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Short Communication

Ichthyoplankton in the Nacional Natural Park Isla Gorgona (Pacific Ocean of Colombia) during September 2005

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ABSTRACT. The taxonomy, spatial distribution, and abundance patterns of ichthyoplankton collected in September 2005 from the coastal zone of Gorgona Island National Natural Park in the Colombian Pacific Ocean were analyzed. The ichthyoplankton in the study area was collected with oblique tows using a minibongo net (30 cm; 250 μm mesh). The tows were made from variable depths depending on the stations but never exceeding 50 m. A sampling grid with 24 stations was used. Fish larvae abundance was between 69 and 16,837 larvae·1000 m^{-3}. Larval stages of 35 species belonging to 14 families were identified. Gobiidae (35%) and Sciaenidae (15%) were the most abundant and frequent families. *Lythrypnus* sp. (8,519 larvae·1000 m^{-3}) and *Sciaenidae* spp. (6,553 larvae·1000 m^{-3}) were the most abundant and frequent species. The analysis of larval spatial distribution suggested a tendency to aggregate towards the south of the study zone, approximately 5 km offshore. Significant differences were detected in the ichthyoplankton abundances between the eastern and the western zones of the study area (Mann-Whitney, p = 0.000062). However, no significant relationship was observed between ichthyoplankton abundance and average temperature (Spearman, R = -0.346), salinity (Spearman, R = 0.227), and water transparency (Spearman, R = 0.10).

Key words: fish larvae, taxonomy, spatial distribution, Gorgona Island, Colombia.

Ictioplancton en el Parque Nacional Natural Isla Gorgona (Océano Pacífico colombiano) durante septiembre 2005

RESUMEN. Se presentan los resultados del análisis taxonómico, el patrón de distribución espacial y abundancia del ictioplancton colectado en septiembre 2005, en la zona de influencia costera del Parque Nacional Natural isla Gorgona, Océano Pacífico colombiano. El ictioplancton en la zona de estudio se obtuvo a partir de arrastres oblicuos con una red minibongo (30 cm diámetro y abertura de malla de 250 μm), desde una profundidad variable dependiente a la profundidad de la estación, pero no mayor a 50 m, siguiendo una grilla de muestreo de 24 estaciones. La abundancia de larvas en la zona de estudio estuvo entre 69 y 16.837 larvas·1000 m^{-3}. Se identificaron estadios larvales de 35 especies pertenecientes a 14 familias, entre las que destacó por su abundancia y frecuencia de ocurrencia las familias Gobiidae (35%) y Sciaenidae (15%). Las especies más abundantes y con mayor ocurrencia fueron *Lythrypnus* sp. (8.519 larvas·1000 m^{-3}) y *Sciaenidae* spp. (6.553 larvas·1000 m^{-3}). El análisis de distribución espacial de larvas sugirió la tendencia de agregación hacia el sur de la zona de estudio, aproximadamente a 5 km de la costa. Se encontraron diferencias significativas en la abundancia de ictioplancton entre el sector oriental y occidental de la zona de estudio (Mann-Whitney, p = 0,000062). Sin embargo, no se detectó una relación significativa entre la abundancia de ictioplancton y los valores medios de temperatura (Spearman, R = -0,346), salinidad (Spearman, R = 0,227) y transparencia del agua (Spearman, R = 0,10).

Palabras clave: larvas de peces, taxonomía, distribución espacial, isla Gorgona, Colombia.

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The growing exploitation of fishery resources in the coastal and oceanic waters of the Colombian Pacific has generated an increase in the usage pressure on the fishing areas. This has heightened interest in protected areas such as Gorgona Island National Natural Park and the Malpelo Island Flora and Fauna Sanctuary. Dealing with this situation requires a modification of developmental approaches, that is, making and implementing decisions that integrate conservation, sustainable use, and fair profit sharing without affecting the basic conditions of life and its development (Beltrán & Ríos, 2000).

