

Short Communication

Accounting for heterogeneity in small-scale fisheries management: The Amazon case

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ABSTRACT

Tropical small-scale fisheries are highly heterogeneous with respect to a wide range of fisheries characteristics, but that heterogeneity has generally not been adequately studied or considered in management. This study investigated fisheries heterogeneity and the extent to which it is accounted for in management regulations in eight small-scale fishing communities located in floodplain ecosystems of the Amazon basin. Analyses of 29,844 fishery landing interview data revealed that fisheries heterogeneity with respect to gear, habitat, species composition, and total catch and fishing effort was high across all communities, but low over the years in the same communities, indicating that each community must be considered as a distinct management unit. Data analyses also revealed that many important community fisheries characteristics were not accounted for by government- and community-based management regulations. Total catch and fishing effort were largely unregulated; there were no size or closed season limits for one-third of the most important fishery species; and the nursery habitats used by most fishery species were not protected in any fashion. Clearly, increased attention to cross-community fisheries heterogeneity can improve the design and implementation of management regulations. The management problems created by the heterogeneity of small-scale fisheries are discussed, and the potential of the “barefoot ecologist” concept to address them is considered.

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1. Introduction

Fisheries management has shifted over the last few decades from a government-centered approach in which scientists and managers assess resource status and define and implement regulations to a decentralized approach with varying degrees of fisher involvement [1,2]. This shift towards decentralized management has taken different forms and occurred to different degrees throughout the world. In general, however, there has been little progress in developing systems to monitor small-scale fisheries and generate data analyses that are passed on to fisher groups.

This tends to be a problem in tropical, small-scale fisheries, because they are highly heterogeneous as they are influenced by distinct local combinations of natural, social, and economic processes [3–6]. For example, a recent study of ten coral reef fisheries distributed along a ~75 km stretch of coastline in Kenya found large variations with respect to most aspects studied, including mean catch, effort, catch per unit effort (CPUE), mean trophic level, functional diversity of fished taxa, diversity of gear, and

management strategies [7]. Yet, the high costs of collecting fisheries monitoring data on geographically-dispersed small-scale fisheries [8–10] have generally led fisheries agencies, when they have the funding, to collect data at major regional fisheries landing sites. This, in turn, has led to a widespread emphasis on understanding the common characteristics of regional fisheries to guide the design of management regulations that are implemented over large geographical regions that encompass a multitude of community small-scale fisheries [2,3,6].

The use of regional fisheries landing data is often problematic for tropical small-scale fisheries, for several reasons. First, the mixing of data from a large number of community small-scale fisheries homogenizes their distinctive characteristics, leading to regulations that may be inappropriate for individual communities. Second, it does not capture subsistence fishing activities, whose catch composition may be different from that of regional landings. Third, the lack of information specific to individual community fisheries deprives local managers of the information they need to manage their fishery. Insufficient access to appropriate data is only part of the problem. Many countries, especially tropical developing countries, also lack the institutional capacity to provide scientific and management assistance to small-scale fisheries [10]. It is thus not surprising that many small-scale fisheries are thought to be overexploited [9].

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One approach to the problems caused by the heterogeneity of small-scale fisheries is the “barefoot ecologist” concept proposed by Prince [11,12]. Prince defines “barefoot ecologists”, as community managers with basic training in fisheries data collection and analysis who work with other community members to design and implement management regulations. According to Prince [12], “barefoot ecologists will need to be pragmatic generalists, skilled in the multiple disciplines... the barefoot ecologist will catalyze change and build social capital within fishing communities.” The “barefoot ecologist” concept is important because it offers a means to rapidly and cost-effectively promote the development and implementation of management regimes specifically designed to address the distinctive characteristics of local, small-scale fisheries.

Despite the potential of the “barefoot ecologist” concept to improve small-scale fisheries management, however, to our knowledge it has not been widely adopted. Advances in incorporating the heterogeneity of small-scale fisheries in decentralized management schemes have been few, although notable (e.g., coastal fisheries in Chile [13]). This dearth in the recognition of the significance of heterogeneity in small-scale fisheries may be due to a lack of recognition of the management problems it can create. To address this situation, this study investigated fisheries heterogeneity and the adequacy of management regulations in small-scale fisheries of the Amazon floodplain. Two hypotheses were tested: (1) small-scale fishing communities vary with respect to characteristics related to fishing gear, habitat, species composition, and catch and effort; and (2) small-scale fisheries heterogeneity is not taken into account by management regulations.

