

**FIRST RECORD OF THE SEAGRASS WRASSE, *NOVACULOIDES MACROLEPIDOTUS*  
(ACTINOPTERYGII: PERCIFORMES: LABRIDAE), FROM REUNION ISLAND,  
SOUTHWESTERN INDIAN OCEAN, WITH A BRIEF DESCRIPTION  
OF ITS COLOUR PATTERN VARIATION, ESCAPE AND REPRODUCTIVE BEHAVIOUR**

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**Background.** Little is known about the seagrass wrasse, *Novaculoides macrolepidotus*. In January 2012 it was recorded for the first time from Reunion Island. As its population increased over the years, field observations were made on colour pattern variation, escape and reproductive behaviour. Regarding a cryptic and poorly documented species, these observations, despite their anecdotal form, need to be made available to ichthyologists. The aim of the present paper was to present this first record with associated field observations and to increase interest of ichthyologists in this species.

**Material and methods.** Observations were made while snorkelling on the west coast of Reunion Island on the fringing reef of L’Ermitage (district of Saint Gilles les Bains). The first specimen was observed on 28 January 2012 in a monospecific seagrass bed of *Syringodium isoetifolium*. Later surveys on the same reef between 2012 and 2016 provided additional observations of the species.

**Results.** Colour pattern and body proportions of the first observed specimen well agree with *N. macrolepidotus* as described by Randall and Earle (2004). Subsequently observed specimens expressed a previously undescribed colour pattern variation. Escape and reproductive behaviour was observed and are discussed.

**Conclusion.** A reproducing population of *N. macrolepidotus* has apparently established at Reunion Island. The present field observations of the behaviour of this species should be followed by more detailed ethological studies.

**Keywords:** ethology, connectivity, Reunion Island, coral reef ecosystems

## INTRODUCTION

The latest checklist of the fish species of Reunion included 984 marine and freshwater species belonging to 164 families (Fricke et al. 2009), with 964 species occurring in marine habitats. Most of the sampling effort was performed in coral reef habitats off the west and southwest coasts of the island. Recent works on non-reef habitats and other coastal segments (Pinault 2013, Pinault et al. 2013a) as well as on the volcanic rocks in the southeast (Bollard et al. 2013, Pinault et al. 2013b, 2014a, 2014b) resulted in several additional species records (Quéro et al. 2011, Quéro and Spitz 2012, Pinault et al. 2014c, 2015, Wickel et al. 2016). However, new records of fish species continue to be reported from coral reefs habitats (Fricke et al. 2015). The seagrass wrasse, *Novaculoides macrolepidotus* (Bloch, 1791), has not been recorded from Reunion though it was known from Madagascar and Mauritius, the closest neighbouring

islands. The first individual was observed on the fringing reef of L’Ermitage on 28 January 2012. Subsequently, the population expanded and spread from one seagrass bed to the next between 2012 and 2016, so that colour pattern variation, escape and reproductive behaviour could be observed in the field. Previously named “*Novaculichthys macrolepidotus*”, this species is now classified in the monotypic genus *Novaculoides* which was proposed by Randall and Earle (2004). *Novaculoides macrolepidotus* has a wide range of occurrence in the Indo-West Pacific region, from the Red Sea in the north, to Madagascar in the south, Seychelles and Mascarene Islands in the western Indian Ocean, east to the Philippines, Papua New Guinea, and Tonga, north to Ryukyu Islands, south to Lord Howe Island and New Caledonia. The species lives cryptic among marine phanerogams, but it is also found on sandy algal flats.

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The aim of this work was to present this first record along with associated field observations, and to arouse more detailed ethological studies on this species.

## MATERIALS AND METHODS

Observations were made on the fringing reef of L'Ermitage (also known as Saint Gilles-La Saline reef) on the west coast of Reunion Island (21°07'S, 55°32'E). Reunion is a French overseas department located about 680 km east of Madagascar and 170 km southwest of Mauritius. Coral reefs of this geologically young island are about 8500 years old (Dercourt 2002); only fringing reefs have developed near the island. The reef of L'Ermitage is less than 8 km long, the maximum width is 500 m and the maximum depth is less than 2 m at high tide. The reef flat contains numerous monospecific seagrass beds of *Syringodium isoetifolium*. The first individual of *Novaculoides macrolepidotus* was observed in the seagrass beds of the northern part of the reef (ca. 21°04'11.2"S, 55°13'12.8"E), near a place known as L'Ermitage-Village. The reef at L'Ermitage is included within the perimeter of the marine protected area (MPA) "Réserve Naturelle Nationale Marine de La Réunion" (GIP-RNMR).

