Environmental Challenges 4 (2021) 100110

Contents lists available at ScienceDirect

Environmental Challenges

journal homepage: www.elsevier.com/locate/envc

Reported capture, fishery perceptions, and attitudes toward fisheries management of urban and rural artisanal, small-scale fishers along the Bahía de Banderas coast, Mexico

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ARTICLE INFO

Keywords:
Small-scale fishing
Attitudes
Perceptions
Urban
Rural
Mexico

ABSTRACT

Artisanal fishing is a very important activity for the subsistence of coastal inhabitants in Latin American countries. Increasingly, what has traditionally been a rural activity is being enveloped by urban expansion, resulting in urban-based artisanal fishers. We administered 98 questionnaires to artisanal fishers along the Jalisco coast of the Bahia de Banderas, on the Pacific Coast of Mexico. Approximately half of the participants belonged to each of urban (Puerto Vallarta) or rural collectives. The aim of the study was to understand the differences and similarities between urban and rural fishers with respect to demographics, fishing behaviors, assessments of past, current, and future fishing resources, attitudes towards fisheries management, and perceptions of human-environment relationships. The respondents represented an aging demographic with a low level of education. They reported catching 27 different species of fish, primarily of the Family *Lutjanidae*, although rural fishers reported a greater variety of species captured. Half of the respondents supplement fishing with a second form of income, a trend that is more prevalent in rural fishers. Fishers indicated that fishing was better in the past and predicted it will be poorer in the future; rural fishers were more negative about fishing conditions. Almost all fishers were concerned about the health of fish populations and three-quarters of them felt that fish populations are disappearing. Specific fishing practices were the highest cited problems facing fishing and making changes to these problems was identified to improve fishing. Half the respondents felt that there is conflict between artisanal and commercial sport fishers, but this is more prevalent in urban fishers. Respondents indicated that fishery managers need to do their job (e.g. resource monitoring, enforcement) and apply fisheries laws in order to help improve regional fisheries. Overall, concerns for a future sustainable fishery are reflected in an ecocentric view of humanity and nature by both groups, although it is often statistically greater in urban fishers. These results provide an insight into differences between urban and rural fishers that can be useful for local fisheries collectives, regional and federal fisheries management agencies, as well as global approaches to small-scale fisheries.

1. Introduction

1.1. The nature of small-scale fishing, including the Pacific Coast of Mexico

Small-scale, artisanal fisheries are defined by "a diverse and dynamic set of activities that include various low-technology, low-capital fishing methods, as well as fish processing and marketing, boat building and net making," (FAO, 2015) as well as labor-intensive activities that are coupled with relatively low productivity (Béné et al., 2015). Characteristics of small-scale fisheries include small boats, either unpowered or powered by small outboard engines with limited off-shore range, use of passive, non-towed, traditional capture gear such as hooks and gillnets, and small crews of only several people (FAO, 2015; Ramirez-Acosta, 2008). Globally, 120 million people work directly in commercial capture fisheries, but greater than 90% of these work in small-scale fisheries, 97% of whom live in developing countries (FAO, 2015). Almost half of people working in small-scale fisheries are women, the majority of whom work in the post-capture activities of processing and selling (FAO, 2015).

Although their activities do not often contribute significantly to gross national products, small-scale fisheries provide important livelihoods, economies, nutrition, and food-security for many local communities (Bravo-Olivas et al., 2015; Chavez-Dagostino et al., 2018; Weeratunge et al., 2014). However, fishers working small-scale fisheries have been recognized as a vulnerable sector of developing country populations (Béné et al., 2007; Cruz-Romero et al., 1991; FAO, 2015, 2019a,b; Kittinger, 2013; McGoodwin, 2001), including environmen-

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https://doi.org/10.1016/j.envc.2021.100110
Received 26 November 2020; Received in revised form 25 March 2021; Accepted 9 April 2021

tal, income, health, working condition, and political marginalization dimensions (Béné et al., 2015). The Food and Agriculture Organization of the United Nations (FAO) has recognized the challenges facing small-scale fishers. Based on the United Nations' 2030 Agenda for Sustainable Development (United Nations, 2015), the FAO has produced voluntary guidelines for the management of small-scale fisheries (FAO, 2015) and has recently recommended targets to improve social protection of small-scale fishers in the Mediterranean (FAO, 2019a) as well as Latin America and the Caribbean (FAO, 2019b). These targets are rooted in "policies and programs that address the economic, environmental and social vulnerabilities of food insecurity and poverty through the protection and promotion of livelihoods" (FAO, 2017).

