

Short note

**FIRST OBSERVATIONS OF SHORTFINNED
ANGUILLA BICOLOR BICOLOR AND LONGFINNED
ANGUILLA MARMORATA SILVER EELS
IN THE REUNION ISLAND.**

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ABSTRACT

Silver stage specimens of *Anguilla bicolor bicolor* and *A. marmorata* were fished with a keep net in an estuary of the Reunion island (Indian ocean). Such silver anguillids eels have not been pointed out since the years 1957-1958 in South Africa. This short note gives the first morphometric observations of these specimens, before starting histological, endocrinological and otolithometrical analysis, that should contribute to a have a better understanding of these tropical eels species biological cycle.

**PREMIÈRES OBSERVATIONS D'ANGUILLES ARGENTÉES
ANGUILLA BICOLOR BICOLOR ET ANGUILLA MARMORATA
DANS L'ÎLE DE LA RÉUNION.**

RÉSUMÉ

Des anguilles *Anguilla bicolor bicolor* et *A. marmorata* au stade argenté ont été pêchées à la nasse dans un estuaire de l'île de la Réunion (océan Indien). De telles anguilles argentées n'avaient pas été signalées depuis les années 1957-58 en Afrique du Sud. Cette courte note présente les premières observations morphométriques de ces spécimens, avant d'entreprendre des analyses histologiques, endocrinologiques et otolithométriques, qui devraient contribuer à une meilleure connaissance du cycle biologique de ces espèces tropicales.

INTRODUCTION

Genus *Anguilla* has 15 species around the world (CASTLE and WILLIAMSON, 1974). Its original biological cycle contains two migrations and for each metamorphosis occurs, the first trophic (leptocephalus and glass-eels stages, see LECOMTE-FINIGER, 1994), and the second genesic (silver eels, see FONTAINE Y.A., 1994). The silvering induces physiological and morphometrical drastic changes (see FONTAINE M., 1975; THOMPSON and SARGENT, 1978; KLECKNER and KRUEGER, 1981; PANKHURST, 1982a, b, c; PANKHURST and LITHGOE, 1982; FONTAINE Y.A., 1989). On the 15 species the genus counts, 12 have a known silver stage (*A. anguilla*, *A. rostrata*, *A. japonica*, *A. australis*, *A. bicolor bicolor*, *A. dieffenbachii*, *A. marmorata*, *A. mossambica*, *A. megastoma*, *A. nebulosa labiata*, *A. obscura* and *A. reinhardtii*; see TESCH, 1928; CAIRNS, 1941; BERTIN, 1942; CALLEMAND, 1943; HOBBS, 1947; BIGELOW and SCHROEDER, 1953; D'ANCONA, 1960; JUBB, 1961; BURNETT, 1969; TODD, 1974, 1981a, 1981b; COLOMBO *et al.*, 1984; SLOANE, 1984; MARQUET, 1987; LE BELLE *et al.*, 1988; FONTAINE, 1994; JELLYMAN and TODD, 1998; AOYAMA *et al.*, 1999). For all these species, following the physiological changes, the silver stage can be recognized by typical external marks: changes in skin colour (back is darker due to melanin, sides and belly are white / silver due to purine, PANKHURST and LYTHGOE, 1982), development of lateral line (ZACCHEI and TAVOLARO, 1988), increase in the eye size (D'ANCONA, 1927; TODD, 1981a; PANKHURST, 1982a), and increase in the pectoral fins (MARQUET, 1987). This silver stage is still unknown for the 3 species left (*A. borneensis*, *A. celebesensis*, and *A. interioris*) and 2 other subspecies (*A. bicolor pacifica* and *A. nebulosa labiata*).

A first specimen of *A. bicolor bicolor* silver female was found in September 1957 in the Zululand, South Africa (64 cm for 0.51 kg; JUBB, 1961), and any specimen hasn't been found since, according to our knowledge. Since SCHMIDT (1927) pointed out silver males of *A. marmorata* in Tahiti (71 and 83 cm for 1.2 and 1.9 kg respectively), only one mature specimen (female, 134 cm for 9.98 kg) has been found in February 1958 in the Sundays River (South Africa; JUBB, 1961). Forty three years later, we found a second *A. bicolor bicolor* and a fourth *A. marmorata* mature specimens in the streams of the Reunion Island, near Madagascar. This paper relates the first morphometric observations of these *A. bicolor bicolor* and *A. marmorata* silver eels, two of the fourth anguillid species which live in the rivers of the Reunion island (KEITH *et al.*, 1999).

