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The Seagrass Filefish, *Acreichthys tomentosus* (Linnaeus), a master of camouflage

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Abstract

The filefishes of the family Monacanthidae are well known for the ability of many of the species to avoid detection by changing their color pattern to that of the immediate environment. Some enhance the deception by adding nodules, filaments, or flaps to the skin, and by their behavior. The Seagrass Filefish, *Acreichthys tomentosus* (Linnaeus), effectively uses all of these guises. The research site is the Marine Reserve Park of the Davao del Norte State College in the northern Davao Gulf, Mindanao, Philippines. Juveniles of the filefish are usually found remarkably well hidden in benthic algae of several species. Subadults and adults are most often seen in seagrass beds (in the reserve mainly tape grass, *Enhalus acoroides*), where they match the color of the amount of epiphytic growth on the seagrass. They feed mainly on the epiphytes of the seagrass. The seagrass and the filefish are an example of symbiosis (ecologists prefer mutualism). Unchecked, the accumulation of epiphytic growth will kill the blade of sea grass. The filefish not only changes its color pattern to match that of a new environment, but is able to instantly alter the texture of its skin, including producing filaments a few mm in length. A plan to videotape the change in the skin in an aquarium, followed by histological study of the filefish skin was cancelled when we learned that Allen *et al*. (2006) published the same remarkable sequence with the filefish *Monacanthus tuckeri* in the Caribbean Sea. *Acreichthys tomentosus* occurs throughout the Indo-Malayan region, ranging north to the Yaeyama Islands of Japan, south to Queensland, east to Tonga, and west to Sri Lanka; an East African record is a probable error.

Key words: ichthyology, ecology, Monacanthidae, symbiosis, *Enhalus*, epiphytes, algae, Indo-Pacific, Philippines

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Introduction

The fishes of the filefish family Monacanthidae are free-swimming, but strongly bottom-oriented. Many species adopt a color pattern that matches the substratum, and some exhibit behavior that enhance their deception. Beebe (1928: 154), Longley & Hildebrand (1941: 293), and Breder (1946: 18) all observed the young of the Orange Filefish, *Aluterus schoepfii* (Walbaum), in the western Atlantic Ocean, drifting vertically, head downward, with snout at the bottom. Beebe added, "An additional aid in the deception was the considerable variation in color in these fish, shifting from plain dark cedar green to a mottled greyish or greenish white." Breder also noted that the young of *Stephanolepis hispidus* (Linnaeus) in New York Harbor are bright green like the common algae of the genus *Ulva*. Randall & Randall (1960) observed a juvenile *Monacanthus ciliatus* (Mitchel) in the Virgin Islands with its head down, slightly above the bottom, its tail broadly spread and curved to one side, its pelvic flap fully extended, and its color bright green like the thalli of the genera *Udotea* and *Avrainvillea*. It often took a position closely adjacent to these algae. They also reported a small individual of *Monacanthus tuckeri* Bean, head downward among the fronds of an unidentified plexaurid gorgonian, and colored to match. Many filefishes, such as those of the genus *Cantherhines*, are able to change their color to closely match the substratum. This in part explains the large number of synonyms of species of this genus: *Cantherhines pardalis* (Ranzani), for example, has 11 synonyms (Randall 2011). Klausewitz (1961) illustrated the striking color changes exhibited by this species in an aquarium. Many filefishes augment the color deception by developing cutaneous filaments or flaps, and sometimes larger leaf-like appendages. The species best known for this is the Leafy Filefish, *Chaetodermis penicilligerus* (Cuvier) (Fig. 1).

The Seagrass Filefish, *Acreichthys tomentosus* (Linnaeus), is featured in the present publication for its incredible ability to match its surroundings. It is wide-ranging in the East Indies, north to the Yaeyama Islands of Japan, south to Queensland, east to Tonga, and west to Sri Lanka (an East African record is likely an error).