Observations were made by the first author (PB) with assistance of his snorkelling partner. The first individual was photographed on 28 January 2012 at 0949 h (Fig. 1) during a long term monitoring project (December 2010–December 2013) of a sea cucumber's nursery located on the rims of these seagrass beds. Later surveys in the same region between 2012 and 2016 provided additional observations of the species. No methodical count of the species population was performed during this period, but the actual population is estimated at more than 40 individuals in the northern half of the L'Ermitage reef.



**Fig. 1.** First recorded individual of *Novaculoides macrolepidotus* from Reunion Island, 28 January 2012 (image: P. Bourjon)

Proportional body measurements and proportions are based on an underwater image. The standard length is abbreviated SL. Because the majority of labrids are protogynous hermaphrodites and because we wanted

to be consistent with a common practice based on a high probabilities (see Gomon 2006), we use the terms "terminal phase" (TP) and "initial phase" (IP) to designate the different colour patterns of adults even though no study on the reproduction mode of *Novaculoides macrolepidotus* was published to our knowledge. We use also the terms "TP male" and "IP female" in accordance with another established practice.

## RESULTS

**Description.** The observed individual of *Novaculoides macrolepidotus* belongs to the terminal phase. Its total length (TL) is estimated as 15 cm, taking into account the underwater visual size overestimation. Body moderately elongated, strongly compressed. Body depth ca. 3.9 in SL, head ca. 4.0 in SL. Dorsal fin with spinous portion lower than soft portion. Caudal fin distally rounded.

Colouration (Fig. 1). Head and body bright green with two white spots behind pectoral fins and midlateral row of small orange spots on posterior third of the body. Most of ventral side of the body with oblique pinkish stripes. Head with faint brownish green band joining snout to back in axis of dorsal fin. A dark purple band from sides of snout to eyes, then continuing as thinner band extending dorsoposteriorly from eye to origin of dorsal fin. Postorbital region with wide curved purple band extending from upper part of opercle to cheek. Opercle with a semi-circular dark purple spot. All purple markings with a submarginal orange to dark pink line. Suborbital region with three broad, oblique, dark pink bands, last band joining curved purple band ending on cheek. Dorsal fin with black spot on first membrane. Dorsal and anal fins green with discontinuous rows of pink rectangular spots positioned perpendicularly to rays on membranes; fin rays green. Caudal fin colouration similar to soft portion of dorsal fin, with pink spots more closely set and shorter. Pectoral fins translucent; pelvic fins not sufficiently visible on images.

**Colour pattern variation.** The colour pattern variation among the numerous individuals observed during this period included those documented by Randall and Earle (2004), as well as additional variation. Concerning the head markings, bands and spot on the upper part of the head are always dark or pale purple (vs. black in the description of Randall and Earle 2004) in individuals observed at Reunion. Three pink bands on the cheeks were not described by Randall and Earle (2004), but are faintly visible on their photographs of the terminal phase (Randall and Earle 2004: figure 3). In the individuals observed at Reunion, the middle band is the largest, the others are thinner, and the third, closest to opercle, may be very short and faint. The middle band may have white spots, the third one may join the curved purple band extending from upper part of opercle to cheek, as in the first observed individual. They are generally pink, but they can be pale violet. Concerning the body markings, the upper terminal phase specimen photographed by Randall and Earle (2004: Figure 3) has some scales with vertical and slightly curved white lines behind pectoral fins, whereas none of the two

other specimens is marked with white at the same place. Most Reunion terminal phase individuals have a series of white midlateral spots behind the pectoral fin. This series may be interrupted but may also form a large triangular white mark (Fig. 2), occasionally followed by a round white spot. A series of about a dozen small faded whitish marks may be situated on the back, adjacent to the dorsal-fin base (possibly due to stress). No substantial variation was observed in initial phase individual.