MATERIAL AND MORPHOMETRIC DATA

The Reunion island (21°S 56°E) is a recent volcanic formation in the South-West Indian ocean. The intertropical weather drops as far as 5 m.year⁻¹, so rivers are subjected to exceptional flow rises, particularly from December to April, preventing stenohaline freshwater species to settle in the hydrosystem (KIENER, 1981). The Roches river is a small catchment (24.5 km², Figure 1) in the Reunion island. We installed a keep net in the estuary, 4 m from the right bank and 100 m from the seawater. Keep net, facing the sea, was collected every day from the 15.02 to the 28.03.2001. *Anguilla bicolor bicolor* and *A. marmorata* silver eels were caught respectively on the 06.03 and the 07.03 at the twilight, when 81 and 89% of the moon was visible.

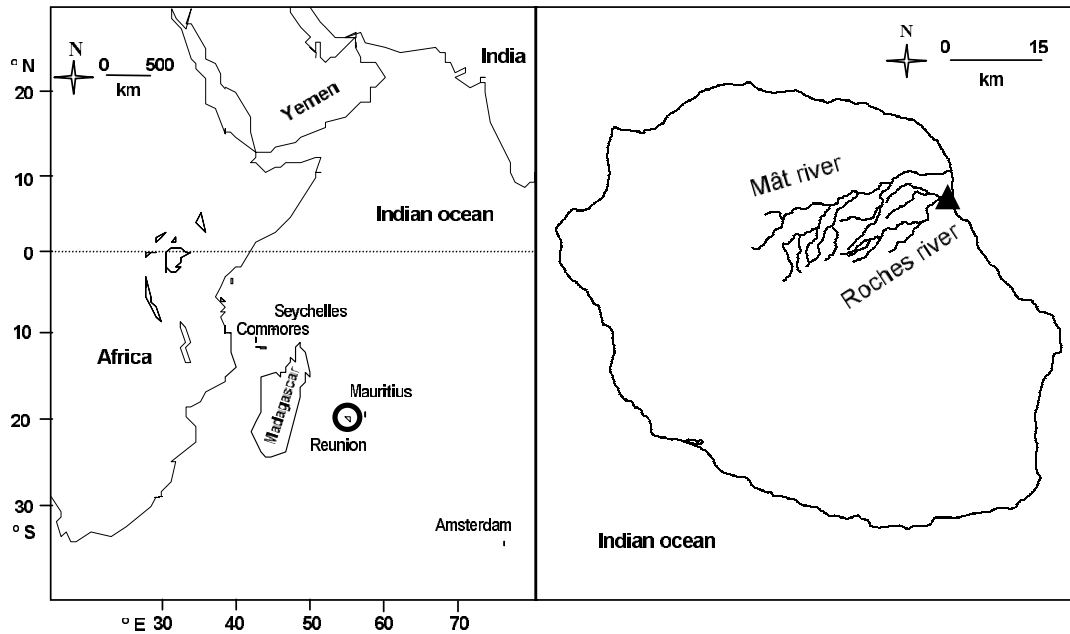


Figure 1

Localisation of the Reunion island and catch sites (▲) on the Roches river. The yellow eels *A. marmorata* for ocular index comparisons were caught in the Mât river.

Figure 1

Localisation de l'île de la Réunion et des sites de capture (▲) sur la rivière des Roches. Les anguilles jaunes *A. marmorata* pour les comparaisons d'indices oculaires ont été pêchées dans la rivière du Mât.

