Satellite transmitters applied to fin whales in the Sicily Straits in winter

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Introduction

Despite several good studies on the presence, distribution, abundance, density, habitat use and diving behaviour of fin whales (*Balaenoptera physalus*) in the Mediterranean basin (Azzellino et al., 2008; Forcada et al., 1995; Laran and Gannier, 2008; Panigada et al., 2011, 2008, 1999), a number of key aspects of the ecology of this species remain unclear. The presence of summer feeding aggregations has been reported in different areas of the north-western basin (Arcangeli et al., 2013; Castellote et al., 2009, 2008; Laran and Gannier, 2008; Panigada et al., 2006). In contrast, very limited information indicate wintering grounds between the south of Spain and the North African coast (Castellote et al., 2008), and in the waters off the Island of Lampedusa (Canese et al., 2006). Thus one of the most important knowledge gaps is an understanding of Mediterranean fin whale distribution and behaviour in winter, along with the timing and nature of their migration.

This lack of knowledge represents and important problem for developing comprehensive mitigation and monitoring plans for this species throughout its geographical and temporal range, as noted by *inter alia* ACCOBAMS. Improved knowledge on the geographic range, seasonal distribution, population structure, and migration routes is thus essential to identify the potential detrimental effects of anthropogenic activities.

The joint IWC-ACCOBAMS workshop on ship strikes, organized in Beaulieu-sur-Mer in September 2010, emphasised the urgent need to collect information on the population structure, distribution and movements of Mediterranean fin whales. This is essential for the correct interpretation of the estimates of abundance and density, the evaluation of possible trends is space and time, and the identification of priority mitigation measures throughout the year.

Here we report on the two field seasons off the Island of Lampedusa, carried out in March 2013 and March 2014, aiming to deploy satellite transmitters on fin whales in the Sicily Straits in the winter months. The project final goal was to obtain additional information on fin whale movements, migration and fine-scale habitat selection in the waters surrounding the Island. A research project in this area provides the possibility to collect fundamental information on the species occurrence, allowing the identification of sectors within the Mediterranean in need of special protection and critical to identify threats and implement proper mitigation actions.

In March 2014, we observed a mother-calf pair feeding close to the coast of Lampedusa; the analysis of the pictures of the mother revealed that this animal was sighted and marked with a satellite transmitter during the field work in 2013. The whale was still carrying the anchoring system of the satellite transmitter deployed over 12 months earlier, providing unique opportunities to monitor attachment duration and the healing process. In addition, the whale was with her calf, providing further evidence that tagging operations may not significantly affect their reproductive parameters.

Tag performance and longevity

Despite considerable effort to review the different available tags to maximise reliability, the satellite transmitters behaved generally more poorly compared with previous deployment in the Mediterranean Sea and elsewhere.

During the field season 2013, three implantable satellite transmitters were deployed and the average duration of transmission was relatively poor, with only 8.3 days, when compared to durations of the same tags in another location in the Mediterranean Sea (mean=68 days, range =2-142 , n=5 (Panigada et al., 2013)). There are several possible explanations for this, but they all remain speculative, given the small sample size. These hypotheses include the following:

(1) Habitat characteristics: the short duration of the transmitter may be related to the particular habitat in which the whales were observed, i.e. very shallow waters of less than 100 meters. During feeding episodes under the surface, the

whales may come into contact with the bottom, and rolling on the side (a common feeding behaviour) may cause the tag to be scratched off the body of the animal.

(2) Body contact: the detachment of the transmitter may also be due to the synchronous behaviour of the whales during feeding activities. If the whales are close to each-other during surface or mid water feeding, they may rip off the transmitter while physically interacting. The month of March is also at the end of their mating season; mating behaviour, even if never observed during our direct observations, may also lead to the loss of the tags from the animals.

(3) Tag failure: an alternative explanation to physical loss of the tags is that there were problems with the instruments themselves resulting on a loss of transmission. This may be a result of two categories of problem: (1) a malfunctioning of the electronic component, or (2) damage to or detachment of the transmitter device from the anchoring system during the deployment. Earlier versions of the transmitters used here have shown design flaws (e.g. Robbins et al., 2013; Zerbini et al., 2013). However, these issues were fixed in the most recent tag designs (similar to those used in this study) and preliminary testing of these instruments on humpback whales in the Gulf of Maine proved to be robust (Zerbini et al., 2013).

During the 2014 field season we photographed a whale which was still carrying part of a satellite transmitter that was deployed in March 2013 (Figure 1). The first time the whale was seen was on 4 March 2013, when the tag was successfully deployed. The animal was sighted again on 19 March 2014, nearly a year later, with the anchoring system still on its body. In 2014 the whale had a calf and was actively feeding at the surface. This finding has two major implications:

1. it shows that the anchoring systems used in this study can provide long attachment durations (since this is the first time ever that such a duration is witnessed on a fin whale). Almost the entire anchoring system is still in the body, with just two small petals coming out.
2. The transmitter component of the tag is missing, suggesting that further improvements need to be made to the anchor/transmitter interface to make the tag more robust.

