Communal control of aquatic resources in lake Titicaca, Peru [1]

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CONTRÔLE COLLECTIF DES RESSOURCES AQUATIQUES SUR LE LAC TITICACA (PÉROU)

RÉSUMÉ

Cet article considère le contrôle collectif des ressources aquatiques, y compris halieutiques, sur le lac Titicaca. Il montre que les communautés littorales gèrent les ressources aquatiques grâce à un système de droits exclusifs et limités sur les ressources halieutiques que l' on trouve dans des zones spécifiques de leur environnement. Une étude bibliographique, un recensement des pêcheurs, une étude générale des activités de 251 d' entre eux et une série d' enquêtes de terrain on permis de mettre en évidence des régularités dans les dimensions sociales et spatiales des territoires de pêches. Ces régularités sont directement influencées par des caractéristiques du milieu naturel.

1. INTRODUCTION

Communal systems of resource allocation have attracted a great deal of attention in recent years from researchers in a number of fields (National Research Council, 1986). In the last decade, a large number of studies have documented the existence of territorial fishing rights over exclusive fishing zones (POLLNAC and LITTLEFIELD, 1983). Such cases, which we call Territorial UseRights in Fishing (TURFs), are systems of water tenure which involve the holding of exclusive and limited rights by locally or culturally defined communities of shore dwellers over fishing

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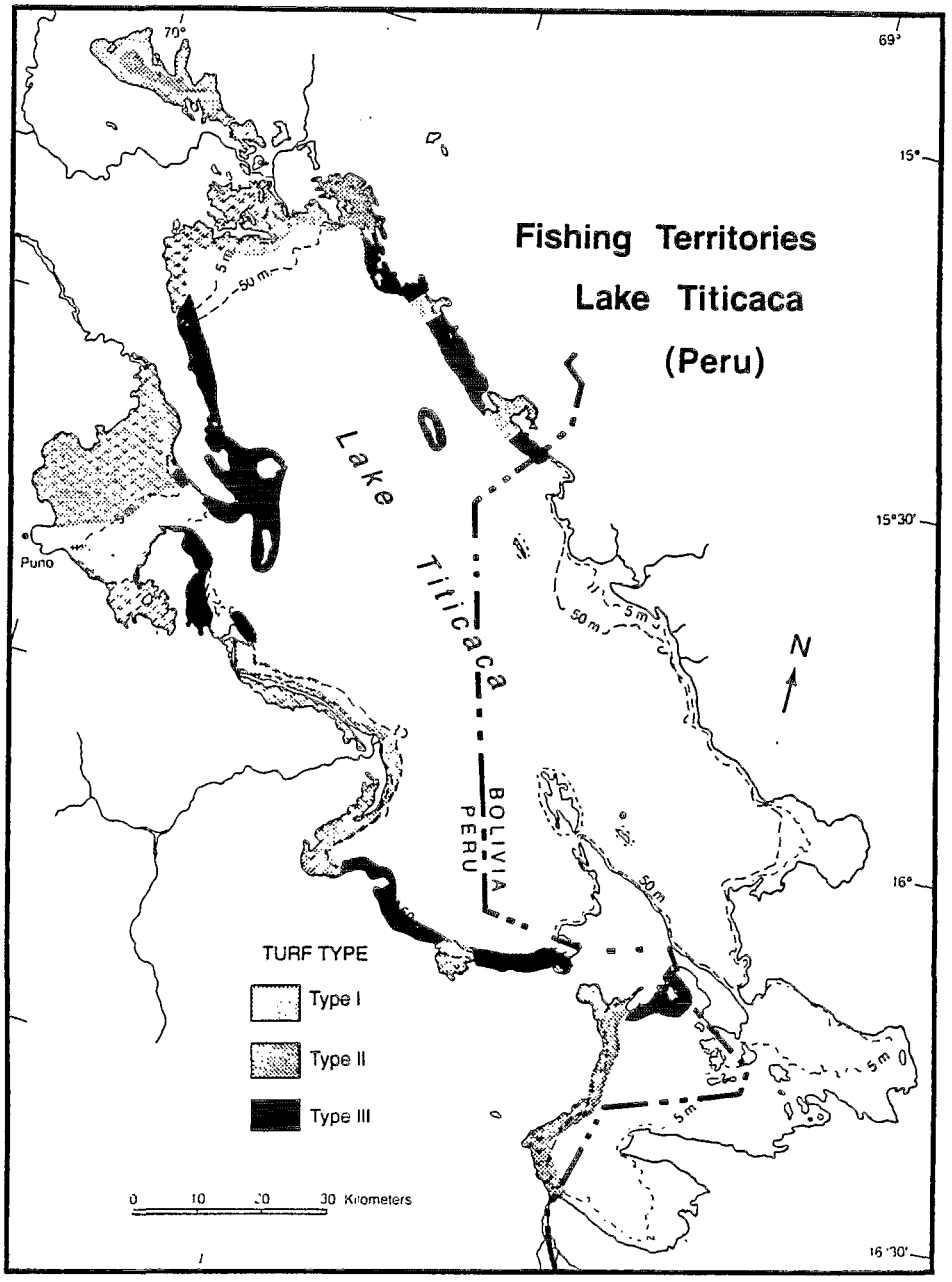

