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Spearfishing to depletion: evidence from temperate reef fishes in Chile

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Abstract. Unreliable and data-poor marine fishery landings can lead to a lack of regulatory action in fisheries management. Here we use official Chilean landing reports and non-conventional indicators, such as fishers' perceptions and spearfishing competition results, to provide evidence of reef fishes depletions caused by unregulated spearfishing. Results show that the three largest and most emblematic reef fishes targeted mainly by spearfishers (>98% of landings) [*Graus nigra* (vieja negra), *Semicossyphus darwini* (sheephead or pejeperro), and *Medialuna ancietae* (acha)] show signs of depletion in terms of abundance and size and that overall the catches of reef fishes have shifted from large carnivore species toward smaller-sized omnivore and herbivore species. Information from two snorkeling speargun world championships (1971 and 2004, Iquique, Chile) and from fishers' perceptions shows the mean size of reef fish to be declining. Although the ecological consequences of reef fish depletion are not fully understood in Chile, evidence of spearfishing depleting temperate reef fishes must be explicitly included in policy debates. This would involve bans or strong restrictions on the use of SCUBA and hookah diving gear for spearfishing, and minimum size limits. It may also involve academic and policy discussions regarding conservation and fisheries management synergies within networks of no-take and territorial user-rights fisheries areas, as a strategy for the sustainable management of temperate and tropical reef fisheries.

Key words: conservation; diving; fishers; human dimensions; perceptions; policy; recreational and artisanal; shifting baselines; speargun fishing.

INTRODUCTION

Concern has been raised about the effects of spearfishing, a popular recreational and commercial activity in tropical and temperate regions, over the size and abundance of reef fishes and the broader ecosystem (Bohnsack 1982, Sluka and Sullivan 1997, Sadovy et al. 2003, Dulvy and Polunin 2004, Pequeño and Olivera 2005, Gillett and Moy 2006, Godoy 2008, Lloret et al. 2008). Despite this growing awareness, the difficulty in evaluating the current state of marine reef fish populations based on the history, magnitude and role of spearfishing as a driver of ecological change, has lead to a lack of regulatory action in many countries. An important constraint is the lack of systematic information on spearfishing landings, effort, and capture per unit effort. This is due to the use of multiple and/or isolated landing sites over wide geographical areas and the diversity of species targeted. Additionally, many landings are noncommercial (e.g., subsistence and recreational) and do not require reporting. Hence, to help inform fishery policy decision makers on the impacts of spearfishing, it would be advisable to use nonconventional sources of information, such as speargun fishing competition results (Dayton et al. 1998, McClenachan 2009), fishers' anecdotes (Pauly 1995), gray literature (Sáenz-Arroyo et al. 2005*a*), and naturalists' observations (Sáenz-Arroyo et al. 2005*b*, Roberts 2007, Lotze and Worm 2009) in addition to the available information on landings.

In Chile, over the past 30 years, spearfishing has intensified, due mainly to the opening of national and international markets and the lack of regulatory measures (Castilla 1994, Godoy 2008). In the early 1950s, following the arrival of wet-suit equipment, reef fish began to be targeted by speargun divers, mostly as a recreational activity. In 1956 the Chilean Federation of Underwater Sports was established, mainly composed of recreational snorkel spearfishers. Subsequently, during the last 20 years, following overexploitation and the implementation of management regulations for shellfish and algae (1991 Aquaculture and Fishing Law Number 18.899), targeted through diving, spearfishing has also become an important commercial activity for thousands of registered artisanal divers. These spearfishers mainly use hookah diving gear (air compressor from a boat), an activity that so far lacks regulation (SERNAPESCA 1979–2008, Fuentes 1981, 1982, Godoy 2008). Currently, seven species of reef fish are principally targeted in Chile. The three largest and emblematic are: the vieja

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negra, *Graus nigra*; the pejeperro or sheephead, *Semicossyphus darwini*; and the acha, *Medialuna ancietae*. Ninety-eight percent of total landings of these species comes exclusively from spearfishing (SERNAPESCA 1979–2008), providing a unique scenario for assessing the impacts of the speargun fishing on reef fish populations, without the confounding effects of gill nets or hook and line.

