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BRIEF COMMUNICATION

Territoriality in the tompot blenny *Parablennius gattorugine* from photographic records

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The behaviour of the tompot blenny *Parablennius gattorugine* was studied from a long-term underwater photographic record from two sites on the south-west coast of the U.K. Repeated observations of individually identifiable *P. gattorugine* during 112 dives revealed that male *P. gattorugine* may guard eggs in a particular crevice over subsequent breeding seasons, reside in the same location for up to 4 years and recover from injuries received in disputes over territory. Further observations included resident males wiping eggs with greatly expanded anal glands, adult-type fighting between juveniles and unusual behaviour where a large male manipulated an empty mollusc shell for the attention of two smaller conspecifics.

Key words: benthic ecology; competition; observations; reproductive behaviours.

The tompot blenny *Parablennius gattorugine* (L. 1758) is a common fish of shallow, sub-littoral rocky habitats (Wheeler, 1969) and is widely distributed in northern Europe (Almada *et al.*, 2001). Although visually appealing and charismatic, its biology and behaviour has been little studied (Dunne & Byrne, 1979; Faria *et al.*, 2010). The male guards eggs laid by several females in its resident rocky crevice (Zander, 1986), in a similar way to other blenny species (Westernhagen, 1983) and many shallow-water marine teleosts in general (Cody, 1993). Yet, to date, there appears to be no information on the courtship behaviour of *P. gattorugine*, nor whether home ranges are retained by males between breeding seasons (Kay & Dipper, 2009).

The guarding of territories around their nests against both intra and interspecific intruders by males of the closely related variable (or ringneck) blenny *Parablennius pilicornis* (Cuvier 1829) was described by Goncalves & Almada (1998). The reproduction of further closely related species the tentacled blenny *Parablennius tentacularis* (Brünnich 1768) and the rock-pool blenny *Parablennius parvicornis* (Valenciennes 1836) suggest some consistent behaviour throughout the family Blenniidae (Giacomello & Rasotto, 2005; Oliveira *et al.*, 2009), with the mating system of these fishes described

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as resource defence polygyny. Reproduction in blennies is typically complex (Neat & Lengkeek, 2009) yet, despite being widespread, little is known about the reproductive strategy of *P. gattorugine*. This study demonstrates how underwater observation and long-term photographic records can reveal intriguing information about behaviour.

Observations of *P. gattorugine* were made during 112 dives between 2011 and 2015 at Wembury Bay, Devon, U.K. (50° 19′ N; 4° 7′ W) in a small area of algae-covered rocky reef with several horizontal crevices. The reef is *c.* 2 m high and water depth at the base of the reef varies between 3 and 8 m, depending on tidal state. Further observations of different behaviour in *P. gattorugine* were made during one dive on 25 September 2011 at Swanage, Dorset, U.K. (50° 36′ N; 1° 57′ W) in a stony area of seabed beneath the main pier.

Dives were made with open-circuit scuba and photographs were taken with a Nikon digital SLR camera (www.nikon.com) and Sigma 17–70 mm zoom lens (www.sigmaphoto.com) in a Subal waterproof housing (www.subal.com). Two Inon Z-240 flashguns (www.inon.jp) mounted on the housing provided lighting. Care was taken when approaching and photographing *P. gattorugine* to minimise disturbance.

Individual *P. gattorugine* were identified with a high degree of certainty from distinct markings on their heads. Territorial behaviours and the manipulation of a mollusc shell were also recorded from photographs. The measured total length of the shell (80 mm) provided scale for distances.

Generally larger and darker *P. gattorugine*, including those occupying crevices, were confirmed as males by the observation of an anal-bulb gland on each of the front two fin rays of the anal fin, as is typical of the males in this genus (Zander, 1975; Giacomello & Rasotto, 2005). Anal glands were enlarged and particularly obvious when the males were guarding eggs [Fig. 1(a)]. Female *P. gattorugine* were generally paler, often with a prominent pale patch mark beneath the eye [Fig. 1(a)] and were usually smaller than males.

Male *P. gattorugine* ($n = 6$), recognised from their head markings, demonstrated long-term occupancy of three particular crevice locations within 2 m of one another on the Devon reef between 2011 and 2015 [Fig. 1(b)]. Individual males typically occupied the same location over at least two consecutive years. Where this extended over 3 or 4 years, there were often intervening changes in occupancy during that time.