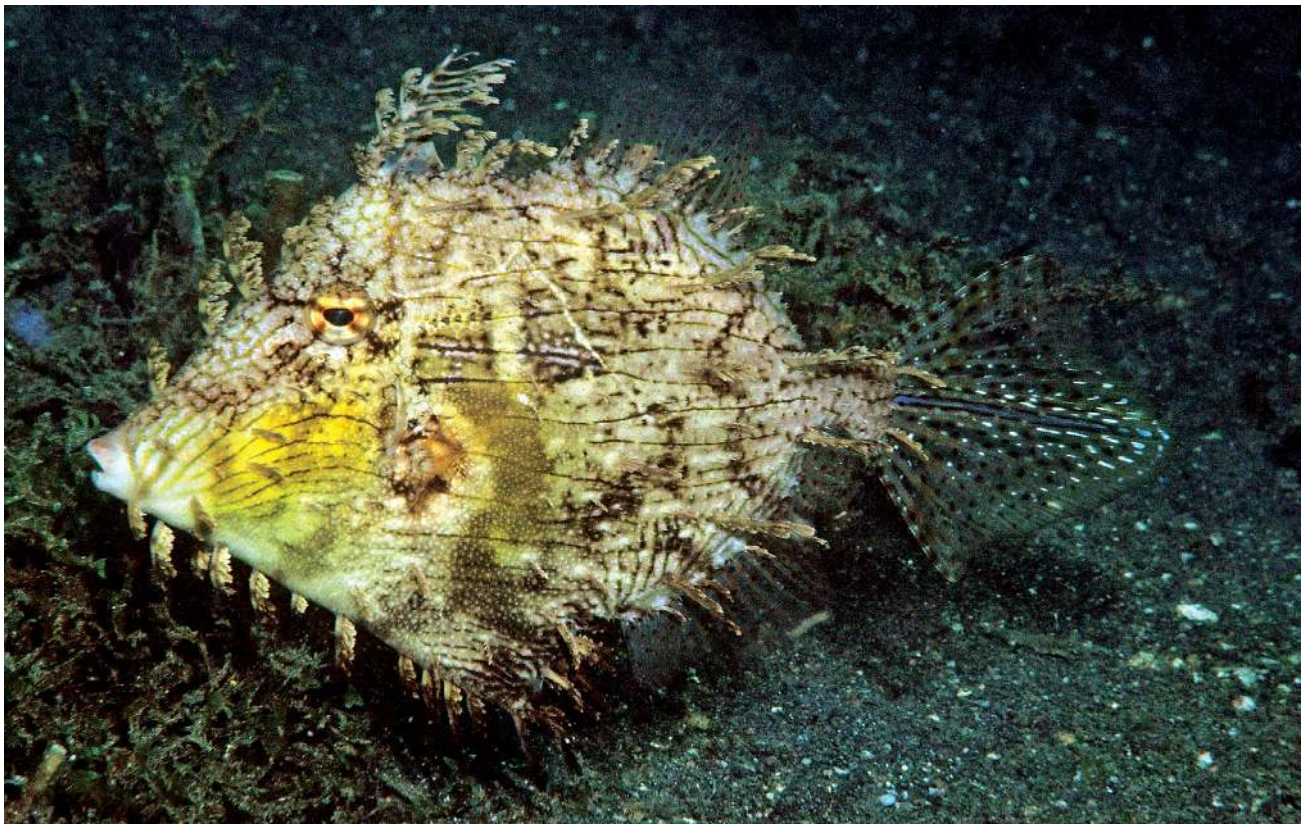

Figure 1. *Chaetodermis penicilligerus*, Sulawesi, Indonesia (G.R. Allen)

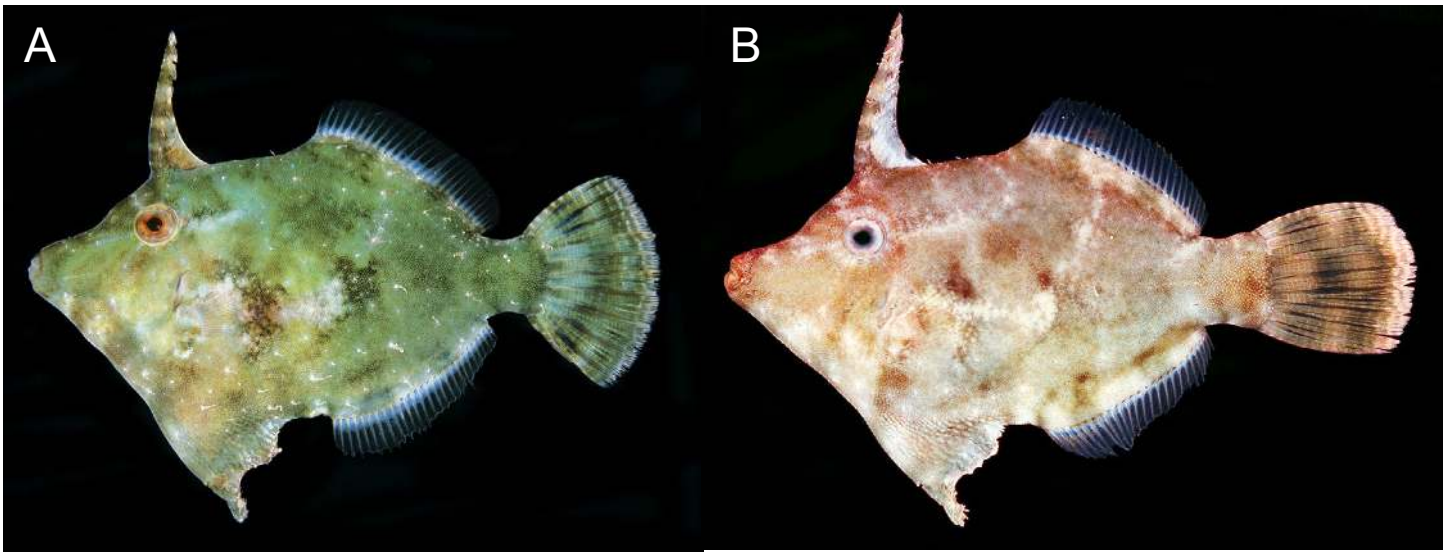

Figure 2. *Acreichthys tomentosus*, A) 74 mm SL in seagrass in Bali Indonesia and B) 67 mm SL on sand and rubble in Palau, Micronesia. Note scattered dermal filaments on the fish in A, few on the fish in B (J.E. Randall).