Fig. 1 - Map of lake Titicaca [2] and situation of TURF types on the lake

[2] *These figures correspond to the period 1979-1980. Current proportions may have changed somewhat, due to a series of years of unusually low and high lake levels, to shifts in fishing effort, and to population dynamics within the biological fish communities.*

resources found in specific parts of the aquatic environment. This definition expands on previous definitions (PANAYOTOU, 1984) because it does not restrict the types of rights involved to exclusive use rights. Our research examines communally-controlled fishing territories in Lake Titicaca, located high in the Andes on the border between Peru and Bolivia (Fig. 1).

Three types of territories are found in this region ; they differ in regard to the distance between the shore and the outer edge of the territories, and the depth of the water at this outer edge. The distribution of these types is strongly influenced by the environmental characteristics of the shores of the lake. Two factors are particularly important: the slope of the bottom of the lake in the littoral zone and the presence and abundance of aquatic vegetation. Each type of territory is restricted to one particular type of shore zone.

2. LAKE TITICACA FISHERIES

Lake Titicaca lies across the border between Peru and Bolivia. It is a large (8 100 km^2), high altitude (3 808 m), tropical (16°S) lake.

Lake Titicaca fish resources include both native and exotic species. The former are endemic to the lake and include the cyprinodont genus *Orestias*, which represents 67% of the annual catch by weight, and the catfish genus *Trichomycterus*, which accounts for less than 4% of this harvest (ORLOVE, 1986). The latter include the rainbow trout (*Salmo gairdneri*), introduced to the lake in the early 1940s, and the silverside of pejerrey (*Basilichthys bonariensis*) introduced in the mid-1950s, each of which contributes about 15% of the total catch (ORLOVE, 1986)

Aquatic macrophytes also contribute in major ways to the local economy (LEVIEIL *et al.*, 1987). The most important macrophytes are a reed, totora (*Scirpus tatora*), and the llachu, an association of three genera of aquatic plants (*Myriophyllum, Elodea* and *Potamogeton*), which are harvested as cattle fodder (COLLOT, 1980).

Fishing on Lake Titicaca involves small-scale operations, with low capitalization, simple gear and small fishing craft. Fishing operations are short-range, rarely lasting for more than an overnight trip. Gill nets are set late in the afternoon and checked or retrieved early the following morning. Lake Titicaca fisheries are not spatially concentrated. Fishing is practiced by individuals from each shore community. The fishermen participate in four basic types of fisheries: the lake bottom or demersal gill net fishery for native species, the pelagic gill net fishery for introduced species, the trawl fishery for native species and the trawl fishery for ispi, a native cyprinodont species.

Local communities manage aquatic resources through a system of TURFs. Each TURF is associated with a specific lakeshore community which consists of a well-defined set of members who have exclusive rights to a specific territory. The TURF consists of a well-defined portion of aquatic space, to which community members have certain exclusive, though informal, rights. These rights focus on two types of resources: the beds of totora reeds, which in most cases consist of plots owned by individuals, and fish. Community members are the only ones who have rights to fish within the TURF ; rather than having certain portions of a TURF restricted to certain individuals, access to the entire TURF is open to all the fishermen in a community [3].