Ichthyoplankton studies constitute an important method for evaluating the state of an area's ichthyic stock. Such studies provide information on the composition, diversity, and productive potential of the area, simultaneously allowing the identification of critical zones and periods for the resource's development (Beltrán & Ríos, 2000). The environmental conditions that affect the larval stages of fish have been widely shown to be decisive elements in the population dynamics; they also structure the ichthyic communities (*e.g*. Dominici-Arosemena *et al*., 2000).

The coastal zone of Gorgona Island, located in the Colombian Pacific, is a singularly important protected marine area having strategic ecosystems that are rare in the Eastern Tropical Pacific such as coral reefs and extensive rocky and sandy bottoms (Díaz *et al*., 2001). Although some studies have been carried out on the existing ichthyic community in this area (Rubio, 1990; Zapata & Morales, 1997; Zapata, 2001), few have been done on the ichthyoplankton. Most notably, Bernal (2003) described and classified the early stages of fish caught with light traps in a coral reef off Gorgona Island. The objective of the present article, therefore, is to describe the early life stages of the fish caught along the coast of Gorgona Island in September 2005, considering their abundance, spatial distribution patterns, and relationship with temperature, salinity, and water column transparency.

The sampling zone was located between 2º90`N-3º06`N and 78º24`W-78º12`W (Fig. 1), where the maximum depth is 120 m (Díaz *et al*., 2001). The zooplankton was collected with oblique tows from 50 m to the surface or, at shallow stations, from the bottom (< 50 m depth); the sampling grid covered 24 stations. A minibongo net (30 cm mouth opening; 250 µm mesh) was used to collect the samples; a digital flow meter was attached to the net to estimate the volume of water filtered. All the tows were carried out at 4 knots. Simultaneously, temperature and surface salinity were recorded at each station using a YSI 85 multi parameter probe. The water column transparency was calculated using a Secchi disk and vertical records of temperature and salinity were made with a Seabird-19 CTD unit. The samples were preserved in 10% buffered formalin in seawater for analysis in the laboratory. Fish larvae were separated from the collected zooplankton and were identified taxonomically according to the meristics and pigmentary characteristics to the lowest possible taxonomic level (family, genus, and/or species), following the identification key of Beltrán-León & Ríos (2000).

The spatial distribution of fish larvae abundance was evaluated graphically on a logarithmic scale. Larval abundance in the eastern (windward) and western (leeward) zones of the study area were compared using the Mann-Whitney non-parametric test. In order to describe the study area's environmental conditions during sampling, the spatial distribution of temperature and surface salinity as well as the water column transparency were evaluated using the graphic routine for interpolation by kriging. The degree of association between larval abundance and the physico-chemical conditions (temperature, average salinity) in the study area water column were also evaluated using a non-parametric Spearman analysis.

Fish larvae abundances fluctuated between 69 and 16,837 larvae·1000 m^{-3}. The highest abundance was found in the southeastern zone of the study area (Fig. 2). Larval stages of 35 species were identified; these belonged to 14 families (Table 1). The most abundant and frequent families were Gobiidae *Lithrypnus* sp. (35%) and *Sciaenidae* spp. (15%); Engraulidae, *Cetengraulis mysticetus* (10%); Bregmacerotidae, *Bregmaceros bathymaster* (8%), and Myctophidae, *Myctophum* sp. (8%). The least frequent families were Mugilidae and Carangidae (registered at only one station). Although ichthyoplankton was only collected from 50 m depth to the surface, the taxonomic analysis included larvae of demersal and deep fish. The sampling, therefore, achieved the goal of incorporating the larvae of pelagic and demersal fish from the study area.