The fish of Fig. 2A was collected by the third author from a bed of old-growth seagrass in Bali; the second was taken from a shallow sand and rubble area adjacent to a seagrass bed in Palau. Note scattered dermal filaments on the first fish, few on the second. Kuiter & Tonozuka (2001) provided underwater photographs of different color forms of *A. tomentosus* from Indonesia, Malaysia, and Singapore, noting that all share a narrow white band that extends posteriorly from the eye. They should have mentioned a thicker, more diagnostic, white band as long as the head that extends posteriorly from the gill opening; it is curved upward at each end and partly bordered in black. Randall (2005) illustrated one hidden in seagrass from Papua New Guinea (Fig. 3).

Figure 3. *Acreichthys tomentosus*, hidden in its typical habitat of old-growth seagrass, *Thalassia hemprichii,* with its dorsal-fin spine elevated and locked (making it difficult for a predator to swallow), and the spine resembling the end of an old blade of seagrass, Papua New Guinea (J.E. Randall).

Materials and Methods

The observations were made in the 14-hectare Marine Reserve Park (MRP) of the Davao del Norte State College, located in Barangay Adecor, Kaputian District of Samal Island, and adjacent areas on the west coast of Samal Island (Fig. 4 and background island of Fig. 5) near the north end of Davao Gulf, Mindanao, Philippines. The area is protected by Samal Island from the strong west winds, and by Talikud Island from the south wind. The MRA area is an officially protected MPA where giant clams, comprising four species of *Tridacna*, are being raised, most hatchery-sourced but some larger clams transferred into the area. The hatchery-produced clams are supplied from the program of the University of the Philippines-Marine Science Institute (UP-MSI) and are being raised to enhance wild stocks. Two of the species of giant clams are currently classified as Vulnerable on the IUCN Red List. Observations, photographs, and videotapes of Seagrass Filefish were made by the first and second authors as part of their research on the fishes of the MRP between 2006 and 2018, centered around the viewing platform of the MRP (Fig. 5).

Results

Observations showed that adult Seagrass Filefish individuals closely matched the background, pale and mottled when crossing sand between seagrass beds, then brighter green among blades of tapegrass *Enhalus acoroides*, and yellower green among blades of turtlegrass *Thalassia hemprichii* , and variously matching the background as shown in Figs. 6 through 23. The filefish usually oriented head-down among the blades, and the white markings matched the light sand patches seen between blades as well as larger patches of white epiphytes growing on the seagrass blades. Small white filaments on the head and body of the filefish matched the small epiphyte filaments on the seagrass blades.

At night, subadults sleep about 0.5–1 m above the bottom (Fig. 6), while adults sleep near the substratum (see Fig 8), head-downward at the substratum, typically wedged among the basal blades and strands of tape grass and typically the snout of the filefish is in contact with an object.

Figure 4. Map of the Philippines Islands with inset enlargement of the Davao Gulf, Mindanao, and the research site RS (from Bos *et al*. 2008).

Figure 5. Study area around the viewing platform of the Marine Reserve Park (MRP) of the Davao del Norte State College in the Davao Gulf, Mindanao, Philippines; the divers in the foreground are students of the first author (G.S. Gumanao).

Figure 6. *Acreichthys tomentosus*, at night sleeping among tapegrass blades (note the progressive encrusting and destruction of the seagrass blades); adjacent is a *Tridacna gigas* in the reserve, Mindanao, Philippines (G.S. Gumanao).

