



## ***Acanthurus tractus* Poey, 1860, a valid western Atlantic species of surgeonfish (Teleostei, Acanthuridae), distinct from *Acanthurus bahianus* Castelnau, 1855**

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### **Abstract**

The ocean surgeonfish, *Acanthurus bahianus*, has been historically recorded from Bermuda and Massachusetts to southern Brazil and the islands of the central Atlantic. We have found that individuals in the southwestern and central Atlantic consistently have a posterior bright yellow margin on the caudal fin and an orange/red margin on the dorsal fin. This coloration is different from the characteristic white/blue fin margins on individuals from the northwestern Atlantic. In addition, there is a clear genetic distinction ( $d = 2.4\%$  mtDNA, *CytB*) between these two lineages. With the corroborating coloration and genetic differences, we suggest that these two lineages represent distinct species. The South Atlantic species retains the name of *A. bahianus* and we propose to resurrect *A. tractus* (Poey 1860) as the valid name for the northwestern Atlantic species.

**Key words:** Caribbean, Brazil, Amazon barrier, biogeography, mtDNA

### **Introduction**

The family Acanthuridae is comprised of six genera and 80 species of marine fishes commonly known as surgeonfishes (Nelson 2007). This group is distributed in tropical and subtropical seas around the world, being absent only from the Mediterranean (Nelson 2007). *Acanthurus* is the only surgeonfish genus that occurs in the western Atlantic, where it is currently represented by three species: *A. bahianus*, *A. coeruleus* and *A. chirurgus* (Randall 2002). Recently, an African species, *A. monroviae*, was also recorded off the coast of southeastern Brazil, but this record does not appear to represent an established population (Luiz-Junior et al. 2004). These species are characterized by deep, compressed bodies, with three movable anal spines and a lancet like spine on the side of the caudal peduncle (Randall 2002; Nelson 2007). They feed primarily on filamentous benthic algae and detritus, sometimes forming large aggregations that can overwhelm other herbivorous species such as territorial damselfishes.

*Acanthurus bahianus* was described by Castelnau (1855) from a specimen collected in Bahia, Brazil. Subsequently, Poey (1860) described *Acanthurus tractus* based on specimens from Cuba as a different species. According to Meek and Hoffman (1884), that species was distributed in Cuba, Panama and Key West. The original description showed no difference between *A. bahianus* and *A. tractus*, what led Randall (1956) to conclude that *A. tractus* was a junior synonym of *A. bahianus*. In his compendium of Cuban natural history, Poey (1860) did not mention *A. bahianus*, which probably indicates he was not aware of the description made by Castelnau in 1855.

The Ocean Surgeonfish, *A. bahianus*, has historically been reported from Bermuda and Massachusetts to southern Brazil, including the oceanic islands of Fernando de Noronha, Trindade, Ascension and Saint Helena (Randall 1956, Floeter et al. 2001). In this work we present morphological and molecular evidence that support the presence of two species north and south of the Amazon barrier, previously combined under *A. bahianus*. With this evidence we propose to resurrect *Acanthurus tractus* (Poey 1860) as the available name for the form that occurs in the northwestern Atlantic, and retain *Acanthurus bahianus* Castelnau 1855 for the species in the southwestern and central Atlantic.

## Material and methods

**Morphology.** Over the years, the second author accumulated data from numerous visual surveys on Brazilian and Caribbean reefs (eg.: Rocha and Rosa 2001, Smith-Vaniz *et al.* 2002), where he recorded coloration patterns of *Acanthurus bahianus*. Color photographs of *A. bahianus* were also obtained from several locations in Brazil and the Caribbean. In addition, several preserved specimens at Brazilian and American collections were examined.

**Genetics.** Due to color differences that were observed between lineages north and south of the Amazon, a preliminary phylogenetic analysis including all Atlantic congeners was carried out using the mitochondrial marker Cytochrome B (*Cyt B*). Sequences from previous datasets were obtained from Genbank for *A. bahianus* (Accession Numbers: AY029306 to AY029309), *A. coeruleus* (AY029310 and AY029311) and *A. chirurgus* (AY029304 and AY029305). In addition, sequences from all 112 individuals (74 from the southwestern and central Atlantic and 38 from the northwestern Atlantic) obtained by Rocha *et al.* (2002) were re-examined. New sequences were generated for the African *A. monroviae* (HQ234705 and HQ234706), which correspond to samples collected in Sao Tome by the second author and were generated using the primers Cyb9 (5' GTG ACT TGA AAA ACC ACC GTT G 3') and Cyb7 (5' AAT AGG AAG TAT CAT TCG GGT TT 3'), following the protocol described in Rocha *et al.* (2002).