Temperature and surface salinity (Figs. 3a and 3b) were homogenous throughout the sampling zone, although slight variations were recorded (T: 27-27.5 ºC, S: 29.4-30.2). However, the water column transparency was highly variable (Fig. 3c), ranging from 7

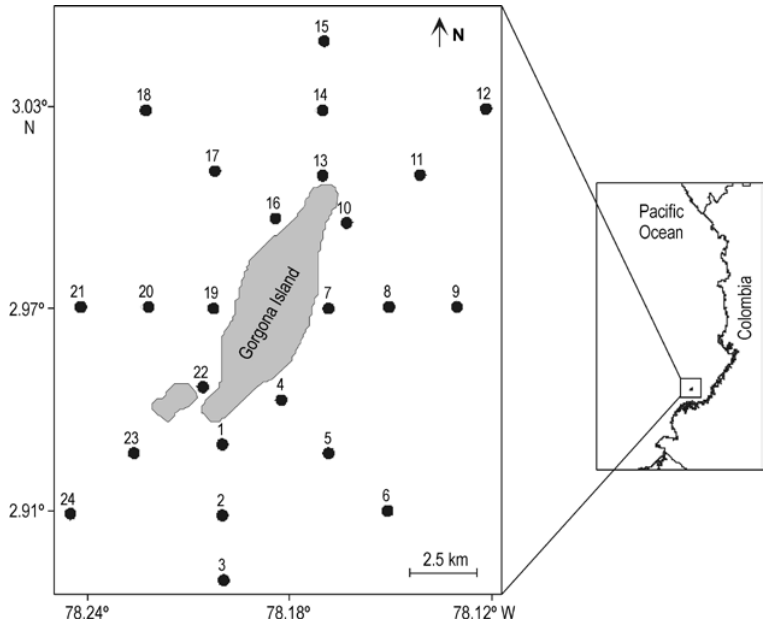

Figure 1. Sampling stations in the coastal influence zone of Parque Nacional Natural Isla Gorgona.

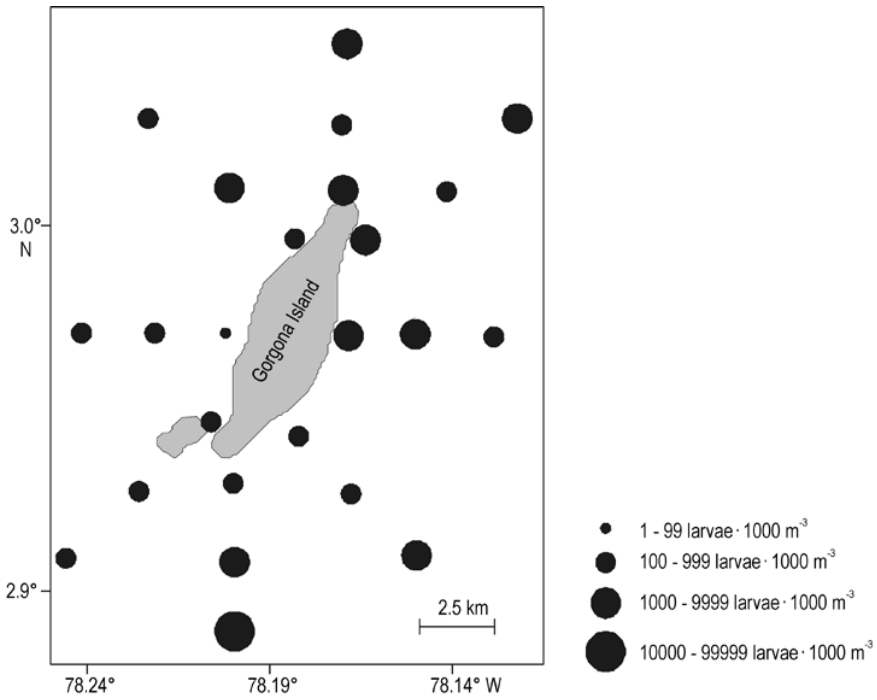

Figure 2. Spatial distribution of fish larvae abundance in coastal influence zone of Parque Nacional Natural Isla Gorgona during September 2005.

Table 1. Taxonomic list of icthyoplankton from Parque Nacional Natural Isla Gorgona during September 2005.