**Fig. 2.** Terminal-phase individual of *Novaculoides macrolepidotus* exhibiting a large triangular white mark behind the pectoral fins (image: E. Morcel)

**Escape behaviour.** The fish, often swimming just above seagrass beds, dived head first into the leaves as the observer approached and hide between the leaves bases where their green colour makes them cryptic. The flight initiation distance (FID, see Ydenberg and Dill 1986) was generally less than 2 m, though it has to be remarked that this population is accustomed to the non-aggressive presence of bathers and snorkelers in this reef, which is part of an MPA (FID was shown to be significantly affected by protected areas, see Januchowsky-Hartley et al. 2012). Hidden individuals reappeared above the seagrass leaves at an unpredictable place a few seconds later and a few metres away while observing the intruder; then they dived again. If the observer remained motionless, the fishes reappeared even closer to him and for a longer time, while they kept watching the observer. This “curiosity” was observed in other labrid fishes as a curious feature among documented escape behaviour (Nunes et al. 2015). These authors suggested that this behaviour might be species-specific as some species exhibited it more than others regardless of the environmental conditions.

**Reproductive behaviour.** A single reproductive episode was observed on 5 March 2016 between 1100 and 1130 h in the middle patch of a seagrass bed composed of three neighbouring patches. Breeding behaviour was related to just a single pair. Estimated individual sizes were: terminal phase 14 cm, initial phase 10 cm. No colour change was observed in either phase. Courtship occurred near the top of the seagrass leaves. In the beginning, the terminal phase individual (TP male) performed numerous

passages above the initial phase individual (IP female) with spread dorsal and anal fins, occasionally interrupted by short stops in front of her while bending its body into a C-shape. When the IP female expressed acceptance by displaying the same shape, the TP male stayed close and regularly touched the middle part of her back with his chin, pelvic fins or abdomen in order to stimulate her. The pair then displayed a position directed obliquely upward with the caudal peduncle and caudal fin hidden in the seagrass leaves. Such stimulations lasted until the IP female displayed a horizontal position at about 15 cm above the tips of the seagrass leaves. Then the TP male positioned himself above her, touching her with his spread pelvic fins, and the pair rushed upwards side by side, the TP male slightly above, maintaining physical contact with the IP female. Simultaneous release of gametes may have occurred at the apex of the rush near the surface, but water was too turbid to observe the release. Immediately afterwards TP male and IP female quickly descended individually and returned into the seagrass bed. Two spawning rushes of the same pair were observed, as the TP male started another courtship display a few minutes after the first rush, which suggests that it may have been a pseudo-spawning behaviour. Again it was impossible to observe a gamete release at the apex of the second rush. No post-spawning display was noticed. No attempts of streak spawning (Warner et al. 1975) were observed, as no other TP male resided in this patch. Only one other IP female was seen in the patch. However, TP males and IP females were seen in the neighbouring patches, none of them exhibiting a breeding behaviour.

On 23 April 2016 around 1000 h an episode apparently linked with reproductive behaviour was observed in the same patch, with three participating TP males and five small IP females (the larger individual about 7 cm TL). No individual was observed in the two neighbouring patches where TP males and IP females were regularly observed before. It is therefore likely that all neighbours gathered in this patch. None of the IP females had an obviously swollen abdomen, while each of them was located in a different section of the patch. All TP males expanded their median fins when passing above an IP female, some of them expressing receptivity by bending their body into a C-shape. A TP male was patrolling along a long, narrow, and invariable circuit in the southern part of the patch, displaying a territorial behaviour. When he met another TP male, the two individuals shortly displayed motionless oblique positions less than 20 cm apart from each other, with the median fins fully spread. Afterwards the territorial TP male chased the intruder and suddenly attacked him at the border of his territory, and the two fishes exhibited a very fast ritualised agonistic behaviour, face to face and nibbling each other’s mouth. Then the second TP male got out the territorial zone and the first one continued patrolling. The resident terminal phase individual of *Novaculoides macrolepidotus* (i.e., the TP male mating on 5 March) was present, recognisable by its markings. He remained in the central part of the patch, together with a small IP female, but apparently did not patrol the territory. This apparent

spatial organization leads to formulate the hypothesis that this patch occasionally operates as a lek-like mating system territory (e.g., Moyer and Yogo 1982, Gladstone 1993, Colin 2010) when numerous IP females are grouped together when ready to spawn, but more observations will be necessary to confirm this. No spawning behaviour was observed that day. At 1130 h all individuals returned to the neighbouring patches except for the resident terminal phase individual and two IP females. No TP male was wounded, which suggests that the agonistic behaviours are limited to ritualised patterns, without real fights.

