Using fishers' anecdotes, naturalists' observations and grey literature to reassess marine species at risk: the case of the Gulf grouper in the Gulf of California, Mexico

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Abstract

Designing fishing policies without knowledge of past levels of target species abundance is a dangerous omission for fisheries management. However, as fisheries monitoring started long after exploitation of many species began, this is a difficult issue to address. Here we show how the 'shifting baseline' syndrome can affect the stock assessment of a vulnerable species by masking real population trends and thereby put marine animals at serious risk. Current fishery data suggest that landings of the large Gulf grouper (*Mycteroperca jordani*, Serranidae) are increasing in the Gulf of California. However, reviews of historical evidence, naturalists' observations and a systematic documentation of fishers' perceptions of trends in the abundance of this species indicate that it has dramatically declined. The heyday for the Gulf grouper fishery occurred prior to the 1970s, after which abundance dropped rapidly, probably falling to a few percent of former numbers. This decline happened long before fishery statistics were formally developed. We use the case of the Gulf grouper to illustrate how other vulnerable tropical and semi-tropical fish and shellfish species around the world may be facing the same fate as the Gulf grouper. In accordance with other recent studies, we recommend using historical tools as part of a broad data-gathering approach to assess the conservation status of marine species that are vulnerable to over-exploitation.

Keywords fishery assessment, historical ecology, overfishing, shifting base line syndrome

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Introduction

In 1995, with the use of a simple example, Daniel Pauly illustrated the inabilities of modern fisheries science to accommodate historical data (Pauly 1995). The case that Pauly uses comes from an anecdote told by of one of his colleague's grandfathers, who remembered in his youth being continuously annoyed by bluefin tuna, when he was setting mackerel nets in the waters of Kattegat, a strait which connects the Baltic Sea with the North Sea. Today blue fin tuna is virtually unknown there. Following Pauly's reflection, interest in the phenomenon that he termed 'the shifting baseline syndrome' has soared. Historical research (Jackson *et al.* 2001; Pitcher 2001; Roberts 2003) and evidence found in fishing vessel logs (Baum *et al.* 2003; Myers and Worm 2003; Baum and Myers 2004), has shown that many species could have been much more abundant in pre-fishing times and how seascapes have changed in far more radical ways than we previously believed. Modelling studies (Christensen *et al.* 2003; Jennings and Blanchar 2004), and analysis of genetic diversity (Roman and Palumbi 2003), have backed this view up and help illustrate how only relying on modern ecological or fisheries data will always result in 'a shifted perspective of the ocean' (Roberts 2003).

In tropical ecosystems, the problem of multispecies fisheries management is also added to the difficulties posed by the shifting baseline syndrome. Many species from a broad range of life histories are involved in these and catches are often landed over large regions within developing countries where resources to collect fisheries information are limited (Munro 1996). Even if data are collected, they may have weaknesses that make them unreliable indicators of population trends. To simplify the problem of multispecies management, catches are frequently combined into coarse taxonomic groups, such as 'groupers' or 'skates', which can mask the depletion of particularly vulnerable species if others in the group increase, perhaps as a result of reduced competition for resources (Dulvy *et al.* 2000).

Here we show how the shifting baseline syndrome, aggravated by the complexity of multispecies tropical finfish fisheries, is masking the depletion of a vulnerable species: the Gulf grouper (*Mycteroperca jordani*, Serranidae) from the central part of the Gulf of California (Fig. 1). The Gulf grouper is a large fish about which little is known. It was listed as vulnerable to extinction in the 1996 IUCN Red List of Threatened Species because of its limited distribution and the known vulnerability of Caribbean *Mycteroperca* species to decline (Hudson and Mace 1996). The Gulf grouper has some of the attributes that makes a fish extremely vulnerable to human hunting (Huntsman *et al.* 1999; Musick 1999; Morris *et al.* 2000; Reynolds *et al.* 2001; Dulvy *et al.* 2003). It is large (approximately 2 m), a possible hermaphrodite, aggregates in specific locations for breeding, and has a small geographical range. Although information on its age and sexual maturity is limited, its large body size and evidence from other congeneric species, suggests that age at maturity could be 6 or 7 years (Sadovy 1996). Despite its natural vulnerability, Gulf grouper landings in Mexico are currently pooled into a coarse statistical category with 15 other species (Poder Ejecutivo Federal 2000). Those included in this category live in a wide range of habitats, from coastal rocky reefs and mangroves to oceanic deep-sea mounts. The category also encompasses a large range of sizes, from small species such as the parrot sandbass (*Paralabrax loro*), which attains 38 cm to very large ones such as the goliath grouper (*Epinephelus itajara*), which can grow up to 240 cm. Systematic data collection on catches from this group began in 1986 and indicate a positive trend for the state of Baja California Sur (Poder Ejecutivo Federal 2000). Consequently, a recommendation for an annual increase of catches of up to 5% has been made for this group in order to reduce pressure on other declining species (Poder Ejecutivo Federal 2000).

