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Theme session K, Functioning of the Marine Ecosystems

Underwater tagging of deep-sea redfish.

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ABSTRACT

The poster describes a tagging method using an Underwater Tagging Equipment (UTE), developed in collaboration between the Marine Research Institute in Iceland and the Marine Device Manufacturer STAR-ODDI. The tagging device can be attached either to a pelagic- or demersal trawl dorsally in front of the codend. Some of the fish that enters the trawl is diverted through the UTE where it enters an adjustable tagging cradle where the fish can be held, adjusted and released. The tagging equipment is controlled from the vessel through a cable wire where the researcher can view the fish on television by four video cameras. The person tagging the fish can adjust the cradle and move the tagging gun into place and tag the fish. The tags used in the UTE have been dummy tags that can in the future be replaced by active electronic tags that can give ambient environmental parameters e.g. temperature and depth profiles. The UTE has been used to tag redfish of size between 32-52 cm, but other species have entered the equipment, such as saithe, and have been tagged with success. The tagging equipment can therefore be used for tagging medium size round fish such as tusk, cod and haddock. The paper describes briefly the UTE device and it's including results of the first recaptured fish from tagging cruises in October 2003 and June 2004.

Keywords: *In situ tagging, redfish, Underwater tagging equipment.*

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Introduction

Tagging experiments have been used in fisheries research since late in 19th century. Although many methods have been developed in fisheries research tagging remains a fundamental tool in research of behaviour of commercial fish especially after development of electronic tags (Arnold, 2000). Tagging methods have generally involved bringing fish to the surface by some fishing gear, hauling them onto deck 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 in tagging experiments, such as the use of containers around the codend of trawls to decrease the time fish spends in air and tagging cradles to immobilise and protect fish, the trip up to surface remains the main problem for the survival of fish in tagging experiment. This is especially for those with a closed swimbladder (Jakobsson 1970, Jones 1979). Many fish species, suffer a great mortality in the capture process and the various redfish species, suffer a total mortality when brought to surface by conventional fishing gear.

It has been a common knowledge that the redfish species in the North Atlantic have been considered impossible to tag by the conventional methods (although not well reported). The main reason is that the fish is unable to release the air from the swimbladder fast enough when going from the high pressure deep waters to lesser depths. As a result, the swimbladder may expand and rupture and if the air does not escape, its expansion can push the internal organs out through the oesophagus and the mouth killing the fish.

Sebastes mentella is the most important redfish species harvested in north Atlantic. There are several management units dealt with within ICES. ICES North-Western working group deals with deep sea redfish with a distribution extending from the Labrador Sea in the West to the Faeroes in the East (Fig, 1). Extensive fishery of deep-sea redfish is carried out with an annual catch of more than 150 thousand tonnes. The fishery is conducted on the shelf and slope of Iceland and the Faeroes 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 (Anon, 2003). Many questions about stock structure of deep sea redfish within this area have been raised.

The Marine Research Institute in 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 its natural environment, thus avoiding the hazardous trip to the surface. The main reason for MRI's interest with the UTE is to obtain more information on vertical and horizontal migration patterns of the various stocks of redfish. This information will be used to answer some key questions such as the unknown stock structure of deep-sea redfish in order to improve the advice on how to manage the resource in the future. Although redfish has been the target species during this work, the equipment is capable of tagging a range of species. The survival of fish through capture and handling varies between species it is however likely that survival rate for most species during tagging could be improved using this technique. The technology of underwater tagging is therefore likely to have a great potential in its application.

The Equipment

In order to use the UTE, a vessel equipped with a fishing trawl and a cable wire winch is required. This is a standard equipment onboard research vessels and on most of the vessels that participate in the 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 (Fig. 2). It is designed to tag fish at up to 1000 m depths.

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 device is equipped with four underwater cameras, enabling the user to view fish in UTE from different angles by live video images. Further technical details of the device are given in table 1.

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 through a grid which directs the fish into tagging place. The fish is observed by one of the four video cameras, 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 (Fig 3).
2. When the fish is placed in a right position in the device, a knife makes a small incision into the peritoneal cavity of the fish for attachment of the tag (Fig. 4) 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 placed inside the abdomen of the fish, and a thin flag (tube) protrudes from the fish to allow identification of tagged fish when recaptured. (Fig 5). 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 first cruises, the fish were not released, but recovered after tagging to inspect for success and tagging injuries. In October 2003, during the first cruise after the testing phase, 200 redfishes were tagged and released 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. The latest UTE redfish tagging expedition was in June 2004 when 550 fish were tagged, both using pelagic and bottom trawl.