Spearfishing in Chile has no gear, size, or catch share regulations despite local awareness of declines in reef fishes landings (Pequeño and Olivera 2005, Godoy 2008), and international evidence of the threats of spearfishing using autonomous (SCUBA) or semi-autonomous (hookah) diving gear (Sadovy et al. 2003, Dulvy and Polunin 2004, Gillett and Moy 2006, Nevill 2006). Ironically, the fact that artisanal reef fish landing statistics are considered data poor has led to this lack of regulatory action (Godoy 2008). Therefore, further evidence on reef fish depletions, by the use of non-conventional indicators, may be key elements in overcoming fisheries agencies lack of understanding about the threats that spearfishing poses to reef fish populations. Thus, this study presents data on official reef fishes landing statistics, spearfishing championship results and artisanal divers' perceptions of the change in reef fishes availability; focusing on the composition, abundance and size of reef fishes targeted through spearfishing. This approach should provide enough evidence to initiate a policy debate on the impacts of spearfishing and the results would therefore have relevance to other countries where speargun fishing is not regulated or enforcement is poor.

Methods

Research setting.—In Chile, spearfishing is an important recreational and artisanal activity. Recreational spearfishing is exclusively performed by snorkeling divers, who must possess a recreational fishing license, issued by the National Fishery Service (Servicio Nacional de Pesca, SERNAPESCA). There are approximately 600 recreational snorkeling divers associated with the Federación Chilena de Deportes Submarinos (FEDESUB). The Federation organizes annual speargun championships (for which authorization is needed from SERNAPESCA), mainly along the central and northern Chilean coast, which have rules on fish size. According to the law, divers are required to submit landing records to SERNAPESCA. FEDESUB hosted snorkeling world championships in Iquique in 1971 and 2004. Artisanal speargun divers in Chile use hookah (semi-autonomous) and/or snorkeling gear to target reef fishes. Hookah divers operate from small wooden boats, while recreational and artisanal speargun snorkel divers operate from the shore. Regardless of the diving method used, artisanal divers must be registered in the National Artisanal Fishery Registry (Registro Pesquero Artesanal, RPA) implemented in 1991. For 2008 the RPA shows 2800 artisanal divers registered to extract reef fishes as part of their livelihood portfolios. This implies they have a statutory obligation to report landings to SERNAPESCA. In Chile, artisanal spearfishing (hookah or snorkel) operates without regulations on fish species minimum size limit, sexual maturity or reproductive periods. Importantly, artisanal spearfishers can also be registered as recreational FEDESUB snorkel divers, since these are not exclusive categories.

In Chile, spearfishing targets seven main reef fishes: The carnivores pejeperro or sheephead, *Semicossyphus darwini*; vieja negra, *Graus nigra*; rollizo, *Pinguipes chilensis*; apañao, *Hemilutjanus macrophthalmos*. The omnivores acha, *Medialuna ancietae*; pintacha or bilagay; *Cheilodactylus variegatus* and the herbivore jerguilla, *Aplodactylus punctatus* (Cáceres et al. 1993, Palma and Ojeda 2002). This fauna is endemic to the southeastern temperate Pacific (Ojeda et al. 2000).

Reef fish landings.—In Chile, fish landing reports are available from 1936 onward, although reef fishes have only been reported since 1979. In this study, we used reef fish landing information from Chilean administrative Regions I (18°27′ S–70°20′ W) to V (30°54′ S–71°31′ W) (see Castilla 2010), where spearfishing is concentrated. The relative landing contribution of the largest and most targeted species, *G. nigra*, *S. darwini*, and *M. ancietae*, and small sized *H. macrophthalmos*, *P. chilensis*, *C. variegatus*, and *A. punctatatus* were analysed. To estimate the total number of artisanal speargun divers, we collected information between 1991 and 2008 from the RPA; information prior to 1991 was unreliable. Since every diver can register more than one species of fish, shellfish or algae, with the RPA, we filtered the information to include only divers registering extraction of reef fish species caught by spearfishing.

