

# Larval Growth, Duration, and Supply Patterns of *Sphyraena barracuda*

EVAN K. D'ALESSANDRO and SUSAN SPONAUGLE  
Rosenstiel School of Marine and Atmospheric Science, University of Miami  
4600 Rickenbacker Causeway  
Miami, Florida 33149 USA

## ABSTRACT

The great barracuda (*Sphyraena barracuda*) is an important predator in mangrove, seagrass, and reef environments of south Florida and the Caribbean. Despite this very little is known about their early life history or population replenishment. In order to determine temporal patterns of larval supply to nearshore waters, a series of light traps was deployed over shallow coral reefs along the upper Florida Keys every other night for six months from May-October of 2002 and 2003. Traps were also deployed monthly during peak settlement times throughout winter and spring (November-April) of 2003 and 2004. Larval growth rates and the pelagic larval duration (PLD) of barracuda were determined through otolith analysis and compared to concurrently collected hydrographic data. Barracuda appeared in the traps only during summer months, with two primary lunar-cyclic pulses occurring between the third quarter and new moons in late June-early July and late August-early September. Water temperature explained most of the variability in early larval growth, however, patterns were unclear for later larval growth. Additional data are needed to augment the four seasonal cohorts and verify these preliminary results.

KEY WORDS: Great Barracuda, *Sphyraena barracuda*, larval growth, duration

## Crecimiento Larval, Duración, y Patrones de Oferta de *Sphyraena barracuda*

La barracuda (*Sphyraena barracuda*) es un predador importante en los manglares, pastos marinos, y arrecifes de coral del sur de la Florida y del Caribe. A pesar de esto, se sabe muy poco con respecto a su historia de vida temprana y al repoblamiento de sus poblaciones. Con el objeto de determinar patrones temporales de oferta de larvas a las aguas costeras, se usaron una serie de trampas de luz en arrecifes someros de los cayos superiores de la Florida cada noche de por medio por seis meses desde mayo hasta octubre durante el 2002 y el 2003. También se usaron trampas mensuales durante la época pico del reclutamiento durante el invierno y la primavera (noviembre a abril) del 2003 y el 2004. Así mismo, se determinó la tasa de crecimiento larval y la duración pelágica larval (DPL) de la barracuda con el análisis de otolitos y se compararon con datos hidrográficos recaudados concurrentemente. Solo se encontraron larvas de barracuda en las trampas durante los meses de verano, con pulsos relacionados al ciclo lunar, bimodales, y picos de oferta entre el cuarto menguante y la luna nueva al final de junio-principios de julio y al final de agosto-principios de septiembre. La mayoría de la variabilidad en el crecimiento larval y el DPL se pueden explicar usando la temperatura del agua. Sin embargo, factores hidrográficos tales como la presencia temporal de eddies tienen una influencia en el transporte de larvas y también pueden contribuir a variaciones adicionales en las características de la historia de vida temprana.

PALABRAS CLAVES: La barracuda, *Sphyraena barracuda*, crecimiento larval, duración

## INTRODUCTION

*Sphyraena barracuda* (Walbaum), or the great barracuda, is an apex predator found in most tropical and sub-tropical seas. While juveniles up to ~30 cm standard length (SL) and three years of age remain in nearshore seagrass and mangrove environments, and older, larger adults occur further offshore, they remain almost exclusively piscivorous throughout their lives (de Sylva 1963, Blaber 1982, Schmidt 1989). In south Florida, barracuda occur in marine mangrove, seagrass, and coral reef environments, as well as estuarine environments of Florida Bay. Although not commercially fished in these areas, the barracuda is an important, if not unavoidable, gamefish. Despite its widespread occurrence, very little is known about the ecology of this species, especially early life history traits such as larval growth rate and causes of variation in this rate. Water temperature has been shown to

be the major cause of variation in the growth rate of another species of reef fish (*Thallasoma bifasciatum*) in south Florida (Sponaugle *et al.* 2006). The objectives of the present study were to:

- i) Identify patterns of larval barracuda ingress to nearshore environments,
- ii) Measure the larval growth rate for this species, and
- iii) Determine whether water temperature is a major cause of larval growth variation.

## METHODS

### Field Sampling

To intercept larval barracuda settling to nearshore environments, larval light traps (for design see D'Alessandro 2005) were deployed over French Reef in Key Largo

every other night from May – October in 2002 and 2003. Traps were also deployed twice monthly (during third quarter and new moons) from November – April in 2003 and 2004. Deployment occurred at sunset and retrieval at dawn, upon which samples were immediately preserved in 95% ethanol.

Water temperatures were recorded by a Sontek Argonaut-MD acoustic Doppler current meter at 21m depth fixed to a subsurface mooring located at 25°04'N and 80°19'W at the shelf break. Data were recorded every 5 min and were made available by Dr. Tom Lee, RSMAS, University of Miami.