The sequences were trimmed and aligned with the software Geneious Pro 5.0.2 (Biomatters). We used the MrBayes (Ronquist & Huelsenbeck 2003) add-on of this software to create a hypothesis of phylogenetic relationships for the mentioned species. The chosen substitution model was the GTR+R (Lanave *et al.* 1984) as given by AIC in Modeltest (Posada & Crandall 1998). The Bayesian analysis was run for 1.1 million generations. A burn-in period of 100,000 generations was set, after which the remaining trees were used to build a strict consensus tree. For the purpose of demonstrating the reciprocal monophyly between *A. tractus* and *A. bahianus* we used *A. coeruleus* as an outgroup, however, our taxon sampling is very limited and the phylogeny presented here should not be viewed as a representation of relationships among Atlantic species.

### *Acanthurus tractus* Poey, 1860

Ocean Surgeonfish

Cirujano Pardo

Figure 1 A–C

*Acronurus nigriculus* Poey, 1875. Type locality: Cuba. Recognized as junior synonym of *A. bahianus* by Randall (1956).

Should now be considered a synonym of *A. tractus* based on the type locality.

*Acanthurus randalii* Briggs and Caldwell, 1957. Type locality: Panama City, Florida. Recognized as junior synonym of *A. bahianus* by Smith-Vaniz *et al.* (2002). Should now be considered a synonym of *A. tractus* based on the type locality.

**Diagnosis.** The Ocean Surgeonfish is distinguished from all of its Atlantic congeners by the following combination of characters: Dorsal fin IX, 23 to 26; anal fin III, 21–23; pectoral rays 15–17; gill rakers 18–24; very small ctenoid scales; spatulate teeth with denticulate edges, 14 in upper jaw and 16 in lower jaw. Body depth about two in standard length; concavity of caudal fin from five to 12 in standard length, more concave in adults; length of caudal spine between 3 and 3.5 in standard length; diameter of eye 3 to 3.5 in head length. Body yellowish to grayish brown, with no dark vertical bars; yellow lines radiating from posterior margin of eye; translucent pectoral fin with yellow tints; white or pale spot on base of caudal fin; caudal fin lunate and caudal concavity between five and 12 in standard length; posterior margin of caudal, anal and dorsal fins with light blue or white margin. Maximum reported length 38.1 cm SL, but most usually individuals not exceeding 25.0 cm TL.

**Color in life.** Overall coloration varies from tones of yellowish brown and grayish to olive-brown; short blue lines radiating from posterior margin of eye; dorsal and anal fins with a blue margin and alternating bands of dull white and bluish green (fewer and less conspicuous in anal fin); caudal fin olive-brown to bluish, with the base often abruptly white or at least paler than the rest of the body and the posterior margin bright blue to white (Figure 1A–1C).

**Comparisons to western-Atlantic congeners.** Among its congeners, the Ocean Surgeonfish is most similar to the Barber Surgeonfish, *Acanthurus bahianus*, having the same body proportions and counts. However these two species differ in the coloration of the margin of the caudal and dorsal fins. This coloration is white to bright blue in the Ocean surgeonfish (Figures 1A to 1C) and orange to bright yellow in the Barber surgeonfish (Figure 1D to 1F).