The shortfinned eel *A. bicolor bicolor* (McCLEALLAND, 1844) was 744.0 mm long for a weight of 661.3 g (Table I). The ratio between anal-dorsal distance and body length was 2.1%, and the plained back of the eel made us sure it was this species, according to EGE (1939). This specimen was a female, according to its high gonadosomatic ratio (RGS = 6.78%). The back was dark-grey until the dorsal sides (Figure 2). The ventral sides became silvered-yellow until the belly, and the belly was white, lightly silvered from the mouth to a clear silver colour at the tail. Its both pectoral fins were golden near the pectoral joint, and being darker until black on the distal part. The lateral line, regularly interrupted by black points (neuromasts), was present 5 mm bellow the separation of the dark dorsal sides and the silver-golden ventral sides. So the silver colour came relatively high on the sides, above the lateral line. Pupils were both black, iris was golden and circled in a grey-blue colour.

The longfinned and marbled eel *A. marmorata* (QUOY and GAIMARD, 1824) was 708.0 mm long for a weight of 773.7 g (Table I). The ratio between anal-dorsal distance and body length was 17.4%, and the marbled back of the eel made us sure it was this species, according to EGE (1939). Its RGS (1.56%) showing a low value in comparison with the high OI, and after a macroscopical exam, we are inclined to think, subject to further histological exams, that this specimen was a mature male. The back, as the dorsal sides, were finely marbled of yellow on a dark-brown background (Figure 2). The dorsal sides coloration stopped 5 mm above the lateral line, where started the really golden

ventral sides. Belly was white near the head and silver-golden near the tail. As *A. bicolor bicolor*, its both pectoral fins were golden close to the pectoral joint, and being darker until black on the distal part. The lateral line was lower than the side colour transition, less marked than *A. bicolor bicolor*, and only represented by neuromasts. Pupils were both black, iris was golden and circled in a grey-blue colour.

Table I

Morphometrics of the silver eels *A. bicolor bicolor* and *A. marmorata*. Total Length (TL), Dorsal Length (DL), Anal Length (AL), Anodorsal Ratio (% AD), body and gonads weights, GonadoSomatic Ratio (% RGS), left and right pectoral fins Width (W) and High (H), left and right eyes Horizontal (H) and Vertical (V) diameters, Ocular Index (OI, PANKHURST, 1982a).

Tableau I

Données morphométriques des anguilles argentées *A. bicolor bicolor* et *A. marmorata*. Longueur Totale (TL), Dorsale (DL) et Anale (AL), rapport AnoDorsal (% AD), poids du corps et des gonades, Rapport GonadoSomatique (% RGS), largeur (W) et Hauteur (H) de nageoire pectorale gauche et droite, diamètre Horizontal (H) et Vertical (V) de l'œil gauche et droit, Index Oculaire (OI, PANKHURST, 1982a).

	TL	DL	AL	% AD	Weight (g)		Pectoral fins		Eyes	
					whole body	gonads (% RGS)	left	right	left (OI)	right (OI)
<i>A. bicolor bicolor</i> (female)	744.0	287.0	302.5	2.1	661.3	44.8 (6.78)	W : 38.1 H : 27.9	W : 38.8 H : 29.1	H : 7.7 V : 7.4 (6.02)	H : 8.7 V : 7.4 (5.72)
<i>A. marmorata</i> (male)	708.0	175.0	298.0	17.4	773.7	12.0 (1.56)	W : 43,6 H : 21,0	W : 42,8 H : 21,9	H : 10,6 V : 11,0 (12.31)	H : 10,3 V : 10,6 (11.53)

DISCUSSION

The shortfinned eel *A. bicolor bicolor*, distinguished from the other subspecies *A. bicolor pacifica* (EGE, 1939), is exclusively reported in the Indian Ocean, in the West part continent and islands (EGE, 1939; JESPERSEN, 1942; CASTLE, 1984, 1986; MARQUET *et al.*, 1997), as in the East part (Indian coast, described as *A. bleekeri*, *A. cantori*, *A. dussumieri* and *A. malabarica*, KAUP, 1856; BAUCHOT *et al.*, 1993). These observations about its silver stage, the second after JUBB (1961), give further and original observations about this poorly known stage. Its ocular index (OI = 6.02 and 5.72) and gonadosomatic ratio (RGS = 6.58) are sufficiently high to believe it is approaching sexual maturity. We haven't got any OI or RGS references for yellow eels of *A. bicolor bicolor*, because of the infrequency of this species in the Reunion's rivers.

