



*Journal of Fish Biology* (2012) **81**, 308–313

doi:10.1111/j.1095-8649.2012.03285.x, available online at wileyonlinelibrary.com

## BRIEF COMMUNICATIONS

### Geographic expansion of the invasive mud sleeper *Butis koilomatodon* (Perciformes: Eleotridae) in the western Atlantic Ocean

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(Received 18 August 2011, Accepted 22 February 2012)

The Indo-Pacific mud sleeper *Butis koilomatodon* (Eleotridae) is recorded for the first time in the south-western Atlantic Ocean, based on 23 specimens caught at seven localities along the northern, north-eastern, eastern and south-eastern Brazilian coast. The occurrence of males and females in different ontogenetic stages indicates that this exotic mud sleeper breeds there. This invasive species has the potential to compete for food and microhabitat with several native gobies and an endemic blenny that dwell in estuaries and mangroves, besides preying on native fishes and crustaceans.

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Key words: alien species; Brazil; estuary; fish; mangrove.

The introduction of alien aquatic species to new environments is recognized as a major threat to ecosystem health, sometimes causing dramatic effects on biodiversity and habitat composition (Vellend *et al.*, 2007; Biggs & Olden, 2011; Lesser & Slattery, 2011; Martin & Valentine, 2011). Many marine organisms are known to have been accidentally transported to regions outside their natural ranges (*e.g.* biological transport *via* ship ballast water) and have established breeding populations in these regions. These organisms include bacteria and other microbes, algae, invertebrates and a relatively small number of marine fish species. The majority of these exotic fish species are small bottom-dwelling fishes of the Blenniidae, Eleotridae and Gobiidae (Springer & Gomon, 1975; Wonham *et al.*, 2000; Gerhardinger *et al.*, 2006; Lasso-Alcalá *et al.*, 2011). Generally, species within these families have physiological, morphological and behavioural characteristics that contribute to their invasive

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success (Wonham *et al.*, 2000). For instance, their tolerance to temperature and salinity variations allows them to take advantage of ballast-intake holes on ship hulls and survive in a wide range of water characteristics of the invaded area. Additionally, their cryptic behaviour and small size (usually <100 mm total length,  $L_T$ ) allow them to seek refuge and lay adhesive eggs in small holes (Wonham *et al.*, 2000).

*Butis koilomatodon* (Bleeker 1849) is a small bottom-dwelling eleotrid native to the Indo-Pacific Ocean from Africa to China (Dawson, 1973). It feeds on crustaceans and small fishes, dwelling in the lower reaches of rivers, estuaries and mangrove creeks (Froese & Pauly, 2011). Invasion by *B. koilomatodon* is reported for several coastal areas of the world, including the Pacific Ocean side of Panama (Dawson, 1973), eastern Atlantic Ocean in Nigeria, Guinea and Cameroon (Miller *et al.*, 1989; Lévêque *et al.*, 1992; Vreven *et al.*, 2007) and western Atlantic Ocean in Venezuela (Lasso-Alcalá *et al.*, 2005). The occurrence of *B. koilomatodon* in the south-western Atlantic Ocean (Brazil) is reported here, and the distribution, mechanisms of introduction and possible ecological interactions of this species are commented upon.

Twenty-two individuals of *B. koilomatodon* were collected independently at six localities along the Brazilian coast, between latitudes 0 and 23° S (Fig. 1). An additional specimen from another locality was found on the shelves of the fish collection housed at the Museu de Zoologia da Universidade de São Paulo (MZUSP). This specimen was collected in 1989 and went unrecognized until identified in 2000 as *B. koilomatodon*. Specific identification was made by comparing the Brazilian specimens with the precise description and illustrations given by Miller *et al.* (1989). The habitats where the specimens were collected range from marine-dominated estuaries with little freshwater input at Curuçá (Fig. 1: mean salinity 31.3) to small creeks with considerable freshwater input at the Rio Escuro (Fig. 1: salinity range 11–27). Specimens collected were photographed (those alive in field aquaria). Live fish were killed by an overdose of anaesthetic and all dead fish were fixed in 10% formalin and then transferred to 70% ethanol. The specimens are in the fish collections of the MZUSP (MZUSP#51599), Museu de Zoologia, Universidade Estadual de Campinas (ZUEC#2742, 5025, 5302 and 5662), the Coleção Ictiológica da Universidade Federal do Espírito Santo (CIUFES#00058, 00070 and 00108) and the Acervo de Ictiologia do Museu Paraense Emílio Goeldi (MPEG#22799–22813).

