Poor retention of passive induced transponder (PIT)* tags for mark-recapture studies on tropical sea cucumbers

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Abstract

We tested the short-term retention of passive induced transponder (PIT)* tags on 20 adult sea cucumbers of both *Holothuria whitmaei* and *Actinopyga miliaris* in New Caledonia. One PIT tag was injected into the coelomic cavity of each individual. One double T-bar tag was inserted into the same hole in the body wall as a means of later identifying the individuals with PIT tags. Only eight days after release in suitable reef habitats, just one-quarter of *H. whitmaei* individuals retained PIT tags and no *A. miliaris* individuals retained them. T-bar tags caused lesions in many *H. whitmaei* and we concur with previous studies that these tags are unsuitable for biological studies on most tropical sea cucumber species. In view of the poor retention of PIT tags, we encourage the development of novel tags for tropical sea cucumbers that are individual, biologically benign, cheap and can be identified in the field.

Introduction

Fishery managers need better information on the growth and movement of commercially valuable sea cucumbers. Reliable estimates of sea cucumber growth rates in natural habitats provide a better understanding of how quickly the animals can attain harvestable size from juvenile stages. These estimates are important, for example, in assigning the periodicity of rotational fishing closures or time frames for temporary closures. Information on displacements of sea cucumbers over medium and long time intervals (e.g. 1–5 years) can inform managers about how far different species are likely to disperse and, therefore, how large no-take reserves need to be to protect breeding populations.

The estimation of growth rate and displacement of marine animals in the field is usually achieved through mark-recapture studies. A number of individuals need to be tagged with tags that are individually identifiable and can be identified rapidly in the field. Tags need to be generally retained for long periods and need to be benign in their effects on the animals' growth and movement.

Previously, we studied the retention and detection of various tag types on the sandfish *Holothuria scabra* (Purcell et al. 2006). That study indicated that coded wire tags and elastomer implants could not be used to identify individuals easily and that T-bar tags were stressful to the animals and expelled quickly in juveniles. We therefore proposed to try the use of passive induced transponder (PIT)* tags, inserted into the coelomic cavity of sea cucumbers, as the new tagging method for the present study. The PIT tags (also called microchips) are the same as those used in livestock and pets. They are commonly 12 mm long and return a signal to a decoder to show the individual tag number. Success in the retention and benign effects of PIT tags has been documented for fish (Ombredane et al. 1998; Skov et al. 2005; Woods 2005), crustaceans (Bubb et al. 2002) and sea urchins (Woods and James 2005) but no studies had been published on their use in sea cucumbers.

The short-term study was conducted to trial the PIT tags in two species, *Holothuria whitmaei* and *Actinopyga miliaris*. These species were chosen because they are commercially important, belong to different genera, and were relatively abundant at the study site. We aimed to determine if the retention of PIT tags was high enough over one month to give confidence in their use for long-term mark-recapture studies. Animals were also tagged with double T-bar tags. The body wall of *Holothuria whitmaei* is 12 mm, whereas it is 6 mm thick in *Actinopyga miliaris* (SPC 2004). Single T-bar tags were used on seven sea cucumber species by Conand (1991), who found that retention was generally poor but could be nearly two years in some individuals. However, she concluded that "the tagging generates a stress" because some tagged individuals eviscerated, individuals of most species shrank after tagging, and tags were often expelled by the animals. We therefore only employed the use of T-bar tags as a means of later distinguishing the tagged animals from wild conspecifics, not as a proposed method for biological studies.

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* Note from the lead author (July 2020): The abbreviation PIT should have been developed as "passive integrated transponder", not "passive induced transponder".

Methods

The study commenced on 25 April 2007 at Ilot Maître, New Caledonia. The large reef surrounding the island was declared a provincial marine reserve in 1990. We collected 20 individuals of two species with different body morphology and size: *Holothuria whitmaei* (black teatfish) and *Actinopyga miliaris* (hairy blackfish). All *H. whitmaei* individuals were collected from the reef base on the northwest side of the main reef, and all *A. miliaris* individuals were collected in shallow lagoon seagrass beds just to the north of the island.

The animals were placed in bins of seawater on a boat, and were drained for about 1 minute on deck before being measured (length and width on the ventral surface, to ± 0.5 cm) and weighed (to ± 5 g, with an electronic balance). The body weights of *H. whitmaei* individuals averaged 2,440 g, while those of *A. miliaris* averaged 532 g.

Immediately after being weighed, one PIT tag was injected into the coelomic cavity on the dorsal surface, about one-third of a body length from the anus. A double T-bar tag was then inserted through the body wall, in the hole from the PIT tag injection, such that one anchor was on the medial surface of the body wall and one anchor was outside the animal. The functioning and individual number of each PIT tag was then verified with a hand-held reader (Fig. 1).