Our research contrasts the official interpretation of recent fishery statistics with information gathered from old grey literature, naturalists' observations and a systematic collection of fisher's anecdotes. This comparison calls into question the recommendations based on fishery data. Contrary to what the statistics suggest, it appears that Gulf grouper stocks collapsed in the early 1970s long before modern statistics started being collected.

Figure 1 A 1.5-m long Gulf grouper with a King angelfish (Holocanthus passer) in Loreto Bay National Park, Baja California Sur (photo by author).

The fishery

The Gulf grouper is distributed along the north-west coast of Mexico, from Mazatlán to southern California in the USA (Thomson *et al.* 2000). However, breeding populations are thought to be restricted to the Mexican north-west (Rosenblatt and Zahuranec 1967). Our research was limited to the central part of the Sea of Cortez on the eastern coast of the Baja California Peninsula (Fig. 2). Groupers are caught in this area by artisanal fishers using hook and line. These fishers catch over 54 other species of finfish (Rámirez-Rodriguez 1996), depending upon seasonal abundances and weather conditions. Currently the Gulf grouper compromises <1% of the total finfish catch from the state of Baja California Sur (Rámirez-Rodriguez 1996).

In the Gulf of California, finfish fisheries date back to the pre-hispanic tribes that occupied Baja California (Cariño-Olvera 2000). However, fishery statistics did not begin being collected until the 1940s, and then only for a limited group of species such as shrimps or totoaba (Martínez-Cabañas 1969). From 1940 to 1987 artisanal finfish fisheries were viewed merely as a means by which local villagers obtained an important source of protein and not included in any data collection, until 1988 when statistics for this group started being assembled.

Currently the procedure to obtain fishing data on finfish fishes in México is as follows. Once fish are landed, catches are reported using common names that may either be the name of a single species (e.g. 'Garropa', which is the name used in Baja California for Gulf grouper), or may refer to a group of species (e.g. 'Cabrilla', which includes the flag cabrilla *Epinephelus/myeteroperca labriformis*, the leopard grouper *Mycteroperca rosacea*, the parrot sandbass *Paralabrax loro* and other species). These records are kept in local fisheries offices that send monthly reports to the head office in La Paz. Once in La Paz, data are fed into a state database. Annually, the La Paz office sends a report to the Pacific Division of the Comisión Nacional de Acuacu ltura y Pesca (National Aquaculture and Fisheries Commission), which is in

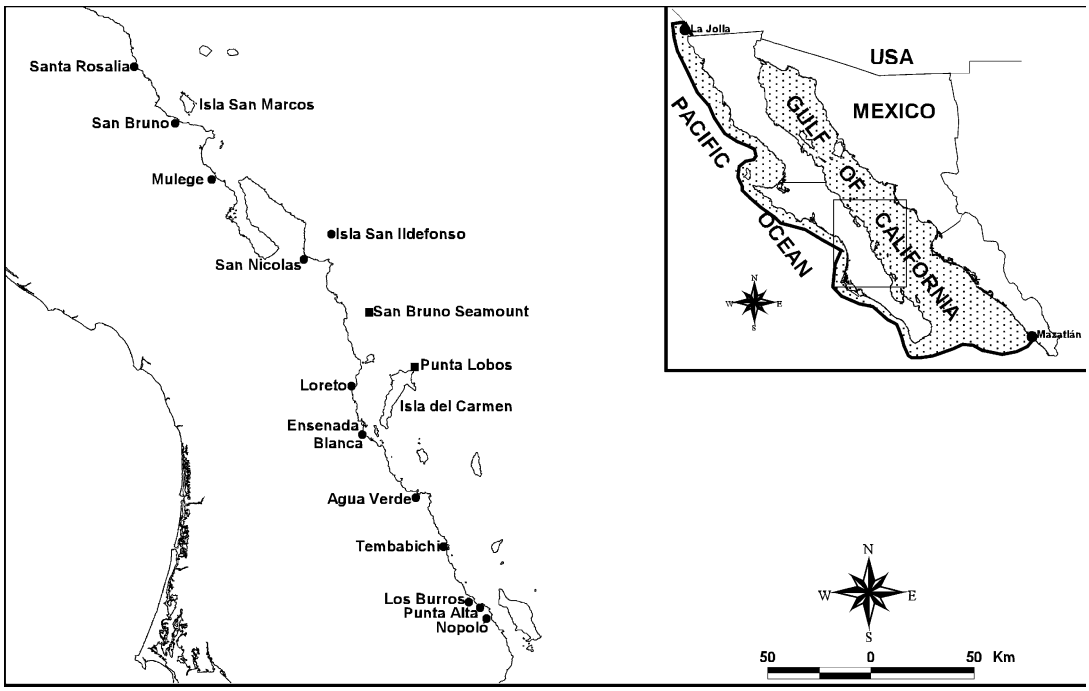

Figure 2 Study Area. Baja California Sur coast in the central Gulf of California. Shaded area in the smaller map represents the Gulf grouper distribution (Rosenblatt and Zahuranec 1967).