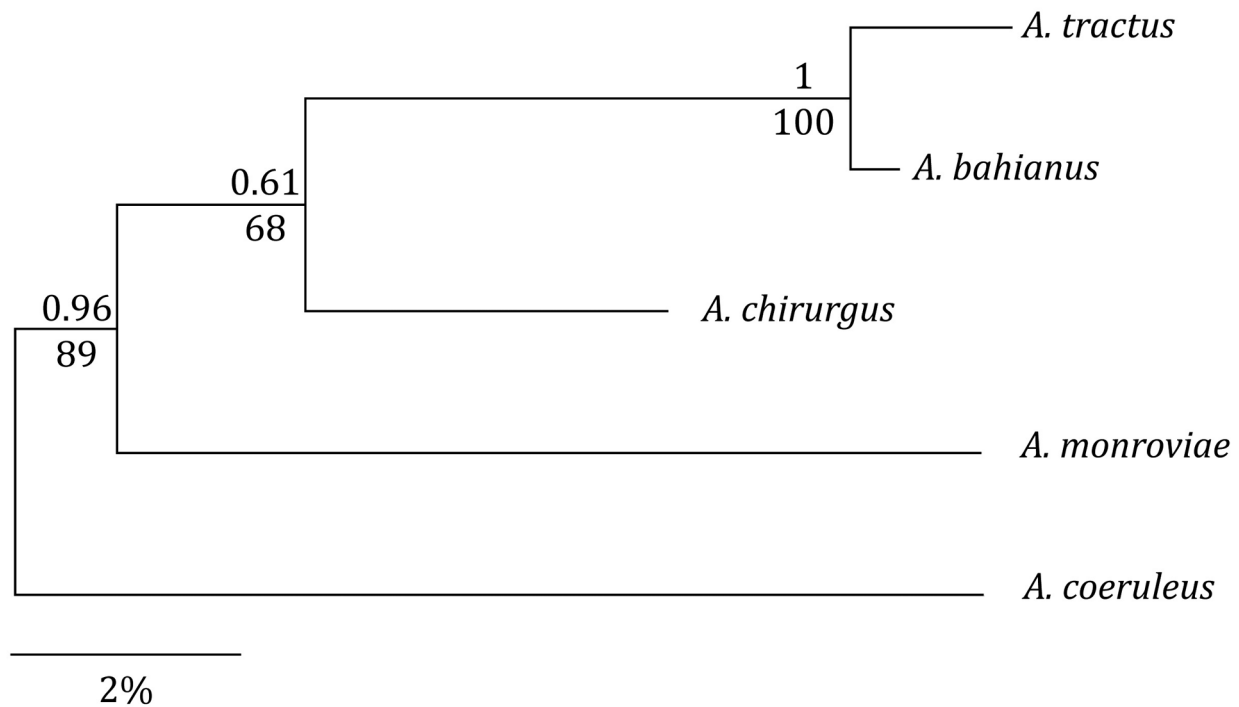
These color differences have previously been noticed by Rocha *et al.* (2002), but did not result in the separation of these two species until now. This color pattern is consistent through the entire range of *A. bahianus*, including Central Atlantic islands (e.g.: Edwards 1990). *A. tractus* also shares fin-ray counts with *A. chirurgus*, however the later is characterized by the presence of 10 narrow dark bars on side of body that are absent in *A. tractus*. In addition, the caudal fin of *A. chirurgus* lacks the distinct pale posterior margin that is present in *A. tractus*. The distinction between *A. coeruleus* and *A. tractus* is more evident as they do not share fin-ray counts. *A. coeruleus* has 24 to 26 anal-fin rays and 26 to 28 dorsal-fin rays, whereas *A. tractus* counts are 21 to 23 and 23 to 26 respectively. They also differ in color pattern, as adult *A. coeruleus* are blue to purplish- grey and juveniles are bright yellow. Finally, the eastern Atlantic *A. monroviae* has similar counts to *A. tractus*, but the former is characterized by having numerous horizontal lines on the side of the body, a very distinctive bright orange-yellow spot surrounding the peduncular spine and black to dark blue fins.



**FIGURE 1.** Underwater photographs of *Acanthurus tractus* (A to C) and *Acanthurus bahianus* (D to F). Note the clear and consistent difference in the coloration of the margin of the caudal and dorsal fins. Photographs by J. Randall (1A), D. Snyder (1B, 1C), O. Luiz-Junior (1D, 1E) and G. Allen (1F).

**Distribution and habitat.** From Massachusetts and Bermuda to Trinidad and Tobago, including the Gulf of Mexico and the islands of the Caribbean. This species inhabits mainly shallow rocky and coral reefs but can also be found around inshore rocky areas with patches of sand, feeding primarily on benthic algae and occasionally grazing on seagrass beds.

