

Perceptions of the status of the white fish fishery in the Galapagos Marine Reserve

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Introduction

The white fish fishery is of historical socioeconomic importance for fishermen in the Galapagos Marine Reserve (GMR). Today approximately 68 species are fished, with mullet, wahoo, yellow-finned tuna, jack, and Galapagos sea bass the most abundant in the catch (Peñaherrera, 2007). The most common method is hand line fishing, with multiple hooks. Unfortunately, the lack of both economic and human resources has resulted in limited scientific knowledge regarding the current status of the fishery. In response to this, a method known as "Participatory Fisheries Stock Assessment" (ParFish) was adapted to Galapagos conditions and used in this study. This method was developed by scientists from the Marine Resource Assessment Group (MRAG) and has been applied recently in diverse sites of Asia and Africa, where scientific data is limited or non-existent, to evaluate small-scale, artisanal fisheries for the development and implementation of co-management systems (Walmsley *et al.*, 2005). ParFish engages the users of the resource at each stage of fisheries management (evaluation, planning, decision-making, and implementation). Management impacts are analyzed and evaluated periodically to reformulate both management plans and actions. In this study, the ParFish method was used to produce a rapid and cost-efficient evaluation of the white fish fishery, based on Local Fisherman Knowledge (LFK). The LFK is understood as an accumulative body of knowledge, practices, and beliefs, generated by the fishers of Galapagos through their observations and experience while fishing.

Methods

To evaluate the status of the white fish fishery in the GMR, the research focused on answering the following questions:

- 1) How much could a fisherman catch (in pounds) during a single day of fishing during the initial phase of commercial exploitation (unexploited catch rate), which occurred from the 1940s to the 1960s?



- 2) How much does a fisherman catch today (in pounds) in a single day of fishing (actual catch rate)?
- 3) What is the minimum catch that a fisherman must obtain per day (in pounds) to consider the white fish fishery profitable (minimum acceptable catch rate)?
- 4) Do the fishermen perceive year-to-year changes in their catch rate?
- 5) What is the perception regarding the current level of fishing (total fishing effort) for white fish?
- 2006, 25 in Puerto Baquerizo Moreno and 27 in Puerto Ayora (Table 1). A random stratification sampling method was used, with a sample size greater than 10% of the active fishermen (for more detail, see Castrejón, 2008). Estimates for both unexploited and actual catch rates were based only on those cases where hand lines were the principal fishing method used. Non-parametric statistical analyses were used to evaluate significant differences among unexploited, actual, and minimum acceptable catch rates, by fishing port. The comparative measure used for these analyses was the median, not the average.

Fifty-five interviews were conducted with fishermen between June and November

Table 1. Sample questions asked during interviews, including the type of information generated and the associated indicator.

Question	Information Obtained	Indicator
1. What method of fishing (hand line with multiple hooks, single hook hand lines, nets, etc.) are you most familiar with and use on a regular basis?	Types of fishing methods used most frequently	Principal fishing method
2. Currently, how many pounds of white fish do you normally catch in one day of fishing?	Actual catch rate during 2006	Actual catch rate
3. During recent years, has your catch rate remained the same, declined, or increased?	Perception of long-term changes in catch rate	Trends in catch rates
4. If you fished in a new fishing area (an area that had never been fished or was closed to fishing and then reopened after a certain length of time), what is the maximum number of pounds of fish that you think you could catch in a single day of fishing?	Perception of the maximum unexploited catch rate obtained during the initial phase of exploitation of the fishery	Unexploited catch rate
5. Do you believe that the actual level of fishing for the current size of the fish populations is: insufficient (could be greater), adequate, or too much?	Perception of the actual level of fishing effort in the white fish fishery	Actual level of fishing effort
6. What is the minimum number of pounds of fish per fishing day below which you would no longer consider it worth your while to continue fishing and would prefer to change your activity from fishing to something else?	Minimum catch rate that is considered sufficiently profitable for a fisherman to engage in fishing activities	Minimum acceptable catch rate

Results and discussion

Unexploited, actual, and minimum acceptable catch rates

Perceptions regarding the unexploited catch rate were highly variable. However, during the initial phase of exploitation, a

fisherman using a hand line should have been able to catch an estimated 400 to 700 pounds of fish per fishing-day (Figure 1).