The ecological management of small-scale fisheries is also a complex issue. This is due to factors such as multiple users (e.g. permitted and non-permitted), target species, and types of gear (Salas et al., 2007). Often, lack of government infrastructure and resources result in poor monitoring practices and data (Espinosa-Romero et al., 2014). These issues have often led to over-exploitation of the resource (FAO 2019a,b; Salas et al. 2007), which can exacerbate the economic and social concerns inherent in small-scale fisheries.

On the Pacific coast of Mexico, small-scale fishers mainly operate through fishery cooperatives (Bravo-Olivas et al., 2015; Chavez-Dagostino et al., 2018; McKay et al., 2014), which should theoretically provide a collective voice for social, economic and environmental management of the fisheries. While McCay et al. (2014) found the infrastructure of the cooperatives in Baja California (northern Pacific coast of Mexico) illustrated a capacity to encourage co-management and respond to environmental changes, the same has not been documented elsewhere. Structural marginalization of small-scale fishers has been observed in Manzanillo, including property rights conflicts, environmental degradation from tourism infrastructure, and competition with sport-fishing (Doyon, 2002). Fisheries management in Mexico is federally managed by a centralized agency, the National Commission for Fisheries and Aquaculture (CONAPESCA), although there are regional, state offices and CONAPESCA has the legal authority to delegate responsibility to state authorities. This centralized management structure has not served Mexican community fisheries well (McKay et al. 2014), either environmentally or socially.

As developing country coasts become increasingly urbanized, many areas that used to be rural fishing communities are now part of urban expansion processes in which small-scale fishing communities have been competing for space with numerous coastal economic activities such as the tourism industry (Chavez-Dagostino et al. 2018). Kadfak (2019) pointed out that there is a lack of urban fisheries studies and that the narratives of small-scale fisheries have largely been based on rural contexts, which often portray small-scale fishers as either inefficient and/or vulnerable. The author found that urban fishers in India are active agents in urbanized communities and have been benefiting from the urban economic diversification, including intensification of fishing vessels and gears and exploring multiple activities, largely within fisheries. Kadfak's findings indicate that fishermen are not losing out but instead continue to fish with high returns. He also calls for more emphasis on research into urban issues in small-scale fishing communities.

The goal of this study was to investigate current fishing activities, perceptions of fishing success and sustainability, opinions regarding fishery management, and perceptions of the environment within the urban and rural small-scale fisher communities in the area surrounding Puerto Vallarta, in Bahia de Banderas, Mexico. The study area provides an excellent example of a growing urban area that has subsumed some rural fisheries into urban environments, but in which both groups fish the same resource. The results will prove useful to the regional fisheries collectives in the study area, regional and central offices of CONAPESCA and future FAO initiatives that aim to improve the lives of regional small-scale fishers. We accomplished data collection through a questionnaire that collected both quantitative and qualitative data.

1.2. Description of study area

Our research took place along the shore of the Bahía de Banderas, within the state of Jalisco, on Mexico's central Pacific coast, where we visited eight locations, comprising 12 fishery collectives, four urban and eight rural (Fig. 1). Urban fishers in this study live within and operate from the city of Puerto Vallarta (population 203, 242 (IIEG, 2019)), while rural fishers live in small communities, often right by the ocean and their boats, along the coast of the Bahía de Banderas (rural area population, 124, 205 in the most recent survey (SEDESOL, 2013)), primarily to the south of Puerto Vallarta. Urban fishers operate out of urban marinas, where they must pay to moor their boats, while rural fishers most often pull their boats up onto the beach or within a river mouth. Urban fishers have close access to numerous fishery markets and restaurants to sell their catch, while rural fishers have less options to sell their catch locally and some travel closer to the city to sell it.

