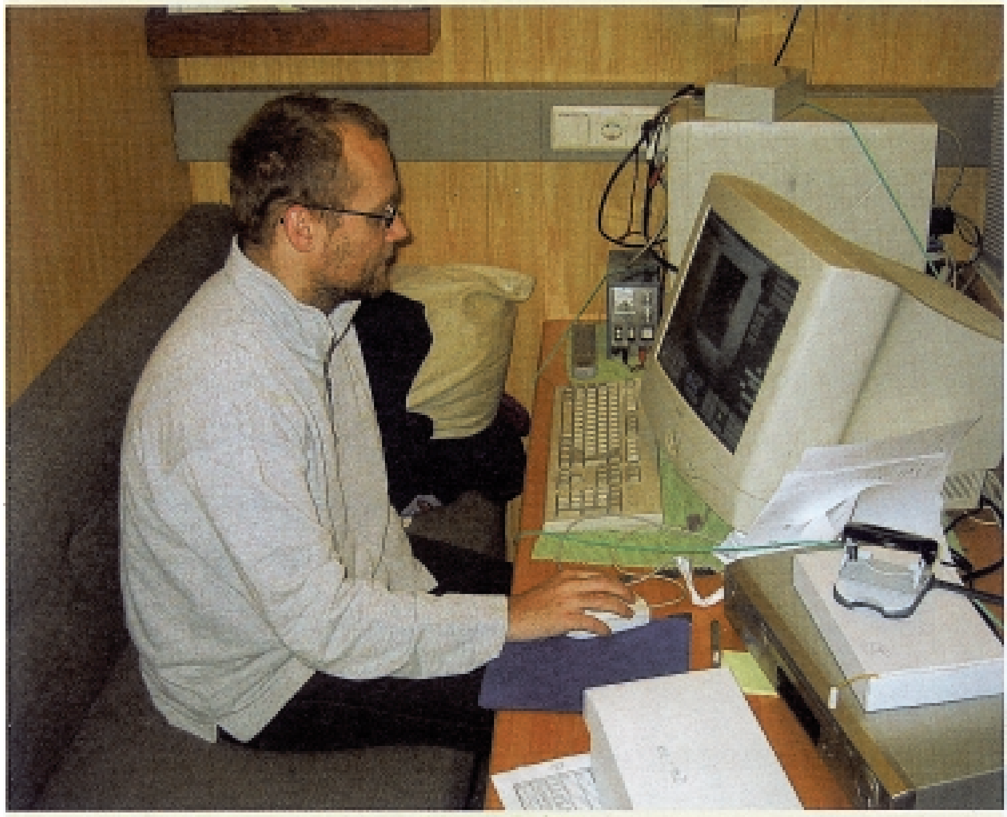

Figure 4. Redfish scientist tagging redfish at depth of 500 m.

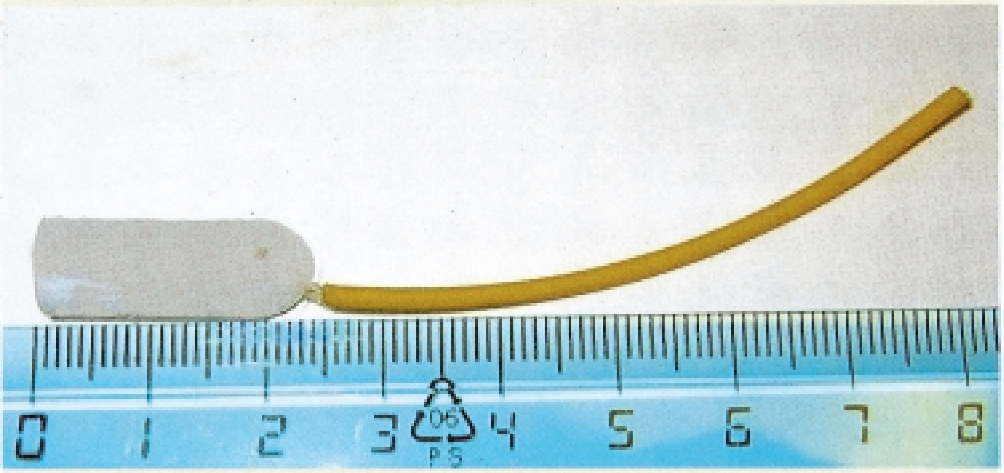

Figure 5. DST micro dummy tag used while tagging redfish in October 2003.

redfish fishery. The fishing technique is as for the commercial fishery. The UTE is placed in front of the codend in the fishing trawl, tagging the fish at fishing depth (Figure 3). It is designed to tag fish at depths down to more than 1,000 m.

