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Identification of early life-history stages of Caribbean Apogon (Perciformes: Apogonidae) through DNA Barcoding

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Abstract

Early life-history stages of 12 of 17 species of western Central Atlantic *Apogon* were identified using molecular data. A neighbor-joining tree was constructed from mitochondrial cytochrome oxidase-*c* subunit I (COl) sequences, and genetic lineages of *Apogon* in the tree were identified to species based on adults in the lineages. Relevant portions of the tree subsequently were used to identify larvae of *Apogon* species from Carrie Bow Cay, Belize, and juveniles from Belize and other western Central Atlantic localities. Diagnostic morphological characters of larvae and juveniles were investigated by examining preserved vouchers from which the DNA was extracted and digital color photographs of those specimens taken before preservation. Orange and yellow chromatophore patterns are the easiest and sometimes only means of separating *Apogon* larvae. Patterns of melanophores and morphometric features are of limited diagnostic value. For juveniles, chromatophore patterns and the developing dark blotches characteristic of adults are the most useful diagnostic features. Larvae were identified for *Apogon aurolineatus, A. binotatus, A. maculatus, A. mosavi, A. phenax, A. planifrons,* and *A. townsendi.* Juveniles were identified for those species (except *A. planifrons*) and for *A. pseudomaculatus, A. lachneri, A. pillionatus, A. robbyi,* and *A. quadrisquamatus.* One larval specimen occurs in an unidentified genetic lineage, and five adults occur in another unidentified genetic lineage. *Apogon* species can be divided into at least four groups based on pigmentation patterns in early life stages. Further investigation is needed to determine if those groups are meaningful in the generic classification of *Apogon* species.

Key words: CO1, cardinalfishes, fish larvae, pigmentation patterns, chromatophores, Belize

Introduction

The family Apogonidae is represented in the western Central Atlantic by three genera, *Apogon, Astrapogon,* and *Phaeoptyx,* and 23 species (Böhlke & Chaplin, 1993; Gon 2002). Early life stages of all species of *Phaeoptyx* and *Astrapogon* have been described (Lara 2006, Baldwin *et al.* 2009a), but less is known about young stages of *Apogon.* Lara (2006) provided brief descriptions and illustrations of early stages of ten species of western Atlantic *Apogon,* but most of the specimens that she was able to identify were juveniles. Although the compilation in which Lara's chapter was included—Richards' (2006) *Early Stages of Atlantic Fishes*—represents the best effort to date to concentrate information regarding early stages of western Central Atlantic fishes, it contains almost no information useful in identifying larval *Apogon*. DNA barcoding (Hebert *et al.* 2003) is emerging as a valuable tool for identifying larvae and juveniles of marine fishes (e.g., Pegg *et al.* 2006, Victor 2007, Baldwin *et al.* 2009a, Packer *et al.* 2009, Victor *et al.* 2009, Valdez-Moreno *et al.* 2010). Additionally, barcoding is useful for resolving complex taxonomic issues (e.g., Baldwin *et al.* 2009b) and for identifying cryptic new species of marine fishes (e.g. Victor 2007, Tornabene *et al.* 2010, Baldwin *et al.* 2011), both of which can aid in the identification of fish larvae and juveniles by providing a more complete picture of species diversity. Valdez-Moreno *et al.* (2010) matched larvae and adults of numerous marine fish species of Mexico through DNA barcoding, including those of *Apogon maculatus.* No descriptions of larvae were provided.

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