Coastline distance from the Jalisco-Nayarit border to Cabo Corrales is approximately 75 km. The fishery is mainly done through regional, community collectives, aboard small, outboard-powered boats called "pangas," using gear such as "chinchorros" (gillnets set overnight), "trasmayos" (gillnets that are pulled in from shore), "cimbras" or "palangres" (vertical long lines with many baited hooks that are set on floats overnight), hand lines, and scuba diving equipment in a few cases. While some of the research regarding the local fishery is dated, the ecological and social difficulties associated with small-scale fisheries have been documented. For example, many fishers work without permits, it is estimated that nearly 40% of the catch is unrecorded, and there is poor management infrastructure (Alcalá-Moya, 1995; Bravo-Olivas et al., 2014; Esquivel-Hernández, 1999; Martínez-González and Lopez-Prado, 2014; Villaseñor-Anguiano and García de Quevedo, 1990). Since the 1970's, communal lands on which the collectives resided have been subject to government forced sale, and thus relocation of fishers, to make way for tourism infrastructure development (Andrade Romo, 2010). More recently, Bravo-Olivas et al. (2015) examined the quality of life (QOL) of the local fishers. High mean QOL scores were recorded for family, friends, and air, while low scores were found for holidays, transportation, and living costs. Fishers tended to indicate QOL gaps related to "mind" (e.g. anxiety, stress, fatigue) and "work" (e.g. little work, poor catch, little financial support). More specifically, Chávez-Dagostino et al. (2018) examined quality of life of artisanal fishers versus the development of tourism activities along the Jalisco coast. The authors concluded that there was evidence to support higher QOL in areas with developed tourism but no conflict.

2. Materials and methods

We designed a questionnaire to collect data concerning demographics, fishing behaviors, perceptions of past, current, and future fishing conditions, attitudes towards fisheries management, and perception of humans and nature. The administration of the questionnaire was approved through the Brandon University Research Ethics Committee (certificate #21683) and informed consent was obtained through an introductory letter and a consent to participate check on the questionnaire before the questions were answered. Questions were a mix of closed and open-ended questions. We administered the questionnaires in Spanish during spring 2018 selecting potential participants using intercept methods (de Leeuw and Hox, 2008) at docks and beaches where fishers keep their boats. In all cases we filled in the questionnaires in an interview-type format where the fishers dictated their answers to us. We collected 98 completed questionnaires (n=48 urban, n=50 rural) and only experienced two refusals to participate. The open-ended, qualitative responses on the questionnaire were translated into English and examined using content analysis methods that recorded the use of key words and word repetition (Strauss and Corbin, 1998) to sort the responses into common expressions. In all sections of the survey, quantitative comparisons