charge of gathering fishing data from all states bordering the Pacific Ocean. With this information a national database is built, published and posted annually on the Internet. With these data, the national policy for all marine fisheries is made and published in a document called Carta Nacional Pesquera (National Fishing Chart) (Poder Ejecutivo Federal 2000). Despite the fact that local reports use some species-specific names, when data are gathered together for the regional statistics they are put into broader categories. Trends in catches shown by the group of 16 species, which includes the Gulf grouper, are shown in Fig. 3. We searched the original state statistics to separate Gulf grouper catches from the other 15 species for 1988 to 2002. We also disaggregated data for the ports located in our study area: Santa Rosalía, La Paz and Loreto. The official landings for Gulf grouper in this area are shown in Fig. 4.

Pooled data for the group of 16 species that includes the Gulf grouper indicate that, contrary to the decline in the majority of Mexico's fisheries (Poder Ejecutivo Federal 2000), catches from this group grew from 372 tonnes in 1986 to more than

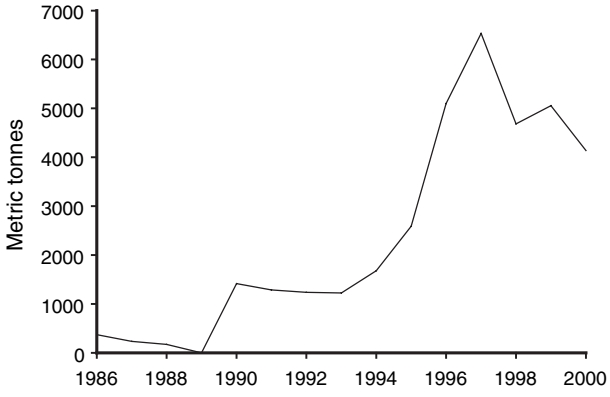

Figure 3 Catch of the group of 16 species from the Pacific coast of Mexico with which the Gulf grouper is evaluated and on which recommendations about fish catches are based. Data provided by Comisión Nacional de la Pesca (Poder Ejecutivo Federal 2000).

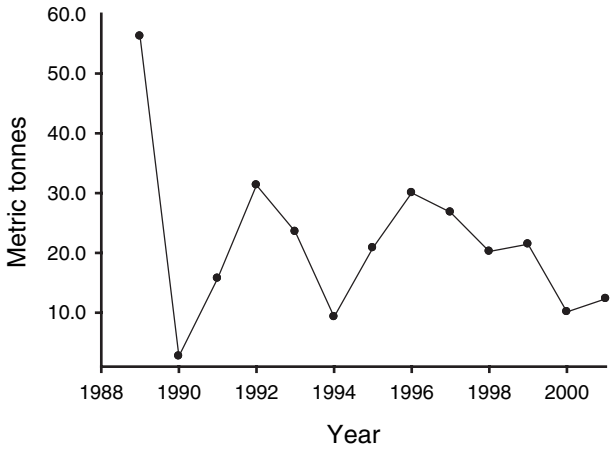

Figure 4 Disaggregated Gulf grouper catch data for Gulf of California ports (Santa Rosalía, La Paz and Loreto). Data provided by the SAGARPA office in La Paz.

5000 tonnes in 1999 (Fig. 3). This upward trend was key in motivating decision makers to propose that fishing effort on the group could be increased by 5% in order to reduce pressure on other fisheries. Disaggregated data on landings of Gulf grouper does not suggest cause for concern either, showing a fishery trend from which very little can be concluded, with a peak of almost 60 tonnes in 1988. In some years landings were poor, being only 2 or 10 tonnes and in several others they were at around 30 tonnes (Fig. 4).

Searching for old grey literature and fisheries memories

To challenge the belief that the Gulf grouper is a naturally rare fish whose unstable catches are expressed in modern fishing statistics, we searched old literature, mainly from the 20th century. We gave special attention to old fishing guides, accounts of natural history journeys and reports of fishing activity in international, national and local libraries and archives. In La Paz we visited 'Biblioteca de las Californias', 'Archivo Pablo L. Martinez' and 'Archivo General del Estado de Baja California Sur'. In México City, 'Hemeroteca Nacional' and 'Biblioteca Nacional' at Universidad Nacional Autónoma de México (UNAM). In the USA, we went to the Bancroft Library, a Californian library specializing in Baja California's documents.