Speargun reef fish world championships.—In Chile, two snorkeling spearfishing world championships (1971, 2004) took place inside Iquique Bay (20°13′ S–70°08′ W). The championships lasted two days each, with six hours of daily diving (approximately 08:00–14:00). According to FEDESUB (1971, 2004), calm sea conditions, maximum wave size and visibility in both championships where similar. In both events the minimum weight for fish captured was set at one kg. In the 1971 and 2004 events catch restriction rules imposed by championship organizers differed in two aspects. In 1971 spearfishing of *S. darwini* was allowed, while in 2004 it was forbidden. Thus, we excluded *S. darwini* from the 1971 data set. In the 2004 championship an informal (not registered in official log books) maximum catch share per diver was implemented at 10 fish per species. Thus, overall catches and CPUE cannot be compared statistically for the two events. As individual diver report forms included the species identification, number, and mass of each fish, we estimated: (1) the average mass of reef fish caught by a diver (kg/diver); (2) the percentage of fish discarded by each diver (fish < 1 kg). Our results are based on the first

TABLE 1. Sampled artisanal speargun fishers in northern and central Chile.

Location	Age class of interviewed artisanal speargun fishers: Young (≤30 yr)	Middle (31–50 yr)	Old (≥51 yr)	Total
Arica	3	4†,‡	5	13
Iquique	5	14	4§	23
Antofagasta	4	6	4	14
Huasco	5	5	4	14
Coquimbo	6	25	7	38
Los Vilos	5	10¶	6#	21
				123

† Interviewees include Miguel Soto, snorkeling speargun world championship, Portugal, 2007.
‡ Interviewees include Ludwin Duarte, captain of snorkeling speargun Chilean team, 2007.
§ Interviewees include Raúl Choque, snorkeling speargun world championship, Chile, 1971.
¶ Interviewees include Franco Bosquez, Pan-American snorkeling speargun championship, Venezuela, 2007.
# Interviewees include Erwin Tapia, South American snorkeling speargun championship, Peru, 1988.

20 ranked divers, to standardize between years. Results were compared using t test methods.

Interviews with artisanal speargun divers.—Between January and December 2007, we interviewed 123 artisanal spearfishers registered for extraction of reef fishes in the RPA, based in six cities/towns covering the regions in Chile where spearfishing activities are centered: Arica (18°27′ S–70°20′ W), Iquique (20°13′ S–70°08′ W), Antofagasta (23°38′ S–70°23′ W), Huasco (28°27′ S–71°14′ W), Coquimbo (29°57′ S–71°20′ W), and Los Vilos (31°54′ S–71°31′ W). Fishers where selected from three age classes: (1) young, less 30 years old; (2) middle-aged, from 31 to 50 years old; (3) old, more than 51 years old (Table 1). Questionnaires were administered in a face to face manner and included a section where fishers were asked about the largest fish they ever caught and the best catch they remembered when spearfishing for the emblematic species: *S. darwini*, *G. nigra* and *M. ancietae*. Answers were grouped into the three age classes. Differences in "best catch" and "largest fish" were tested using ANOVA and Tukey honestly significant difference (hsd) test. Prior to this, the data were tested for normality and homocedasticity with Kolmogorov-Smirnov and Levene's tests, respectively. Additionally, the questionnaire asked fishers to identify the year or decade (only one point in time) in which the interviewee remembered catching the largest fish and the best catch for *S. darwini*, *G. nigra*, and *M. ancietae*. Finally, the questionnaire asked about changes in the composition of species captured and for an appreciation/judgement of the status of the reef fishery in the area. Fifty spearfishers were interviewed for *M. ancietae*, since this species is restricted to the coast between Arica and Antofagasta.