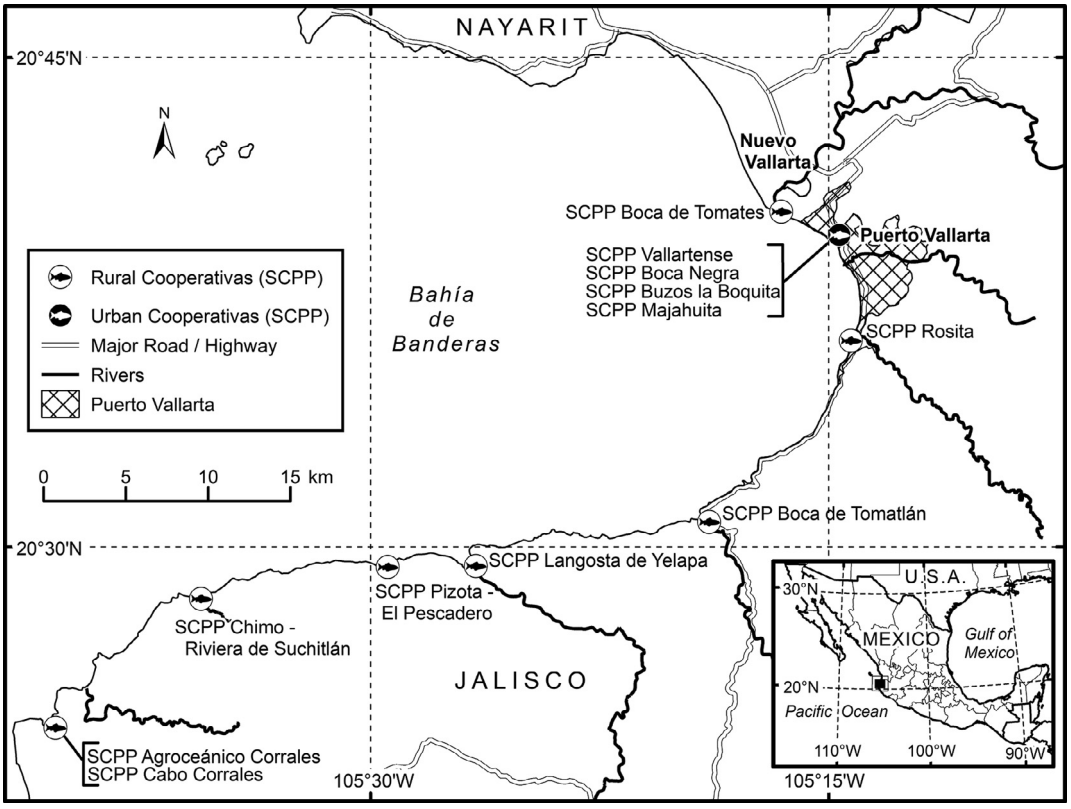

Fig. 1. Study area, including locations of urban and rural artisanal cooperatives in the Bahía de Banderas, Jalisco, Mexico. (SCPP = *Sociedad Cooperativa Producción Pesquera*).

between urban and rural fishers were made using the Mann-Whitney U-test.

The demographic section of the questionnaire asked for the participant's age, highest education level completed, years spent fishing, and whether they belonged to a fishing cooperative, followed by either the name of the cooperative for positive responses, or "Why not?" for negative answers. The second section of the questionnaire collected information regarding the respondent's fishing activities, beginning with whether they fished year-round, what three species of fish they were catching most often and which three they would like to catch most often. We used Lucano-Ramírez et al. (2001) and Espino Barr et al. (2004) to confirm local, colloquial fish names with their scientific names to correctly identify species, and www.fishbase.org (Froese and Pauly (Eds.), 2019) to confirm taxonomic author references and English common names. We then asked if the participants supplemented fishing with a secondary source of income.

The third section of the questionnaire asked the respondents to provide their opinion regarding the state of fishing. We first provided open-ended questions asking what the best and worst periods of the year were for fishing, followed by their opinions regarding current, past, and future state of fishing; options for each were "poorer than average", "average", or "better than average". We then asked whether they were concerned about the health of fish populations followed by whether they thought fish populations are disappearing; in both cases we provided the opportunity to explain their responses.

The fourth section of the questionnaire reported in this paper addressed fishers' opinions of fishing management. We first asked what they perceived to be the biggest problem facing fishing, followed by whether they felt that they have a role to play in fishing conservation and what that might be. We then asked what they believed could be done to improve fisheries. Hearing that there is a perceived conflict between artisanal and commercial sport fishers, we asked whether the respondents thought a conflict exists, as well as whether they considered the two types of fisheries can coexist and why. Finally, we asked how they thought fishery managers can help improve fisheries.

