Seasonal and habitat influences on fish communities within the lower Yasuni River basin of the Ecuadorian Amazon

K. Galacatos\textsuperscript{a}, R. Barriga-Salazar\textsuperscript{b} & D.J. Stewart\textsuperscript{a}
\textsuperscript{a}Department of Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, Syracuse, NY 13210, U.S.A. (e-mail: katiagalacatos@mindspring.com)
\textsuperscript{b}Escuela Politécnica Nacional, Quito, Ecuador

Received 6 May 2002 Accepted 20 December 2003

Key words: neotropical, community structure, floodplain, piscivore–transparency–morphometry (PTM) model

Synopsis

We sampled lagoon, river and forest stream habitats during the rising water, wet, falling water, and dry seasons in the lowland region of the Yasuni National Reserve in the Ecuadorian Amazon. We collected 195 species, increasing the current number of species for the Napo River basin to approximately 562. The steady rate of species accumulation per sample suggests that the fish fauna is still undersampled. Lagoon, river and forest stream fish communities are highly diverse and variable, composed of common species found within several habitats, of characteristic species found throughout the year, and of seasonally migrating species. Characteristic lagoon species were mainly the curimatids \textit{Curimata vittata}, \textit{Psectrogaster amazonica}, \textit{Potamorhina altamazonica}, \textit{P. latior} and \textit{Cyphocharax plumbeus}. The characins \textit{Hyphessobrycon copelandi} and \textit{Hemigrammus cf. lunatus} and the catfishes \textit{Nemadoras humeralis}, \textit{Pimelodella} sp. C and \textit{Sorubim} sp. A were characteristic river species. Characteristic forest stream species included \textit{Hoplias malabaricus}, \textit{Hyphessobrycon copelandi}, \textit{Pimelodella} sp. B and \textit{Sternopyugus macrurus}. During the dry season, lagoon and river habitats had the highest number of individuals and species, as fishes were concentrated in decreasing habitat area. In contrast, stream habitats had the highest species richness and abundance during the rising water and falling water seasons. Species collected included vital food fishes and seasonal migrants. The migratory catfishes \textit{Brachyplatystoma vaillantii}, \textit{Hemisorubim platyrhynchos}, \textit{Platynematichthys notatus}, \textit{Platystomatichthys sturio} and \textit{Sorubim lima} were collected during the falling water season, which suggests that these species may begin migrating earlier than expected. These findings highlight the importance of seasonality for both adequately assessing aquatic biodiversity and for developing research and conservation programs encompassing whole river ecosystems.

Introduction

The flood pulse concept by Junk et al. (1989) proposes that a river, its catchment area, and its floodplain are an ecological unit, and that the majority of riverine production stems from production and nutrient recycling within the floodplain. Thus, species adaptations and life history characteristics suited to flood pulses may be reflected in community structure (Junk et al. 1989). Species collected at a particular site represent a subset of a much larger pool of species. During the dry season, communities may include fishes trapped in a contracting aquatic environment (Lowe-McConnell 1987). While during the wet season, communities may include migratory fishes taking advantage of expanding food and habitat resources. A community can be defined as individuals occurring at the same place and time. This is an ecological entity (Saint-Paul et al. 2000) reflecting the area’s floodplain with seasonally expanding and contracting aquatic environment.

Studies on spatial and temporal variation in neotropical fish communities have focused on river (Goulding et al. 1988, Ibarra & Stewart 1989, Boujard 1992, Jepsen 1997, Stewart et al. 2002),
processes operating. Be nonrandom, with both deterministic and stochastic (Winemiller 1996) indicate that fish communities may within the Venezuelan llanos with expanded spatial (Strange et al. 1992, Keast 1996, Angermeier & Winston 1997, Saint-Paul et al. 2000, Vono & Barbosa 2001). In addition, studies have investigated lagoon fishes found within floating macrophyte habitats (Henderson & Hamilton 1995, Meschiatti et al. 2000), differences among habitats within a localized area (Cox Fernandez 1997, Saint-Paul et al. 2000, Petry et al. 2003), and differences between natural and flow-regulated rivers (Mérigoux & Ponton 1999).


Ichthyological studies within the Ecuadorian Amazon have described the habitat and food preferences of fishes of the upper Rio Aguarico (Saul 1975). Dry season sampling has documented the Napo River drainage diversity (Stewart et al. 1987) as well as fish community patterns for riverine sandy beaches (Ibarra & Stewart 1989), lagoon and associated tributaries (Galacatos et al. 1996) and deep river and adjacent sandy beach habitats (Stewart et al. 2002).

Many of the above mentioned studies indicate highly variable stochastic fish communities (Lowe-McConnell 1987, Goulding et al. 1988, Jepsen 1997, Saint-Paul et al. 2000). However, most of these studies have limited temporal and geographic scales. As temperate studies of community structure have demonstrated, conclusions drawn from studies with extended temporal and geographic scales can differ significantly from conclusions drawn from short term and localized studies (Jackson & Harvey 1989, Strange et al. 1992, Keast 1996, Aungermeier & Winston 1998, Gehrke & Harris 2000). Indeed, recent studies within the Venezuelan llanos with expanded spatial (Rodríguez & Lewis 1994, 1997) and temporal scale (Winemiller 1996) indicate that fish communities may be nonrandom, with both deterministic and stochastic processes operating.

In particular, Rodríguez & Lewis (1997) proposed the piscivore–transparency–morphometry (PTM) model for predicting floodplain lake fish assemblage patterns. The PTM model predicts that lake water transparency can largely determine the presence of major taxa and piscivore types. For example, during the dry season as water transparency decreases, the number of visually-oriented fishes, such as characiforms, cichlids and clupeomorphs, should decrease relative to nocturnal and sensory adapted piscivores, such as catfishes and knifefishes. Tejerina-Garro et al. (1998) further proposed that the PTM model also may apply to the fish communities of the Vinces River floodplain in western Ecuador.

The present study examines the seasonal occurrence of fish species within and among lagoon, river and forest stream habitats in the lower Yasuni River basin, Yasuni National Park, eastern Ecuador. We tested the following hypotheses: (1) lagoon, river and forest stream habitats have distinct fish communities; (2) fish communities within each habitat are influenced by rainfall seasonality; and (3) the PTM model (Rodríguez & Lewis 1997) will predict the dry season lagoon fish community.

Study sites

We conducted this study in the Yasuni National Reserve (Figure 1), which comprises 982,000 ha and is the largest nature preserve in Ecuador. We collected fishes from four sites representative of three habitat types: lagoon, river and stream. Site one, Jatuncocha Lagoon (0°59′46.2″S, 75°26′59.8″W), is a large shallow blackwater lagoon connected to the Yasuni River via the blackwater Jatuncocha River. Site two, Yasuni River (0°59′37.9″S, 75°25′59.1″W), is a major tributary of the Napo River that varies seasonally between conditions close to blackwater and those approaching whitewater. Sites three and four, Cotoyacu (1°00′34.7″S, 75°26′15.1″W) and Tambococha (0°58′32.6″S, 75°25′29.5″W), are groundwater-fed forest streams. Cotoyacu drains into the Yasuni River, while Tambococha drains into the blackwater Tambococha River. Jatuncocha Lagoon and Streams Cotoyacu and Tambococha are flooded blackwater habitats during the wet season.

Rainfall data collected over 13 years by the Instituto Nacional de Meteorología e Hidrología at Nuevo Rocafuerte reveals a dry season between December and February, and a wet season between May and June,