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[3] *Such systems of open access within a communal fishing territory, rather than ones in which individuals have rights to private fishing spots, are common in settings such as Lake Titicaca, in which fish move from one area to another, and in which the size of fish populations can vary between seasons or years; by contrast, the predictability of totora yields encourages individual ownership of plots. For fuller discussion of these themes, see* NETTING *(1976, 1982) and* OSTROM *(1987). For the Lake Titicaca fishermen, this contrast also corresponds to the manner in which terrestrial resources are allocated, since individuals typically have ownership or usufruct rights to agricultural fields, but communal control is more common for pasture, whether permanent grasslands or fallow agricultural fields (*BRUSH and GUILLET, *1985 ;* ORLOVE and GODOY, *1986).*

3. METHODS

A complete demonstration of the existence of TURFs should show both that TURF holders control access to fishing and that they exclude outsiders. We have used a series of bibliographical references; the official registration lists of fishermen and fishing craft; a census of local fishermen and a survey of the activities of 251 fishermen, both carried in 1976 by Peruvian government scientists; and numerous interviews conducted during fieldwork in 1979-1981 and 1984.

Table 1 - Characteristics of TURF Types on Lake Titicaca

	Type I	Type II	Type III
Width of Totora bed	> 500 m	10 - 500 m	< 10 m
Lateral boundary	channels in totora beds or manmade markers precise impermeable	channels, man-made markers, land reckoning precise impermeable	land reckoning imprecise somewhat permeable
Offshore boundary	100-200m beyond outer edge of totora	200-500m beyond outer edge of totora	5km offshore when ispi schools are present
Maximum depth	< 3-5m precise impermeable	10-20m imprecise some permeability	> 50m very imprecise somewhat permeable

4. RESULTS

Fishing territoriality in the sense of exclusive fishing with defense does occur along the shoreline. We can speak of TURFs because the fishing territories are controlled by shore communities and because they involve more than simple space allocation. Fishermen censuses confirm that shore dwellers have been able to prevent inland dwellers from entering local fisheries. By lumping together all available sources of evidence of the existence of TURFs on Lake Titicaca we were able to demonstrate that TURFs can be found along the entire shoreline, with the sole exception of the water immediately adjacent to Puno, the one city located on the lake.

We have distinguished between three different types of TURFs according to the distance from shore to which they apply. Most communal fishing zones include a shallow water area, often demarcated by the presence of aquatic

macrophytes, and an area of open water, both of variable width. The presence of totora reeds is significant in distinguishing these three types, since this plant commonly grows in waters between 2 and 4 meters deep, and is rarely found elsewhere. Table 1 summarizes the characteristics of the three types of TURFs.

4.1. Type I TURFs

TURFs of the first type are found where the shallow water area extends to a great distance from the shoreline, because of a gentle bottom slope (Fig. 1). These areas are characterized by the presence of aquatic macrophytes, particularly by dense beds of totora reeds. Communities with type I TURFs extend their boundaries far into these totora beds and usually, though not always, claim some open water space, not more than one or two hundred meters wide, on their outer edge. It is difficult to associate the outside boundary of type I TURFs with any precise depth contour, though it rarely goes beyond 3 meters and almost never beyond 5 meters.

4.2. Type II TURFs

In the second type of TURFs, a steeper bottom slope brings the outer edge of the totora reed beds to within a few hundred meters from shore. In such cases, local community members claim the totora beds in the shallow waters and an area of open and deeper water a few hundred meters wide. The outer limit of type II TURFs is often close to the 10 meters depth contour. However, when this depth occurs fairly close to shore, the outer edge of type II TURFs may be located as far as the 20 meter depth contour.

4.3. Type III TURFs

In type III TURF areas, the shallow water area and the totora reed beds are only a few meters wide, because of a very steep bottom slope. The totora may even be entirely absent, because of a rocky substrate or exposure to wave action. In these areas, alternative criteria of demarcation are used, and the width of the corresponding area is highly variable, depending on the fish resource and harvesting methodology involved. Where gill net fishing for demersal or bottom native species predominates, the 50 meters depth contour provides a good approximation of outer edge of type III TURF areas ; even though gill nets for demersal fish are rarely anchored deeper than 20 meters, this additional width offers a buffer against outsiders. Alternatively, where the trawl fishery for ispi predominates, no precise depth contour seems to correspond to the outer edge of type III TURF areas; instead, the communities seek to exclude outsiders from coming within 5 kilometers of the shore.

5. CONCLUSIONS

In spite of their informal status and of the opposition of government officials, TURFs are widely enforced around Lake Titicaca. Members of shore communities repel trespassers by threatening them physically or by destroying their gear.

We have examined a number of examples of group-based control of resource use from one region, and demonstrated regularities in the spatial and social dimensions of this control. These regularities are directly influenced by environmental variables.

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