RESULTS

Reef fish landing statistics.—Long-term Chilean official landing statistics for reef fishes include three large carnivore species: *S. darwini*, *G. nigra*, *H. macrophthalmos*, and the omnivore *M. ancietae*. Starting in 1981, smaller sized species have gradually been included in reef fish landings: since 1981, the carnivore *P. chilensis*; since 1997, the herbivore *A. punctatus*; and since 2004, the micro-carnivore *C. variegates* (Fig. 1). Maximum reef fish landings were observed between 1986 and 1990 (approximately 900 tons/yr), with *G. nigra* and *S. darwini* accounting for up to 80%. Between 1998 and 2009, total reef fish landings in Chile fluctuated around 90 tons per year, with an increased contribution of the smaller sized species, *P. chilensis*, *A. punctatus*, and *C. variegatus*, which accounted for approximately 85% of total reef fish landings between 2006 and 2008 (Fig. 1). Importantly the herbivore *A. punctatus* accounts for 30% of these landings.

The RPA shows an increase over the years in the number of speargun divers indicating at least one species of reef fish as a livelihood alternative, with 600 registered in 1991 and 2800 in 2006 (Fig. 1).

Spearfishing championship results.—When comparing the 1971 and 2004 world championships held in Iquique, the average (±SD) mass of reef fish captured in 1971 of 2.159 ± 0.29 kg, was significantly greater than the 1.414 ± 0.518 kg caught in 2004 ($t = 7.91$; $P < 0.0001$; Fig. 2A). The percentage of fish discarded in 1971, 11.33% ± 2.40%, was significantly lower than the 36.76% ± 16.03% in 2004 ($t = 9.92$; $P < 0.0001$; Fig. 2B). In addition, the average number of total (multiple species) reef fishes caught by a diver in 1971 was 18.54 ± 14.80, while in 2004 it was 4.73 ± 4.11; with no diver reaching the maximum limit of 10 reef fish for any given species.

Interviews with speargun fishers.—Divers' responses to the semi-structured interviews regarding catches of reef fishes show that 70% of interviewees perceived a negative change in the composition of the catch, with large carnivore and high value emblematic species being replaced with smaller sized, lower value, and herbivore fishes. These 70% of divers agreed that this change had taken place during the last 10–15 years. Divers also perceived that the number of hookah reef fish divers involved in spearfishing had increased. In fact, 55% of interviewees mentioned an increase in fishing effort associated with hookah spearfishing. Reef fishes are seen as an important livelihood activity by 92% of artisanal snorkeling and hookah divers interviewed, however only 78% of them acknowledge that using the speargun with hookah diving gear was an important trigger driving emblematic reef fishes over exploitation. Additionally, 100% of interviewed fishers perceived that the main reef fishes showing signs of overexploitation (a decrease in landings and sizes) are *S. darwini*, *G. nigra*, and *M. ancietae*.

Largest fish ever caught.—When fishers were asked to state the size and year/decade in which they caught their

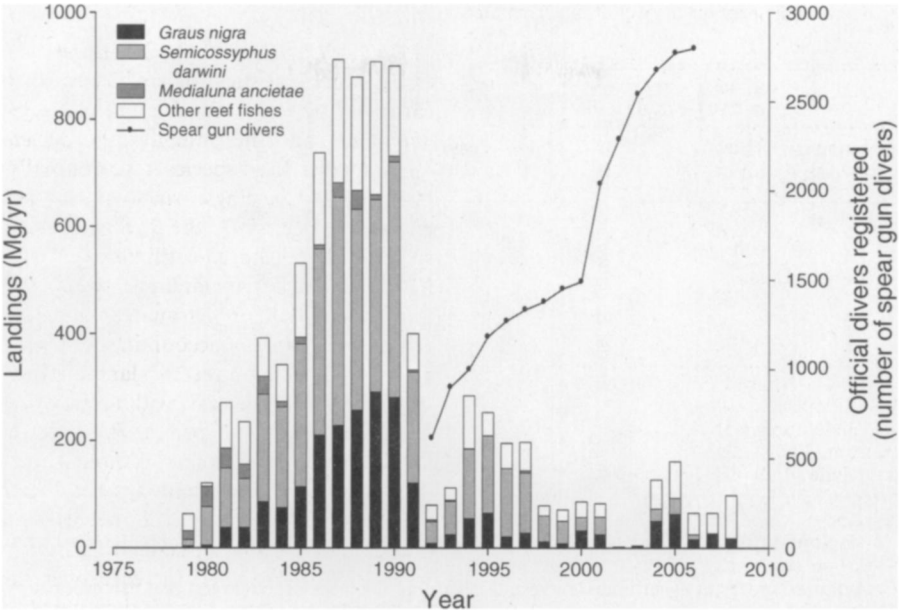

FIG. 1. Total official reef fish landing statistics (from SERNAPESCA) showing the landing of the main temperate reef fishes and the official speargun diver register.

