Project Update: July 2010

Below is an extended abstract of my project that was sent to the Colombian Conference of Marine Sciences (Senalmar) that is going to be held in October this year.

Other good news is that the study area where my work is being carried out (Bahía Málaga) was designated last week as a new Marine Protected Area by the Government. I am attaching two links, one in English from WWF Colombia website and another in Spanish from the official site of the National Park Authorities

http://wwf.panda.org/wwf_news/?194527/Malaga-Bay-declared-national-park-...
http://www.parquesnacionales.gov.co/PNN/portel/libreria/php/decide.php?p....

MANGROVE CREEK ICHTHYOFAUNA OF BAHIA MALAGA, COLOMBIA, TROPICAL EASTERN PACIFIC

Castellanos-Galindo G.A.[1,2,3], Krumme U.[2], Ramirez G.[4], Rubio-Rincón E.A.[4]

1. WWF Colombia. Programa Marino-Costero. Carrera 35 No. 4A-25, Cali, Colombia. gustavoa80@yahoo.com, gcastellanos@uni-bremen.de
2. Leibniz Center for Tropical Marine Ecology (ZMT), Fahrenheitstrasse 6, Bremen, Germany. uwe.krumme@zmt-bremen.de
3. Centre of Excellence in Marine Sciences (CEMarin), Calle 26A Nr. 3-55 Oficina. 410, Prado Plaza, Santa Marta, Colombia.
4. Universidad del Valle, Departamento de Biología Sección de Biología Marina, Cali, Colombia. garman86@yahoo.com, erubio@univalle.edu.co

ABSTRACT

Mangrove ecosystems have been extensively recognized as nursery areas for a large number of marine organisms. The nursery function of mangroves for fishes is, however, far from being understood. To determine the spatio-temporal variability of intertidal fish assemblages in Bahía Málaga, central Colombian Pacific coast, repetitive block net sampling was carried out between December – February at mangrove creeks in two salinity zones at day and night. A total of 34 fish species were caught. *Lile stolifera* (Clupeidae), *Centropomus armatus* (Centropomidae), *Diapterus peruvianus* (Gerreidae) and *Lutjanus argentiventris* (Lutjanidae) accounted for 50.6, 10.6, 7.9 and 6.7% of the total abundance, respectively. Catch weights in the medium salinity creeks were greater than in the lower salinity creeks. Fish assemblage structure differed between zones with an almost complete absence of *L. stolifera* in the low salinity creeks. The large amount of juvenile snappers (especially *L. argentiventris*) suggests that Bahía Málaga mangroves are important nursery areas for these species.

Keywords: mangroves, nursery areas, macrotides, Bahía Málaga, tropical eastern Pacific

INTRODUCTION

Mangroves are amongst the most threatened ecosystems in the world declining by 1–2 % per year (Valiela et al., 2001). Sediment trapping, protection to natural disasters and increased fisheries yields in adjacent waters are some of the ecosystem and economic services provided by mangroves (Alongi, 2002, 2008). It is considered that 30% of the world's commercial fish species are mangrove-dependent (Naylor et al., 2000). Nevertheless, the role of mangroves as fish habitat and nursery areas is little understood (Beck et al., 2001, Nagelkerken et al., 2008). Without such understanding conservation measures will lack appropriate tools decisive for decision-makers.

Colombia is amongst the 15 countries in the world with larger mangrove areas (358.000 ha, 3% of the global coverage). Mangrove cover in the Pacific coast of the Americas is ca. 1.21 million ha, representing 26.6 % of the total mangrove area in the Americas. In the Colombian Pacific the estimated mangrove area is ca. 250.000 – 300.000 ha, being more than four times greater that the area in the Colombian Caribbean coast (Lacerda et al., 2002). Although a considerable number of reports refer to the nursery function of mangroves for fish in the Colombian Pacific, no critical studies exist documenting the spatial and temporal variability of fish assemblages in mangroves of this area. Thus, the aim of this study was to determine the fish assemblage structure in mangrove creeks of a representative area in the Colombian Pacific (Bahía Málaga) and its variability with respect to differences in salinity and between daytime and nightly inundations. This information will further provide a better assessment of the nursery function for fish of these mangroves.

METHODOLOGY

Bahía Málaga is a relatively pristine estuarine system located in the central region of the Colombian Pacific coast (3º 56' - 4º 05'N and 77º 19 - 77º 21'W) within the tropical eastern Pacific region. The Bay is surrounded by low falls (200-300 m high), with an elongated form, a surface area of ca. 130 km^2 and average water depth of 15 m. The coast is bordered by rocky cliffs constituted by tertiary sediments of mudstones and limestone and is strongly modified by erosion with groups of islands distributed within the whole area, and well-developed riverine and fringe-type mangroves and mudflats. Average rainfall in the Bay is 6000 mm $year^{-1}$, with two rainy periods: from April to June with an average of 374 mm $month^{-1}$, and September to November with an average of 567 mm $month^{-1}$ (CVC meteorological station). Mean air temperature is 25º C. Mangroves in Bahia Malaga are predominantly concentrated in the inner part and dominated by *Rhizophora mangle* with trees up to 40 m high (Cantera et al., 1999). Other mangrove species are *Avicennia germinans* and *Pelliciera rhizophorae*. Tides are semidiurnal with tidal amplitude from 1.77 to 4.97 m.