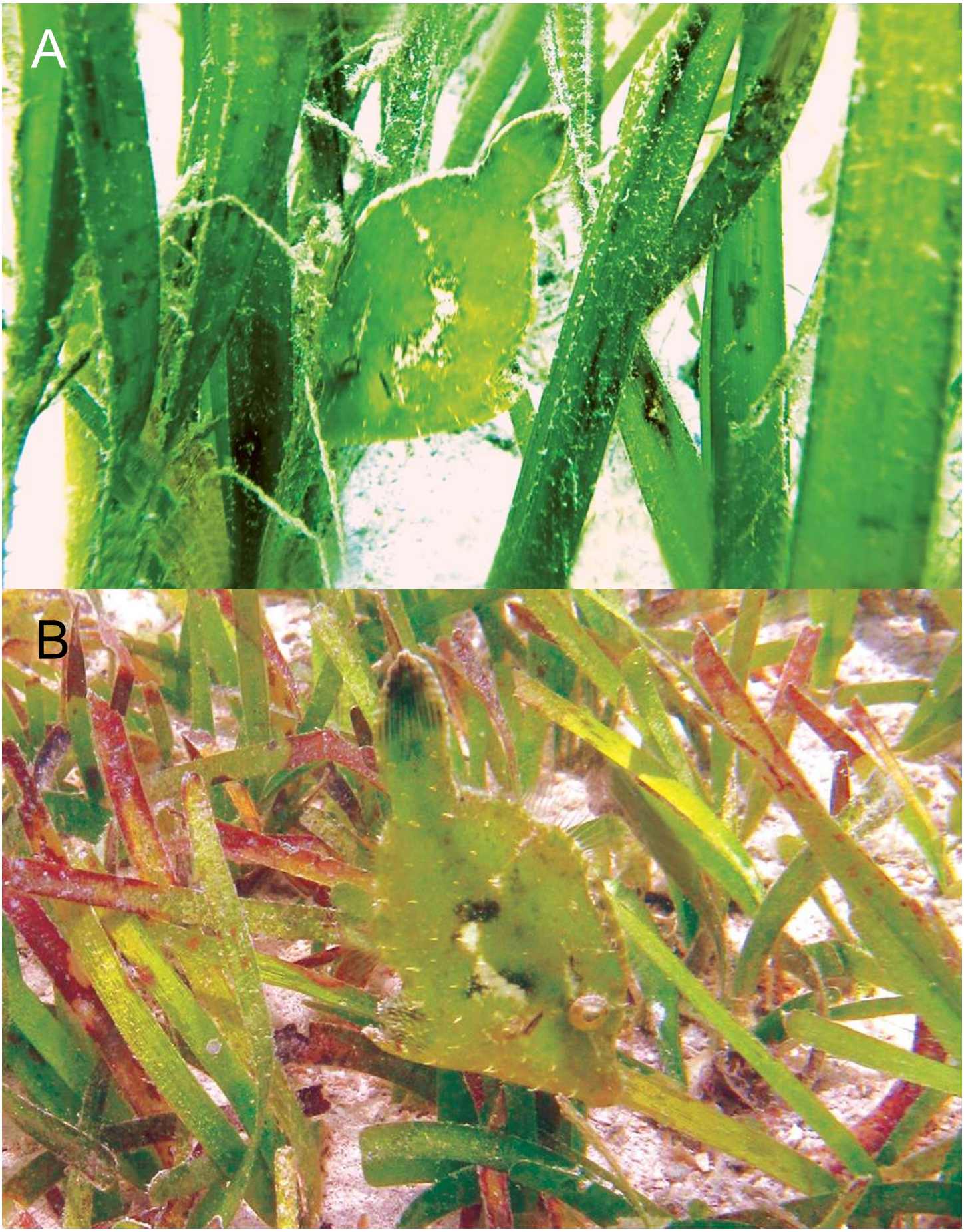

Figure 7. *Acreichthys tomentosus*, in bright green tapegrass (A) and among yellow-green turtlegrass blades (B), Mindanao, Philippines (A: G.S. Gumanao, B: A.R. Bos).

Figure 8. *Acreichthys tomentosus*, at night wedged in tapegrass stems, The edge of each blade of tapegrass is reinforced by a tough fibrous strand that resists decay, now accumulating, covered with algae and silt, and looking like lost pieces of heavy fishing line. These were once widely used to make fish nets, Mindanao, Philippines (G.S. Gumanao).

Figure 9. *Acreichthys tomentosus*, adult male among *Sargassum* (left) and a clump of *Padina* (right) (males have the patch of small setae on the caudal peduncle that narrows anteriorly), Mindanao, Philippines (A.R. Bos).

Figure 10. *Acreichthys tomentosus*, in a clump of *Turbinaria ornata* near a coral reef, Mindanao, Philippines (L.T. Cardona).

Figure 11. *Acreichthys tomentosus*, adult arriving at a ledge on a coral reef; it has changed the color and the texture of its skin to that of the ledge just before it arrived, Mindanao, Philippines (A.R. Bos).

Figure 12. *Acreichthys tomentosus*, adult among branches of *Acropora* coral, note that the usual white markings on the fish are now beige in the coral reef, with projections from each side like coral polyps, Taiwan (C.-T. Chiang).

Figure 13. *Acreichthys tomentosus*, adult among branches of *Porites* coral, Mindanao, Philippines (G.S. Gumanao).

Figure 14. *Acreichthys tomentosus*, the same fish as in Fig. 13 moving onto a reef with mixed substrate of algae, blue sponge, and fine *Millepora* coral, Mindanao, Philippines (G.S. Gumanao).