largest fish, results show that the largest fish were harvested between 1960 and 1980. In fact, when a linear regression was fitted between the mass of the largest fish ever caught and the year caught, a negative slope was obtained for *S. darwini, G. nigra*, and *M. ancietae* (Fig. 3A–C), with *G. nigra* showing the smallest slope. Shifting perspectives regarding the largest fish ever caught were also evident across the three age classes of fishers analyzed. The mean weight for *M. ancietae* was 13 kg for old fishers, 10 kg for middle-aged fishers, and 4 kg for young fishers ($F_{2,49} = 39.84$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 3D). Similar tendencies were found for *S. darwini* ($F_{2,122} = 94.29$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 3E) and for *G. nigra* ($F_{2,122} = 64.49$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 3F).

Best catch in a day.—When fishers were asked to state the year/decade in which they had caught their best individual catches, higher values were reported by older fishers who remembered their best day's catch between 1960 and 1980 for *S. darwini*, *G. nigra*, and *M. ancietae*. When a linear regression was fitted between the best catch and the year the catch was reported, the result were significant, with negative slopes for the three species (Fig. 4A–C). Shifting perspectives regarding the best day's catch were also evident across the three fisher's age classes (Fig. 4D–F). The average abundance of the best day's catch showed a significant decrease in the number of reef fishes caught from the older divers towards the younger divers. The mean best day's catch of *M. ancietae* was 18 fish for old divers, seven for middle-aged divers, and one for young divers ($F_{2,49} = 103.07$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 4D). The mean best day's catch of *S. darwini* showed a similar tendency, with mean catches of 25 fish for old divers,

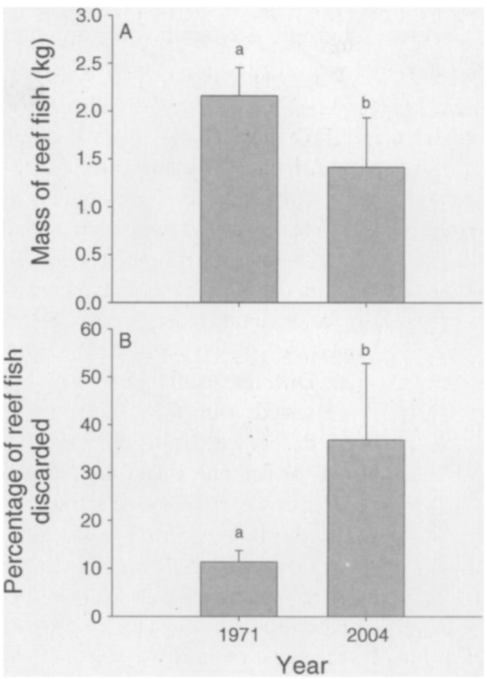

FIG. 2. World championships reef-fish speargun results for (A) average mass of reef fish (kg) and (B) percentage of reef fish discarded in the bay of Iquique in 1971 and 2004. Different lowercase letters above bars indicate statistically significant differences.