From December 2009 to February 2010, four mangrove creeks with similar topographic characteristics were blocked at slack high tides on a monthly basis using block nets (20 m x 4 m, 12 mm mesh size). Two of these creeks were located at a low salinity zone (high tide: X±SD= 15.4±5.1, low tide: X±SD= 4.8±2.8) and two were located at a medium salinity zone (high tide: X±SD= 21.6±1.7, low tide: X±SD= 12.3±3.7). Creeks were on average 10 m wide and 3 m high at their mouths and 70-80 m long. Samples were taken at both daytime and nightly inundations.

RESULTS AND DISCUSSION

A total of 34 fish species from 22 families were recorded. Most speciose families were Lutjanidae (six species) and Carangidae (four species). *Lile stolifera* (Clupeidae), *Centropomus armatus* (Centropomidae), *Diapterus peruvianus* (Gerreidae) and *Lutjanus argentiventris* (Lutjanidae) accounted for 50.6, 10.6, 7.9 and 6.7% of the total abundance, respectively. In contrast, *Lutjanus argentiventris*, *Sphoeroides rosenblatti* (Tetraodontidae), *Ariopsis seemani* (Ariidae) and *L. stolifera* accounted for 27.2, 14.7, 14.5 and 10.6% of the total catch weight, respectively (Table 1). Compared to Shervette et al. (2007), that sampled mangrove creek fish assemblages in Ecuador during a dry and wet season, we found a similar number of species (34 vs 36) and 12 species in common. Species' dominance, however, was different among studies. In Ecuador, the most abundant species were *Mugil curema* and *Atherinella serrivomer*, while their creeks were devoid of Lutjanidae. These differences may be due to a different sampling methodology employed in Ecuador (seine), a different seascape setting or the relatively disturbed state of the mangroves in Ecuador, which have been cleared in great extent for the construction of shrimp ponds.

Greater catch weight per sampled creek was observed at the medium salinity zone (mean catch weight = 1980.1 g) compared to the low salinity zone (mean catch weight = 841.9 g). Apparently samples taken at night had usually higher catch weights, however this pattern needs further examination. Mean catch weight in mangrove creeks of Brazil yielded a considerably higher value (5.7 kg mean total spring tide catch, Krumme et al., 2004). These differences may be due to the outstanding dominance of Ariidae and Tetraodontidae and slightly larger size of the creeks sampled in Brazil.

Compared to similar studies in macrotidal areas of northern Brazil employing the same sampling methodology, the mangrove fish assemblage structure of Bahía Málaga differs considerably in terms of the catch weight of the most important families. Whereas in Brazil there is a dominance of Tetraodontidae, Ariidae and Sciaenidae (Giarrizo & Krumme 2008), in Bahía Málaga, there is a remarkable dominance of Lutjanidae (36.3%), followed by Tetraodontidae (14.7%), Ariidae (14.5%), Clupeidae (10.6%) and Centropomidae (10.0%). However, a common feature of both mangrove fish assemblages is the presence of Ariidae and Tetraodontidae as distinctive mangrove fish families with a significant contribution to the total catch weight.

Table 1. Most important (catch weight) fish species encountered in four mangrove creeks within Bahia Malaga from December 2009 – February 2010.

Species	*n*	Weight (g)	LT (cm)		Mass (g)	
			X±SD	Range	X±SD	Range
Clupeidae						
Lile stolifera	574	3217.5	9.2±0.6	11.2–6.8	5.7±1.1	14.8–2.8
Ariidae						
Ariopsis seemani	29	4318.4	25.1±3.5	31.6–19.6	148.9±58.5	252.3-66.3
Belonidae						
Strongylura scapularis	17	830.0	33.3±2.6	39.5–28.0	48.8±17.0	98.1–27.5
Centropomidae						
Centropomus armatus	120	2116.1	11.66±3.6	22.9-6.5	18.2±21.0	146.9–1.9
Centropomus medius	22	882.4	15.0±6.1	29.9–8.8	40.1±52.1	193.0–5.3
Carangidae						
Caranx caninus	10	468.8	15.6±2.7	20.0–11.0	46.9±24.1	84.4–18.3
Caranx sexfasciatus	16	705.6	15.1±3.1	20.6–10.3	44.1±27.8	106.5–12.3
Lutjanidae						
Lutjanus argentiventris	76	8107.6	16.7±7.0	38.1–6.8	106.7±140.2	686.0–4.2
Lutjanus jordani	7	1776.3	24.7±4.2	29.4–19.8	253.8±129.2	413.5–117.5
Gerreidae						
Diapterus peruvianus	90	682.9	8.4±1.8	15.4–5.6	7.8±7.3	54.4-1.6
Tetraodontidae						
Sphoeroides rosenblatti	30	4380.1	18.2±2.7	24.6–14.0	138.1±80.6	404.1–56.0