For the fifth and final section, we employed the New Ecological Paradigm (earlier called the New Environmental Paradigm) (NEP) (Dunlap et al., 2000), a commonly utilized, tested, and reviewed (e.g. Amburgey and Thoman, 2012; Dunlap, 2008; Hawcroft and Milfont, 2010; Luo and Deng, 2007; Noblet et al., 2013; Pienaar et al., 2013; Vikan et al., 2007) set of fifteen questions that measures a respondent's relative feeling towards society's relationship to nature on a spectrum from anthropocentric to ecocentric (Milfont and Duckitt, 2010), essentially an ecological worldview. Each question offers the respondent the options of 1, "strongly disagree," to 5, "strongly agree," with 3 as "unsure." Agreement with the odd-numbered questions indicates an ecocentric view, while agreement with the even-numbered questions indicates an anthropocentric view. The scores for the even numbered questions were reversed for scoring, such that a high aggregate score throughout the questions indicated an ecocentric view (Pienaar et al., 2013). We followed the recommendations of Noblet et al. (2013) and (Hawcroft and Milfont, 2010), who recommend caution in comparing results of NEP across studies as NEP has been administered and analyzed in a variety of ways which makes it difficult to compare between studies; we therefore only compare statistical findings within our study, such as trends between urban and rural populations.

3. Results

3.1. Demographics

Participants in this survey were 100% male and represented an aging demographic: 43.9% were 51–65 years old and another 22.2% over 65, with only 33.9% younger than 50. The fishers also held a low level of education where 8.8% did not complete elementary school, 67.6% had completed only elementary school, and 13.2% high school. Most of the

respondents had been fishing the majority of their lives, with 23.7% having fished for 40 to 49 years and 25.8% greater than 50 years, reflecting the aging demographic of fishers in this area. For all these demographics there were no significant differences between urban and rural fishers (age: M-W U=807, p=0.474; education: M-W U=403, p=0.204; experience: M-W U=885.5, p=0.171). Only three fishers, all rural, responded that they did not belong to a fishing cooperative. For two out of the three, fishing was a secondary job, a "hobby."

3.2. Fishing behavior

Fishers in this study reported catching 27 different species of fin fish, two species of shellfish, octopus, and lobster (Table 1). The fin fish reported represent 15.6% of the 173 commercially fished fin fish species in the Bahía de Banderas listed by Lucano-Ramírez et al. (2001). The top nine species reported, which includes one non-finfish species (*Octopus hubbsorum*, Hubb's octopus) accounted for 81% of captures by species. Snappers (*Perciformes: Lutjanidae*) accounted for 44.4% of the total reported catch by species and *Lutjanus peru* (Pacific red snapper) accounted for 47.3% of the reported capture of snappers. This species, locally referred to as "guachinango" or "huachinango", is regionally the most important economic species of snapper, and was reported separately from other species of snappers, referred to in general as "pargo." "Pargo" (except for *Lutjanus peru*), account for 17.2% of the total species reported. "Lunarejo" or "flamenco" (*Lutjanus guttatus*, spotted rose snapper or rose snapper), the second-most important snapper species, was sometimes referred to separately from "pargo", and accounted for 5% of the total. Likewise, *Lutjanus colorado* (Colorado snapper) was referred to directly as "listoncillo" by 0.8% of fishers, and *Lutjanus novemfasciatus* (Pacific dog snapper) as "colmillón" by 0.4%. However, *Lutjanus guttatus, Lutjanus colorado*, and *Lutjanus novemfasciatus* may also have been included as "pargo" by some fishers. There is no statistically significant difference in the species caught between urban and rural fishers (M-W U=7231, p=0.568), as the majority of fish caught in both cases are the snappers. However, rural fishers reported capture of a greater diversity (in low catch numbers) of species than the urban fishers: rural fishers reported capture of 29 species in total, 27 finfish species, octopus, and "pepino" (*Isostichopus fuscus*, brown sea cucumber), while the urban fishers reported 19 species in total, 17 finfish species, octopus (*Octopus hubbsorum*) and "ostión" (*Striostrea prismatica*, stone oyster or rock oyster).