2. Methods

2.1. The study area

The studied small-scale fisheries are in floodplains of the Amazon River near the city of Santarém, in what is known as the Lower Amazon region of the State of Pará, Brazil (Fig. 1). The floodplains of the Amazon, known as *várzea*, comprise a mosaic of habitats that are adjacent to the main river channel and that are

completely flooded by annual water level changes (on the order of 6 m [14]).

Fisheries on the Amazon floodplain consist of a mosaic of individual community fishing territories that cover often-overlapping areas within 3–4 h by canoe from the community. Though broadly similar, community fisheries can be quite variable in terms of the specific mix of ecological characteristics, such as vegetation cover, land use history, levee height, lake morphology and connectivity, population size, the relative importance of economic activities, such as agriculture, fishing (subsistence and commercial), large and small cattle ranching, and access to regional urban centers and markets. They also differ in the degree to which fishing, cattle ranching and other activities are regulated by formal and/or informal rules.

We studied household fishing activity and management regulations in eight floodplain communities (Fig. 1). These communities range in size from 35 to 150 families and are located in three co-management districts within a 50 km radius of Santarém: Itiqui Region (Aracampina, São Benedito, São José, São Raimundo and Santana), Tapará Region (Pixuna and Santa Maria), and Aritapera Region (São Miguel; Fig. 1). The basic fishing unit is a wooden canoe, powered by paddle, sail, or outboard engine carrying a 120-liter Styrofoam icebox. Fishers, either singly or in pairs, undertake nearly daily fishing trips for a few hours. Gillnets and cast nets are the most used gear, though various gears are important at different times of year (Table 1). Total catch is composed of some 40 species, however, a few species account for most of the total catch. Fishing occurs mostly in lake and river habitats, but also in other floodplain environments as fish move in and out of the floodplain with the rise and fall of the river. Part of the catch is consumed locally and the rest is sold in nearby urban markets.

The harvested species perform three migratory strategies [17]. Floodplain sedentary species inhabit flooded forests during high water levels and lakes and channels during low water levels. Migratory characiforms species also inhabit flooded forests during high water levels, but they generally migrate hundreds of kilometers in river channels during low water levels. Migratory catfishes live almost entirely on river channels where they may migrate thousands of kilometers, though they occasionally inhabit floodplain lakes.

The studied communities have developed over the last few decades policies and institutional arrangements for fisheries co-management [16–18]. This was done to address the depletion

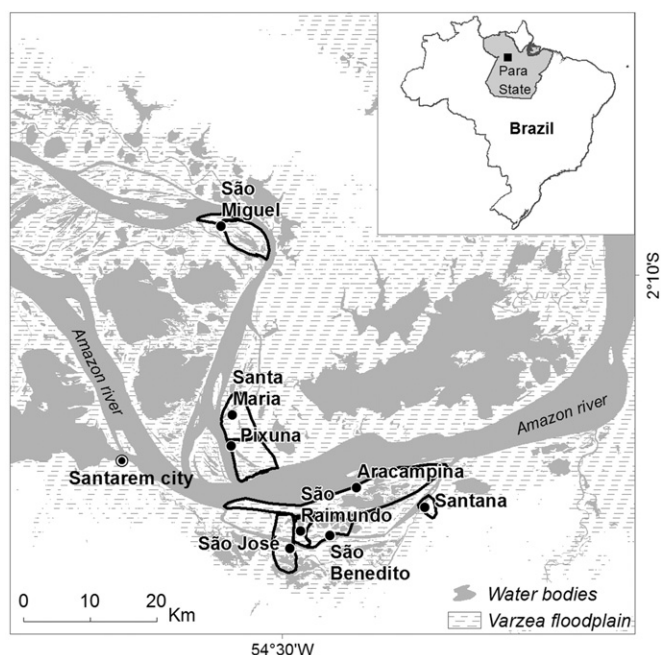


Fig. 1. The study area and the sample communities.

Table 1
Descriptions of the most common fishing gear.

English name (local)	Description
Harpoon (<i>Arpão</i>)	Wooden pole with sharp metallic head used for catching large species
Fence trap (<i>Cacuri</i>)	Wooden fences built on the ground directing fish into traps
Fishing rod (<i>Canico</i>)	Rod, line, and hook used for medium-sized species
Longline (<i>Espinhel</i>)	Line with several hooks used to catch large river species
Arrow (<i>Flexa</i>)	Light-weight rod with sharp metallic head used for medium-sized species
Handline (<i>Linha de mão</i>)	Line and hook used for various species
Gillnet (<i>Malhadeira</i>)	Multi- or single-filament nets used for various species
Castnet (<i>Tarrafa</i>)	Funnel-shaped net used for small pelagic species
Trident (<i>Zagaia</i>)	Wooden pole with metallic trident used for medium-sized species in shallow water

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