From the first batch of releases in October 2003, 6 fishes have already been recaptured, 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 (see Fig. 6). Rather limited horizontal movement was observed from the first recaptures. The distance from the tagging place to the recapture place varies from 4- 23 nautical miles, all recaptured west of the tagging place. Although the number of fishes are very limited, this might indicate a slow westerly movement of the fish during this period, possibly towards the areas where the females extrude their larvae.

Tagging mortality of redfish, tagged with the UTE has not been estimated, as it is difficult to catch redfish and hold in a cage. Manual experiments have however been done on cod in captivity, where the tags were surgically attached in a similar way, as done in the UTE. The cod was from a pisciculture and 20 fish were tagged. Incision was made with a scalpel and a tag placed in the body cavity of the fish. All of the fish survived the tagging and no mortality was observed during the next 3 weeks until the experiment was terminated. Three of the recaptured redfishes have been examined at the MRI and did not show any visible injuries caused by mechanical handling by the tagging gear. The cuts inflicted during tagging had healed and showed no indication of infection or swelling. Furthermore there was no indication of internal damage. Two of the recaptures were not 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 acting on the fish such as pressure, temperature and light changes and therefore smaller mortality may be expected compared with traditional methods.

The tag and attachment resembles the conventional internal - external tags produced by Hallprint tags (http://www.hallprint.com/). The tagging procedure is very fast and the fish shows no fright reaction. This method has therefore potential for the welfare of fish. (Erickson, 2003; Thorsteinsson, 2000).

An important future step is the replacement of the dummy tag by an electronic tag and a data storage tag (DST) would be a likely choice.

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.

Acknowledgements

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References

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Tables

Table 1. Technical Specifications of the UTE.

Weight in air	650 kg
Base material	Stainless steel, low corrosion
Operational pressure/depth	100 bar/1000m
Communication	Standard cable wire transfers signals between ship and UTE. This includes measurements, video from four underwater cameras, and the control of all tagging functions.
Video cameras	Black and white
Light	Helical bulb. Light filter optionally attached, allowing only red light through in order to protect the eyes of the fish
Actuators	Hydraulic
Measured parameters	
Temperature	-2°c to 40°c (28°F to 104°F)
Depth/pressure	0 to 1000 m/ 0 to100 bar
UTE inclination	Roll and pitch +/- 45°
Hydraulic pressure	0 to 250 bar
UTE control unit	PPC (Programmable Process Controller) Communication unit
	Light and video switching actuators
	Hydraulic pump, control unit remote controlled hydraulic pressure
PC Control Unit	Standard PC
	UTE tagging software with video card
	Communication unit, composite video output for VCR
	Power supply for charging the battery containers
Battery container lifetime	Appr. 5 hours (rechargeable). 2 battery containers, replaceable.
Tagging gun	Remote controlled, can be moved in two directions
Capacity for tags	59 tags
Tags applied	DST micro dummy tags
	DST micro electronic tags, measuring temperature and depth
Size of tags (diameter x length)	8.3 mm x 25.4 mm (plus the plastic tube)