Artisanal fishers reported 13 species of fin fish, two species of shellfish, octopus, and lobster were what they wanted to catch (Table 1). The top seven species account for 89% of reported species: "guachinango" (33.6%), "pargo" (31%), and "lunarejo"/ "flamenco" (4.2%), all snappers, account for 68.8% of the total. Some fishers (4.3%), all urban, responded they would like to catch "dorado" (*Coryphaena hippurus*, mahimahi or common dolphinfish), a species that is restricted to sport fishing capture (EUM, 2018), and a few fishers (1.7%) reported that they would like to catch "tiburón" (*Carcharhinus limbatus*, blacktip shark), a species that was not reported as one being captured. Urban and rural responses reveal some variety again at the lower percentage catch answers, including only urban fishers answering that they would like to catch dorado, but the overall responses to this question are not significantly different between the two groups (M-W U=1271, p=0.078).

Approximately half of all participants, urban (50%) and rural (56.7%), hire workers to help them (M-W U=532, p=0.587); approximately one quarter (26.3% urban; 25% rural) of these fishers hire one worker, 68.4% of urban and 43.8% of rural fishers hire two, while 5.3% of urban and 31.2% of rural fishers hire more than two. There was no statistical difference between urban and rural fishers in this case (M-W U=180.5, p=0.150). Overall, half of the fishers (51.6%) supplement their income with a second job; however, rural fishers are statistically more likely to have a second job than urban fishers (69.6% versus 40.5%; M-W U = 332.0, p=0.008).

3.3. Fishing conditions

While there was some slight disagreement, 81.6% of urban and 84.6% rural fishers reported that the wet season (approximately mid-June through mid-October), or part of it, is the better part of the year for fishing (M-W U=617, p=0.115). Although there is an indication on the part of the fishers that a particular time-period of the year of the year provides less successful fishing, the majority of respondents (urban, 97.4%; rural, 82.8%) fish year-round (M-W U=468.5, p=0.703).

Urban and rural fishers differed significantly in their perception of fishing in the past and the present but agreed in their perception of the future (Table 2). While the majority of both urban (86.5%) and rural (62.5%) fishers stated that fishing was better five years ago, a large percentage of rural fishers (20.7%) also stated that it was worse than present. A much larger percentage of rural fishers (70%) also stated that fishing is presently worse than average. The majority of both rural and urban fishers agreed that fishing in the future will be worse than present. Overall, rural fishers exhibited a statistically more negative perception of the state of fishing in the past and present than urban fishers.

Almost all fishers (98.6%), urban and rural, were concerned about the health of fish populations. Urban and rural fishers reported some different reasons for this, although the overall set of answers is not statistically different (M-W U=303, p=0.223). The most common answer for urban fishers was food and/or income for their families (38.1%), followed by a perception that there are not as many fish as in the past (19%), while the most common reason cited by rural fishers was that small fish are kept when they should be thrown back (38.9%), followed by food and/or income for their families (16.7%). The majority of fishers (77.1%), urban and rural, also felt that fish populations are disappearing. We received a total of 25 different reasons why, many just given by one person. Almost half of urban fishers suggested there is too much exploitation of fish populations (48.9%), followed by use of "chinchorros" (17.8%). Rural fishers' answers were more varied, resulting in a statistically significant difference in answers between the two groups (M-W U = 1626.5, p=0.003), although the most common answer was also too much exploitation of fish populations (21.2%), followed by a perception that there is increasingly less capture of fish and climate change, both at 12.1%. Of the respondents that responded they do not consider fish to be disappearing, 62.5% of urban fishers and 66.7% of rural fishers indicated that fish are moving / migrating to other areas and thus did not consider this to constitute "disappearing" *per se* but changing geographical locations. One urban fisher indicated that there are "lots of fish," and one rural fisher was specific in saying that it was because of climate change that the fish are moving away.

3.4. Management of fishing

For the question "What do you consider to be the greatest problem facing fishing" we received forty-one different answers (n=165); 53.1% of fishers responded with more than one answer and many answers were given by only one fisher. Overall there was no statistical difference in the variety of responses (M-W U=3510, p=0.719); urban and rural fishers had similar responses for use of "chinchorros" (20.8% vs 21.2%), climate change (10.4% vs 9.6%), overexploitation of the resource (6.8% vs 7.5%), and pollution (4.7% vs 3.0%). However, urban fishers were more concerned about fishers that keep fish alive in ocean corrals until they need them (13.6%) versus rural fishers (4.5%) and were also more concerned with the use of "cimbras" (14.6%) versus rural fishers (3%).

