Ontogenetic changes in colouration and morphology of white teatfish, *Holothuria fuscogilva*, juveniles in Kiribati

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Abstract

Little is known of the appearance or ecology of white teatfish (*Holothuria fuscogilva*) juveniles, which are very rarely found in the wild. In this study we use juveniles cultured in Kiribati to describe their ontogenetic changes in colouration and morphology, which differ strikingly from those of the adults. Juveniles are mostly yellow and up to ~15 mm in length, then gaining more black blotching on the body and becoming brown with black blotches around 20–30 mm in length. At this size they have stout, spike-like, dorsal protrusions on the body. When they reach ~50 mm in length, the body becomes progressively smoother and often cream-coloured with dark blotching. We present a length–weight relationship (r^2=0.95) from hatchery produced juveniles, which allows conversion of these measures among future studies. Our observations should assist in the identification of white teatfish when they are small, and shed light on suitable habitats for releasing them into the wild for restocking.

Introduction

The white teatfish, *Holothuria fuscogilva*, is one of three high-value sea cucumbers in the tropics. It is widely distributed across the Indo-Pacific and, apparently, in parts of the Indian Ocean (Uthicke et al. 2004). The adults can be off-white or light brown coloured, sometimes with dark mottling, and sometimes almost entirely dark brown (but light brown ventrally).

Despite its value, the life history of white teatfish is poorly known. In particular, little is known of the juvenile phase, which is rarely recorded in field surveys and field studies (Conand 1981, 1989). Moreover, small juveniles of holothurian species may be quite different in appearance from adults, preventing their identification in the field. Correct identification will enable reliable sightings in the field to expand our knowledge of their habitat association and ecology.

In Tarawa, Kiribati (Gilbert Islands group), white teatfish have been produced by the Ministry of Fisheries and Marine Resources Development since 1997. The sea cucumber production was supported, both technically and financially, by the government of Japan through the Overseas Fisheries Cooperative Foundation (OFCF). Thousands of the juveniles have been released into the wild to try to restock breeding populations in Kiribati, which have been depleted by overfishing (Friedman and Tekanene 2005). Here, we use individuals produced in a hatchery to document the colour patterns and morphology of *H. fuscogilva* so they can be reliably identified in the field. In addition, we present a length-weight relationship for converting length measurement to body weight.

Colouration and morphology

Marked ontogenetic changes in colouration and morphology of white teatfish mean that juveniles bear little resemblance to adults. Juveniles of <15 mm (i.e. <0.2 g) are mainly yellow, with some patches of black (Fig. 1). They have a few prominent spike-like protrusions on the dorsal body wall. When they are 15–30 mm in length (i.e. 0.2–1 g), juveniles gain more dark blotches on the body and still have yellow colouration and possess anterior horn-like protrusions that are usually black. At this size, they have numerous broad, spike-like protrusions on the dorsal body wall. When they are 20–30 mm in length (i.e. ~0.4–1 g), the yellow colouration is replaced by beige, brown and black blotches. Once they reach about 50 mm (i.e. ~5 g), the juveniles progressively lose the prominent spike-like protrusions, becoming smoother on the dorsal surface. The colouration becomes generally lighter, often beige or cream in colour, but still with dark brown blotches.

We recognise the possibility that the hatchery environment could either modify colour patterns or the rate at which these change ontogenetically. For example, hatchery-reared juveniles of the topshell (*Trochus niloticus*) undergo ontogenetic changes in shell morphology at a smaller size than wild juveniles (Purcell 2002). That is, the hatchery-reared juveniles are morphologically precocious. Therefore, the colouration and morphology of white teatfish juveniles produced in the hatchery may well reflect

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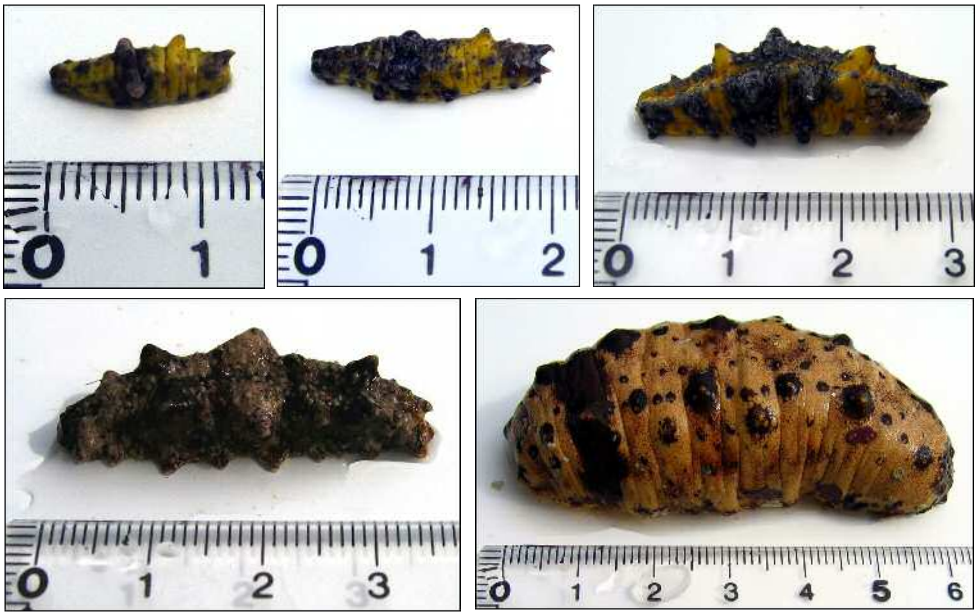

