

Presence of Postflexion Spotfin Butterflyfish, *Chaetodon ocellatus* (Chaetodontidae), in a Southern Maine Estuary, Gulf of Maine

Michelle E. Furbeck¹, Leland W. Pollock¹, Jeremy W. Miller¹, and Jason S. Goldstein^{1,*}

Abstract - A postflexion (tholichthys-stage) *Chaetodon ocellatus* (Spotfin Butterflyfish) was captured in a Southern Maine estuary in October 2017. As the Gulf of Maine continues its current warming trend, we anticipate an increase in the presence of such transient tropical species.

Adult *Chaetodon ocellatus* Bloch (Spotfin Butterflyfish) commonly inhabit both tropical and sub-tropical waters associated with coral reefs. These fish occur throughout the Caribbean, the Gulf of Mexico, and the Western North Atlantic including the Bahamas and the US coast from Florida to the Carolinas (reviewed in McBride and Able 1998). Subtropical spawning occurs from the winter into spring (January–May), with a peak in May (Fahay 2007).

Young-of-the-year Spotfin Butterflyfish include early (preflexion) larval stages (as small as 11 mm total length [TL]), a distinctive postflexion pelagic juvenile stage referred to as “tholichthys” (17–22 mm TL), and a post-settlement benthic juvenile stage (25–77 mm TL) (McBride and Able 1998). However, little is known about preflexion larvae of this species. The post-larval tholichthys form is unique to chaetodontids and is recognizable by an armored head enclosed by bony plates. Viewed laterally, these plates extend onto the fore-body as dorsal and ventral projections and include a pair of ear-shaped lobes dorsal to the pectoral fins (see details in: Fahay 2007, Richards 2006). Settlement and progressive reduction of head plates follows, and by 25–27 mm TL, these fish transition to benthic juveniles.

The development time for this species permits larval Spotfin Butterflyfish to become entrained in the Gulf Stream with some regularity, and thereby transported northward along the western North Atlantic coastline. McBride and Able’s (1998) detailed observations in a New Jersey estuary illustrate the frequency with which this occurs (e.g., 63–131 Spotfin Butterflyfish individuals captured per year, 1990–1993). Juveniles of this species have been reported broadly throughout the mid-Atlantic region, along the coast of southern New England, and in 3 extreme instances, farther northward (McBride and Able 1998). A 31-mm TL juvenile (likely a post-settlement benthic form) was recorded in August 1933 in Musquodoboit Harbor, NS, Canada (Vladykov 1935, cited in McBride and Able 1998). A post-larval specimen (TL = 19 mm, likely a pelagic tholichthys stage) was found in the Little River Estuary, Wells, ME, in August 1989 (Murphy 1991) at even greater distance from its mid-Atlantic spawning limits as measured by dominant current. In addition, 3 individuals of this species, but of unspecified lengths or stages, were observed also in 1989 from the mouth of Portsmouth (NH) Harbor (personal communication referenced in McBride 2002).

¹Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090. *Corresponding author - jgoldstein@wellsnerr.org.

The specimen reported herein, a pelagic tholichthys stage (TL = 18 mm), was caught on 20 October 2017 as part of a long-term (since 2008) ichthyoplankton monitoring project, with a sampling frequency of ~4 times monthly, at the ingress to the Webhannet River Estuary, Wells, ME (43°19'12.82"N, 70°33'48.11"W; Fig. 1). Ichthyoplankton are collected for a 1-hour period on incoming tides using a General Oceanics 0.5-m diameter net (mesh size = 500 μ m), deployed at a fixed depth of 1 m from the Wells Harbor Dock. Samples are transported to the Maine Coastal Ecology Center at the Wells National Estuarine Research Reserve (Wells NERR) and immediately preserved in 70% ethanol. To date, nearly 7000 fish larvae have been identified and documented, representing 34 species of estuarine resident, marine migrant, and marine straggler guilds.

This specimen (Fig. 1) is the first Spotfin Butterflyfish to be found in this continuing 12-year time series. We confirmed the identification of this species according to taxonomic criteria of Fahay (2007); spine and ray counts for dorsal, anal, and pectoral fins fall within ranges described for Spotfin Butterflyfish. At 18 mm TL, this specimen is smaller than the smallest tholichthys juvenile (19.6 mm TL) included in the Able and Fahay (2010) study of scale formation in this species. However, like their 19.6-mm specimen, the post-opercular body of the Wells individual was well covered with scales.

Water-quality and meteorological data are collected as part of the System Wide Monitoring Program (SWMP) at the Wells NERR. Water temperature at the Wells



Figure 1. *Chaetodon ocellatus*, tholichthys (postflexion), captured at the ingress of the Webhannet River Estuary in Wells, ME, October 2017. Scale bar = 4 mm. Arrows point to ear-shaped plate extensions characteristic of this life-history phase.

Harbor inlet site averaged 14.0 °C for the 3 weeks preceding the collection of this specimen. At the time of collection (10 October 2017), salinity readings averaged 31.3 psu and dissolved oxygen averaged 7.5 mg/L. In providing context for our specimen capture, we queried additional oceanographic data from a nearby offshore buoy (Western Maine Shelf Buoy, station ID: B01, <http://www.neracoos.org/data-tools/historic>) and determined the average water conditions ~ 20 days prior to our collection date as follows: water temperature = 16.3 °C; salinity = 31.3 psu; wind and current direction = S and SW; current speed = 0.43 m/s.

Gulf Stream transport of multiple other species of reef fishes into northern clines is not uncommon (Hare et al. 2002), but continuation on into the Gulf of Maine (GoM) is less frequent (e.g., isolated individuals of a few species as summarized in Bigelow et al. 2002). Such northern transport is particularly rare for planktonic forms, in part because dominant surface currents affecting the GoM include entry flow via the Nova Scotian Current, counter-clockwise flow around the Gulf (Gulf of Maine Coastal Current), and outflow via the Great South Channel and the southern fishing banks (Pettigrew et al. 2005). As such, we explored the possibility that an individual Spotfin Butterflyfish spawned in, for example, the Carolinas (USA) and following the most likely route connecting these 2 locales, could be found in the late tholichthys stage in southern Maine by mid-October. We considered average current speeds for each leg of the journey and allowed flexibility for less than ideal transport and oceanographic linkages in these estimates. The arrival of this post-flexion specimen at our location by natural means appears to be in keeping with a May (or earlier) spawning date along the mid-Atlantic coast and the length of time necessary to complete chaetodontid larval development (as described in Degidio et al. 2017). Most reef fish larvae transported from tropical and subtropical regions are unable to tolerate conditions typical of temperate and boreal regions (McBride and Able 1998). These authors have shown that Spotfin Butterflyfish cease feeding at 12 °C and exhibit high mortality at temperatures below 10 °C.

The GoM is presently experiencing an especially rapid warming trend (Morley et al. 2018, Pershing et al. 2015), that could broadly affect early-life history dynamics of fishes (e.g., spawning, egg and larval dispersal, and pelagic larval duration; Llopiz et al. 2014). Should this trend continue in the GoM, the arrival of more such larval wanderers is likely to become increasingly frequent.

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