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Getting old: an endangered seahorse (*Hippocampus whitei*) lives for up to 7 years in the wild

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Abstract

A long-term monitoring programme from 2005 to 2021 has allowed the assessment of age and longevity in an endangered seahorse *Hippocampus whitei* in the wild. Seahorses were marked using visible implant fluorescent elastomer (VIFE) which allows for individual identification. The longest period from marking to last sighting was 6 years 8 months and 17 days for a female. Using a von Bertalanffy growth function model for the species, this individual would have been approximately 7 years 7 months old on last sighting. These observations suggest that seahorses in the wild can live for over 7 years and demonstrate the benefits of using VIFE in long-term movement, population abundance and life-history studies of seahorses.

KEYWORDS

elastomer, longevity, syngnathidae, threatened species, VBGF

Assessing age of marine fishes is important for fishery resource assessments, understanding species biology, and is used to develop growth models for species. Determining age in fishes can be conducted using varying techniques with the most used methods including counting growth rings of fish spines, scales, vertebrate and otoliths (Brothers *et al.*, 1976; Koch & Quist, 2007; Maceina *et al.*, 2007).

One group of marine fishes where there has been very little work conducted on age and growth is the unique and charismatic seahorses (*Hippocampus* spp.). There are approximately 48 species of seahorses worldwide (IUCN, 2021) with only a few species having their age or growth in the wild assessed (Curtis & Vincent, 2006; Harasti *et al.*, 2012). The natural lifespans of seahorses are unknown, with most estimates acquired from aquarium observations. The iSeahorse website (https://www.iseahorse.org/) run by Project Seahorse states: "The natural lifespans of seahorses are virtually unknown, with most estimates coming from captive observations. Known lifespans for seahorse species range from about one year in the smallest species to an average of 3 to 5 years for the larger species" (iSeahorse, 2020). One of the reasons for a lack of age research being undertaken on seahorses is that many of them are considered "threatened" or "near threatened" (IUCN, 2021), and standard aging methods (*i.e.*, ring counting in otoliths) are avoided because of their harmful nature.

An alternative method that can be used to assess age and longevity in seahorses is through the application of a growth model such as von Bertalanffy growth function (VBGF) (King, 1995). The VBGF model can be developed by using non-obtrusive methods such as recording growth increment data in marked individuals as has been demonstrated for *Hippocampus guttulatus* Cuvier 1829 and *Hippocampus whitei* Bleeker 1855 (Curtis & Vincent, 2006; Harasti *et al.*, 2012). This can then be used to estimate growth rates, generation length and life span which are all idiosyncrasies that are used in threatened species assessments such as the IUCN Red List (IUCN, 2021). Nonetheless, developing a growth model for *H.* spp. from the wild can be challenging as it requires constant resightings of individuals to assess their growth. This can be difficult as several studies have found that the resighting rates for seahorses are generally low and decline over time (Curtis & Vincent, 2006; Masonjones *et al.*, 2010; Claassens and Harasti,2020).

In 2018, the White's seahorse *H. whitei*, a species considered to be endemic to the east coast of Australia (Short *et al.*, 2019), was upgraded on the IUCN Red List to an endangered species. The endangered species listing was based on large population declines as a result of natural habitat loss (Harasti, 2016; Harasti & Pollom, 2017) and ongoing assessment of this species requires biological data such as age, survival and longevity to inform future conservation actions and Red List assessments.

From 2006 to 2015, *c*. 1100 *H. whitei* were marked within the Port Stephens estuary (32° 43′ 05″ S; 152° 08′ 29″ E) as part of several other research projects assessing the biology, ecology and conservation of *H. whitei* (Harasti *et al*., 2014a; Harasti *et al*., 2014b; Harasti & Gladstone, 2013; Manning *et al*., 2018). Ethics and tagging procedures were conducted under NSW ACEC permit 15/01 and NSW DPI scientific research permit P01/0059(A). Visible implant fluorescent elastomer (VIFE: https://www.nmt.us/) was used to mark individuals with each seahorse receiving three small (1–2 mm) elastomer tags so that each animal could be uniquely identified. This followed the procedures of Woods and Martin-Smith (2004). For each seahorse the total length was estimated (from the tip of the tail to the top of the coronet), and the sex was recorded. Sex of seahorses can easily be determined through the presence of a brood pouch in males. On each occasion a marked seahorse was found, their unique ID, sex, size and location found were recorded.