Twenty-three specimens of *B. koilomatodon* are known from Brazil to date: 17 males, four females and two of unknown sex. Mean standard length ( $L_S$ )  $37.8 \pm 15.8$  mm (range 12.8–68.8 mm); first dorsal fin with six spines and nine (range eight to nine) segmented rays; anal fin with one spine and eight (range seven to nine) segmented rays; left pectoral with rays 21 (range 20–21). The head is slightly to moderately flattened with serrated edges along the preorbital area and the supraorbital margins. There is no spine on the preopercle. The body colour of live and fresh specimens (Fig. 2) is pale beige to greyish beige with four to seven dark-brown diffuse bands (the last band at the caudal peduncle); part of the first dorsal fin and second dorsal fin is brown, accompanying corresponding body bands; the caudal fin is beige to pale brown; the anal and pelvic fins are beige to pale blackish-brown; the pectoral fins are pale beige (nearly translucent) to greyish beige. The head has narrow dark-brown bands between the anteroventral edge of the eye and the middle of the upper lip. This species is distinguished from its congeners by four to seven regular bands on the body and a serrated process (preorbital knob) on the snout (Yokoo *et al.*, 2006; Vreven *et al.*, 2007). Most specimens were caught on the mud bottom

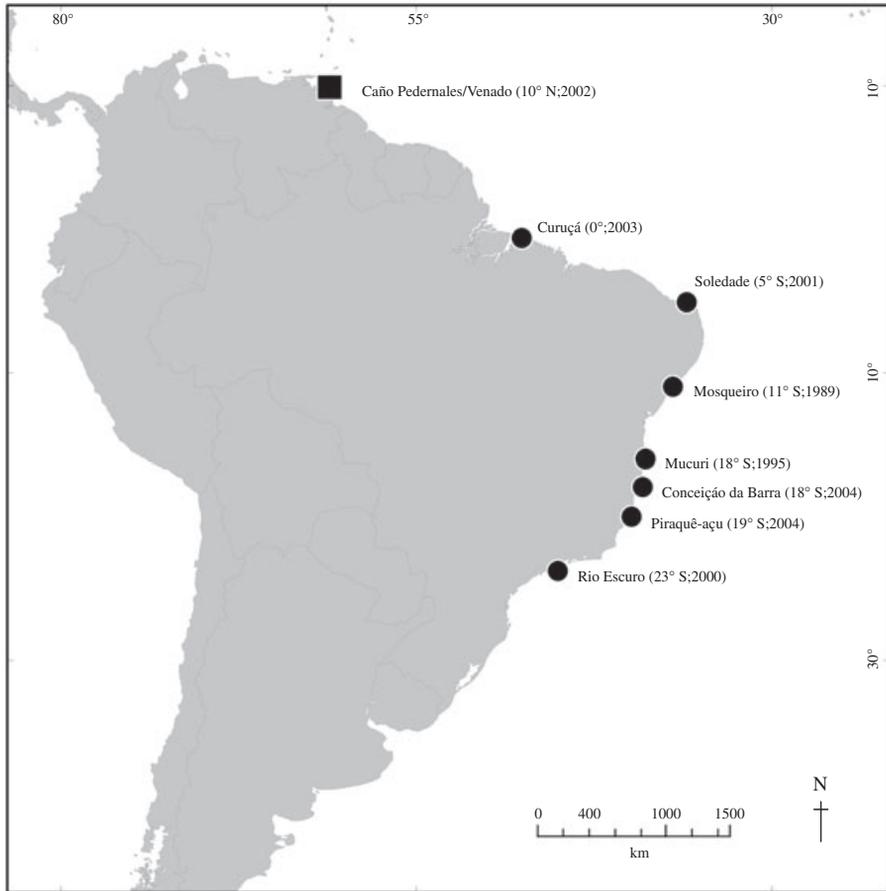


FIG. 1. Localities at which *Butis koilomatodon* have been recorded in the western Atlantic Ocean. ■, a published reference (Lasso-Alcalá *et al.*, 2005); ●, Brazilian specimens (this paper). Numbers in parentheses are latitude co-ordinates and record dates at each locality.

of estuaries, but the two from the Rio Escuro were found among algae attached to mangrove roots.