Family/specie	Mean abundance (larvae·1000 m^{-3})	Composition by family (%)
Gobiidae		35
Lythrypnus sp.	2.130	
Gobiidae sp. 1	655	
Gobiidae sp. 2	983	
Gobiidae sp. 3	492	
Gobiidae sp. 4	983	
Gobiidae spp.	164	
Scianidae		15
Scianidae spp.	1.966	
Larimus sp. 2	328	
Engraulidae		10
Cetengraulis mysticetus	1.147	
Bregmacerotidae		8
Bregmaceros sp.	168	
Bregmaceros bathymaster	1.638	
Myctophidae		8
Lampanyctus parvicauda	492	
Myctophum nitidilium	164	
Myctophum aurolaternatum	492	
Benthosema panamensis	492	
Myctophum sp.	164	
Lampanyctus sp.	164	
Symbolophurus evermany	164	
Ophidiidae		6
Ophidiidade sp.	164	
Lepophidium negropina	328	
Lepophidium sp.	1.147	
Trichiurudae		3
Trichiurus nitens	983	
Serranidae		3
Diplectrum sp.	819	
Serranus sp.	328	
Serranus sp. 2	164	
Paralabrax sp.	164	
Serranus sp. 3	164	2
Cynoglossidae		
Symphurus sp.	492	
Paralichthyidae		2
Citharichthys sp.	164	
Citharichthys gilberti	328	
Citharichthys fragilis	164	2
Bythitidae		
Cataetyx cf. simus	328	
Gigantactinidae		2
Gigantactis sp.	328	
Mugilidae		2
Mugil sp.	164	
Carangidae		2
Seriola sp.	164	

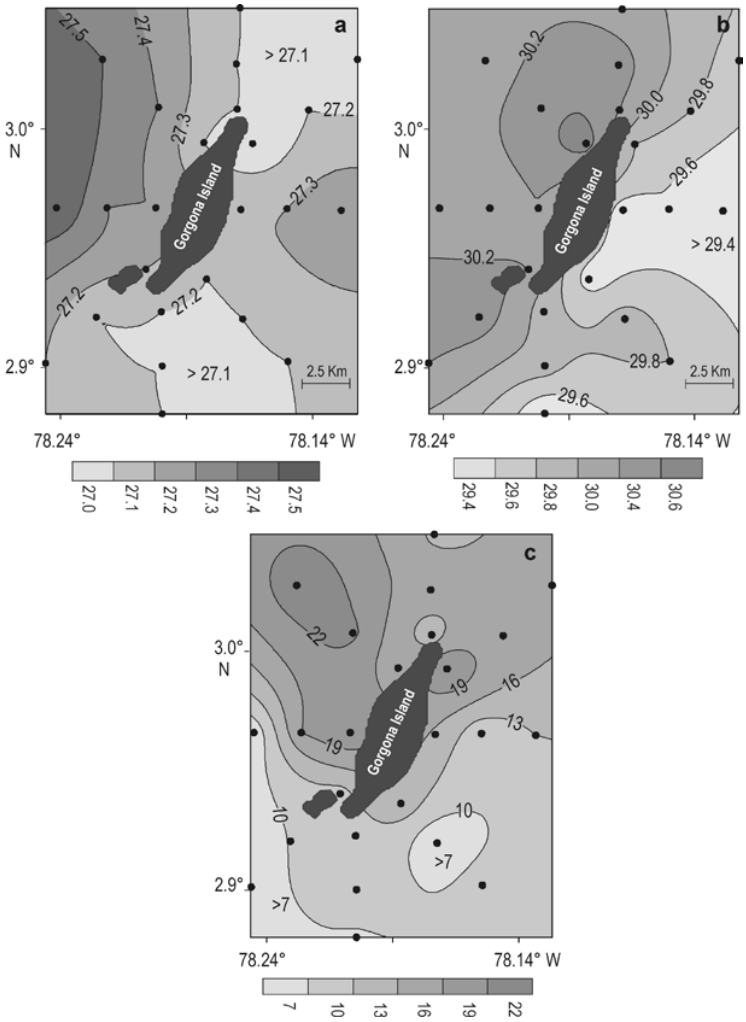

Figure 3. Spatial distribution of parameters sampled in the coastal influence zone of Parque Nacional Natural Isla Gorgona during September 2005. a) temperature, b) salinity, c) transparency.