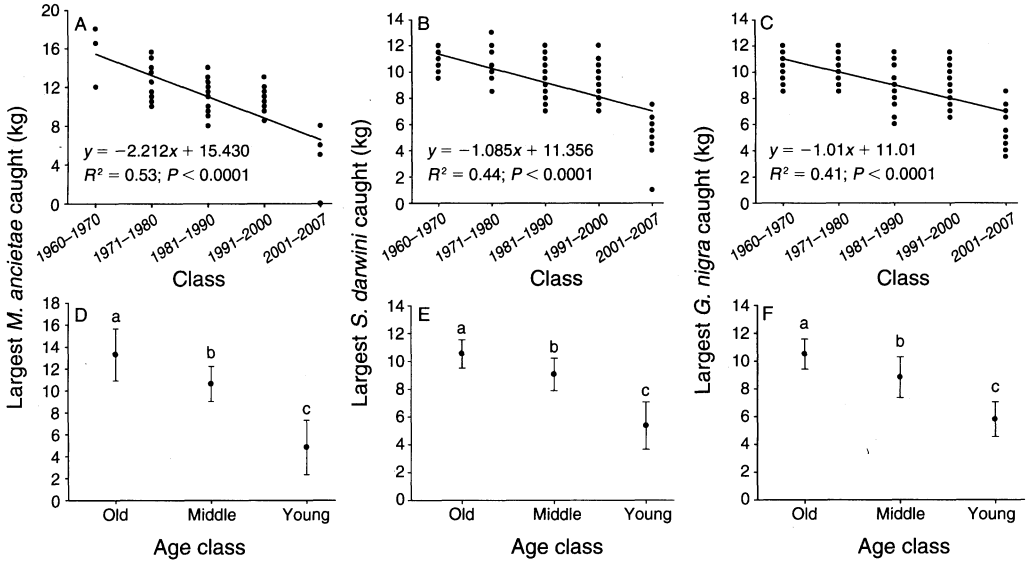

FIG. 3. (A–C) Artisanal speargun fisher interview results regarding the mass of the largest reef fish ever caught plotted against the decade in which it was captured and (D–F) the mean mass (±SD) of the largest fish ever caught for three age classes of fishers regarding *Medialuna ancietae*, *Semicossyphus darwini*, and *Graus nigra*.

10 for middle-aged divers, and two for young divers ($F_{2,122} = 70.52$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 4E). The *G. nigra* best day's catches also showed shifting perspectives with 18 fish for old divers, 10 for middle-aged divers, and four for young divers ($F_{2,122} = 123.26$, $P < 0.001$; hsd test, all groups are significantly different at $P < 0.05$; Fig. 4F).

DISCUSSION

One of the major limitations on regulating spearfishing is that the official fishery data are rather poor. This situation is found in many tropical (Johannes 1998) and temperate (Defeo and Castilla 1998, Godoy 2008) near shore marine fisheries. Evidence suggests that in these cases the development of fishery management policy options requires the combination of multiple sources of

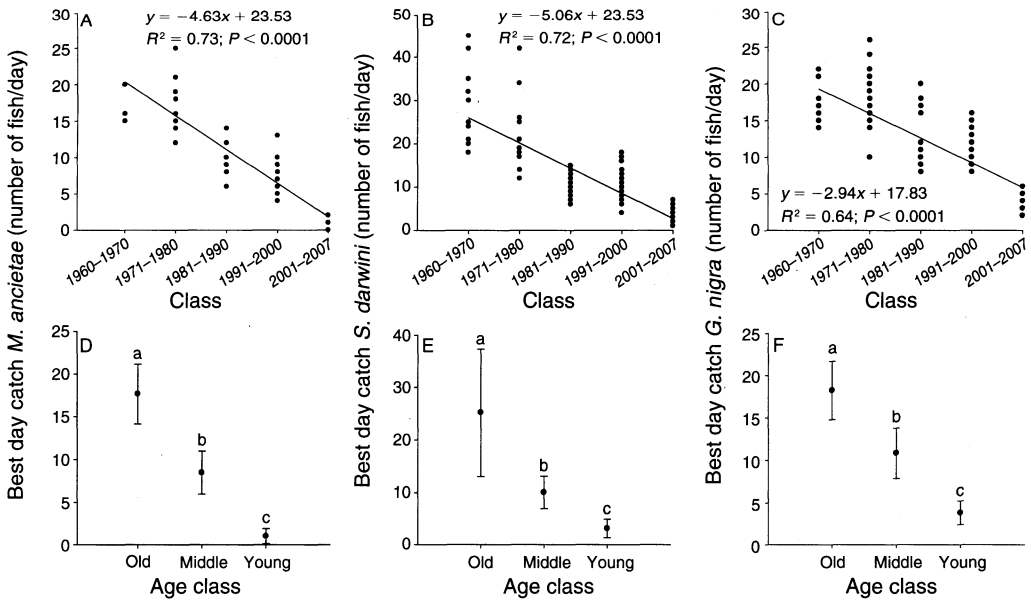

FIG. 4. (A–C) Artisanal speargun fisher interview results regarding the best catch in a day (number of fish) plotted against the decade in which it was captured and (D–F) the mean maximum number of fishes caught (±SD) for three age classes of fishers regarding *Medialuna ancietae*, *Semicossyphus darwini*, and *Graus nigra*.