The catch rate in 2006 varied between 100 and 175 pounds/fisherman/fishing-day, significantly less than the unexploited catch rate (Figure 1). This range in values is similar to that reported by Reck (1983),

who estimated that between 1977 and 1981, the average catch rate using a hand line ranged from 94.6 to 143 pounds/fisherman/fishing-day. Although the reduction in catch rate from the initial phase of exploitation to the current situation is significant, the possibility exists that catch rates have remained stable from 1977 to 2006, and the demonstrated reduction is actually due to a combination of the increasing diversity of fishes caught and the fact that fishing effort for white fish has declined due to tourism and the expansion of both the lobster and sea cucumber fisheries in the mid 1980s to 1990s (Castrejón, 2008).

The actual and minimum acceptable catch rates differed significantly in both ports. The minimum acceptable catch rate ranged from 50 to 90 pounds/fisherman/fishing-day (Figure 1).

According to these figures, the actual catch rate remains at an economically profitable level for the fishermen. The minimum acceptable catch rate could be considered a reference point below which exploitation of the resource is considered undesirable and a level at which management measures should be implemented to permit the recovery of the fishery.

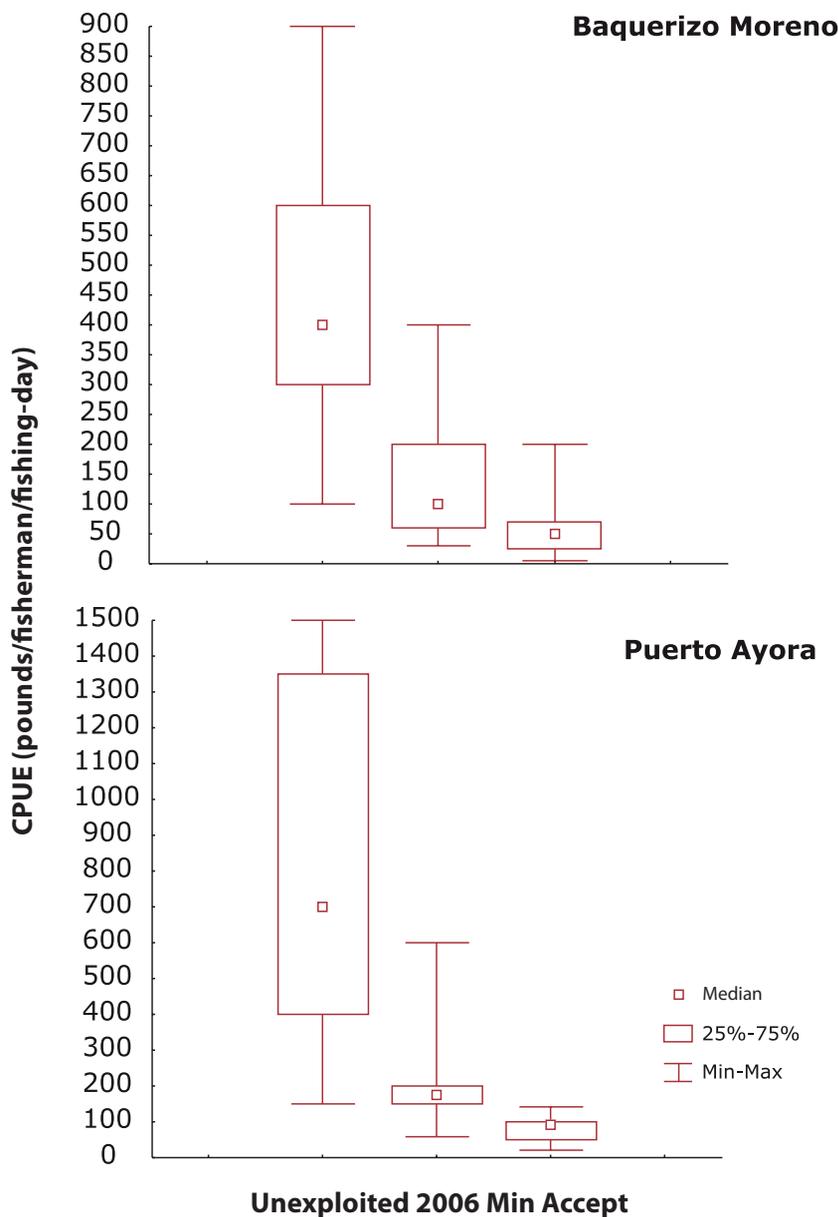


Figure 1. Comparison of the unexploited, actual (2006), and minimum acceptable (Min Accept) catch rates (in pounds/fisherman/fishing day), recorded in Puerto Baquerizo Moreno and Puerto Ayora. Note: estimates for the unexploited and actual catch rates are based only on those cases where a hand line was the principal fishing method used.