Injuries around the mouth of a resident male *P. gattorugine* were witnessed on at least two occasions, before subsequently healing [Fig. 1(c)]; mouth and fin damage was also observed on other individuals. The timing of mouth damage first being observed and changes in occupancy [Fig. 1(b)], indicates that these wounds resulted from fights between rival males over territory. Typically, territorial encounters would involve two *P. gattorugine* facing each other a few cm apart for between 5 s and 1 min before the visiting *P. gattorugine* swam away, although stand-offs lasting up to 20 min were occasionally observed. ‘Mouthing attacks’ (Zander, 1986) were only seen infrequently. Unpublished observations (P. Naylor) in both Devon and Dorset, and those reported by other divers, indicate that attacks involve males attempting to bite the side of the head (operculum area), mouth area or the fins of their rival. In September 2014, bouts of aggression were observed between juvenile *P. gattorugine*, *c.* 25 mm total length (L_T) [Fig. 1(d)], in the same area of Devon reef where the observations on adults were made. Juvenile *P. gattorugine* settle from the plankton when *c.* 18 mm L_T (Ford, 1922; Fives, 1986).

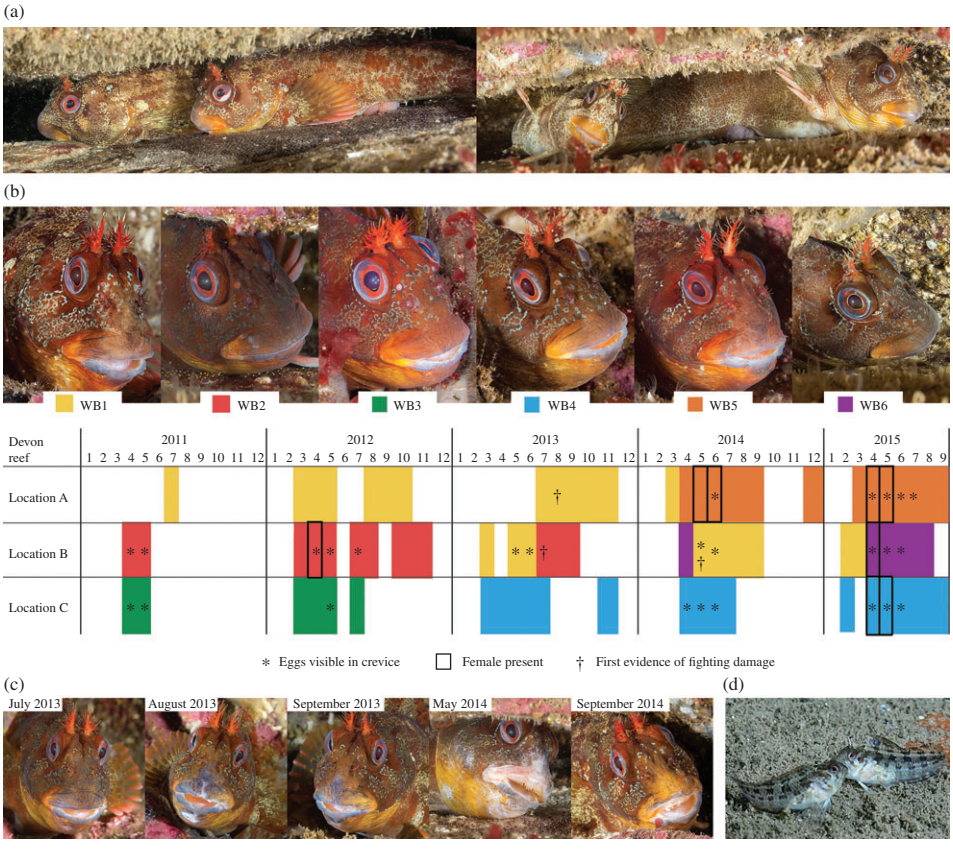

FIG. 1. *Parablennius gattorugine* on the Devon reef. (a) Resident male *P. gattorugine* (with obvious and enlarged anal-bulb glands) and visiting female in crevice. Male on right in both photographs. (b) Six individual male *P. gattorugine* (all *c.* 150 mm total length, L_T), readily distinguished by their head markings, and their observed occupancy in three particular crevice locations from 2011 to 2015. ■, ■, ■, ■, ■, ■ represent the occupancy of the individual confirmed by at least one photograph during that month. No colour represents months where residency was unknown due to stormy weather preventing diving observations or to the individual being absent or positioned too far back in the crevice to permit photo-recognition (all more likely in winter months). Eggs were much easier to see in location B (and to a lesser extent in C) than in A. (c) A male *P. gattorugine* [individual WB1 from (b)] at different times during 2013 and 2014, showing fight damage around the mouth and subsequent healing. (d) Aggression between two juvenile *P. gattorugine*, 25 mm L_T (still from video).

Male *P. gattorugine* were seen guarding eggs between April and July in their resident crevices on the Devon reef [Fig. 1(b)]. Eggs were attached to the crevice floor, ceiling or both. Males were regularly observed wiping their anal-bulb glands across the eggs as they wriggled within the crevice. In many cases, eggs in different parts of the egg mass were clearly at different stages of development and had been laid at different times. Females were on occasion observed within the resident crevices between April and June [Fig. 1(b)], but were never seen in the same crevice on the next dive, even on subsequent days. Females within resident crevices often appeared to be laying eggs, with the male in close attendance [Fig. 1(a)].