**Genetics.** The split between *A. bahianus* and *A. tractus* is evident from the results of the Bayesian tree. The sister species form a clade supported by 100% Bayesian posterior probability in the tree and are separated from each other by an average pairwise distance of 2.4% (Figure 2). Rocha *et al.* (2002) had already observed that samples from the North and South Atlantic share no haplotypes and are separated by 11 mutations with  $\Phi_{ST}$  between 0.805–0.836 ( $P < 0.001$ ) in the same gene. Meanwhile, comparisons within the northwestern and southwestern Atlantic biogeographic regions showed no differences (Rocha *et al.* 2002).



**FIGURE 2.** Relationships among Atlantic *Acanthurus* based on Bayesian analysis of mitochondrial *CytB* sequences. Numbers above branches correspond to posterior probabilities and those below branches are bootstrap support. Since our analysis did not include Pacific or Indian Ocean surgeonfishes, relationships in this tree (especially the position of long branches) may change with the addition of other taxa.

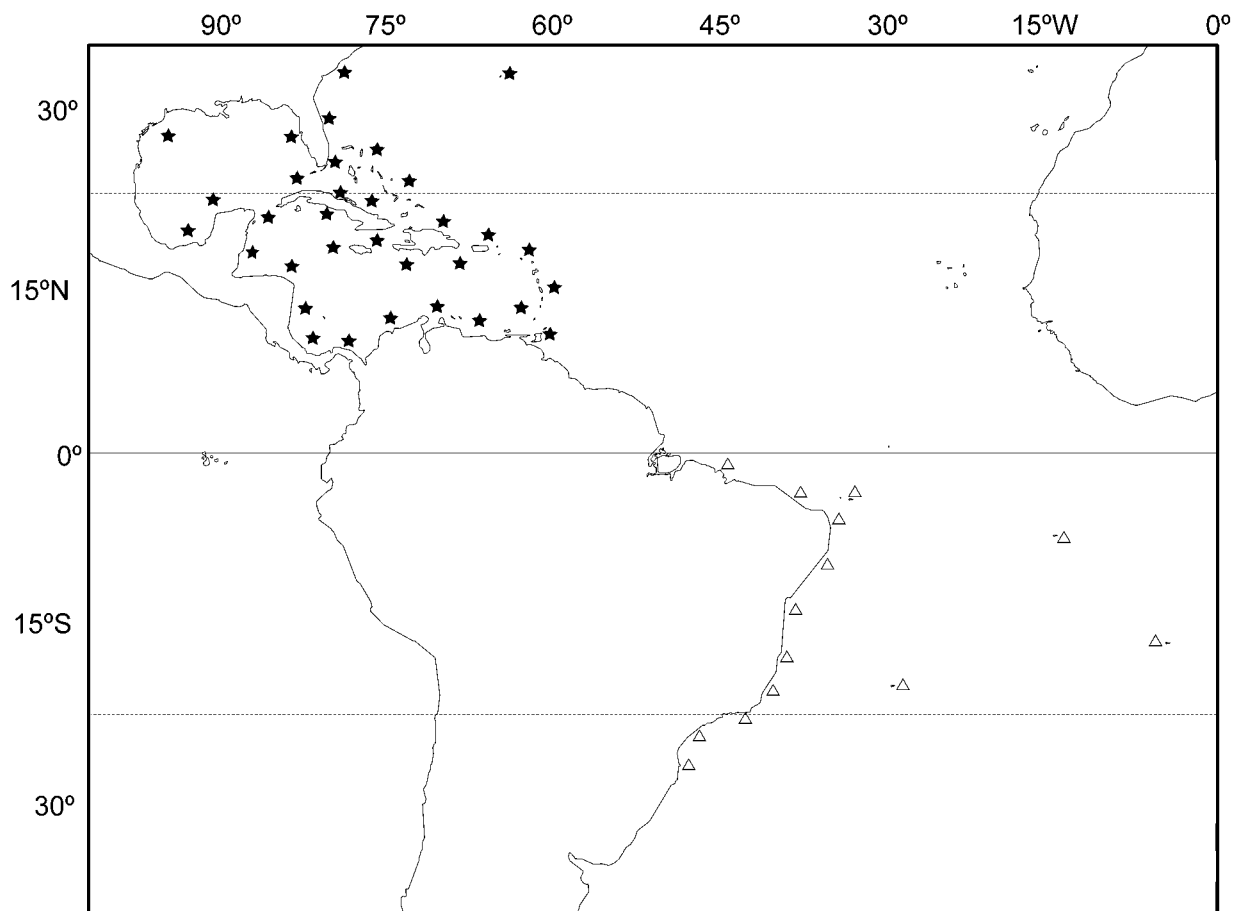
The divergence found between these two species is comparable to that found among other recognized closely related species. For example, in a survey of 81 fish genera, Johns and Avise (1998) found 39 pairs of sister species in which the pair-wise divergence was below 2.5% for the mitochondrial marker *Cyt B*. More recent examples with comparable divergence in reef fishes include grunts (Rocha *et al.* 2008), angelfishes (Bellwood *et al.* 2004) and wrasses (Rocha 2004).