Additionally, we interviewed 108 fishers selected from three generations in 11 fishing communities of central Baja California (Fig. 2): young (15–30 years, $n = 40$), middle-aged (31–54 years, $n = 34$), and old (≥55 years, $n = 34$) using a stratified sampling method. We questioned fishers from each age group specifically about the fishery for the Gulf grouper, asking them about the best day's catch they ever remembered landing, the largest animal they ever caught, and the years in which these remarkable catches were made. We asked them specifically to tell us about catches caught exclusively with hook and line and to draw on the ground or on a wall the length of the largest fish they had ever caught. This was then measured to the nearest centimetre and converted to biomass using a length–weight relationship ($W = aL^b$) (Hart and Reynolds 2002) with constants for *Mycteroperca* species published in FishBase (http://www.fishbase.org/search.cfm). Afterwards we plotted the 'best day's catch' and largest fish ever caught' reported by fishers against the year in which this catch occurred (Figs 5 and 6).

Interviews were conducted from May to September 2002. To ensure a representative sample, the questionnaire was answered by at least 5% of the fishing population in each of 11 localities visited (Bunce *et al.* 2000). The sample size for each locality and age class was determined from data in the State Population Census (see Table 1 and the questionnaire in Appendix 1 for more information on how the sample was selected). To approximate randomization, the questionnaire was applied haphazardly to fishers we met on the beach in each community until the appropriate sample size for each age category was reached. All interviews were conducted in private. We visited old retired fishers in their homes after asking younger fishers where we could find them. To these retirees, we also gave a semi-structured interview, which allowed them to relate anecdotes about past abundance of the Gulf grouper.

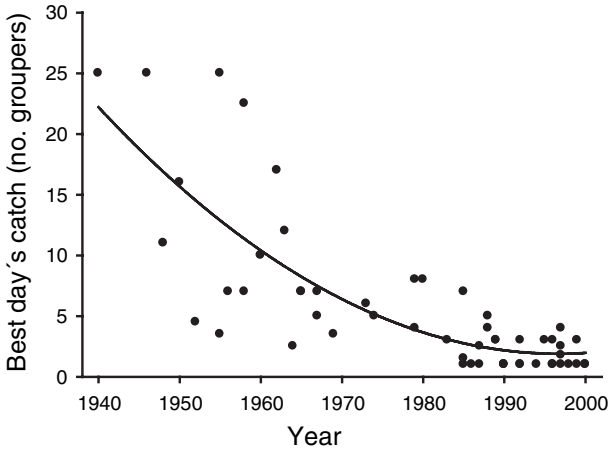

Figure 5 Size of the best day's catch for Gulf groupers plotted against the year in which the fisher remember landing it (with a second order regression line shown $r^2 = 0.62$, $P < 0.001$) (±95%CI). $Y = 25207.8–25.24X + 6.32X^2$.

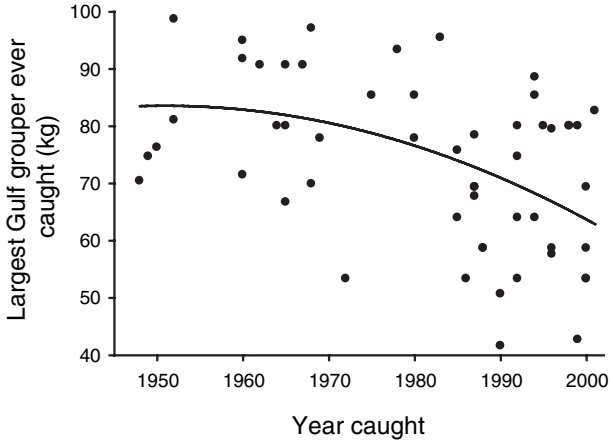

Figure 6 Second order regression for weight of the largest Gulf grouper fishers' recalled vs. year in which it was landed (with a second order regression line fitted, $r^2 = 0.21$, $P < 0.001$) (±95%CI). Line of best fit $Y = -31310.45 + 32X + 6.32X^2$.

Old reports about the Gulf grouper

Old documents found in local archives show that the picture of the Gulf grouper being a species for which catches are either increasing or unstable is just an artefact of analysing population trends using only recent information. For example, in a tourist guide published in 1954 which specialized in economics, the Gulf grouper was listed along with three species of large snappers as being 'among the species for which profitable exploitation could be considered' (Anonymous 1954). This matches a 1960 report on local catches found in a box labelled 'fisheries' in the state archive (Anonymous 1960). This document reports state fish landings that were collected by an isolated initiative of some local officer between September 1959 and May 1960. It shows that from the total state finfish production, the Gulf grouper comprised 45% of the catches. However, in a later 1970s document it is possible to see how this importance dropped rapidly from the beginning of that decade. A report sent by the head of the fisheries office to the Baja California Governor (Flores-Villegas 1973) shows that by 1970, 1971 and 1972, the percentage of the finfish fishery that was composed of Gulf grouper dropped to 10, 7 and 6% respectively. This trend has subsequently continued such that today the Gulf grouper comprises <1% of the state finfish artisanal catch (Rámirez-Rodriguez 1996).

