

Local ecological knowledge concurs with fishing statistics: An example from the abalone fishery in Baja California, Mexico



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ABSTRACT

The use of local ecological knowledge (LEK) to assess species status has been controversial among marine scientists. While some consider this to be one of the few historical tools available to understand the extent of change that has occurred in marine animal populations and ecosystems with a long-term historical perspective, others believe fishers tend to exaggerate catches and that their memories cannot be considered a reliable source of information to assess species at risk of extinction. This study compares long-term fishery data on catches with fishers' memories in the abalone (*Haliotis spp*) fishery from Baja California, Mexico. Results show that historical landings and fishers' memories strongly concur in the history of how this fishery has collapsed over the last 60 years. Pearson correlation analysis between both sets of data reports a value of 0.75, showing a high correlation ($p < 0.0001$), adding evidence to the increasing literature on the importance of local ecological knowledge to understand species' trends in marine ecosystems. As with any other proxy of population abundance, fishers' ecological knowledge gives an imperfect but informed trend on the status of marine species that should not be discarded by our own bias that ecological data always produces accurate estimations.

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1. Introduction

Over the past few decades, marine ecosystem restoration has become an important scientific topic due to the advanced deterioration of the environment and species at risk of extinction [40]. A proposal to define suitable restoration goals has been made and the need for appropriate historical baseline abundances has been recognized as a key element [5,13,17,25,29,34,38].

The use of local ecological knowledge to increase our understanding of marine population dynamics has been underlined since the publication of Bob Johannes' seminal papers in the 1980s and 1990s [19–21], and also gained a great deal of attention after Jeremy Jackson and colleagues' groundbreaking paper which started the debate on how narrow our perspective was as far as understanding human impacts on the marine environment [17]. Despite increasing evidence that fishers provide systematic trends on how the ecosystem has been altered throughout modern history (e.g. [9,23,35]), some scholars still contest this knowledge, arguing that fishers

might exaggerate due to “memory illusions” [11,28]. For example, in a relatively recent review on the historical trends of catching sea-horses in the Philippines, the authors compared interviews conducted with 21 fishermen in 1995 on their memories of a “usual” or “typical” average catch over a time period of more than 40 years, and contrasted them with modern logbooks, extrapolating them for the past and arriving to the conclusion that fishers might have exaggerated on a perceived historical decline [28]. However, recent work in the marine and coastal realm has shown that fishers' memories are comparable with ecological data and should be incorporated into our tool box to understand the extent of human impacts on the marine environment [6].

This study compares almost 50 years of total fishing data with perceptions of the best catch ever recorded by abalone fishermen from central Baja California in Mexico (Fig. 1), and discusses why asking fishermen about their most memorable day's catch will give a better illustration of population trends than exploring fuzzy indicators of past abundance. This paper points out the importance of addressing trends, rather than abundance, to properly use local ecological knowledge as one of the tools available to understand the dynamics of wild populations from a historical perspective.

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Fig. 1. Abalone Shells from Baja California (Photo courtesy of Annie Waller).

The abalone fishery (*Haliotis spp*) from Baja California has been an important economic activity in shaping the development of coastal villages in western Baja California [31]. Over the last 30 years, it has been managed by a relatively successful model of multispecies spatial rights, granted to fishing cooperatives under a co-management system with the Mexican Government [24]. Despite several efforts to manage and recover past productivity, abalone populations have shown a noticeable decline due to a combination of overfishing in the past and an increase in environmental variability [26,27,31]. However, since the cooperatives were established, and particularly after the 1998 el Niño Event, abalone catches have been recorded meticulously both on a local and regional level, making it one of the best fisheries to provide fishing data in Mexico. Shepard and colleagues estimated that catch per unit effort (CPUE) is a crude estimation of population abundance and has a strong correlation with total catch (TC) [36]. In addition, abalone fishing methods have not changed since the Japanese brought diving technology to Baja California: it is caught by divers using an air compressor with a long hose (Fig. 2).