The separation between the two clades can be explained by the freshwater outflows of the Orinoco and Amazon basins. These rivers change the conditions from clear waters with shallow coral reefs, to murky low salinity waters along the northeast coast of South America (Rocha 2003). In this particular case, *A. bahianus* and *A. tractus* are restricted to shallow reefs, so individuals are unable to cross this barrier. Similar cases of sister species on both sides of the freshwater plume have been described for cardinalfishes (Gilbert 1977), damselfishes (Greenfield & Woods 1974), parrotfishes (Moura *et al.* 2001) and wrasses (Rocha 2004).

With the revalidation of *Acanthurus tractus* the number of surgeonfish species present in the western Atlantic increases from three to four. The history of the genus *Acanthurus* is filled with changes in nomenclature and misidentifications (Randall 1956 & 2002), probably caused by the wide distribution, ability of many species to change color and similarity between closely related species. However, to the knowledge of the authors, there are no other lineages in this group that could potentially warrant species level recognition in the Atlantic.

**Notes on *Acanthurus bahianus* (Castelnau 1855).** The common name “Ocean Surgeonfish” has been historically used for the Caribbean species, and we propose that this common name be kept for *A. tractus*. Because the bulk of the southern species distribution is the Brazilian coast, we suggest the adoption of the Brazilian common

name of Barber Surgeonfish (“Cirurgiãõ Barbeiro” in Portuguese) for *A. bahianus*. The Barber Surgeonfish is thus found in tropical and subtropical waters of the coast of Brazil, from Parcel Manuel Luiz to Santa Catarina, including the Oceanic Islands of Fernando de Noronha, Atol das Rocas, Trindade, Ascension and St. Helena, in the South and Central Atlantic.



**FIGURE 3.** Geographical distribution of *Acanthurus tractus* (★) and *A. bahianus* (△) in the tropical western and central Atlantic. Neither species is present between the Amazon and Orinoco rivers in the northern coast of Brazil as an effect of the fresh water influx of these rivers.

**Material examined.** Institutional abbreviations are as listed at <http://www.asih.org/codons.pdf>, except for CIUFES (Colecao Ictiologica da Universidade Federal do Espirito Santo, Brazil) and UFPB (Universidade Federal da Paraiba, Brazil). Materials are listed alphabetically by locality, and number of specimens examined in each lot is given in parenthesis after the collection number.

*Acanthurus tractus*

Bahamas: UF 171552 (10), CAS 23800 (2). Belize: UF 209809 (3). Cayman Islands: UF 28781 (7), UF 32490 (11). Colombia: UF 224106 (5). Panama: CAS 31730 (7). Navassa Island: USNM 360416 (2). Florida: UF 31235 (2), UF 67552 (28). Trinidad and Tobago: USNM 319192 (7). US Virgin Islands: UF 159194 (4), UF 159195 (4), UF 159196 (3), UF159197 (6).

*Acanthurus bahianus*

Ascension Island: USNM 381170 (9). Bahia, Brazil: USNM 43281 (2), CIUFES 130751 (3). Espirito Santo, Brazil: ZUEC 2826 (1), CIUFES 130007 (5), CAS-SU 67767. Paraiba, Brazil: UFPB 3505 (11), UFPB 5066 (3), UFPB 5342 (12). Pernambuco, Brazil: CAS-SU 67765 (2). Trindade Island, Brazil: ZUEC 1530 (1), CIUFES 1538 (2), CIUFES 1714 (1).

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