The first record of *B. koilomatodon* in American waters was reported by Dawson (1973) at the Panama Canal area (Pacific Ocean side) and recently, this eleotrid was found in Venezuela, north-western Atlantic Ocean (Lasso-Alcalá *et al.*, 2005). In the south-western Atlantic Ocean (Brazil), this species was first collected in 1989, but went unrecognized until 2000. The present distribution of *B. koilomatodon* on the Brazilian coast ranges from 0 to 23° S. At the Panama Canal, the most plausible mode of introduction of *B. koilomatodon* is from ships' ballast water (Dawson, 1973), the same way it probably colonized Nigeria (Miller *et al.*, 1989). Subsequently, the species either spread from Nigeria to Guinea and Cameroon in west and central West Africa (Vreven *et al.*, 2007) or was independently introduced to those regions.

There are several major ports along the south-western Atlantic Ocean coastline where the specimens were collected in this study, and the introduction of this invasive eleotrid probably occurred in the way suggested by Dawson (1973) and Miller *et al.*



FIG. 2. *Butis koilomatodon* in field aquarium: (a) ZUEC 5302, juvenile (12.8 mm standard length,  $L_S$ ) from Rio Escuro, (b) ZUEC 5025, large juvenile (33.1 mm  $L_S$ ) from the Rio Escuro; most dorsal and lateral scales missing due to poor handling during capture and (c) large juvenile (31.4 mm  $L_S$ ) from Conceição da Barra.

(1989). The occurrence of *B. koilomatodon* in Brazilian waters possibly predates the earliest date (1989) for a known specimen of this eleotrid, but its presence was probably undetected because of lack of sampling in suitable microhabitats, or even misidentification. As noted by Walford & Wicklund (1973), invasion records are

occasional as they depend on biologists capable of identifying the species caught at particular places and times. *Butis koilomatodon* is suggested by Gerhardinger *et al.* (2006) as a potential Brazilian invader in a paper that describes another recent fish invader in Brazil, the muzzled blenny *Omobranchus punctatus* (Valenciennes 1836). Thus, this study confirms the suggestion of Gerhardinger *et al.* (2006).

The wide range of the invasive *B. koilomatodon* in the south-western Atlantic Ocean indicates that it found suitable environmental conditions there (see Miller *et al.*, 1989 for comments on the ecology of this species in Nigeria). There is no information, however, to confirm that *B. koilomatodon* actually breeds along the Brazilian coast, other than the size range that includes both very small juveniles and presumed adult individuals. In Brazilian estuaries and mangroves, *B. koilomatodon* has the potential to compete for food and microhabitat with native bottom-dwelling fish species, including the gobiids *Bathygobius soporator* (Valenciennes 1837), *Ctenogobius boleosoma* (Jordan & Gilbert 1882), *Ctenogobius smaragdus* (Valenciennes 1837), *Ctenogobius stigmaticus* (Poey 1860), *Gobionellus stomatus* Starks 1913 and *Microgobius meeki* Evermann & Marsh 1899, and the eleotrids *Eleotris pisonis* (Gmelin 1789), *Erotelis smaragdus* (Valenciennes 1837) and *Guavina guavina* (Valenciennes 1837). At the Rio Escuro, this invader dwells in the same microhabitats occupied by the endemic blenny *Lupinoblennius paivai* (Pinto 1958) (Sazima & Carvalho-Filho, 2003). Additionally, due to its carnivorous habits, *B. koilomatodon* probably preys on several species of small native fishes and crustaceans. Further studies are needed to ascertain the current distribution, population status and the ecological interactions that this wide ranging exotic and invasive fish may have on native organisms of Brazilian estuaries and mangroves.

We thank J.-C. Joyeux, L. P. Chagas, C. R. Pimentel, A. P. Almeida and L. Barbudo for their help, J. B. Teixeira for the map, CEPEMAR, AVPLAN and BahiaSul Celulose for logistic support. R.M.M. and T.G. acknowledge financial support by PACT, Projeto do Milênio, Uso e Apropriação de Recursos Costeiros, Grupo Biodiversidade e Qualidade Ambiental. Biological material was collected with permit from the Instituto Estadual de Meio Ambiente (IEMA) and the Instituto Brasileiro de Meio Ambiente e de Recursos Naturais Renováveis (IBAMA).

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