The longest period that an animal was observed from initial marking to the last sighting was 2452 days (6 years 8 months 17 days) for a female originally tagged on 8 March 2014 and last seen on 19 April 2021 measuring 15.7 cm (Figure 1). When this individual (named Dawn; Figure 1) was first marked, it measured a total length of 12.5 cm and using the VBGF developed for female *H. whitei* (Harasti *et al*., 2012), it would have been approximately 320 days old on initial marking. This female would therefore have been approximately 7 years and 7 months old on its last sighting and was found to still occur at the location where it was first recorded moving only a maximum distance of *c*. 30 m over the past 6 years. This surpasses the previous documented longest resighting period for a seahorse in the wild which was a male *H. whitei* that was recorded over a period of 4 years, 8 months, 9 days (1 August 2005 to 10 April 2010) (Harasti *et al*., 2012).

It is difficult to compare longevity between *H*. spp. as there have been very few studies that have assessed age in wild seahorse populations. On one of the rare occasions where marked individuals were followed over a period greater than 1 year, an individual of the endangered seahorse *Hippocampus capensis* Boulenger 1900 was recorded 647 days after initial tagging (Claassens & Harasti, 2020) giving an indication this species can live for up to 2 years in the wild. Nonetheless, this is much less than captive *H. capensis* specimens that have been recorded living in aquaria for up to approximately 8 years (Malini Pather, pers. comm). There are other species that have been shown to survive for many years in aquaria with *Hippocampus abdominalis* Lesson 1927 known to live for over 10 years in captivity (Paula Carson, pers. comm), whereas *H. guttulatus* Cuvier 1829 and *Hippocampus hippocampus* Linnaeus 1758 estimated to be 4 and 3 years, respectively (Miguel Correia, pers. comm). Although this study found that *H. whitei* live for over 7 years in the wild, the life expectancy for *H. whitei* in aquaria is estimated to be only *c*. 3 years (Sydney Aquarium and Manly Oceanworld, pers. comm. in Harasti *et al*., 2012).

FIGURE 1 Female *Hippocampus whitei* (named Dawn) estimated to be over 7 years and 7 months old at the Pipeline site in the Port Stephens estuary, New South Wales, Australia. Two orange visible implant fluorescent elastomer (VIFE) tags can be seen on its neck with a third below its pectoral fin

As many *H*. spp. are facing extinction within the wild (IUCN, 2021; Zhang & Vincent, 2019), collecting data on longevity in *H*. spp. provides information that can be used in future IUCN Red List assessments for individual species. Maximum age can be used in combination with life-history data to provide time-based measures that are scaled at different rates at which a species survives and reproduces which is referred to as generation length (IUCN, 2019). As there are only three seahorse species where age and growth has been assessed in the wild (*H. whitei*, *H. guttulatus* and *H. capensis*), it is imperative that more research is undertaken on obtaining life-history data such as age at first reproduction and generation length, especially for those species classified as threatened on the IUCN Red List.

This study provides an insight into how long seahorses can live for in the wild and the benefits of using VIFE for the marking of seahorses. For long-term monitoring studies of *H*. spp., VIFE is considered to be more suitable than methods such as neck and collar tags (Freret-Meurer *et al*., 2013; Morgan & Bull, 2005) which are known to foul with algae and can also cause potential entanglement. VIFE has been shown to be long-lasting in *H. whitei* with no adverse effects noticed on seahorse behaviour or physiology over a period of 6 years and the use of VIFE is recommend in *H*. spp. studies as it allows easy ongoing individual identification over a long time period. The ability to monitor tagged individuals over long-term periods provides useful information that can be used in life-history, population parameters and movement studies that can be incorporated into threatened species assessments for this threatened group of marine fishes.

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