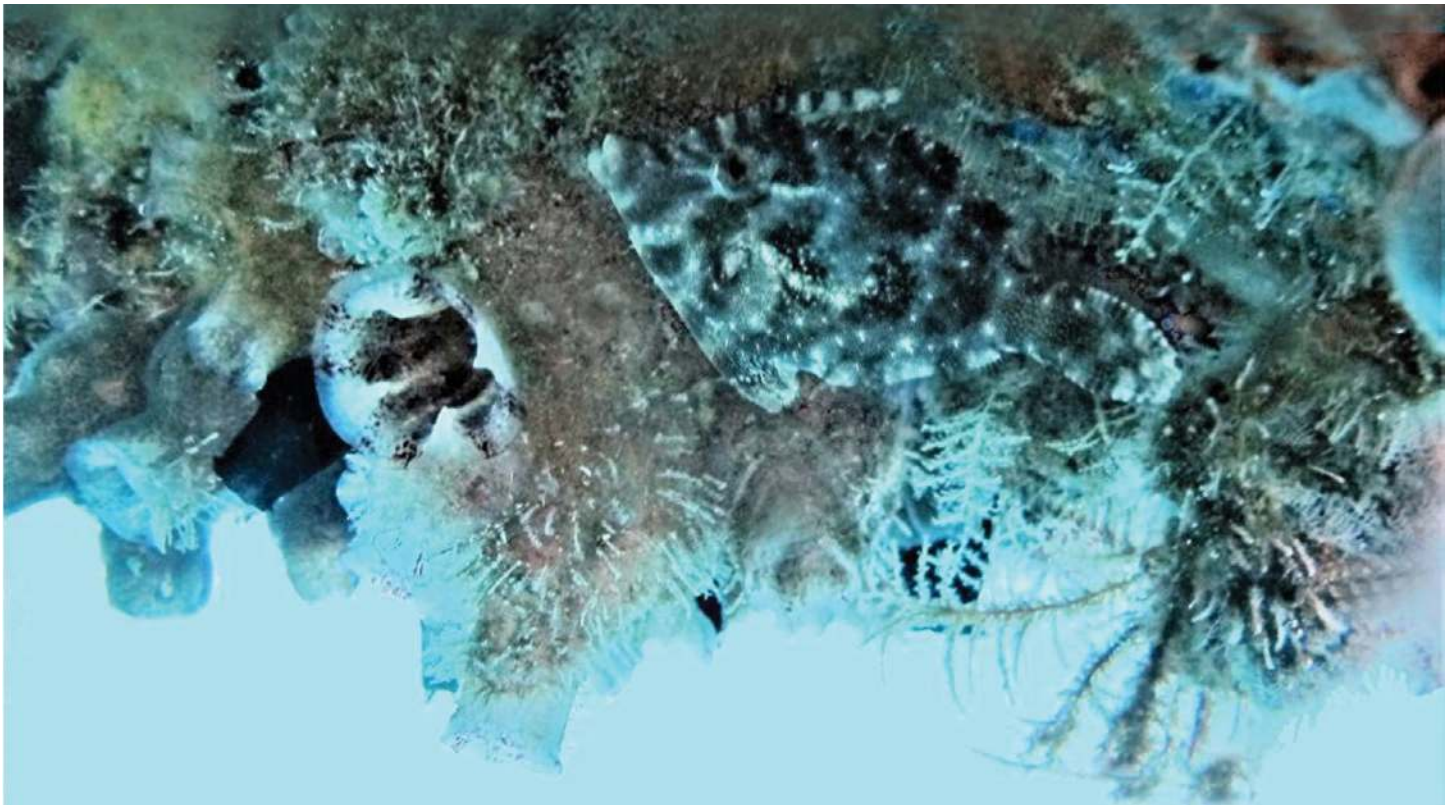

Figure 15. *Acreichthys tomentosus*, adult under the floating platform in the MRP with a complex substrate of algae, sponges, and tunicates; the filefish has selected a site where it is most hidden, Mindanao, Philippines (G.S. Gumanao).

Figure 16. *Acreichthys tomentosus*, adult under the floating platform in the MRP among filaments of stinging hydroids; the filefish is evidently immune to the nematocysts, Mindanao, Philippines (G.S. Gumanao).

Figure 17. *Acreichthys tomentosus*, adult under the floating platform in the MRP among fronds of *Laurencia* algae; the filefish was better hidden in the denser part of the clump, Mindanao, Philippines (G.S. Gumanao).

Figure 18. *Acreichthys tomentosus*, pale newly settled juvenile, about 10 mm SL, among fronds of *Laurencia* algae; it has not yet acquired the ability to change its color pattern to match that of the surrounding algae Mindanao, Philippines (G.S. Gumanao).