Trends in fishing levels

In Puerto Baquerizo Moreno, the majority of the fishermen interviewed believe that their actual catch rates have declined (64%), while in Puerto Ayora the majority believe that they have remained the same (46%, Figure 2). However, between 12 to 14% believe that their catch rates vary greatly, declining or increasing depending upon conditions at sea. There are also differing perceptions in the two ports regarding the total fishing effort (Figure 3). In Puerto Baquerizo Moreno, the majority consider that the current total fishing effort is adequate (50%), while in Puerto Ayora the majority believe that it is insufficient and could be increased (48%).

These results demonstrate the differences in perception between the two ports regarding the current state of the white fish fishery and raise the following two questions:

- 1) Why do a higher percentage of fishermen in Puerto Baquerizo Moreno, in relation to the percentage in Puerto Ayora, believe that their catch rates have declined?
- 2) Why do the majority of fishermen in Puerto Ayora believe that the total level of fishing could be increased while those in Puerto Baquerizo Moreno think that current levels are adequate?

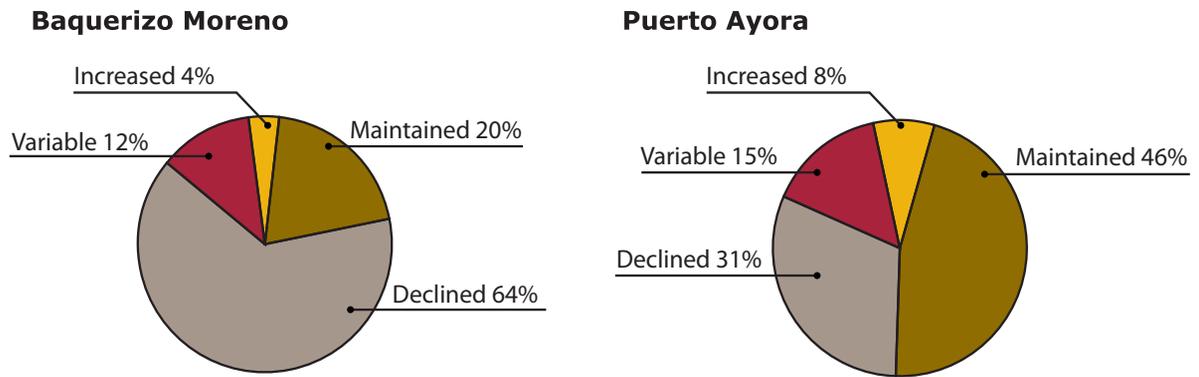


Figure 2. Trends in the catch rates of white fish (in pounds/fisherman/fishing-day), without regard to fishing method, according to the perception of the fishermen of Puerto Baquerizo Moreno and Puerto Ayora.