### Otolith Analysis

Prior to dissection, the standard length (SL) of all larvae were measured to the nearest 0.01mm. All otoliths (sagitta, lapillis, and asterisciis) were removed from each larva and placed on a microscope slide in a drop of medium viscosity immersion oil. After clearing for approximately one week, the clearest lapilli from each individual was photographed at 400X oil-immersion magnification through a Leica DMLB microscope and accompanied Dage MTI video camera and frame grabber. Images were sharpened and read using Image Pro Plus 4.5 image analysis software. Daily increments were enumerated and measured along the longest axis of the otolith twice by the same individual (E.D.) and the larva was omitted from analysis if the age differed by more than two days between reads. All increments were considered larval because larvae were intercepted during ingress to juvenile habitat. Because it was assumed that increment formation began at the onset of exogenous feeding (Jones 1986), three days were added to the age of each larvae based on yolk absorption times of the closely related species *S. borealis* and *S. argentea* (Orton 1955, Houde 1972).

### Data Analysis

To examine temporal patterns of larval barracuda ingress, the total number of barracuda larvae collected were collapsed into a single lunar cycle with day 29 corresponding to a new moon and day 15 corresponding to a full moon. A Rayleigh test (Zar 1999) was then used to determine whether catches were distributed randomly about the lunar cycle.

An approximate larval growth rate was obtained from the slope of a regression between larval SL and larval age. Barracuda larvae were classified into early summer (May - July) and late summer (August - October) cohorts in 2002 and 2003. The effect of water temperature on larval barracuda growth was examined by regression of the average water temperature a cohort encountered while in the plankton (estimated by back-calculation of the hatch date) with the average otolith increment width over different periods of larval growth.

## RESULTS AND DISCUSSION

In total, 108 barracuda larvae were captured during the two years of light trapping over French Reef. The near-continuous time series of larval barracuda ingress from May-October in 2002 and 2003 indicated that in both years there was peak larval ingress in late June-early July and late August - early September. No barracuda were captured in light traps during monthly sampling from November-April in either year. A Rayleigh test ( $Z = 9.54$ ;  $p < 0.01$ ) revealed that most supply occurred between the third quarter and new moons in each month (lunar day = 27). This suggests that barracuda spawn in spring and summer which agrees with previous work examining barracuda gonads (de Sylva 1963). Of the 108 barracuda larvae captured over the reef, measurement of SL was possible for 48 larvae (many larvae were damaged by the time of preservation), and only these were included in otolith analyses. The SL of barracuda larvae ranged from 5.98 to 23.3 mm, with a mean SL of 15.69 mm. The age of these larvae ranged from 9 to 22 days, with a mean age of 16.46 days. Regression of SL on age ( $r^2 = 0.84$ ;  $p < 0.01$ ) revealed a larval growth rate of 1.2 mm/day over this period. Significant regressions between mean water temperature and average increment widths by cohort existed for increments 1 - 5 but not for overall average increment width or for any other part of the otolith. Thus, water temperature explains a major portion (99%) of variability in growth rate early in the barracuda larval life but other factors such as prey availability may be equally or more important for the majority of the pelagic larval duration (PLD). Caution must be used in the interpretation of these regressions, however, due to the low sample size of only four cohorts. Further, if the vertical positions of larvae change over time, the effective water temperature is likely to vary and a single location at the shelf break may not be reflective of the water in which the larvae spent their PLD. Additional data are needed to verify these preliminary results.

## LITERATURE CITED

- Blaber S.J.M. 1982. The ecology of *Sphyraena barracuda* (Osteichthyes: Perciformes) in the Kosi system with notes on the Sphyraenidae of other Natal estuaries. *South African Journal of Zoology* **17**:171-176.
- D'Alessandro, E.K. [2005]. Patterns and processes of larval fish supply to the coral reefs of the Florida Keys. Unpubl. Ms., University of Miami, Miami, Florida USA.
- de Sylva, D.P. 1963. Systematics and life history of the great barracuda, *Sphyraena barracuda* (Walbaum). *Studies in Tropical Oceanography* **1**:1-179.
- Houde, E.D. 1972. Development and early life history of the northern sennet, *Sphyraena borealis* DeKay (Pisces: Sphyraenidae), reared in the laboratory. *Fishery Bulletin* **70**:185-195.

- 
- Jones, C. 1986. Determining age of larval fish with the otolith increment technique. *Fishery Bulletin* **84**:91-104.
- Orton, G.L. 1955. Early developmental stages of the California barracuda, *Sphyraena argentea* Girard. *California Fish and Game* **41**:167-176
- Schmidt, T.W. 1989. Food habits, length-weight relationship and condition factor of young great barracuda, *Sphyraena barracuda* (Walbaum), from Florida Bay, Everglades National Park, Florida. *Bulletin of Marine Science* **44**:163-170
- Sponaugle S., K. Grorud-Colvert, and D. Pinkard. 2006. Temperature-mediated variation in early life history traits and recruitment success of the coral reef fish *Thalassoma bifasciatum* in the Florida Keys. *Marine Ecology Progress Series* **308**:1-15
- Zar, J.H. 1999. *Biostatistical Analysis: Fourth Edition*. Prentice Hall, Upper Saddle River, New Jersey USA.