Figures

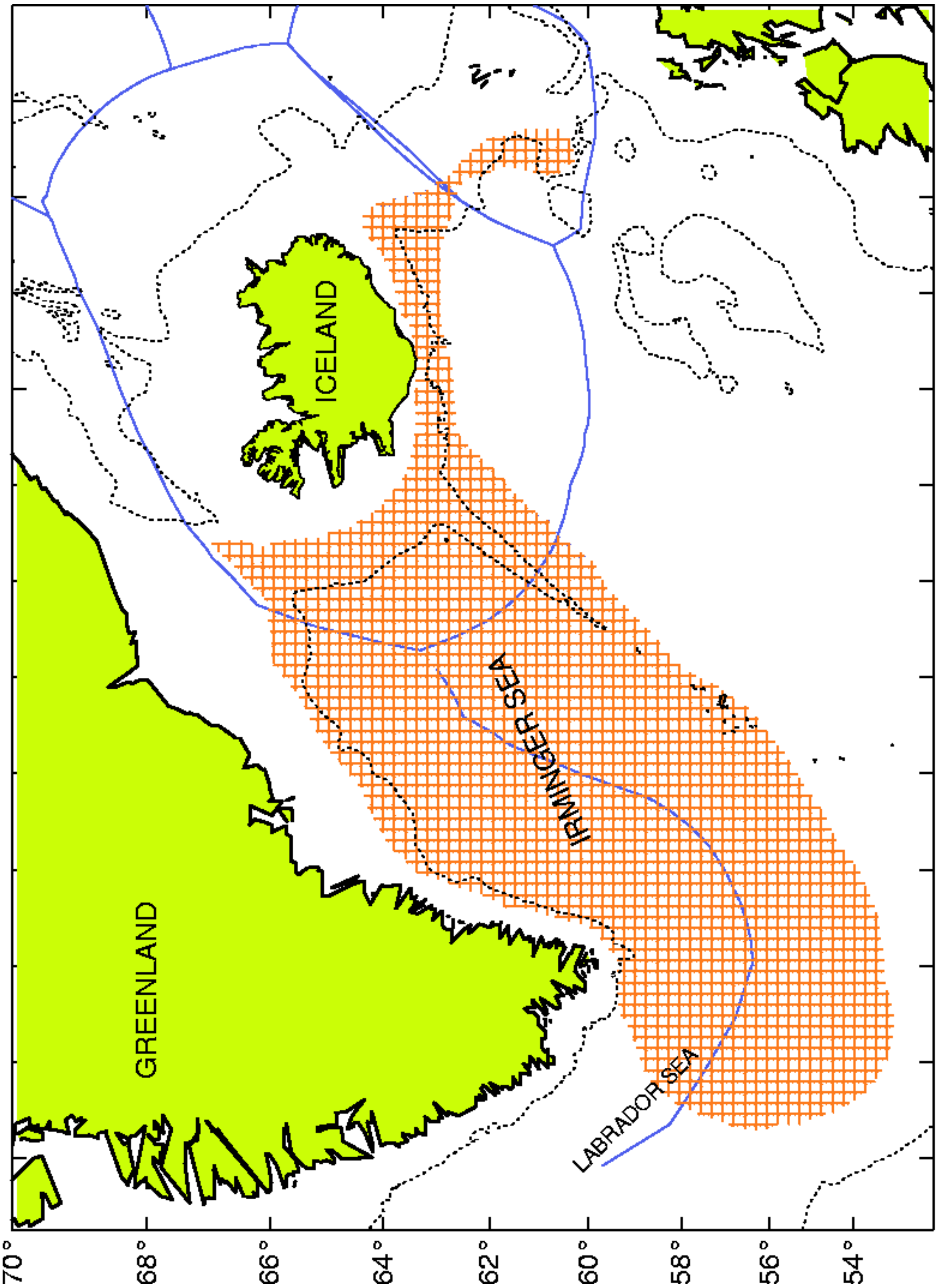

Figure 1. Schematic overview of fishing areas for deep-sea redfish from west of the Faroes to the Irminger Sea.

Figure 2. The Underwater Tagging Equipment (UTE).

