

## The occurrence of *Acanthurus monroviae* (Perciformes: Acanthuridae) in the south-western Atlantic, with comments on other eastern Atlantic reef fishes occurring in Brazil

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The presence of 'vagrants' of the eastern Atlantic surgeonfish *Acanthurus monroviae* is confirmed for the south-eastern coast of Brazil. Three other species, *Aulostomus strigosus* (Aulostomidae), *Parablennius pilicornis* (Blenniidae) and *Epinephelus marginatus* (Serranidae) have apparently also crossed the Atlantic from east to west, whereas the great majority of 'amphi-Atlantic' species appears to have their origin in the western Atlantic. © 2004 The Fisheries Society of the British Isles

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Virtually all reef fishes have a pelagic larval stage (Johannes, 1978; Leis, 1991) with a quite variable duration, ranging from a few days to several months (Leis, 1991). This life-history theoretically provides a powerful means of dispersal among marine animals (Scheltema, 1968; Lessios *et al.*, 1998). Geographic barriers and ecological factors, however, may limit dispersal, reducing gene flow between populations and promoting speciation (Palumbi, 1994; Rocha *et al.*, 2002). This creates areas with distinct species composition and levels of endemism, known as biogeographic regions (Briggs, 1974; Floeter & Gasparini, 2000). The mid-Atlantic barrier, a broad expanse of open and deep water, divides the tropical Atlantic Ocean into a western and eastern region (Briggs, 1974, 1995; Muss *et al.*, 2001). Some species are occasionally seen outside their

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normal geographic range, but without establishing viable populations in the new area. These are referred to as 'vagrants' (Joyeux *et al.*, 2001).

The African surgeon fish *Acanthurus monroviae* Steindachner is a conspicuous reef fish that inhabits the tropical eastern Atlantic. It is known from the coast of Morocco to South Africa (Randall, 1956; Desoutter, 1986), including the archipelagos of Cape Verde [Fig. 1(a)] (Reiner, 1996), the Canaries (Brito *et al.*, 2002) and the island of São Tomé in the Gulf of Guinea (Afonso *et al.*, 1999). In the last two decades, vagrants of *A. monroviae* were found in the western Mediterranean, off the Spanish coast (Crespo *et al.*, 1987), and in the eastern Mediterranean on the coast of Israel (Golani & Sonin, 1996).

Recently, vagrant individuals of the African surgeonfish were detected at the south-eastern coast of Brazil (Moura, 2000; O.J. Luiz-Júnior, pers. obs.). In this paper, the first photographic record for this species in the western Atlantic is given [Fig. 1(b)]. The photograph was taken in the *Parque Estadual Marinho da Laje de Santos* (Laje de Santos Marine State Park), a marine protected area located 36 km south of the city of Santos, São Paulo State, Brazil (24°15' S; 46°10' W). The presence of *A. monroviae* in the south-western Atlantic Ocean extends the known range of the species by >3900 km. The single individual of c. 35–40 cm standard length ( $L_S$ ) was repeatedly observed at the main island of the Laje de Santos Marine State Park. All encounters were in the same reef area of c. 50 m<sup>2</sup>, suggesting a relatively small home range for this individual. Although normally solitary, this particular animal was also seen joining a school of *Acanthurus chirurgus* (Bloch) and feeding together with the members of this group. The formation of interspecific groups is a common behaviour among acanthurids (Lawson *et al.*, 1999; Dias *et al.*, 2001).

Despite the presence of the mid-Atlantic barrier, there are some species of reef fishes that occur with established populations on both sides of the tropical Atlantic (Briggs, 1974; Bernardi *et al.*, 2000; Bowen *et al.*, 2001; Joyeux *et al.*, 2001; Muss *et al.*, 2001; Carlin *et al.*, 2003). The geographic separation of such populations may be explained by one of the two hypotheses: 1) at some point in time the populations were continuous and subsequently separated by the formation of unsuitable habitats inside their distributional range (vicariance) without speciation, or 2) migrants from one population founded the other *via* long distance dispersal (Platnick, 1976). The earliest fossil remains of acanthurids are dated to the Lutetian (up to 52 million years ago) (Patterson, 1993), which would have been when the Atlantic was quite young (Rosen, 1975). There is no evidence, however, to show that *A. monroviae* was already present early on in the development of the Atlantic. It is highly unlikely that the present day populations were originally a single, continuous population before the separation between Africa and South America and that their species identity has been maintained for such a long time without recent gene flow.

Assuming that the observed disjunct distributions are a result of dispersal across the central Atlantic barrier, the origin of these 'amphi-Atlantic' fishes (Briggs, 1974) may be inferred by analysing the distributional range of the species. It is commonly assumed that the place of origin of a particular species is where it reaches the largest area of occurrence (Briggs, 1974, 1995; Joyeux *et al.*, 2001; Moura & Sazima, 2003; Rocha, 2003). From an analysis of a database of reef-associated amphi-Atlantic fishes (S.R. Floeter, pers. comm.),