These preliminary results suggest that mangroves in Bahía Málaga are important nursery habitats for at least one snapper species (*Lutjanus argentiventris*) and one snook (*Centropomus armatus*). Both species are important for the local artisanal fisheries. The yellow snapper *L. argentiventris* is known to make ontogenetic habitat shifts, with juveniles living in mangroves, sub-adults in shallow rocky reefs and adults in deeper rocky reefs (Rojas et al., 2004, Aburto-Oropeza et al., 2009). Despite most of the individuals collected in Bahia Malaga correspond to small size classes (mean TL = 16.7 ± 7.0 cm), we also collected relatively large individuals (maximum TL = 38.1 cm). This partially differs from the study of Aburto-Oropeza et al. (2009) in the Gulf of California where *L. argentiventris* individuals > 25 cm were rare in mangroves and may be due to the presence of subtidal rocky habitats in the vicinity to the mangrove creeks in Bahía Málaga.

The fish composition differences observed with studies in the same biogeographical province and the tropical western Atlantic in similar macrotidal areas, suggest that both, local and regional differences in the fish assemblage structure may be explained by the interplay of contrasting seascape settings and the intrinsic biogeographic history of each marine province.

ACKNOWLEDGEMENTS

Support for this project has been given by the Rufford Small Grants Foundation, Grupo de Investigación en Estuarios y Manglares - Universidad del Valle, WWF-Colombia and the Leibniz Center for Tropical Marine Ecology.

REFERENCES

Aburto-Oropeza, O., Dominguez-Guerrero, I., Cota-Nieto, J., Plomozo-Lugo, T. 2009. Recruitment and ontogenetic habitat shifts of the yellow snapper (*Lutjanus argentiventris*) in the Gulf of California. Marine Biology (156): 2461-2472.

Alongi, D.M. 2002. Present state and future of the world's mangrove forests. Environmental Conservation (29): 331-349.

Alongi, D.M. 2008. Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. Estuarine, Coastal and Shelf Science (76): 1-13.

Beck, M.W., Heck, K.L.Jr., Able, K.W., Childers, D.L., Eggleston, D.B., Gillanders, B.M., Halpern, B., Hays, C.G., Hoshino, K., Minello, T.J., Orth, R.J., Sheridan, P.F., Weinstein, M.P. 2001. The identification, conservation and management of estuarine and marine nurseries for fish and invertebrates. BioScience (51): 633-641.

Cantera, J.R., Thomassin, B.A., Arnaud, P.M. 1999. Faunal zonation and assemblages in the Pacific Colombian mangroves. Hydrobiologia (413): 17-33.

Giarrizzo, T., Krumme, U. 2008. Heterogeneity in intertidal fish fauna assemblages along the world's longest mangrove area in northern Brazil. Journal of Fish Biology 72:773-779.

Krumme, U., Saint-Paul, U., Rosenthal, H. 2004. Tidal and diel changes in the structure of a nekton assemblage in small intertidal mangrove creeks in northern Brazil. Aquatic Living Resources (17): 215-229.

Lacerda, L.D., Conde, J.E., Kjerfve, B., Alvarez-León, R., Alarcon, C., Polania, J. 2002. American mangroves. En: Lacerda, L.D. (Ed.), Mangrove Ecosystems: Function and Management. Springer, New York, pp. 1–61.

Nagelkerken, I., Blaber, S.M.J., Bouillon, S., Green, P., Haywood, M., Kirton, L.G., Meynecke, J.-O., Pawlik, J., Penrose, H.M., Sasekumar, A., Somerfield, P.J. 2008. The habitat function of mangroves for terrestrial and marine fauna: A review. Aquatic Botany (89): 155-185.

Naylor, R.L., Goldburg, R.J., Primavera, J.H., Kautsky, N., Beveridge, M.C.M., Clay, J., Folke, C., Lubchenco, J., Moony, H., Troell, M. 2000. Effect of aquaculture on world fish supplies. Nature (405): 1017–1024.

Rojas, P.A., Gutiérrez, C.F., Puentes, V., Villa, A.A., Rubio, E.A. 2004. Aspectos de la biología y dinámica poblacional del pargo coliamarillo *Lutjanus argentiventris* en el Parque Nacional Natural Gorgona, Colombia. Investigaciones Marinas (32): 23-36

Shervette, V.R., Aguirre, W.E., Blacio, E., Ceballos, R., Gonzalez, M., Pozo, F., Gelwick, F. 2007. Fish communities of a disturbed mangrove wetland and an adjacent tidal river in Palmar, Ecuador. Estuarine, Coastal and Shelf Science (72): 115-128.

Valiela, I., Bowen, J.L., York, J.K. 2001. Mangrove forests: one of the world's threatened major tropical ecosystems. BioScience (51): 807-815.