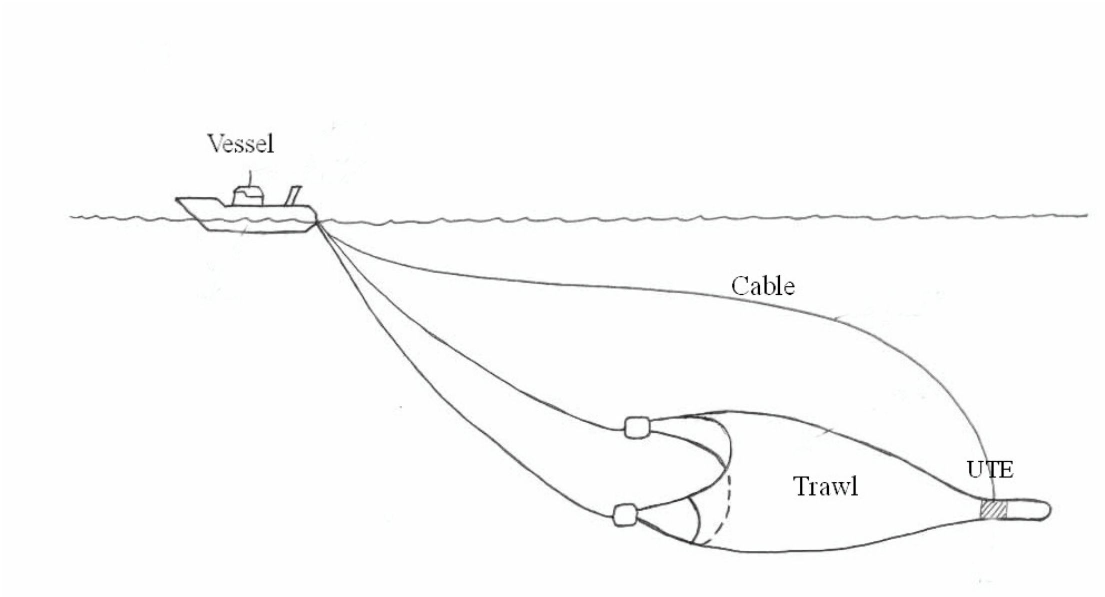

Figure 2 . Placement of the UTE in the fishing gear.

Figure 3. Redfish scientist tagging redfish at depth of 500 m.

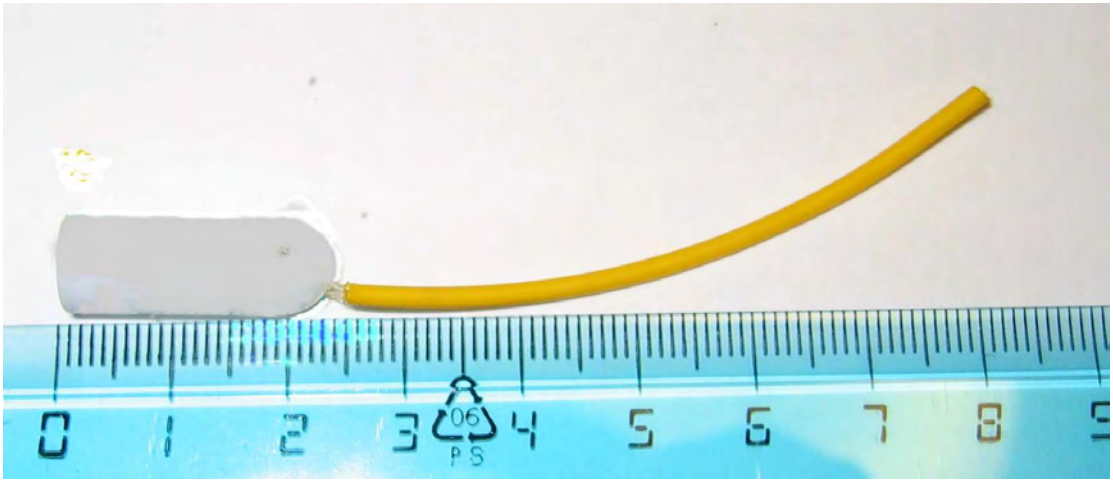

Figure 4. DST micro dummy tag used while tagging redfish in October 2003 and in June 2004.

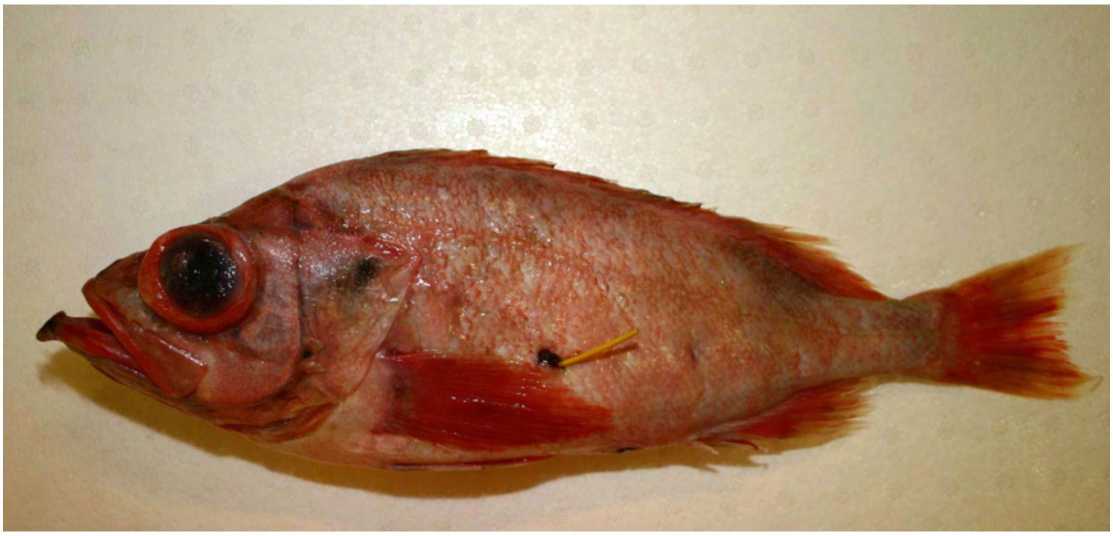
Figure 5. Recaptured redfish. The flag indicating the tag inside the fish can be seen.