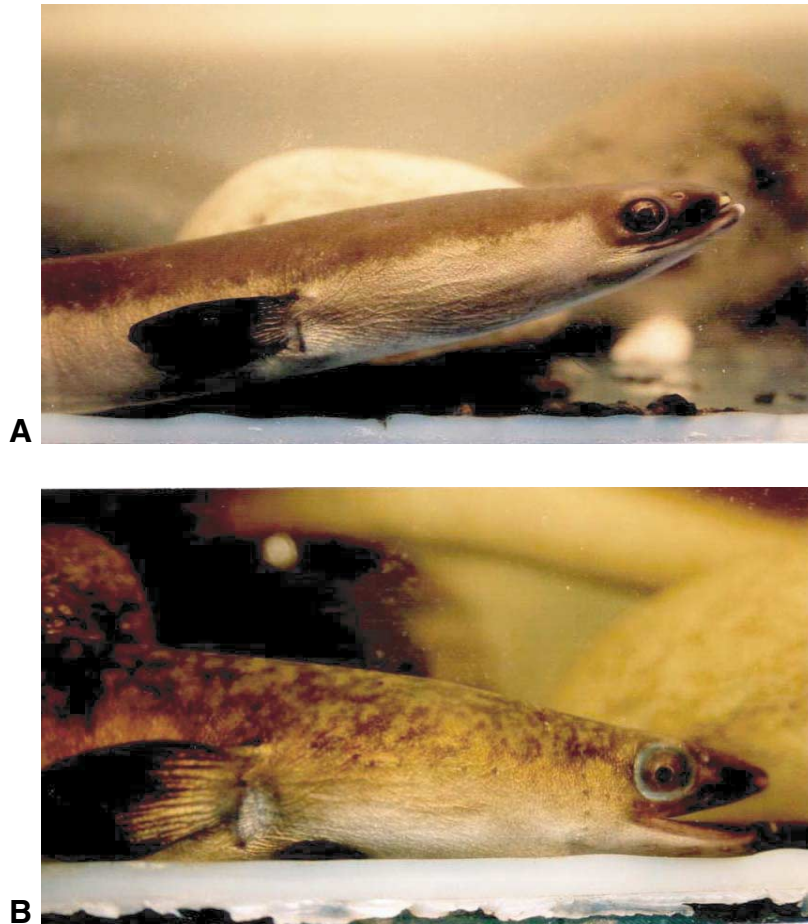


Figure 2
Pictures of the silver eels *A. bicolor bicolor* (A) and *A. marmorata* (B).

Figure 2
Clichés des anguilles argentées *A. bicolor bicolor* (A) et *A. marmorata* (B).

The longfinned and « giant marbled eel » *A. marmorata* is the eel species with the widest repartition area, from Polynesia (Gambier Islands) to the South-East African coast (EGE, 1939; NISHI and IMAI, 1969; KIENER, 1981; MARQUET and LAMARQUE, 1986; JELLYMAN, 1987; MARQUET and GALZIN, 1991; MARQUET, 1992; WILLIAMSON and BOËTIUS, 1993; TZENG *et al.*, 1995; BUDIMAWAN, 1997; MARQUET *et al.*, 1997). Its ocular index (OI = 12.31 and 12.53) are typical of others *Anguilla* sp. mature specimens ready to quit freshwaters. Its OI are compared to OI of yellow eels *A. marmorata* (Figure 3), fished in the Mât river (Figure 1). For a total length between 200 and 600 mm, yellow eels have an OI lower than 6.0, except two big yellow specimens (OI = 7.19 and 7.49). The *A. marmorata* silver eel has an OI near two times bigger than those hypothetical same length yellow eels, and could therefore be considered as « *sexually maturing adult* » according to previous works on *A. anguilla* (PANKHURST, 1982a). Such a difference between yellow and silver stage eyes diameter for a given body length is not observed for the pectoral length of the present specimens.