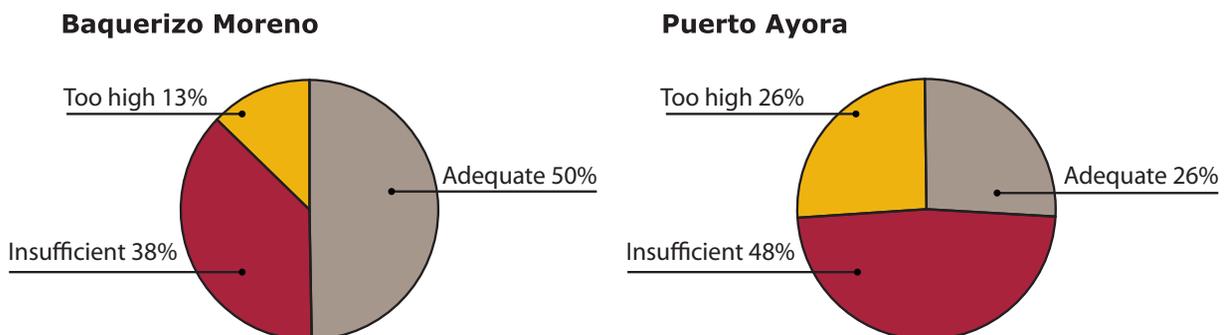


Figure 3. Perception of fishermen regarding the total level of fishing effort in the white fish fishery in Puerto Baquerizo Moreno and Puerto Ayora.

It is possible that a greater percentage of fishermen from Puerto Baquerizo Moreno believe that catch rates have declined because they specialize in catching different types of fish species with different life histories and levels of exploitation than do the fishermen in Puerto Ayora. In Puerto Baquerizo Moreno, fishermen have historically fished demersal fishes (sea bass of Galapagos, hawk fish, etc.), for which the risk of overexploitation is probably greater than it is for coastal-pelagic species (Reck, 1983). In Puerto Ayora, on the other hand, fishing as a livelihood has a shorter history and it appears that the fishermen concentrate on the coastal-pelagic species (tuna, wahoo, etc.), with the goal of satisfying the local demand from restaurants and tourist boats. The level of abundance of this type of species is probably greater than that of demersal fishes, because the historical levels of exploitation have been lower (Castrejón, 2008). Therefore, it is possible that the perception of trends in catch rates of demersal fishes held by the fishermen of Puerto Baquerizo Moreno are directly related to population levels of those species, while the perceptions of the fishermen from Puerto Ayora are probably associated with the coastal-pelagic fishery. This can explain why the majority of fishermen of Puerto Baquerizo Moreno perceive that their catch rates have declined, while those in Puerto Ayora think they have remained at the same level over the years.

In Puerto Ayora, the majority of fishermen believe that their level of fishing effort for coastal-pelagic species can still be increased, while those in Puerto Baquerizo Moreno believe that the current level of fishing effort directed toward demersal fishes is adequate, given that they believe that their catch rates have been declining.

RECOMMENDATIONS

Considering the above hypotheses, a more detailed follow-up study is recommended to focus on which types of species are exploited in each port. The white fish fish-

ery should be evaluated as two sub-fisheries: the demersal fish fishery using a hand line and the coastal-pelagic fishery, which uses all of the other fishing methods found in the GMR (nets, lures, etc.). Simultaneous evaluations of the spatial dynamics of the principal species that make up the white fish fishery and of the fishing fleet are also indispensable. For this a systematic collection of more biological-fishery data is needed to reduce the level of doubt currently existing regarding the current status of the demersal and coastal-pelagic sub fisheries. This type of research will provide a better basis for understanding the difference in perceptions between the fishermen of San Cristóbal and those of Santa Cruz regarding the white fish fishery in the GMR.

Finally, this type of research should be expanded to include marine resources with lower economic values than the spiny lobster, white fish, and sea cucumbers (such as slipper lobsters and minor benthic resources) for which there is a total lack of both historical and current knowledge regarding levels of exploitation.