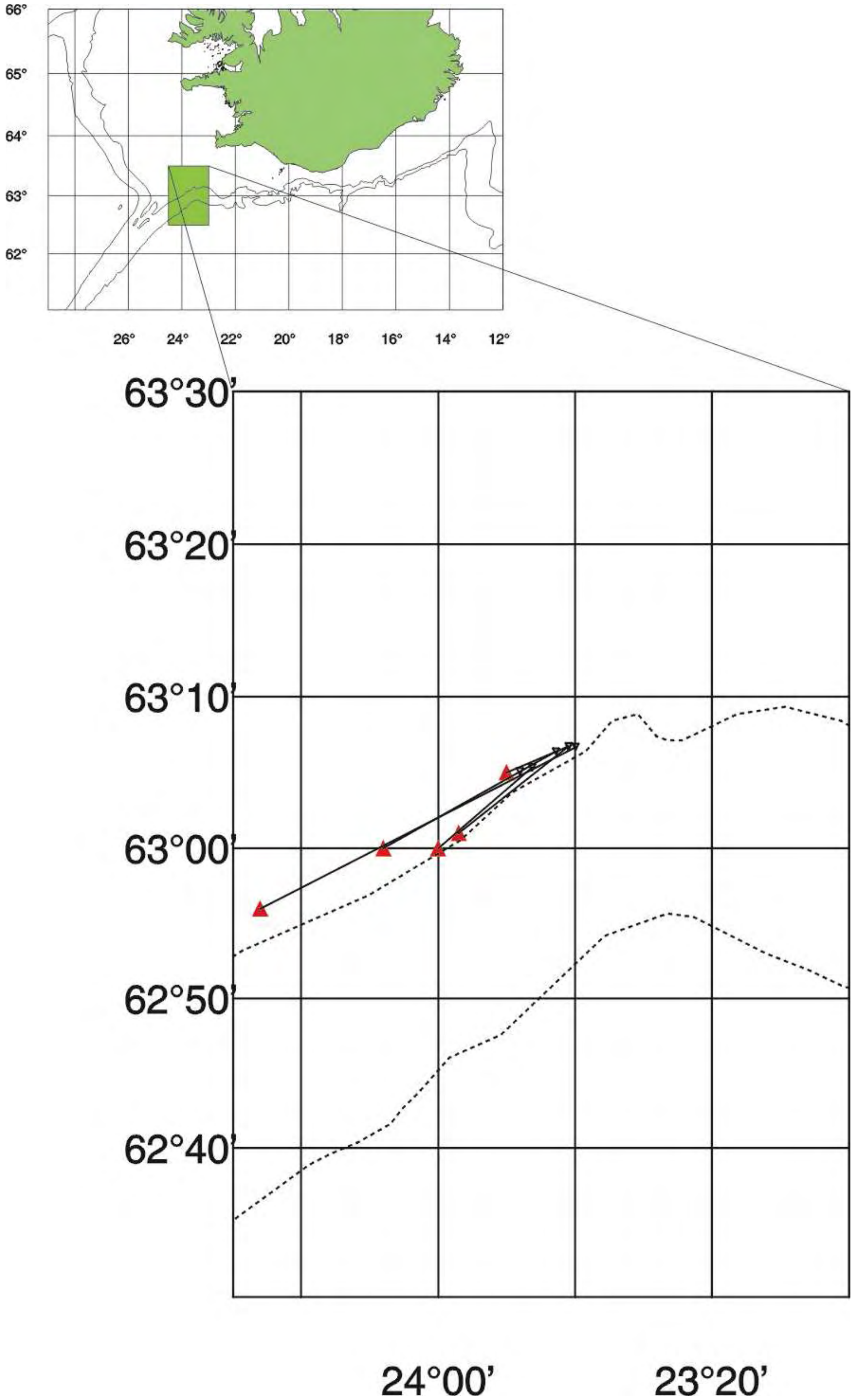

Figure 6. Tagging and recapture locations for the 5 deep sea redfish where exact position of recapture is known.