Observations of naturalists also concur with these documents on past Gulf grouper abundance. In 1932, naturalist Bancroft (1932) wrote of the Gulf groupers from San Idelfonso Island in the central Gulf of California, 'In unimaginable numbers, from one edge to the other, Garopuas (sic) haunt the rocky ledges of coast and islands. If a jigger is trolled at a speed of about four miles an hour over the proper bottom there is no question of catching something, the only gamble is in species and size.

Table 1 Additional testimonies on the former abundance of Gulf grouper.

Source	Date and site	Quote
Interview with a 72-year-old fisher from Loreto	1950. Close to San Nicolas Village	'In the 1950s all the rocky shore north to San Nicolas was crowded with Gulf grouper. During the night, the needlefish spawned close to the coastal Sargassum. Loads! You could even hear the noise they were producing from the beach. Since Gulf groupers feed on needlefish, next morning, you could see hundreds of Gulf groupers with their dorsal spines outs of the water, eating needlefish'
Conversation with a 73-year-old fisher from San Nicolás	1960. Close to San Idelfonso	'40 years ago, north to San Nicolas, you could see loads of Gulf grouper' Interviewer: 'How many were loads?' 'I do not know; loads, groups of 500'
Interview with a 56-year-old diver from Santa Rosalía	1970 North Santa Rosalia	'North to Santa Rosalía, in the 1970s we saw a big group of around 100 Gulf groupers. They used to swim in circles, going up and down. I have not seen that behaviour anymore or such an amount of Gulf groupers nowadays'
Interview with a 74-year-old fisher from Mulegé	1958–1959 Close to Mulege	'Close to San Lino point, there is a place that used to be extremely productive for Gulf grouper. In 1958–1959 we used to catch six or seven big animals in just one hour. In those times there were more fish than you could imagine today'
Interview with an 82-year-old fisher in La Paz	1940. Punta el Calabozo in San Jose Island	'Do you want to hear about the heyday of the Gulf grouper? Well, I witnessed something that you will not believe. By 1940, in Punta el Calabozo a canoe was filled quickly with 25 groupers in just a few hours!'
Interview with a 68-year-old fisher from San Nicolás	1940s and 1950s Close to San Idelfonso Island	'In the 1940s we used to catch Gulf and leopard grouper with dynamite. We used around 12 cartridges with a large fuse, which allowed us to exploit the bottom. After several minutes, we started to see fish emerging at the surface' Interviewer: 'How many Gulf groupers do you calculate were killed each time you used this method?' 'I do not know, around 40…100 in total counting Gulf and leopard grouper'

The slogan 'a ton an hour' can often be bettered.' Garropa de astillero is the Spanish local name for Gulf grouper and garropa jaspeada for broomtail grouper *Mycteroperca xenarcha*. As the life stages of the latter are restricted to mangroves and estuaries, which are uncommon close to the San Idelfonso area, it is likely that Bancroft was talking exclusively about the Gulf grouper.

Croker (1937) of the California Division of Fish and Game concurred by writing ,'Sport fishermen who angle in Mexican waters encounter no difficulty in catching their fill of the abundant cabrilla and grouper'. In his notes, Crocker identified grouper as *Myccteroperca jordani* and cabrilla as another grouper *Epinephelus analogus*. He concluded by stating 'in fact, fishers find it virtually impossible to catch anything else along the rocky shores inhabited by these voracious and unwary fish that will strike at any moving object smaller than themselves'.

An interesting regret, general to large groupers and seabasses, of a famous sport fisher regarding the fate of these species helps to illustrate how abundant they were in the past and when fishing started to cause problems. In his middle age Ray Cannon – a former Hollywood actor and director – became a devoted sport fisher and writer from Baja California waters. Recognized as a father of the sport fishing industry in the area, he wrote more than 1000 sportfishing articles in the *Western Outdoors News* and a classic book *The Sea of Cortez*, which promoted this area as a fishing paradise for American anglers in the early 1960s. In 1961, Cannon wrote an article in which he expressed his doubts on the

pessimistic concern regarding groupers' fate, 'Considerable fear has been expressed that the great 50 to 100 year-old basses in the Gulf will be fished down and the anglers would have to wait another half century or so for replacements to grow up. The more I get around in this bountiful Sea, the more I doubt the pessimistic concerns… with an exception of the sites near cities and resorts the majority of the 6,000 miles of fishable shoreline in Baja California costal water are inexhaustible'. He quotes as an example, 'Cabo Virgenes', a pronounced and isolated reef between Bahía Concepción and Santa Rosalía, 'little times fished before I visited it…whenever we let out a lure a large grouper would latch on…Virgenes is only one of hundreds of isolated regions where bass and snapper populations will go on growing old'. Just a few years later, Cannon had second thoughts. By 1973 in his article *Giant bass should not be caught*, concerns on the longevity of these species in relation of their fecundity were expressed 'I will release every bass that looks like a 30-pounder' (Kira 1999).