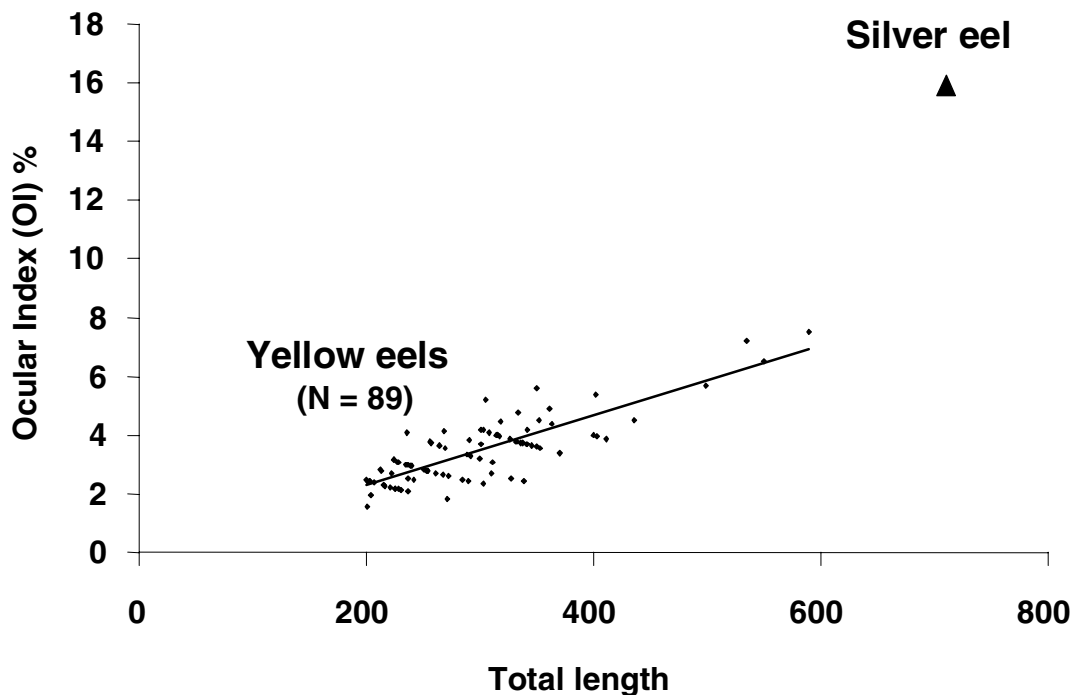


Figure 3

Evolution of the ocular index (PANKHURST, 1982a) with the total length of *A. marmorata* in the Mât river (Reunion island). The silver eel (OI = 15.93%) is clearly out of the yellow eels adjusted line ($y = 0.0119x - 0.1044$ and $R^2 = 0.6967$). The linear series in yellow eels index are due to the measurement precision of eye diameter (0.5 mm).

Figure 3

Evolution de l'indice oculaire (PANKHURST, 1982a) avec la longueur totale de *A. marmorata* dans la rivière du Mât (Ile de la Réunion). L'anguille argentée (OI = 15,93 %) est largement en dehors de la ligne ajustée des anguilles jaunes ($y = 0,0119x - 0,1044$ et $R^2 = 0.6967$). Les séries linéaires visibles dans les indices d'anguilles jaunes sont dues à la précision des mesures (0,5 mm).

According to JESPERSEN (1942), a first spawning area of *A. bicolor bicolor* is expected to locate in South-West Sumatra deep waters, confirmed by ARAÏ *et al.* (1999). According to the present findings, and to the regional currents, a second spawning area for the Indian ocean may locate around the North-East waters of Madagascar. Concerning *A. marmorata*, at least five distinct populations are known today, all emerged from an Indonesian ancestral population shared with *A. reinhardtii*, spread on the actual repartition area by the circum equatorial current, between 100 and 50 million years ago (TSUKAMOTO and AOYAMA, 1998). These findings will be further developed by an histological exam of gonads, sexual hormones concentrations measurements in plasma and pituitary, muscle lipid rate and bones calcium measurements, and otolithometric readings. These analysis should clarify the *A. bicolor bicolor* and *A. marmorata* life history in this region, particularly their silvering metamorphosis, and, in comparison with glass-eels otolithometric data, should also give a clue on the distance from the Reunion island of their respective spawning area.

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