The animals were held briefly in bins with fresh seawater before being placed on the reef in two groups. All of the 20 *H. whitmaei* were placed within an area of about 20 m^2 on sand-covered pavement in the lagoon next to large rocks where they could find shelter. This is a habitat in which we find *H. whitmaei* on other reefs and in which we have found this species at Ilot Maître. The 20 *A. miliaris* were placed in a separate group in shallow seagrass beds, in an area of about 20 m^2 near where they were collected. We also removed untagged *A. miliaris* from that area. The functioning of the PIT tags underwater was verified using the decoders, through a plastic bag, on several occasions.

Eight days after tagging and releasing the sea cucumbers, we returned to the field sites where the two groups had been placed. All 20 individuals of both species were relocated visually. We then recorded whether the animals had retained the T-bar tag, and noted the tag number (Fig. 2). The presence of a PIT tag was checked thoroughly using the decoders, as practiced in the previous week. Because few PIT tags were detected (discussed below) we also dissected a couple individuals, which verified that there were no PIT tags retained in the body cavity.

Results and discussion

Eight days after tagging, only 5 out of the 20 tagged *H. whitmaei* had retained PIT tags, and only 10 out of the 20 individuals had retained the T-bar tags. Additionally, we observed that about half of the individuals with T-bar tags had infected lesions (white growth and exposed tissue) around the insertion point of the tags. A T-test showed that animals retaining PIT tags were not significantly heavier than those that lost them (t_{18}=0.53, p = 0.60). Although *H. whitmaei* individuals that retained T-bar tags were heavier (2,641 g) than those that had expelled them (2,240 g), the difference was not significant (t_{18}=1.54, p = 0.14).

None of the *A. miliaris* had retained PIT tags, but 12 out of the 20 individuals had retained T-bar tags. Notably, only a couple of the animals with T-bar

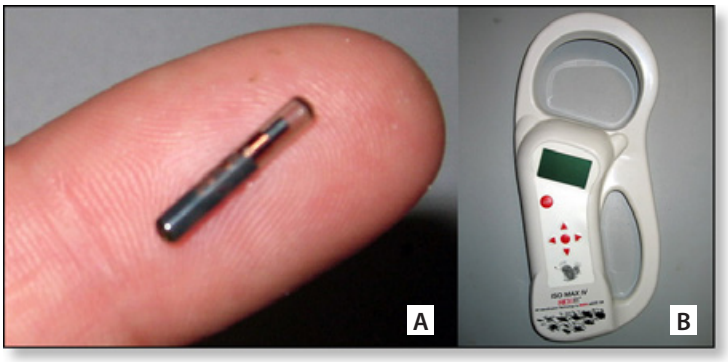

Figure 1 . A) PIT tag. B) Hand-held PIT tag decoder (Loligo Systems ApS, Denmark).

Figure 2. A black teatfish, *Holothuria whitmaei*, on the lagoon reef platform, showing an orange T-bar tag (circled) retained in the body wall, eight days after tagging.

tags had lesions near the tag insertion points. *A. miliaris* individuals that retained T-bar tags were heavier, on average (566 g), than those that lost them (481 g), but the difference was marginally non-significant (t_{18}=2.07, p = 0.053).

In view of low tag retention rates after only eight days in both species, we concluded that PIT tags were unsuitable for these species, and probably for other related species too. Also, the lesions seen with T-bar tags, and the relatively high loss rate of about half the tags in eight days, suggested that they were also unsuitable for studies on growth and behaviour. In both species, we found an indication that larger individuals retain T-bar tags better than smaller ones. Similarly, Conand (1990) found that small *A. echinites* lost T-bar tags more readily than large ones and caused "necrosis of the body wall, sometimes leading to death". Deleterious effects were a general conclusion of Conand (1991) using single T-bar tags on five of seven sea cucumber species. Her findings on movement of tagged *A. mauritiana* and *A. echinites* are valuable, as few results of this nature exist, but whether the movement rates were affected (higher or lower) by the tags cannot be discounted. A key result of Conand (1991) was that the utility of T-bar tags differs among species. Based on findings on the two species in the present study, we believe T-bars have limited use in biological studies (e.g. growth, movement, mortality) on most tropical sea cucumbers. Further improvements to minimise deleterious affects of external tags on sea cucumbers could prove resolve this problem.

Conclusions

T-bar tags can cause lesions in sea cucumbers, and we argue that external tags of this nature may confound results from studies on growth and movement due to deleterious effects on animal health. PIT microchips were mostly rejected and, unfortunately, do not appear to be suitable tags for sea cucumbers.

Genetic fingerprinting remains a useful "tagging" method for mark-recapture studies on sea cucumbers (Uthicke and Benzie 2002, Uthicke et al. 2003). However, it requires much analytical competence, detection is relatively costly, and tagged and untagged animals are indistinguishable in the field. Fluorochrome marking (Purcell et al. 2006) is cheap but is mostly a batch-marking technique that could only be applied in the field to small isolated groups of individuals, which again, are distinguishable only after examination of tissue samples in the laboratory. We therefore encourage the development of novel tagging methods for sea cucumbers that are cheap, allow animals to be individually distinguished in the wild, and are benign in terms of their affect on animal health.

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