Los peces: a comparative study of the fishes across four sites in Costa Rica

Daniel M. Braden, Margaret L. Grace, Stephanie E. Hampton, Gabrielle A. Miller-Messner, Jaime E. Musnicki, and Adam J. Sepulveda

Abstract: For Costa Rican fish, three distinct biogeographic regions can be identified where endemism is high. We sampled fish populations in four protected Costa Rican sites to compare abundance and composition among the three regions, hypothesizing that distinct fish communities would be found in each. We further hypothesized that for the two sites (Monteverde and Palo Verde) found within one biogeographic region (Chiapas-Nicaraguan), the higher-elevation site (Monteverde) would have lower diversity and abundance in accordance with the River Continuum Concept. We found no fish in Monteverde, and distinct assemblages at the other three sites. Of 12 morphotypes identified, only one, *Compsura dialeptura*, was found in more than one site. Our data support the hypothesis that unique fish communities occur in distinct biogeographic regions in Costa Rica, but these conclusions are weakened by the low number of fish we caught overall. Additionally, differences in aquatic habitats and terrestrial inputs available at the sampling sites may strongly influence the communities present at each site.

Key Words: biogeography, icthyofauna, minnow traps, seine

Introduction

The geologic history of Costa Rica has produced observable patterns in current fish distribution (Bussing 1998). During the Upper Cretaceous or Paleocene times, an intercontinental land bridge existed, permitting exchanges of biota between North and South America. The land bridge was then partially submerged before reemerging more recently, allowing a second biotic exchange which continues today. As a result, the fish fauna of Costa Rica can be divided into three distinct biogeographic regions, characterized by rich endemism within each: the Chiapas-Nicaraguan in the northern Pacific side of the country, the Isthmian on the southern Pacific coast, and the San Juan on the Atlantic side of the country. In addition, the mountainous terrain of Costa Rica provides elevational gradients that influence the dispersal and distribution of fish.

Here we compared the diversity and composition of fish fauna among the three regions of Costa Rica. Palo Verde and Monteverde are, respectively, low elevation and high elevation sites in the Chiapas-Nicaraguan region. Corcovado is an Isthmian location, which is also heavily influenced by proximity to the Pacific Ocean, and La Selva lies relatively far inland within the San Juan region. We hypothesized that the fish fauna of each region would be distinct, with very little overlap among the regions sampled. Additionally we predicted that while Palo Verde and Monteverde would be similar, Monteverde's fish community would be more depauperate than that of Palo Verde, due to the comparatively low diversity of aquatic habitats and the predominance of shallow first- and second-order streams at this high elevation site (sensu the River Continuum Concept).

Methods

We used minnow traps (7 mm steel mesh with a 23 mm opening) and a seine net (3.8 mm mesh, 5.6 m wide, 1.2 m tall) to sample fish at each study site. Traps were baited and placed in pools that were easily accessible. The seine was used both against and across the current. We placed fish in plastic containers filled with stream water and used Bussing (1987, 1998) to identify fish to the lowest taxonomic level possible. Although the number of minnow traps and the number of seine sweeps differed at each site, we standardized effort by limiting trapping, seining, and identification to one morning (ca. 4.5 h).

Palo Verde:

On 11 January 2001, we placed two minnow traps in the Río Tempisque marsh surrounding the bird tower (ca. 0.5 km W of the Palo Verde OTS research station), two traps in a pool neighboring the Tempisque marsh (2 km W of the research station), two traps in a cement watering hole (2 km E of the research station), and two traps in a natural watering hole adjacent to the cement water hole. We baited each trap with a slice of Bimbo™ white bread and allowed them to collect fish for three hours while we seined the watering hole. The majority of effort was spent on identification.

Monteverde:

On 18 January 2001, we placed three minnow traps downstream and three minnow traps upstream of the waterfall closest to the Monteverde field station (possibly a branch of the Quebrada Guacimal). Traps were baited with brown bread and left overnight. We seined the pool directly downstream of the waterfall on 19 January 2001.

Corcovado:

On 2 February 2001 we placed three minnow traps 50 m upstream and three traps 50 m downstream of the swimming hole located on the Río Claro at the convergence with the Sendero Río Claro. We baited traps with saltine crackers and collected them after three hours, during which time we seined the swimming hole.

La Selva:

On 12 February 2001 we placed two minnow traps each at the first and second intersection of Quebrada El Taconaza with Sendura Sura. Traps were baited with coconut cookies and collected the following morning. On 13 February 2001, we seined the pool located at the second intersection of Quebrada El Taconaza and Sendura Sura, and the pool located upstream of the intersection of Quebrada La Laone and Sendero Tres Ríos.

