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The platform and equipment for satellite-monitored tagging experiments in NEWREP-A and NEWREP-NP

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In recent years, satellite monitored tags have been recognized as crucial tools for behavioural studies of wild animals. These tools have been used for monitoring movement patterns of free-ranging animals such as marine mammals and sea turtles (e.g. Hoenner *et al*., 2012; McIntyre, 2014; Lee *et al*., 2017). However, the attachment of the tags on the body of large whales is a challenging issue, as attachment of the tag needs to be made from moving vessels on moving whales.

Recently satellite tags housed in stainless steel and air-pressured tagging guns have been used successfully for the long-term tracking of large whales to investigate their migration routes (e.g. Kennedy *et al.*, 2014; Garrigue *et al*., 2015; Panigada *et al*., 2017). From the analysis of time series location data, the changes of movement speed and the swimming angle can be calculated, and the latest modelling approach enables the definition of behaviour of the animals, such as foraging or migrating (Jonsen *et al*., 2005; 2013; Silva *et al*., 2013; 2014; Prieto *et al*., 2014; Dulau *et al*., 2017).

Satellite tracking of baleen whales was part of the objectives of NEWREP-A and NEWREP-NP, and the Institute of Cetacean Research (ICR) have been working on the development of tags, and attachment systems to be used from the platform of large vessels. This paper reports on the platform and instruments of the satellite monitored tagging experiments conducted during NEWREP-A and NEWREP-NP surveys including a description of the tags, the attachment system and the vessels from where the experiments were conducted. Results of the experiments will be summarized in future TEREP-ICR issues.

Satellite monitored tags

The ICR used the so-called Type C tags. The anchoring systems and electronic packages are consolidated and embedded in the body of the animals with an external antenna (IWC, NOAA and ONR, 2019). This Type C tags have been used for relatively large whales. Geographical locations are obtained by satellite transmissions, such as Argos system operated by Collected Localisation Satellite (CLS). Specifically the ICR used the SPOT177 tags (113 mm with triangle stop plate; Wildlife Computers Inc.) (Figure 1).

SPOT177 was designed to track the positions of the whales. The anchor was designed by ICR (*ca*. 100 mm in ISOD-type ver.2) for stabilizing the tags at implantation, and it was screwed on the anterior of the tag-housing (Figure 1 and 2). The penetration into the body was almost 200 mm (from the stopper at the end of tags to the

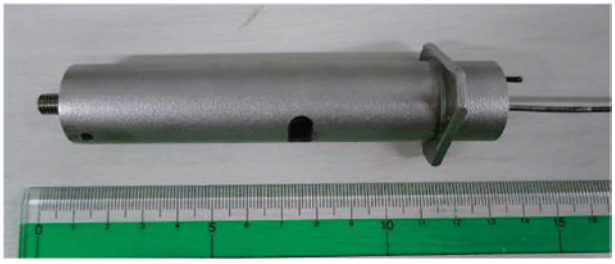

Figure 1. Satellite monitored tag SPOT177 (Wildlife Computers Inc.)

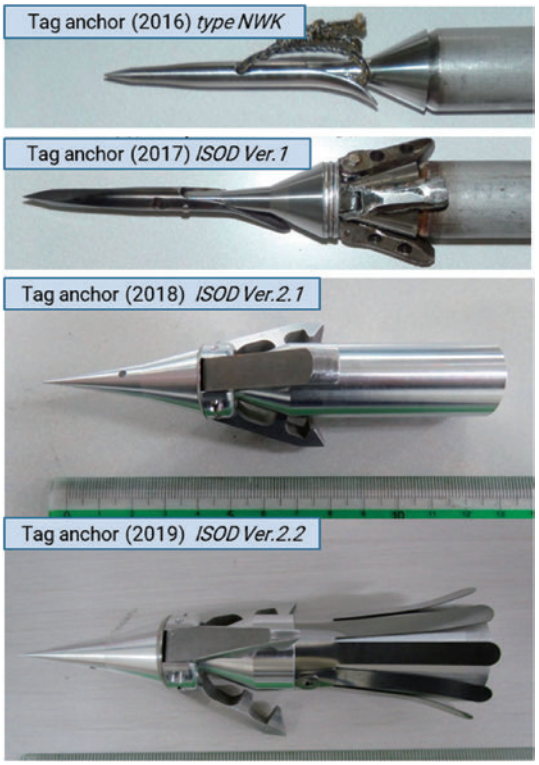

Figure 2. The anchors designed by the ICR for SPOT type tags.

tip of the anchor). The ending part of the tag was connected to a pipe-like LK-Carrier (made of polycarbonate designed by LK-ARTS, Skutvik, Norway) (Figure 3) with a timing release, and inserted into the barrel of the Airgun. LK-Carrier also works as a float in case deployment failure occurs at sea. The anchors and tags were sterilized before their use. Once deployment was confirmed as successful, a saltwater sensor activated the tag that started transmitting when the dry switch sensor surfaced.