information in order to understand the historical status and dynamics of fisheries (Johannes 1998, Sadovy et al. 2003, Cheung and Sadovy 2004, Lotze and Worm 2009). Currently, the number of scientific studies using multiple sources of information to address resource collapses in data-poor fisheries is growing (Pauly 1995, Sáenz-Arroyo et al. 2006, Ainsworth et al. 2008, Godoy 2008, Pinnegar and Engelhard 2008, McClenachan 2009). These studies provide important evidence of depletions, in terms of number, abundance and size, of reef fishes, sharks and invertebrates (Baum and Myers 2004, Dulvy and Polunin 2004, Sáenz-Arroyo et al. 2005*a*, Ainsworth et al. 2008, Bunce et al. 2008, Knowlton and Jackson 2008, Lozano-Montes et al. 2008). This study shows that unregulated spearfishing has depleted reef fishes in temperate near shore ecosystems along part of the Chilean coast and has also caused shifts in the composition of catches over time. Thus signaling a spearfishing reef fish crisis, a usual prerequisite for initiating policy discussions aimed at the sustainable management of fisheries (Makino and Matsuda 2005, McClanahan and Castilla 2007, Castilla and Gelcich 2008, Olsson et al. 2008, Castilla 2010).

Results suggest that three large and emblematic reef fish species, *G. nigra*, *S. darwini*, and *M. ancietae*, were depleted by the end of the 1990s. According to official landing information, since 1998 reef fish landings have declined to around 10% of historical levels; signaling fishery collapses according to collapsing criteria used by Worm et al. (2006). Data from two snorkeling speargun world championships held in Chile (1971 and 2004) show how the overall size of reef fishes catches have also declined. Additionally, artisanal (snorkel and hookah) divers' perceptions concerning reef fish landings indicate a reduction in overall abundance and size. In general, older reef fish divers perceived and remembered catching higher abundances and larger sized reef fishes. This perception changes when consulting middle-aged and younger divers. The collapse of the *M. ancietae* fishery is particularly dramatic, with the species being practically unknown to young generations, as one hookah diver stated (in Iquique in 2007): "Acha [*M. ancietae*] is a fish that has been almost totally exterminated in the last 10 years, if you catch one you are extremely lucky. I have only caught three in my life. However when I was a boy we use to eat a lot of acha . . . ." This situation is similar to the local extinctions reported for the giant humphead parrotfish, *Bolbometopon muricatum*, where speargun fishing was identified as the primary threat (Dulvy and Polunin 2004). Furthermore, artisanal speargun divers in Chile perceive that diving with hookah gear, to target reef fishes, has been a main cause for their overexploitation. Similar evidence suggests that heavy SCUBA spearfishing pressures across the tropical Pacific have caused, and continue to cause, severe declines in reef fish populations (Gillett and Moy 2006).