Figure 1. Photographs of white teatfish (*Holothuria fuscogilva*) juveniles cultured in the Kiribati Fisheries Department Hatchery at Tarawa, showing ontogenetic changes in morphology and colouration.

those of wild white teatfish juveniles, but the sizes at which those changes occur may be different.

The colour patterns of juveniles provide some clues to the ecology and likely nursery habitats for *H. fuscogilva*. The yellow andblack banded colouration of small juveniles (<15 mm) could camouflage them in a specific microhabitat, but we note that this is a typical warning colouration in animals that are toxic or unpalatable when eaten (Brodie and Brodie 1999). Whether small juvenile white teatfish are toxic, or simply mimicing toxicity, is not known but this would be an interesting topic for future research.

In the Maldives, Reichenbach (1999) found that white teatfish (*H. fuscogilva*) juveniles occurred predominantly in shallow seagrass beds. Gentle (1979) reported to have found white teatfish juveniles, <20 cm in length, among turf-like "seaweeds" in Fiji. He hypothesised that their patchy brown colouration could act as camouflage in this microhabitat. Our study shows that the dark, blotchy, colour pattern occurred in hatchery-produced juveniles of 15–30 mm in length. We believe that dark coloured surfaces such as hard reef substrata with epilithic algae, or among certain seagrasses, may indeed allow this juvenile phase to be camouflaged. Releases of juveniles into these habitats could provide protection from predation, and be more suitable than sand or coral rubble for releasing juveniles for restocking. This hypothesis will be examined in a restocking experiment in Abaiang, Kiribati.

Length–weight relationship

Hatchery produced juveniles (n = 38) were weighed to ± 0.01 g, and their body lengths measured ventrally to ± 1 mm. The length–weight relationship for juveniles 10–90 mm is given in Figure 2. The function explained 95% of the variation in body weight by measurement of length of the juvenile white teatfish. Since the exponent (slope of the curve) 2.629 (± 0.298, 95% CI) is significantly less than 3, growth is allometric, with white teatfish becoming progressively thinner (or flatter) for their length as they grow longer.

The relationship should be useful when converting these measurements between studies or for rapid conversion to weight from length measurements taken in the field. The range in juvenile sizes examined here mirror those used for restocking in Kiribati (see Friedman and Tekanene 2005). The curve from our morphometric equation for *H. fuscogilva* is steeper than that determined by Conand (1989) principally from adults (i.e. $\text{weight}=0.0011*\text{weight}^{2.407}$). Our results, therefore, present a function to estimate weights of juvenile white teatfish from length measurement, whereas Conand's (1989) function should be used for conversion of length to weight in adult specimens.

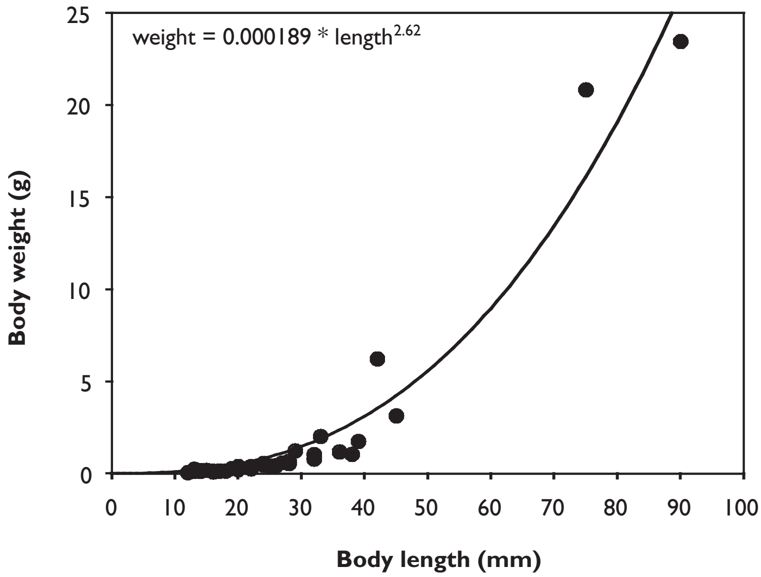

Figure 2. **Length–weight relationship of hatchery produced white teatfish juveniles, using the general morphometric equation, y = a*length^b.**

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