Airgun

The Air Rocket Transmitting System (LK-ARTS), which was developed by Lars Kleivane in cooperation with Restech-Norway, was used for launching the tags in NEWREP-A and NEWREP-NP (Figure 4). LK-ARTS is designed to launch satellite tags, sensor packages, biopsy darts etc. by compressed air. The entire body is made of alumite and the barrel (launching tube) and the posterior stock (shoulder support) are detachable, so that the length can be changed depending on the tag shapes. Total length is approximately 1,350 mm with a 780 mm launching tube. An optical sight and a pressure manometer are connected. The air cylinder with hose is connected to the valve of the LK-ARTS in the Figure 4. Air pressure is easily controlled by the valve on the base. This allows shooting at different distances.

Figure 3. A set for SPOT177 attachment. Anchor, tag and LK-Carrier are connected.

Vessels

The tags were deployed from the bow deck (6.5 m height from sea surface) of the R/V *Yushin-Maru*-type vessels (*ca*.720 GT) with length of about 70 m (Figure 5). The use of this type of vessels has the advantage of being able to conduct tag attachments far from shore and under rough sea condition. In parallel to tagging, skin biopsies were also collected from the same individual whales for genetic analyses using a Larsen gun system (Larsen, 1998).

During the tagging experiments, the part of the whale body where the tags were attached was recorded (Figure 6). Also, photos of the attached tags were taken to in-

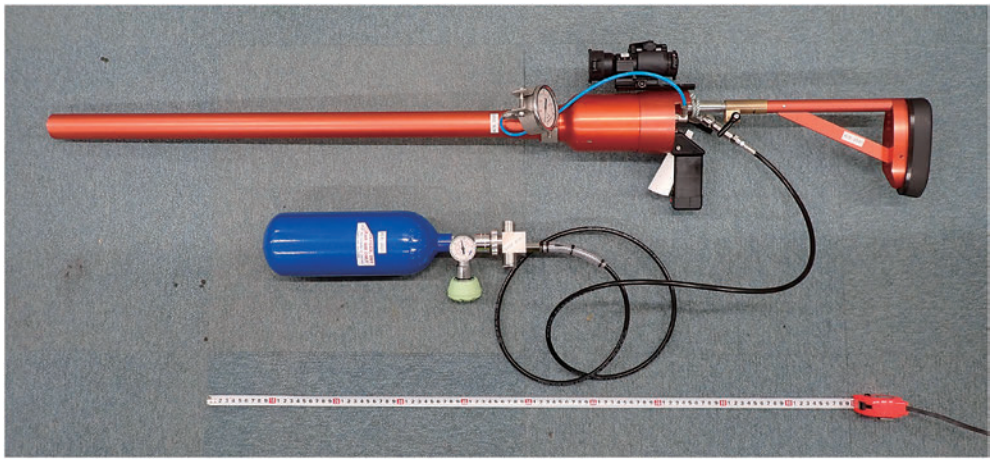

Figure 4. The Air Rocket Transmitting System (LK-ARTS) launching system.

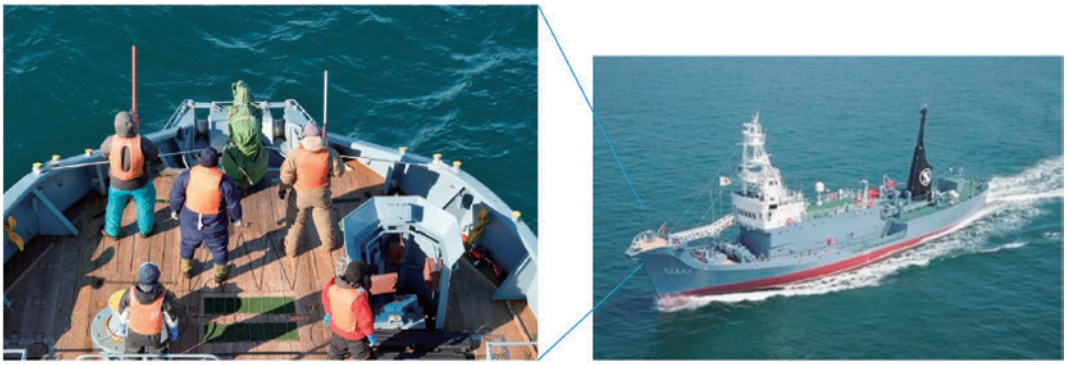

Figure 5. *Yushin-Maru*-type vessel and its bow deck.

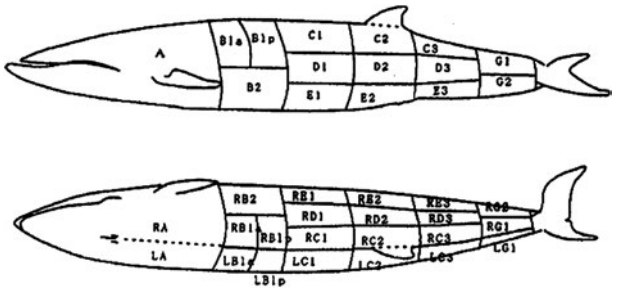

Figure 6. Code of whale body area used for recording the location of tags deployment.

vestigate the relationship between the depth of penetration and the radio transmissions for modification of the anchor and improvement of the attachment techniques.

Target whale species

The platform and equipment described in this note have been used in all NEWREP-A (2015/16–2018/19) and NEWREP-NP (2017–2019) survey years. The satellite-monitored tags were deployed on the Antarctic minke whales in the Indo-Pacific region of the Antarctic, and on common minke, sei, fin and blue whales in the western North Pacific. The tracking results will be reported in future TEREP-ICR issues.

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