Spearfishing in Chile is highly selective for large-bodied species that show site fidelity such as *S. darwini* and *G. nigra* (Vásquez 1993). Research in other near shore ecosystems has shown that fish with such life history traits are particularly vulnerable to overexploitation (Dulvy et al. 2003, Sadovy et al. 2003). Additionally, spearfishing in the Pacific Islands and on the coast of California (a similar temperate subtidal near shore ecosystem) shows that reef fish overfishing had direct and indirect effects over subtidal reef community structure and the broader ecosystem (Dayton et al. 1998, Gillett and Moy 2006). For example, the California sheephead, *Semicossyphus pulcher*, is considered an essential predator regulating sea urchin populations, with indirect ecological effects on kelp density (Tegner and Dayton 1981, Cowen 1983, Dayton et al. 1998). In Chile, trophic studies on the sheephead, *S. darwini*, suggest a similar ecological role, as the species feeds on the black sea urchin, *Tetrapygus niger*, which has been reported as having an important role in structuring subtidal kelp communities (Vásquez et al. 2006). *G. nigra* shares several feeding characteristics with the sheephead (Moreno 1972, Fuentes 1982) and also plays an important role in structuring kelp forest communities (Vásquez et al. 2006). Unfortunately, subtidal ecological information in Chile is scarce, which for the moment makes it impossible to assess these hypotheses and thus the wider ecosystem effects associated with reef fish depletions remain unrecognized.

In addition to depleting large and emblematic reef fishes, spearfishing has also shifted the composition of reef fish catches from large carnivore/omnivore fishes, toward smaller sized omnivore and herbivore species. Signaling that spearfishing has caused a "fishing down the food web" situation (i.e., fishing at lower trophic levels), similar to that reported in larger scale fisheries (Pauly et al. 1998). Raúl Choque, the Chilean snorkeling speargun world champion in 1971, describes this phenomenon as: "Before 1985 the main target species were the large carnivore rocky fish, [*G. nigra*, *S. darwini*], however today we catch anything, even the Jerguilla [herbivorous reef fish], which no one used to eat 10 years ago because of its bad taste . . . ." The ecological consequences of a depletion in high trophic fishes generally entail regime shifts to less desirable ecosystem states (Bohnsack 1982, Bellwood et al. 2004, Guidetti 2006, Eriksson et al. 2009).

Spearfishing with SCUBA or hookah, while banned in many countries, is still permitted in many regions of the world such as in the southeastern Pacific (Chile, Peru, Ecuador), western Australia, Tasmania, and many Pacific Islands (Gillett and Moy 2006, Nevill 2006, Godoy 2008). In addition, night spearfishing is still permitted extensively around the globe. These situations need urgent review and portray the absence of understanding on the part of fisheries agencies concerning the ecological consequences of reef fish depletions. In Chile, scientific, as well as local divers' knowledge on reef fishes depletion, has accumulated and must now be included in the public policy debates concerning management

options. An urgent discussion on the banning of SCUBA and hookah-diving gear for spearfishing is necessary (see Sadovy et al. 2003, Gillett and Moy 2006, Nevill 2006, Godoy 2008). Also, there is a need to improve reef fish landing statistics, add information on CPUE and to incorporate biological regulations on minimum fish size and total catch per diver.

In terms of spatial management, evidence shows that No-take Marine Protected Areas (MPAs) protect reef fishes targeted by spearfishing (Roberts and Polunin 1993, Jouvenel and Pollard 2001), which can potentially generate benefits for the fishery through spillover (Meyer 2007). In addition, partially protected areas such as Territorial User Rights for Fisheries (TURFs) have been shown to support higher abundances and richness of reef fishes than open-access areas (Gelcich et al. 2008*a*, Lester and Halpern 2008) and to foster local environmental stewardship (Gelcich et al. 2008*b*). Thus initiating policy discussions regarding the synergistic effects of MPA-TURF combinations with respect to reef fish regulations is a timely global challenge. Chile is at the forefront of this challenge as 707 TURFs have been decreed during the past 10–15 years, accounting for ~1100 km^2 near shore habitats (Gelcich et al. 2008*a*). Although Chilean TURFs were created to manage benthic resources they also support a significantly greater abundance and biomass of reef fishes (Gelcich et al. 2008*a*). Chile is beginning to create a network of MPAs combined with TURFs (Gelcich et al. 2009, Tognelli et al. 2009). This unique national scale network could serve as a basis for testing the potential of integrating place based conservation and management policies. Hence initiating a policy debate regarding the implementation of regulations for reef fish fisheries, and developing research on reef fish home ranges and larval dispersal are critical issues. Time is short, and action is required, in order not to loose a unique opportunity to manage and conserve reef fishes, divers' livelihoods and coastal artisanal communities' fishery identities.

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