Results

Across the four locations at which we sampled, we found a total of 69 individuals of seven identified and four unidentified species in five families (Table 1). The characid fish *Compsura dialeptura* was found in both Palo Verde and La Selva and was the only species that occurred at more than one site. Bussing (1987) was used to identify *Cichlasoma* spp. at Palo Verde (Table 1). Since that publication, *Cichlasoma* has been divided into new genera (Bussing 1998), and we are now unable to determine to which genera these specimens belonged. Monteverde was the only site where no fish were caught or seen. At both Corcovado and La Selva we observed many additional fish swimming in the sampling areas, but we were unable to catch them.

Discussion

Our results generally supported our original hypotheses that fish communities would be distinct among sites and between the two elevations in the Chiapas-Nicaraguan region (Palo Verde and Monteverde). Fish communities in the three biogeographic regions differed, with *Compsura dialeptura* as the only species found in more than one region. Additionally, fish abundance and diversity were greater at Palo Verde than at Monteverde, perhaps due to the relatively small number of aquatic habitats and low order of streams at the high elevation site. Russell (2000) was also unable to locate any fish using cast net and snorkeling in the upper reaches of Monteverde's Quebrada Guacimal. He concluded that fish do not occur in the streams of Monteverde until the streams are larger, well below the town of Monteverde.

Table 1. Families and species of fish caught during sampling at biological stations at Palo Verde, Monteverde, Corcovado, and La Selva, Costa Rica. Parentheses indicate uncertainty in species identifications. Methods and locations are described further in the text.

Site	Family	Species	Number	Sample method	Location
Palo Verde	Characidae	*Compsura dialeptura*	1	seine	water hole
	Poeciliidae	*Phallichthys* sp.	2	seine	water hole
	Pimelodidae	unknown	1	seine	water hole
	Cichlidae	*Cichlasoma* sp. 1	52	minnow trap	marsh pool
	Cichlidae	*Cichlasoma* sp. 2	1	minnow trap	marsh
Monteverde	N/A	N/A	N/A	N/A	stream
Corcovado	Syngnathidae	*Pseudophallus (starksi)*	2	seine	swimming hole
	Cichlidae	unknown	1	seine	swimming hole
	Gobiidae	*Awaous banana*	1	seine	swimming hole
La Selva	Characidae	*Compsura dialeptura*	3	minnow trap	Q. El Taconaza
	Characidae	*Roeboides (bouchelleia)*	2	minnow trap	Q. El Taconaza
	?	baby fish	2	tupperware	Q. El Taconaza

While our results could suggest that regional biotas are distinct, the conclusions that can be drawn from our sampling are weakened by the low number of fish captured. Particularly in Corcovado and La Selva, we observed many more fish than we caught. Previous studies (Winemiller 1983, Burcham 1988, Wootton and Oemke 1992, Russell 2000) have used a broad range of sampling methods — including dip nets, electro-shock, snorkeling, angling, and capture by hand — to characterize fish communities. Various combinations of all of these techniques may still fail to accurately represent the species obviously present in a given habitat. For example, Burcham (1988) found that seine trapping in La Selva streams was frequently ineffective due to the muddy substrate, which reflects our experience, and that electro-shocking also failed to collect fish that she could see were very common. Our two methods (seining and trapping) did not appear to collect a representative sampling of individuals across species and sites. More sampling with a greater diversity of methods may provide a more accurate picture of the fish communities of these four sites.

While differences in fish communities among our sites are likely to be at least partially attributable to the geologic history of the region as we initially proposed, several other important factors would probably affect the fish composition at these sites. The aquatic habitats available at the four sites were very different. For example, even in similar terrestrial settings, one would expect marsh species (Palo Verde) to differ from those of a first- or second- order stream (La Selva). The fish assemblage of our sampling site on the Río Claro in Corcovado was obviously strongly influenced by its proximity to the mouth of the river; marine and estuary fish were present here that could not possibly occur at our other field sites. In addition to the differences in the aquatic habitats themselves, the surrounding terrestrial environment can influence fish communities. Burcham (1988) suggested that geographically close stream communities within La Selva differed according to whether the food base was primarily allocthonous (terrestrial fruits and debris) or autochthonous (photosynthetic activity within the stream). Such differences could not be standardized among our sites and so may bias our accounts of the fish communities of the regions in general.

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