to 21 m. The thermocline was stable in all the study area. Two layers could be differentiated: a warmer surface layer (T > 26 ºC from 40 m to the surface) and a cooler deep layer (T < 18 ºC below 50 m deep) (Fig. 4). The vertical salinity distribution varied widely (Fig. 4) due to the presence of numerous freshwater tributaries in the study area and to the effect of the Patía-Sanquianga River plume on the southern area of the island, with subsurface values below 29. Significant differences were detected when the variability in larval abundance was analyzed between the windward and the leeward zones (Mann-Whitney, p = 0.000062). The abundance in the windward zone (to the east of Gorgona Island) was significantly higher. However, no significant relationships were detected between the larval abundance and the physical and chemical variables evaluated ($Spearman_{temperature}$ R = -0.346; $Spearman_{salinity}$ R = 0.227; $Spearman_{transparency}$ P = 0.10).

In general terms, the larval abundance in the study area was high compared to the average abundance values for the Colombian Pacific Ocean Basin (Escarria *et al.,* 2005, 2006). This suggests that the island's coast has significant ecological importance in a re-

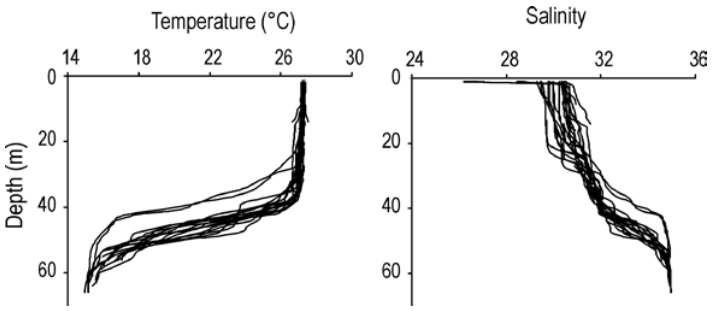

Figure 4. Vertical variation of temperature and salinity in the coastal influence zone of Parque Nacional Natural Isla Gorgona, during September 2005.

gional context. It is likely that the highest abundance on the southeastern side of the island (station 3) is associated with local retention processes, the general circulation pattern, and/or the presence of coral and rocky formations in the area. In this zone in particular, the water column is shallow (approximately 12 m); thus, the surface effect of the general local wind pattern (southwest wind) produces strong waves that generate a surface drift current toward the island. This increases coastal aggregation processes (E. Rodríguez, pers. comm.). Recently, Giraldo (2006) suggested that the spatial distribution of zooplankton organisms along the coast of Gorgona Island, including ichthyoplankton, is mainly dominated by the local circulation pattern, which generates two marked aggregation cores located in the northwest and southwest sectors of the island, probably as a result of the island's shadow effect.

The mass effect, described by Hammer & Hauri (1981) for the Great Barrier Reef in Australia, favors the development of high biological productivity in shallow coastal areas such as the south sector of the study area. Moreover, the oceanographic conditions in the study area are regulated by both mesoscale (e.g. annual upwelling in the Panama Bight, the Colombia Current) and local scale processes (e.g. the influence of the continental water discharge plume from the Patía and Sanquianga river complex). The study area is specifically affected by the input of low salinity, high turbidity water from the south (Giraldo & Zapata, 2006) and high salinity, low turbidity water from the west. Besides, when considering the general wind patterns and local surface circulation described by Díaz *et al*. (2001), the eastern sector of the study area is characterized by low dynamism, which favors the retention of organisms with poor swimming abilities, for example, fish larvae. This sector of the island is also a suitable spawning area for most marine fish species.

It is important to mention that most of the fish present in the study area were concentrated in the areas where coral reefs develop, mainly on the east side of the island. On the other hand, fish larvae from the families Sciaenidae and Engraulidae are primarily pelagic; the adult specimens of these species, which are of commercial interest, prefer to feed in coastal areas with sandy and muddy bottoms, conditions that are readily available in the area studied herein.

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