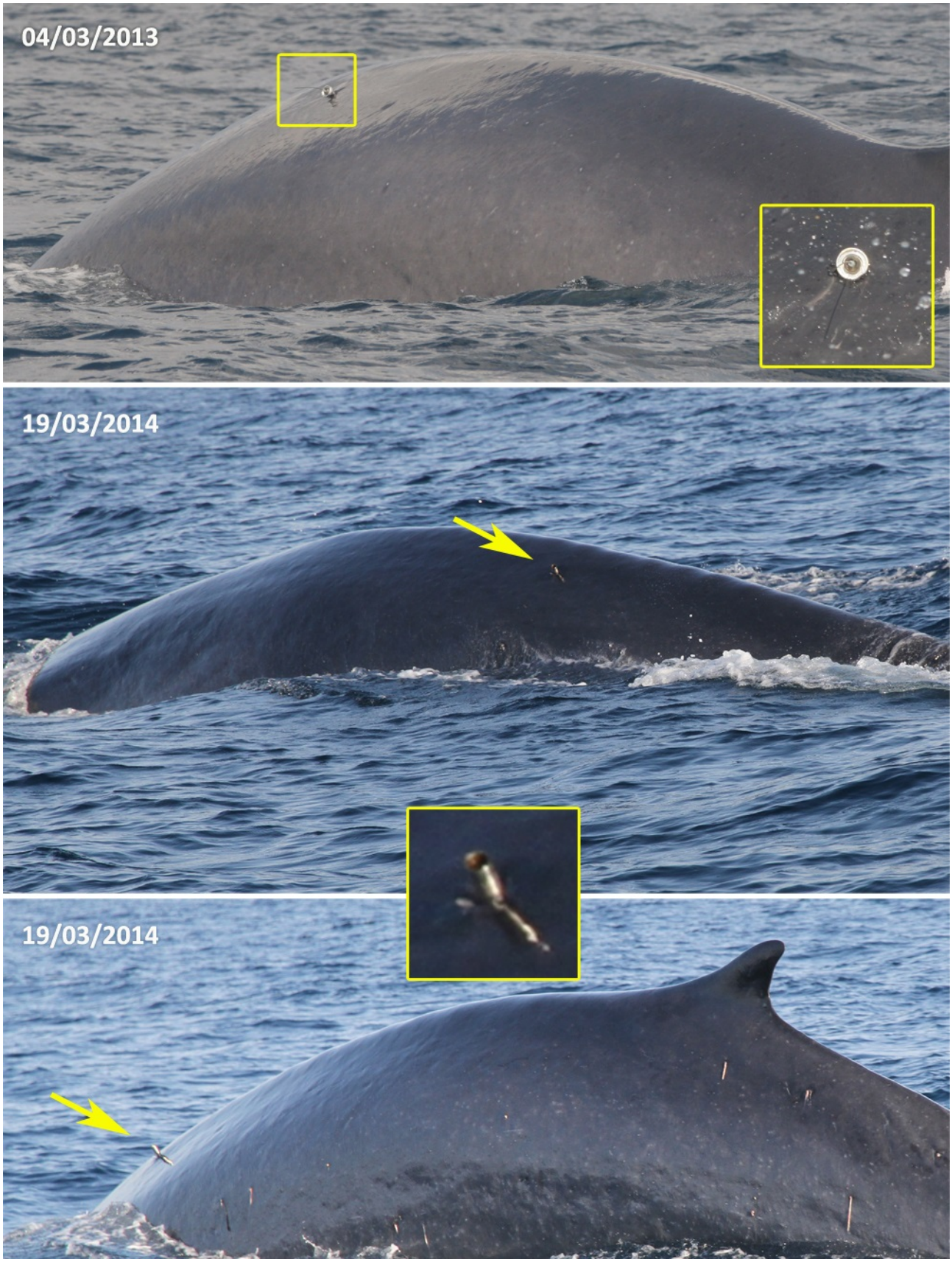

Fig. 1 – The same whale (March 2013 and 2014) with the satellite transmitter on its body.

Discussion

This type of follow-up information is particularly important when trying to assess potential causes for tag failure. By looking carefully at the pictures taken during the 2014 sightings there are a few considerations to make:

i. The image clearly shows the reinforced anchor implemented since 2013, after design faults with an earlier version of this tag was discovered (Robbins et al., 2013; Zerbini et al., 2013). In the picture we can see the reinforcement sleeve exposed but the front end of the anchor is still attached to the body, showing just a couple of petals migrating outwards.

ii. It is very difficult to say whether the tag broke off at the edge of the reinforcement sleeve or if it unscrewed from it and fell off. A careful look in the back end of the anchor, we can clearly see the edge of the sleeve, but there is something inside that looks amber in colour. It is unclear whether this corresponds to (a) the epoxy where the electronics are cast, (b) oxidation (inside an empty sleeve), or (c) an effect of the light in the picture. We believe the most likely scenario is (b), which implies the transmitter unscrewed from the anchor, but this is hard to validate. This failure, however, seems unusual because preliminary tests that were conducted during tagging experiments with Gulf of Maine humpback whales showed the reinforced anchor/transmitter interface to be robust and to last long on the whales.

iii. The fact that the anchor stayed this long on the whale is encouraging because it suggests the use of the shorter (less invasive) tags (240mm in length used in 2013 versus 300mm long one used in 2012) may be appropriate. The resightings of this individual provides clear evidence that the tag did not stop transmitting because the attachment failed. Thus, the use of shorter transmitters with a more robust wall thickness and a fully integrated anchoring system in the future is recommended.

iv. Perhaps most important, the picture does not show any type of significant tissue reaction to the presence of the tag. The tag site does not appear swollen and there is no evidence of discoloration, depressions or other physical reactions. There is only a small "whitish" string of what looks like tissue coming out diagonally from the tag wound, which has been seen before on other species (e.g. Robbins et al., 2013) and is consistent with an outward-migrating object.

These results also reveal that there is a certain degree of site fidelity towards the area, with whales possibly returning year after year, while the presence of mother-calf pairs provides indication of proximity with potential breeding grounds as well.

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