2. Methods

During the summer of 2009 and spring 2010, 127 active and/or retired abalone divers spanning three generations from five fishing communities in Central Baja California, Mexico (Fig. 3) were interviewed. The three generations consisted of i) young divers (under 30 years old, $N=37$, Percentage=29.2%), ii) middle-aged divers (between 31 and 44 years old, $N=46$, Percentage=36.2%) and iii) older divers (over 45 years old, $N=44$, Percentage=34.6%) (Table 1). These fishing communities were selected because together they catch more than 80% of the total abalone production in Mexico [31]. In order to start the interview process, we asked for permission from the cooperatives' board of directors, who then helped us to make a list of experienced abalone divers from different generations (See Table 1). Fishermen were interviewed in their houses using a semi-structured questionnaire (Appendix A). Responses were processed in a database and statistical analyses were done with STATA and EXCEL.

Total catch was obtained from CONAPESCA's (the National Commission for Fisheries and Aquaculture) year books and information reported in a published report by INAPESCA for the trends in all commercial fisheries in Mexico [15]. INAPESCA is the official entity in charge of gathering data from all fisheries in Mexico. Green (*Haliotis fulgens*) and pink abalone (*Haliotis corrugata*), the two species that make up almost 100% of the total catch of regional abalone fisheries historically, were aggregated in catches until the mid 1990s. Data of total landings of both species were also grouped together for subsequent years, and the same was done for the best catch ever recalled by fishermen from the 1960s to 2010. In order to run the correlation, landings reported for each year were repeated for each of the years the best catch was reported by fishermen.

During the interviews the best day's catch recalled by the divers was recorded. This was measured by the largest number of abalones ever caught, applying the same methods the first author used for the Gulf Grouper in the Gulf of California [23,35,37], and which has been replicated by others (See for example [9]). These interviews were carried out following the procedures and ethical guidance of Bunce and contributors [8] and Robertson [32].

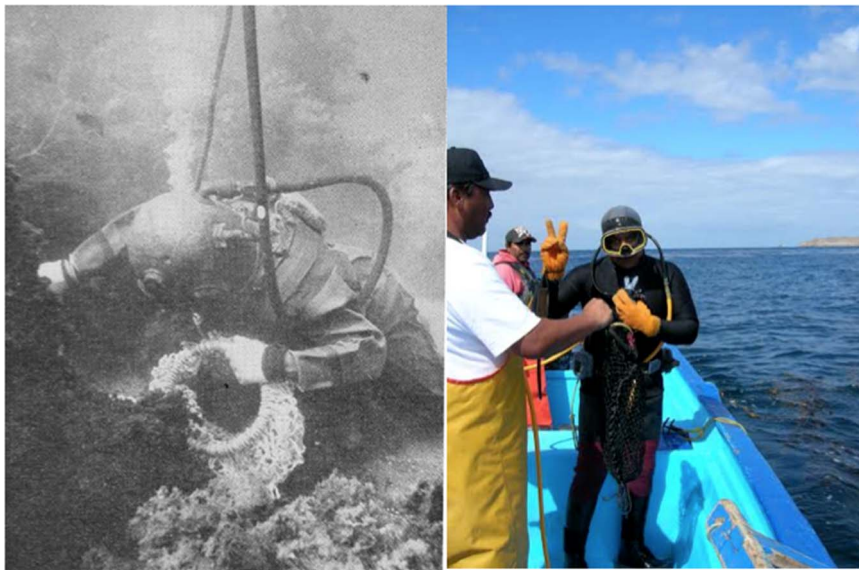


Fig. 2. Abalone diver from the mid 20th century in California (Cox, 1962) [3] (Photo courtesy of the California Department of Fish and Wildlife; a modern-day abalone diver from Isla Natividad, Photo courtesy of Leo Vazquez).

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