FIG. 2. Male *Parablennius gattorugine* at Swanage, moving a whelk shell while apparently observed by two smaller conspecifics.

Interactions between male *P. gattorugine* and smaller conspecifics (without obvious anal glands) in the vicinity of the males' residences were regularly observed, generally between July and October. Smaller individuals would rest on the seabed within *c.* 30 cm of the residence entrance (often much closer), sometimes rolling their body over at an angle to the seabed. The visitor would then swim away, sometimes chased by the resident male.

A remarkable example of *P. gattorugine* behaviour was observed at Swanage, Dorset. Firstly, an aggressive interaction between two large males was observed over a period of 8 min, during which time the apparently dominant male moved to bite the operculum and fins of the other male multiple times. At one point during this interaction, a smaller conspecific approached the males. Following the aggressive interaction, and a period of resting within a crevice, the dominant male emerged and moved an empty shell of a whelk *Buccinum undatum* around the seabed, with a series of head movements. In a period of 6 min, the male moved the *B. undatum* shell on 10 separate occasions over distances of 1–8 cm (mean = 3·6 cm). Coincident with the most intense periods of shell movement, two smaller conspecifics (without obvious anal-bulb glands) approached to within 10 cm of the male and appeared to watch this activity (Fig. 2). One of the two smaller conspecifics exhibited the rolling behaviour described above; this was the same individual that had approached the earlier aggressive interaction between the males.

Information on the breeding and territorial behaviour of *P. gattorugine* is currently sparse with no details on the long-term retention of territory by males. This study shows that photographic records can be used reliably to recognise individual *P. gattorugine* over several years so their long-term residence can be ascertained.

Observations on the Devon reef showed that individual male *P. gattorugine* were regularly found occupying the same locations over more than one breeding season. One male was found in the same area of reef for four consecutive breeding seasons, although the exact location changed during that time. This contrasts with the population of the intertidal blenny *Lipophrys pholis* (L. 1758) studied by Almada *et al.* (1992) where the territories of the breeding males were temporary and established each breeding season. It is noteworthy that, although the studied Devon reef is exposed to wave action from the south and west, occupancy of the *P. gattorugine* individuals remained largely unchanged over the winter of 2013–2014 when south-west England was battered by severe storms that caused coastal damage and large movements of sediments (Hiscock,

2014). The long-term retention of residences by male *P. gattorugine*, plus some shifts and exchanges, along with the injuries sustained in territorial fighting, all suggest that competition between males over territory is intense. Fighting between juvenile *P. gattorugine* within a few weeks of their settling from the planktonic larvae, and before they develop territories, may be important in terms of access to shelters and predator avoidance, as described for other blenny species by Faria *et al.* (1998).

Male *P. gattorugine* on the Devon reef had enlarged and very obvious anal-bulb glands when they were guarding eggs. In other blenny species, the anal-bulb glands of males produce pheromones which attract females (Barata *et al.*, 2008) and mucus containing anti-microbial compounds that, when applied to eggs, improve their survival (Giacomello *et al.*, 2006; Pizzolon *et al.*, 2010). The observations here of male *P. gattorugine* wiping expanded glands across rafts of eggs suggest their functions include an egg-maintenance role in this species. Observations reported here are consistent with previous reports of fractional spawning by female *P. gattorugine* (Dunne & Byrne, 1979) and of males guarding eggs laid by several females in a resident crevice (Zander, 1986). Polygamy among related blenny species is well known, with a single male attempting to ensure a number of females deposit eggs in its resident crevice and a female laying eggs in the resident crevices of several different males (Giacomello & Rasotto, 2005).

The basis of interactions between resident males and smaller conspecifics approaching the residences is not clear. It was regularly observed outside the breeding period for *P. gattorugine* which is spring to early summer (Dunne & Byrne, 1979; Zander, 1986; Devon observations this study) so may well represent agonistic behaviour rather than courtship. Also, Neat & Lengkeek (2009) noted that male selectivity and aggression towards females is commonly exhibited by other blenny species.

The manipulation of a mollusc shell by a male *P. gattorugine* in the Dorset observations appeared to attract the attention of two smaller conspecifics. There was no food (mollusc or hermit crab) within the shell and it occurred outside the reported breeding period. The basis of the behaviour is therefore unclear. Further research into such use of objects by *P. gattorugine* while interacting with conspecifics would be very interesting. Fishes have been observed using tools to access and capture food (with anvils and water jets) and in nest building and care, and transport of eggs. This is, as yet, limited to a few observations in a small number of groups, not including blennies (Brown, 2012).

This study provides good evidence of territoriality and long-term retention of territory in a small number of *P. gattorugine*. Detailed data have only been collected in a single location, although the conclusions are consistent with general observations in other areas where this species is found. A number of observations support the conclusion that behaviour in this charismatic species is complex. The manipulation of an object during interactions between individuals is intriguing and merits further investigation under controlled conditions.

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