Figure 19. *Acreichthys tomentosus*, juvenile hidden within thallus of *Sargassum* adjacent to the tapegrass bed, Mindanao, Philippines (G.S. Gumanao).

Figure 20. *Acreichthys tomentosus*, juvenile almost invisible within thallus of *Sargassum* near the tapegrass bed, Mindanao, Philippines (G.S. Gumanao).

Figure 21. *Acreichthys tomentosus*, subadult against isolated thallus of *Padina* on sand adjacent to the reef, Mindanao, Philippines (G.S. Gumanao).

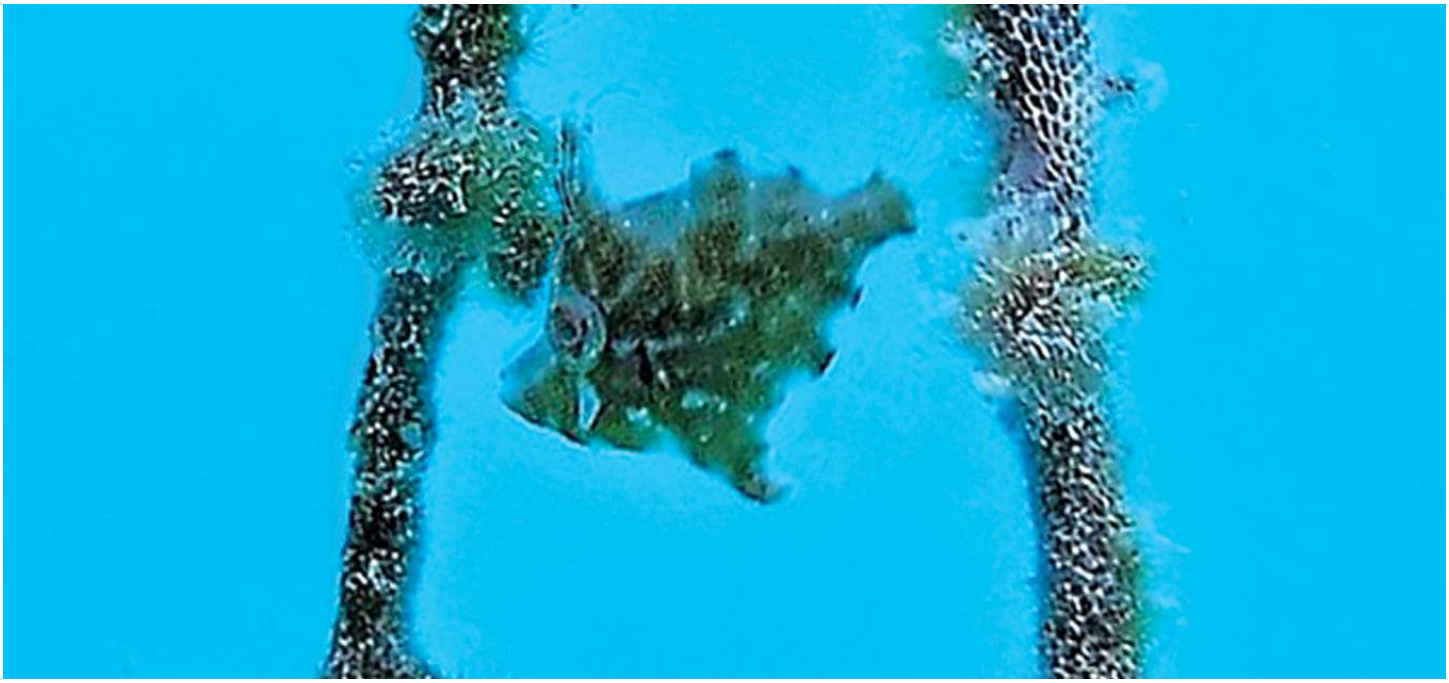

Figure 22. *Acreichthys tomentosus*, small juvenile soon after settlement between dead branches of *Sargassum*, Mindanao, Philippines (G.S. Gumanao).

Figure 23. *Acreichthys tomentosus*, subadult (left) and juvenile (right) almost invisible within heavily encrusted fronds of *Sargassum*, Mindanao, Philippines (G.S. Gumanao).

The opportunity to photograph rapid color and morphological change in the skin of Seagrass Filefish came when the first author approached a subadult hiding head-down among blades of tapegrass nearly a meter above the substratum (Fig. 24). Note the dark body stripe on the fish of the first photo (A) in alignment with the blade of tape grass. Also, the caudal fin has four pale spots at the edge that resemble bite marks that herbivorous fish make on the new growth at the tip of a blade. The first author's approach startled the fish, causing it to elevate its first dorsal-fin spine and begin to swim down toward the substratum, which took only seconds. By the second photograph (B), the fish had already darkened and begun to develop the maze of short and long whitish filaments on the surface of the skin to resemble the increasing epiphytic growth of the adjacent blades of tapegrass. By the third photograph (C), the fish was darkening to match the base of the seagrass stems and developing pale patches to match the broken light background of the sandy bottom. By the fourth photograph (D), the fish was fully darkened and the white skin filaments looked like the adjacent heavy growth of filamentous algae and epiphytes.