## DISCUSSION

The first observed individual (Fig. 1) well agrees with *Novaculoides macrolepidotus* based on Randall and Earles's (2004) description and on photographs of this species in Allen and Erdmann (2012), taking into account the intraspecific variability. Its size (15 cm) is near the maximum documented size of 16 cm (Allen and Erdman 2012). Subsequently, just a single juvenile was observed (additional to numerous adults), though it was impossible to photograph it. The juvenile displayed a brown-blotched pattern with white marks on the dorsum. Juveniles apparently rarely leave the substratum, and move between lower parts of the plants. This behaviour would be consistent with that of the subadult of the species believed to be a mimic of venomous scorpaeniform fishes of the genus *Ablabys*. This mimicry involves a bottom-living behaviour and a reluctance to move (Randall and Spreinat 2004), which make field observations difficult in dense seagrass beds.

The first terminal phase individual appeared to be solitary, but the observers noticed a continuous increase of the population between 2012 and 2016, along with a progressive dispersal towards other seagrass beds situated further south in the reef. It is now possible to observe single individuals, pairs or groups in up to 1.5 km distance from the site of the first observation.

Reef fish populations were extensively studied in Reunion during the past thirty years. It is difficult to imagine that this species could have escaped the authors of the most recent exhaustive survey of fish species published in 2009 (Fricke et al. 2009); one of the authors (RF) repeatedly observed the same habitat between 1995 and 1999 without detecting the species. On the other hand, the other author (PB) and his snorkel partner have been spending about six hours per week throughout the year on the L'Ermitage reef since 2009, and they frequently visited its seagrass beds. It is therefore likely that the individual observed in January 2012 was one of the first settling individuals of this species in a coral reef at Reunion. This record may then support the dispersal connection hypothesis from Mauritius to Reunion as the South Equatorial Current might carry larvae from Mauritius to Reunion but not from Madagascar (Crochelet et al. 2013, Wickel et al. 2016). Comparing the ages of settling larvae obtained by otolith study to the time predicted for them to drift from Mauritius to Reunion (ca. 200 km distance) by a dispersal simulation model, the authors show that

this dispersal connection was suggested by the combined results. The dispersal simulation model predicted that the larvae of the target species—*Epinephelus merra* Bloch, 1793—released from the other reefs of the region (northeast Madagascar, Tromelin, Saint Brandon Rocks, and Rodrigues) could not reach Reunion Island within the study period. The pelagic larval duration (PLD) of *Novaculoides macrolepidotus*, estimated to a mean of 70.5 days (Victor 1986, as "*Novaculichthys macrolepidotus*", from two specimens), is longer than that of *E. merra* (29 days, from 200 specimens, Crochelet et al. 2013). Nevertheless, the swimming abilities of larvae allow them horizontal progression (including against the current) and vertical migration that strongly influence dispersal strategies. There are also differences in individual abilities linked with phenotypic heterogeneity in the same species that may result in differences in larval behaviour in terms of dispersal (Nanninga and Berumen 2014). Moreover, Leis et al. (2011), observing that the labrids they studied settled at the same size despite great differences in PLDs, hypothesised that larvae with long PLDs swim more slowly than those with short PLDs. Last, the larvae drifting from Mauritius to Reunion can be trapped by the "island effect" on the outskirts of the island, and by near-shore fine-scale hydrodynamic conditions facilitating their retention before settling or stay in temporary habitats as the Saint Paul's Bay, as hypothesized by Crochelet et al. (2013) to explain a 14 days discrepancy between the calculated PLD of *E. merra* and the predicted arrival date of settling individuals. The differences in the PLDs of *E. merra* and *N. macrolepidotus* should therefore not invalidate for the latter the dispersal connection hypothesis from Mauritius to Reunion.

The increase of the number of individual *Novaculoides macrolepidotus* at L'Ermitage reef between 2012 and 2016 seems to indicate that the species finds suitable living conditions at Reunion, and that it established a breeding population. Seagrass habitats are worldwide threatened (Orth et al. 2006, Waicott et al. 2009), but despite local and regional threats to the coral reefs of Reunion (see Fricke et al. 2009), they remain suitable habitats for the colonisation of additional fish species.

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