Different experiences for fishers from different generations

Analysing fishers' memories of the best fishing day for Gulf groupers that they have ever had also provides a more complete picture of the Gulf grouper's past abundance (Figs 5 and 6). While old fishers recalled great catches in the 1940s and 1950s of up to 25 fish in a day, by the 1960s this had dropped to 10 or 12, and by the 1990s it was one or two (Fig. 5). This suggests at least a 10-fold reduction in abundance. Although memories of the golden days of a fishery have never previously been used as an indirect index of population trends, they provide support for views expressed by naturalists' observations and other old grey literature on the early days of this fishery. However, the real scale of the reduction is likely much greater than this because large catches remain possible so long as there are still unexploited or lightly fished areas. Remote offshore reefs have only been targeted recently. Trends based on the best day's catch might provide conservative estimates of the magnitude of decline as they are not sensitive to serial overfishing of sites. In combination, these lines of evidence show that Gulf grouper was an abundant fish in the past but that by the early 1970s much of the population had been removed.

Analysing fishers' memories of the largest fish ever caught also provided interesting insight, especially as the Gulf grouper may be an hermaphrodite. While the largest fishes caught from the beginning of the 1940s up to the end of the 1960s were ≥80 kg, from then on the average weight of the largest fish declined, falling to approximately 60 kg by 2000 (Fig. 6). If this fish is a protogynous hermaphrodite as many of the *Mycteroperca* species are (Heemstra and Randall 1993), it is possible that the male breeding population size has been greatly reduced since the early 1970s, potentially with serious impacts on breeding success (Coleman *et al.* 1996; Hawkins and Roberts 2004).

Some relevant stories

Punta Lobos and the history of *El Club de Vuelos*

El Club de Vuelos in Loreto was one the first resorts in Baja California to be developed on the basis of sport fishing. It started operating in 1951 and closed in 1963. As there were no commercial flights to the Peninsula or a paved road until the early 1970s, the company used its own B25 screw plane to bring tourists to Loreto. According to one of the former managers, the club promoted its activities on the basis of Gulf grouper catches in Punta Lobos and San Bruno Sea Mount (Fig. 2) and by the late 1950s and early 1960s the company owned six boats. For a fishing trip, the boats would leave Loreto at 5:00 hours and reach Punta Lobos or San Bruno Sea Mount by 6:00 or 7:00 hours. Back by noon, each boat would contain about 10–12 mostly large Gulf groupers. Weights varied from about 50–100 kg for the big ones, with the smallest being about 36 kg.

Old fishers we interviewed told us that Gulf grouper meat from Club de Vuelos catches was mostly given away to the poor in Loreto. However, in 1962 the former club owner, Taylor, found it profitable to export Gulf grouper filets to the USA using his own B25. Preserving the fish with ice brought down from the US, he made two or three weekly trips to San Diego. According to the former manager, Taylor's commercial venture stopped after two months, because of conflicts of interests with local cooperatives. Although Taylor's commercial operation was short-lived it provides valuable information for helping calculate how many Gulf groupers were around Punta Lobos at that time. A 73-year-old retired fisher who was part of Taylor's fishing team for just one month, told us that in May and June of 1962, Taylor's six boats were catching

35–40 Gulf groupers every day. We now know that these months fall within the Gulf grouper's breeding period (Sala *et al.* 2003). Calculating that fishermen would rest on Sundays and that the average daily catch was 37.5 Gulf groupers per day, around 900 fish would have been caught during each of those months. If each animal weighed an average of 70 kg, the productivity from a single site would have been around 63 tonnes of Gulf grouper in one month. Given that the highest productivity recorded from the entire central Gulf of California coast in recent years is just 60 tonnes in a whole year, such a monthly figure from a single site is remarkable.

In the last four years (2001–2004) two of us (Andrea Sáenz–Arroyo and Jorge Torre) have made just over 30 dives during the Gulf grouper breeding period. During that time we have observed a maximum of three Gulf groupers in Punta Lobos. We selected our diving sites on the recommendation of four old local fishers who worked for Taylor during the days of the Club. Hence a once prime spawning ground now appears to support very few fish.