FIG. 1. Reef-associated fishes which have migrated from the east to west Atlantic. (a) *Acanthurus monroviae* from the Cape Verde Archipelago, eastern Atlantic ( $16^{\circ}00' N$ ;  $24^{\circ}00' W$ ). November 1996. 10 m depth. (b) *Acanthurus monroviae* from the Laje de Santos Marine State Park, south-eastern Brazil ( $24^{\circ}15' S$ ;  $46^{\circ}10' W$ ). June 2002. 12 m depth. (c) *Aulostomus strigosus* at Cape Verde Archipelago, eastern Atlantic ( $16^{\circ}00' N$ ;  $24^{\circ}00' W$ ). September 1988. 15 m depth. (d) *Aulostomus strigosus* from St Paul's Rocks, an isolated island off north-eastern Brazil ( $00^{\circ}55' N$ ;  $29^{\circ}21' W$ ). November 1999. 20 m depth. (e) *Epinephelus marginatus* at Madeira Island ( $33^{\circ}80' N$ ;  $17^{\circ}16' W$ ). August 1990. 20 m depth. (f) *Epinephelus marginatus* from the Laje de Santos Marine State Park, south-eastern Brazil ( $24^{\circ}15' S$ ;  $46^{\circ}10' W$ ). May 2001. 6 m depth. (g) Female *Parablennius pilicornis* from the Balears Islands, Mediterranean Sea ( $38^{\circ}46' N$ ;  $01^{\circ}26' E$ ). May 1994. 4 m depth. (h) Female *Parablennius pilicornis* from the Laje de Santos Marine State Park, south-eastern Brazil ( $24^{\circ}15' S$ ;  $46^{\circ}10' W$ ). 10 m depth.

only four (3.7%) out of 106 that occur on hard bottoms (*i.e.* coral or rocky reefs) appear to have migrated from east to west. Besides *A. monroviae*, the other three species are: *Aulostomus strigosus* Wheeler, *Epinephelus marginatus* (Lowe) and *Parablennius pilicornis* (Cuvier) (Fig. 1).

The best-documented case of westward migration across the Atlantic is that of trumpetfish *A. strigosus* [Fig. 1(c), (d)]. A phylogeographic study of the genus based on mtDNA analysis (Bowen *et al.*, 2001) indicated that the Brazilian trumpetfish are genetically identical to the eastern Atlantic trumpetfish, contradicting previous studies which assumed that the Brazilian trumpetfish was the Caribbean species *Aulostomus maculatus* Valenciennes (Wheeler, 1955; Lubbock & Edwards, 1981; Randall, 1996). Wide ranging in the eastern Atlantic, from Madeira to South Africa (Wheeler, 1955; Maul, 1959), *A. strigosus* established large populations in the western Atlantic at the St Paul's Rocks (Lubbock & Edwards, 1981; Feitoza *et al.*, 2003), an oceanic rocky formation off north-eastern Brazil, and also on the coast of Espírito Santo State (J.L. Gasparini & S.R. Floeter, pers. obs.), in south-eastern Brazil. Individuals from both locations were analysed in the study by Bowen *et al.* (2001).

The second, more conspicuous and better-known putative east-to-west migrant is the dusky grouper *E. marginatus* [Fig. 1(e), (f)] with records for the Brazilian coast dating from the 19th century (Eschmeyer, 1998). The dusky grouper occurs in almost all of the eastern Atlantic, from the British Isles to South Africa, Mozambique in the Indian Ocean and in the Mediterranean Sea (Heemstra & Randall, 1993). In the western Atlantic, its range is restricted to the southern coast of South America, from Rio de Janeiro State south to Argentina (Riguelet & Aramburu, 1960; Figueiredo & Menezes, 1980; Rico & Acha, 2003). Heemstra (1991) examined specimens of *E. marginatus* from both the eastern Atlantic and Brazilian coast and found no morphological differences. The northernmost established population of *E. marginatus* in the western Atlantic is found in the Cabo Frio region (23°44' S), *c.* 150 km north of Rio de Janeiro (Ferreira *et al.*, 2001).

The ringneck blenny *P. pilicornis* [Fig. 1(g), (h)] is the fourth reef fish that is probably a westward migrant. Its range includes the western Mediterranean Sea and the eastern Atlantic Ocean, from the Bay of Biscay, Spain to South Africa, (Zander, 1986; Bath, 1990; Almada *et al.*, 2001). Bath (1977) revised the family Blenniidae and examined specimens of *P. pilicornis* from both the eastern Atlantic and Brazilian coasts, including type specimens of *Blennius ater* Sauvage and *Blennius pantherinus* Valenciennes, which are junior synonyms of *P. pilicornis*. Bath (1977) found no morphological differences between the specimens from the eastern and western Atlantic. In the western Atlantic, the range of *P. pilicornis* is also limited to the southern South American region, including Rio de Janeiro (Bath, 1977; Rangel, 1998), São Paulo and Santa Catarina states (Barreiros *et al.*, 2004; O.J. Luiz-Júnior, pers. obs.) south to Patagonia (Bath, 1977). *Parablennius pilicornis* is one of the most abundant fish species in some shallow rocky reefs and tide pools of south-eastern Brazil (Ferreira *et al.*, 2001; Barreiros *et al.*, 2004).

Despite observations of restricted gene flow across the mid-Atlantic barrier in some shore fish species (Muss *et al.*, 2001, Carlin *et al.*, 2003) the lack of genetic differences between the eastern and western populations of *A. strigosus* and the

recent recruitment of *A. monroviae* to south-eastern Brazil suggest that migration from east to west across the Atlantic can occur. Further genetic investigations on *E. marginatus* and *P. pilicornis* from both sides of the Atlantic are required to test whether the morphologically similar specimens on each side of the Atlantic are also genetically similar. Finally, the oceanographic barriers to dispersal in the tropical Atlantic Ocean are expected to be variable in their effectiveness over geological time (Rocha, 2003), and the effects of stochastic climatic events on the ocean currents (Philander, 1986, Venegas *et al.*, 1996, Joyeux *et al.*, 2001, Carlin, *et al.*, 2003) could promote periods of favoured dispersion alternating with periods of isolation.

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