The UTE has been tested both with bottom trawl and pelagic trawl. The control unit of the UTE is attached to the cable wire. The tagging procedure can be divided into three steps:

1. As a fish inside the trawl approaches the equipment at the cod-end section it enters a grid which directs the fish into tagging place. The fish is viewed through an onboard video camera, and the tagging gun is moved into position. The tagging operator controls all tagging from a PC computer onboard that is linked via the cable wire to the UTE (Figure 4). The device is equipped with four underwater cameras, enabling the user to view (from different angles) live video images from the UTE.
2. When the fish is placed in a right position in the device, a knife makes a small incision into the skin of the fish for the tag (Figure 5) to be pushed into its body cavity. It may take some time to position the fish correctly for tagging but the tagging operation itself takes only few seconds. When the fish is tagged, the tag is in place inside the abdomen of the fish, but a thin flag (tube) protudes from the fish to allow identification of tagged fish when recaptured. (Figure 6). At this stage of the procedure a digital photo is stored and the length of the fish is estimated from the picture.
3. After tagging the fish it is released through a channel in the device and out into open water.

Since 1999, several experimental cruises have been made. During the cruises, the fish were not released, but recovered after tagging to inspect it for tagging injuries. In October 2003, during the first cruise after the testing phase, 200 redfishes were tagged at the Reykjanes-Ridge about 150 nautical miles Southwest of Iceland, on the research vessel Bjarni Sæmundsson. The fish was tagged at a depth of 500-550 m. Both electronic tags (measuring and storing information on temperature and depth), and tags without electronics, can be used in the UTE, but only the latter have been used until now.

Already 6 fishes have been recaptured from this first batch of releases, the last one in April 2004. All the recaptured fish have been recovered onboard stern-trawlers that have been fishing in the area of the tagging.

Survival rate of tagged redfish with the UTE is difficult to estimate as it is not possible to catch redfish and hold in a cage.

Figure 6. Recaptured redfish. The flag indicating the tag inside the fish can be seen.

Figure 7. The UTE in action.

Experiments were however done on cod, using the same tagging technique. The cod was from a pisciculture and 20 fishes were tagged. Incision was made with a knife and a tag placed in the body cavity of the fish. All of the fishes survived the tagging and none of them died during the next 3 weeks when the experiment was terminated. This indicates that the method does not result in a serious tagging mortality. Three of the recaptured fishes were examined at the MRI and did not show any visible injuries caused by mechanical handling by the tagging gear and the cut wounds inflicted during tagging were healing and showed no indication of infection or swelling. Furthermore there was no indication of internal damage. This further supports the conclusion that the method is relatively harmless. Two of the recaptures have not been examined as the tags were not detected before the fish had been processed onboard the vessels.

Future use of the UTE

As the UTE is designed to tag fish at fishing depths, it has several advantages over the traditional tagging methods. First of all, it is specially designed for tagging deepwater fish that cannot survive the changes in pressure and temperatures when brought to the surface, which is unavoidable with traditional tagging methods. It reduces the time spent in handling the fish and leads to increased tagging efficiency. As the fish is tagged in its natural environment there are fewer stress factors reacting on the fish such as pressure, temperature and light changes and therefore smaller mortality may be expected compared with traditional methods.

It is thought that the experience with the UTE has been very positive and opens new fields in fish research, making it possible for researchers to tag, for the first time, deepwater species that can not survive being brought to the surface.

In early June 2004 a 2-week cruise is planned for further deep-sea redfish tagging to acquire knowledge on the migration of the redfish in attempt to clarify some of the unknown aspects of the stock structure of the species. Taking the uncertainty of the stock structure of deep-sea redfish into account, the results from tagging will help scientists to learn more about the migration and behaviour of the species, and will provide better understanding on distribution, feeding behaviour, vertical and horizontal movements and mixing between stock units. Such information may be the bases for improved stock assessment and make management of the fishery and decision making easier.

REFERENCES

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