Fishing with dynamite: the San Bruno seamount and the boat *La Avecita*

Almost all the old fishers we interviewed remembered the days when dynamite was commonly used for fishing. As an indication of when this activity began, a 63-year-old fisher from San Nicolas remembered that when he was a child 'interested for the first time in adult conversations', it was common to hear that someone 'lost a hand or even their life due to dynamite fishing'. The San Marcos Island Gypsum Mine, which opened in 1923 was apparently the most important provider of this dynamite. According to a young *San Marqueño*, who currently works as an engineer for the company, this practice stopped in the early 1960s when the company realized the amount of accidents that dynamite fishing was causing. Although fishers all associated dynamite fishing with the gypsum company, records show that this illegal activity first occurred some years before it was founded. For example, at a conference in 1918 of the Mexican Society of Geography and Statistics, one speaker complained about this practice and its possible nasty consequences on marine ecosystems 'to get better production without working, some fishers fish with dynamite, a terrible means that destroys all the animals' (Estrada, 1918 (1977)).

Whenever this activity did start, its consequences for the marine environment are still within living fishers' memories. Although most fishers remembered that dynamite was used to catch bait for other fisheries (e.g. sardines or small grunts), others remembered its effects on the Gulf grouper population. A 72-year-old fisher from San Nicolas remembered that in the 1950s the San Bruno Sea Mount 'was crowded with Gulf grouper until one year a ship named *La Avecita* from Guaymas threw in dynamite and killed thousands of animals'. He remembers that they could only carry away the boat's capacity of 70 tonnes from all the animals killed. Two former captains and one of the former managers from El Club de Vuelos confirmed the story about this boat and its effect on the Gulf grouper population. Assuming that the average weight of a Gulf grouper caught in Punta Lobos during the El Club de Vuelos venture was 70 kg, then a catch of 70 tonnes taken by that one boat from one seamount in a single day equates to the removal of 1000 Gulf groupers. Once again, this catch far surpasses the entire Mexican yield in recent years.

As part of a monitoring programme of the fisheries in the Loreto Bay National Park, our colleague, Erika Castañon, joined fishers on eight-day trips to the San Bruno Sea Mount during the Gulf grouper breeding period of 2002 and 2003. The fact that only a single grouper was caught during this time provides further evidence that Gulf grouper populations on this seamount were extirpated long before fishing statistics started being collected.

Other testimonies about former Gulf grouper abundance are provided in Table 2 and give increased weight to the view that the species has declined precipitously.

Discussion

As ecologists and fisheries scientists we are trained to disqualify most historical information as 'anecdotal'. This point is greatly lamented in Daniel Pauly's 'shifting baseline syndrome' paper where he contrasted the inability of fisheries science to incorporate past observations into current thinking, compared with disciplines such as astronomy or oceanography where insights are valued that can be thousands of years old (Pauly 1995). There is a major problem with this: erroneously, we are basing fisheries management decisions and the fate of

Table 2 Details of the sample of fishers in the central Gulf of California.

	Communities sampled				
	Santa Rosalía, San Bruno, Mulegé	Loreto, San Nicolás, Ensenada Blanca	Agua Verde, Tembabichi	Punta Alta, Los Burros, Nopoló	Total number of fishers from each age class
Total number of fishers	920[1]	326[2]	116[3]	45[3]	
Number interviewed					
15–30	20	9	7	4	40
31–54	15	9	6	4	34
≥55	14	12	5	3	34
Total fishers interviewed	49	30	18	11	108

Numbers obtained from
[1]Dirección de Fomento Pesquero.
[2]Loreto Bay National Park Programa de Ordenamiento Pesquero.
[3]Sociedad de Historia Natural ''Niparajá'' censo de embarcaciones pesqueras.
The age distribution of the population for each location was extracted from INEGI (2002).

marine species on a science that expects all its answers to come from packages of experimental data and recent observations. We are placing our faith in a science that naively reduces a holistic problem to only a few of its components. While this approach is useful in some respects, such as simplifying the dynamics of complex systems to tractable levels, by not looking far enough back in time, it prevents us from seeing the full extent of species depletion and from taking decisions with a correct historical context.

In his book 'The Landscape of History' Gaddis (2002), offers a solution to this problem. Addressing 'hard scientist's' who see history as unscientific, he invites them to reflect on the question of which sciences are actually historical. Evolutionary biology, for example, is an historical science. Just as no historian could have witnessed the collapse of the Roman Empire, no evolutionary biologist has ever seen a process of speciation. In both disciplines, scholars construct theories with all the evidence they have to hand. From this perspective, fisheries science and marine conservation biology is an historical science. In order to correctly explain the patterns and processes prevailing today, we need to consider how human impacts have affected wild population in the past. There is no way to design some experiment that can correctly explain the patterns and process prevailing today without considering human impacts over wild population in the past. First, we need to piece together all the available evidence of human impact over wild populations and then use this to help form our theories. This will need to be performed not just using the methods we are used to applying as fisheries scientists, but also employing methods used by historians. Indeed, what ecologists and fishery scientists call 'anecdotes' are for professional historians (like one of us, Micheline Cariño-Olvera), a very important source of knowledge. There is an entire specialty in history known as oral history, with its own methods to validate information recovered from oral testimonies (Joutard 1983; Lozano 1993).