We were astounded at the speed of the change in the color and texture of the skin attained by this filefish. The whitish nodules and filaments have to be present in compact form within the dermis that can be instantly released. We had planned to reproduce this event in an aquarium and document it with close-up video, along with before and after histological preparation of the skin. While searching the literature for histological research of the dermis of fishes, the first author found a reference by Justine Allen and three coauthors on the Slender Filefish, *Monacanthus tuckeri* Bean, a small species that ranges throughout the tropical and subtropical western Atlantic. Dr. Allen was contacted and provided a copy of the paper. She and coauthors had completed the same research on *M. tuckeri* that we had planned for *A. tomentosus* (Allen *et al*. 2015).

Close observation and videophotography of the feeding of Seagrass Filefish by the first author documented its preference for epiphytes

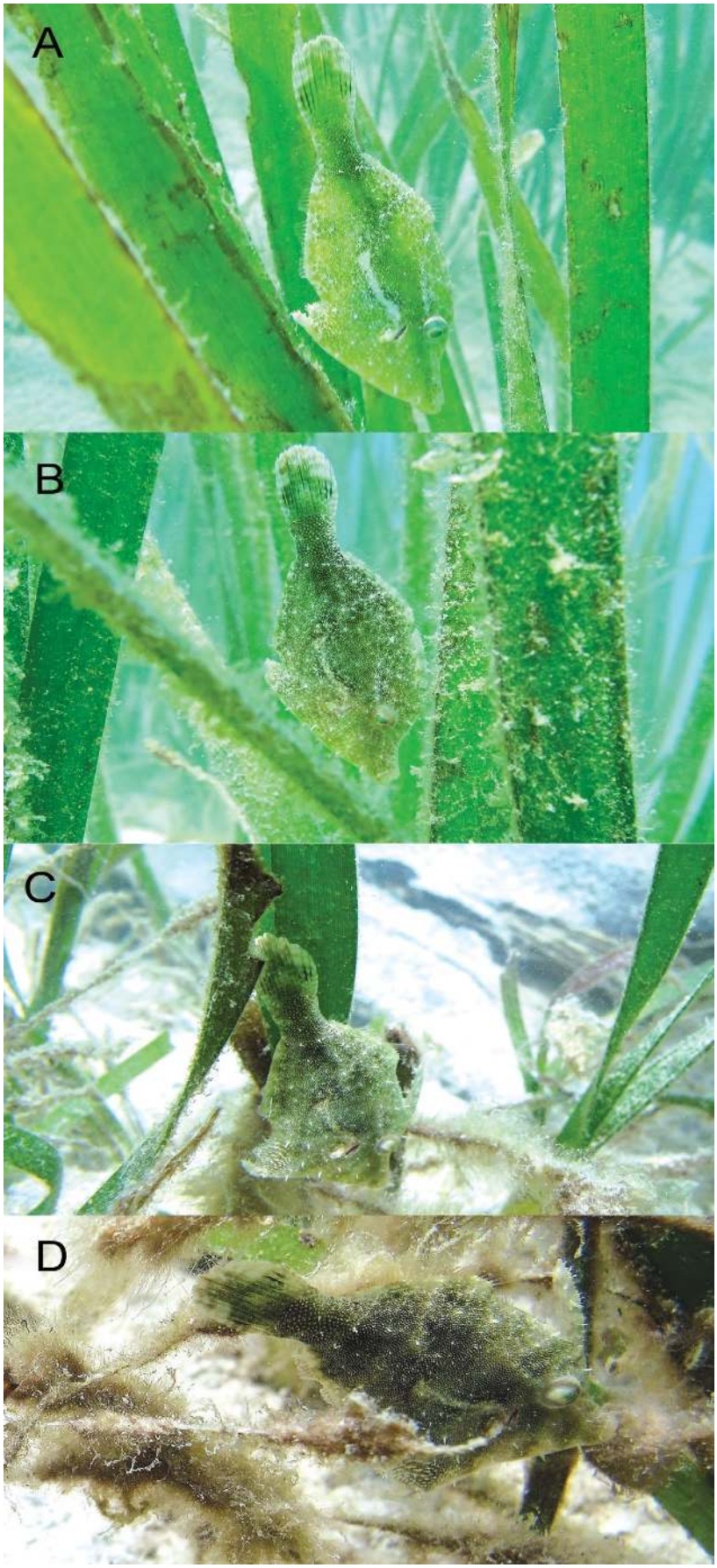

Figure 24. *Acreichthys tomentosus*, sequence of photographs of a Seagrass Filefish rapidly changing color and skin texture, Mindanao, Philippines (G.S. Gumanao).