The examples presented in this paper show that it is possible to use data contained in old documents, naturalists' observations, anecdotes and fishers' memories, to construct a more congruent history of the exploitation of the Gulf grouper than by only relying on recent fishing statistics. Piecing together all this evidence reveals that the Gulf grouper was abundant in the past and probably dominated the rocky-reef fish community in terms of biomass. It declined steeply in the 1970s and is now scarce and in danger of complete disappearance. Comparing three different sources of information suggests that populations have dropped to a few percent, at most, of the numbers present in the 1940s. Based on change in numbers aggregating to spawn, the decline could be greater than 99%. The extent and rate of decline from the 1940s to the 1970s would qualify this species to be considered as Critically Endangered, according to

criteria established by the World Conservation Union (80% or more population decline in 10 years or three generations) (Hudson and Mace 1996). However, if the same criteria were applied based on recent data and without any knowledge of early abundance, the species would not qualify for this category of concern. Assuming that because of its large size, the Gulf grouper is similar to the Goliath grouper in having a generation time of six years (Ault *et al.* 1998), then the maximum time period over which population decline could be assessed is 18 years. This dates back to the 1980's, which is well after the period of greatest decline. Using this baseline to assess the Gulf grouper means that the strongest possible assessment for it would be 'vulnerable', which is what the species is presently listed as, based on its small geographical range, vulnerability to fishing, and risk of future decline from intensifying fisheries.

We should start rethinking our criteria for assessing marine species at risk not just in the context of the shifting baseline, but also with respect to the type of information we require for these assessments. By only trusting the evidence that we are trained to use as ecologists or fisheries scientists we continue to run the risk of failing to adequately protect species that have been depleted without our noticing. A good example of how a species can almost disappear without raising concern is illustrated by the Chinese bahaba *Bahaba taipingensis*. This is a large fish from the croaker family (Sciaenidae) that used to spawn in abundance in rivers of southern China in the early 1930s (Sadovy and Cheung 2003). Up until the 1980s, the Chinese bahaba sustained a modest but valuable fishery based on the medicinal value of its swimbladder. However, no fishery data were ever collected nor was there any written history about the fishery (Sadovy and Cheung 2003). Today this fish is on the verge of complete disappearance. Its former abundance only became apparent after researchers pieced together knowledge obtained from old local fishers (Sadovy and Cheung 2003).

In both the Chinese bahaba example and the one we present for the Gulf grouper, fisher's knowledge enabled a reconstruction of historical exploitation. Increasingly, studies have found this type of information is crucial for not 'missing the boat' when designing fishing policies (Johannes *et al.* 2000). In their paper, Johannes *et al.* highlight the importance of fishers' traditional insight on migratory routes, nocturnal movements, temporal migrations, species behaviour and stock size. Other studies suggests that fishers' perceptions of how abundant a species was in the past are likely to be more accurate than has commonly been thought (Neis *et al.* 1999). For example, in the Canadian north Atlantic, fishers' perceptions of declining catch-per-unit-effort in the cod fishery proved to be similar to trends described by official statistics. Both fishing data and fishers' perception concurred that there was up to a 90% decline in catch-per-unit-effort (Neis *et al.* 1999).

In conclusion, the Gulf grouper may be at high risk of extinction without it being apparent from current fishery statistics. This could also be true for many other species exploited in multispecies tropical and semitropical artisanal fisheries. Reappraisal of historical catch and anecdotal data from industrial fisheries in temperate waters is also warranted. Unless we recognize fisheries science as an historical science and start to use historical information as well as modern statistics, we are likely to overlook some marine species that are under threat. Both forms of evidence are equally important for constructing the history of exploitation of marine species. On the basis of this research and from calls made by other workers on the importance of addressing long-term historical impacts (Pauly 1995; Jackson *et al.* 2001; Pitcher 2001; Christensen *et al.* 2003; Myers and Worm 2003; Roberts 2003; Roman and Palumbi 2003; Baum and Myers 2004; Jennings and Blanchar 2004), we recommend using historical methods to reassess the status of all marine species currently or previously exploited, if their life-history characteristics suggest they may be vulnerable to human impacts.

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Appendix

Questionnaire

Have you ever caught a Gulf grouper (*Mycteroperca jordani*)?

Yes ( ) No ( )

i. If your answer was yes, what was the size of a the largest fish of this species you ever caught

—— cm.

—— kilograms.

What year was this? ——

Where was it caught? ——

What type of fishing gear was used? ——

ii. How many Gulf groupers did you catch in your best day of fishing?

——

What month was this? ——-

In which year? ——

Where was it caught? —-