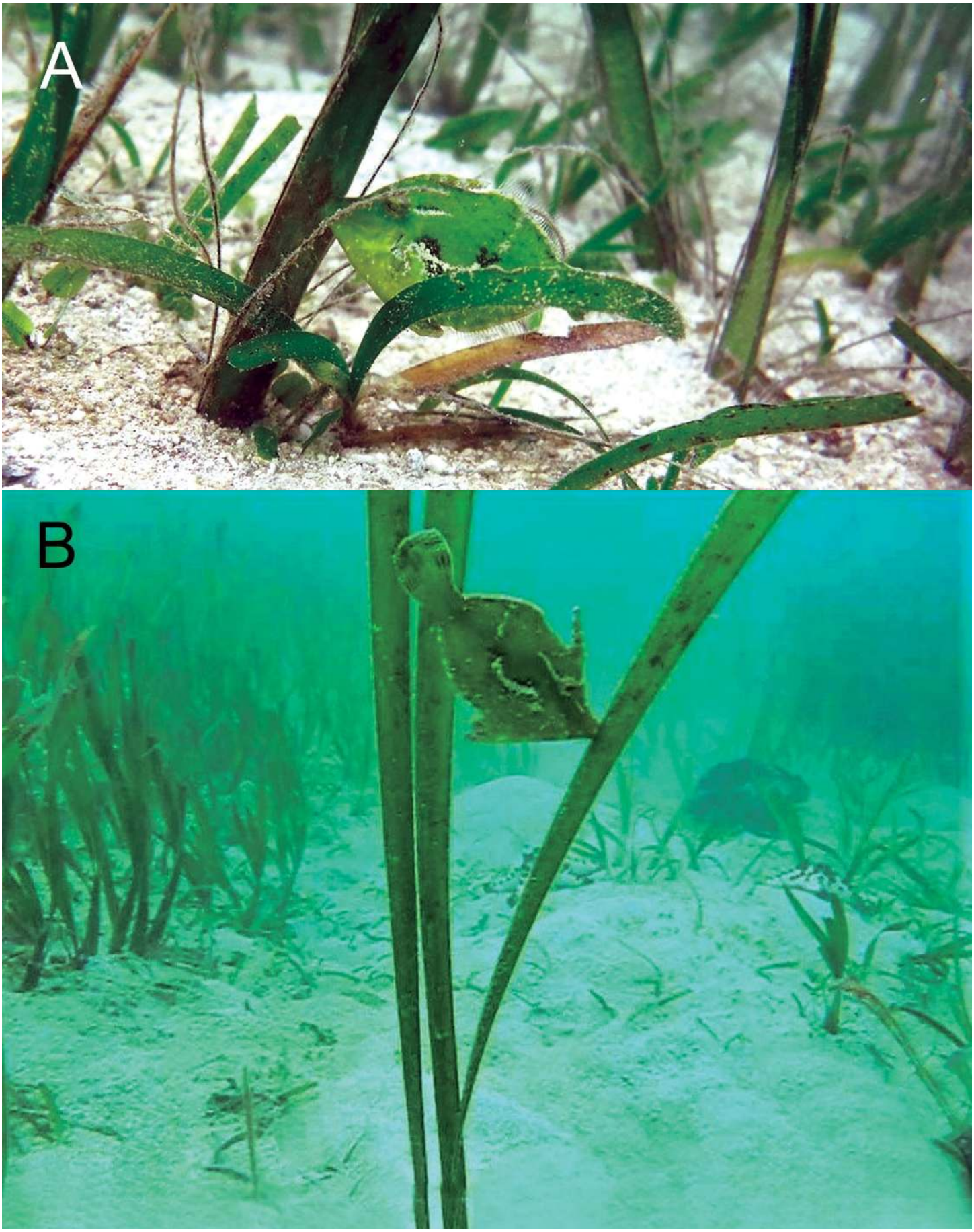

Figure 25. Videoframes of *Acreichthys tomentosus* feeding on epiphytes of tapegrass near the substratum (A), and about a meter above (B), Mindanao, Philippines (G.S. Gumanao).

of tapegrass as the main food of the filefish in the study area (Fig. 25). Small juveniles were also found feeding on the epiphytes of *Sargassum*, the habitat into which they settle.

The epiphytes of seagrasses include a multitude of settling organisms: algae, fungi, bacteria, protozoa, sponges, hydroids, polychaetes, crustaceans, bryozoans, mollusks, and tunicates. Clearly, when unchecked, these organisms collectively will cover the blade of seagrass entirely and block out the light for photosynthesis, causing the death and disintegration of the blade (e.g. see Fig. 6). This interaction of the Seagrass Filefish and the seagrasses would thus represent an example of symbiosis (or mutualism in ecological parlance), where both organisms derive a benefit from the interaction.

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