Almost all respondents (95.8%) indicated that they feel they have an important role in the conservation of fishery resources. We received 18 different answers (n=79) regarding what they feel their role entails; there was no statistical difference in the answers between urban and rural fishers (M-W U=772.5, p=0.717). The main answers were conservation-oriented: 29.3% of urban and 38.9% of rural fishers indicated that their role is to release small fish, 29.3% and 22.2% reported they must be "aware" or "conscientious" of the resource when they fish,

Table 1
Species reported captured by urban and rural artisanal fishers in Bahia de Banderas, 2018.

Order: Family	Species[a]	Author[b]	Local name	English common name[c]	Percentage of total reported capture	Caught by urban or rural	Percentage of desired capture	Desired by urban or rural
Fin fish								
Perciformes: Lutjanidae	*Lutjanus peru*	(Nichols & Murphy, 1922)	Guachinango, huachinango	Pacific red snapper	21	U, R	33.6	U, R
	e.g. *Lutjanus guttatus, Lutjanus argentiventris, Lutjanus colorado, Lutjanus novemfasciatus*	various	Pargo	Snappers in general, other than *Lutjanus peru*	17.2	U, R	31	U, R
	Lutjanus guttatus	(Steindachner, 1869)	Lunarejo, flamenco	Spotted rose snapper, rose snapper	5	U, R	4.3	U, R
	Lutjanus colorado	Jordan & Gilbert, 1882	Listoncillo, guacho	Colorado snapper	0.8	R		
	Lutjanus novemfasciatus	Gill, 1862	Colmillón	Pacific dog snapper	0.4	R		
Perciformes: Gerreidae	*Gerres cinereus*	(Walbaum, 1792)	Mojarra, mojarra plateada	Yellow fin mojarra	8	U, R	5.2	U, R
Perciformes: Scombridae	*Scomberomorus sierra*	Jordan & Starks, 1895	Sierra	Pacific sierra	7.6	U, R	8.6	U, R
Perciformes: Coryphaenidae	*Coryphaena hippurus*	Linnaeus, 1758	Dorado	Mahi-mahi, dolphin fish	5.7	U, R	4.3	U, R
Perciformes: Sciaenidae	*Umbrina xanti*	Gill, 1862	Curvina	Polla drum	5	U, R	0.9	U
Tetraodontiformes: Balistidae	*Balistes polylepis*	Steindachner, 1876	Bota, puerco	Finescale triggerfish	4.2	U, R	0.9	R
Perciformes: Carangidae	*Selar crumenophthalmus*	(Bloch, 1793)	Ojotón	Bigeye scad	1.9	U	0.9	U
Perciformes: Centropomidae	*Centropomus nigrescens*	Günther, 1864	Robalo, robalo redondo	Black snook	1.9	U, R	1.7	U
Perciformes: Serranidae	*Mycteroperca xenarcha*	Jordan, 1888	Bacalao, bava, garlopa arenosa, garlopa pintada	Broomtail grouper	1.1	U, R	0.9	R
	Dermatolepis dermatolepis	Boulenger, 1895	Mero	Leather bass	1.1	U, R		
Perciformes: Carangidae	*Caranx caninus*	Günther, 1869	Jurel, Toro	Pacific crevalle jack	1.1	R		
Perciformes: Sphyraenidae	*Sphyraena ensis*	Jordan & Gilbert, 1882	Barracuda	Mexican barracuda	0.8	U, R		
Perciformes: Scombridae	*Euthynnus affinis*	(Cantor, 1849)	Chora	Kawakawa	0.8	R		
Perciformes: Acanthuridae	*Prionurus punctatus*	Gill, 1862	Cirujano	Yellowtail surgeonfish	0.8	U, R	1.7	U, R
PPerciformes: Carangidae	*Seriola peruana*	Steindachner, 1876	Medregal	Amberjack	0.8	R		
	Caranx vinctus	Jordan & Gilbert, 1882	Castel, Jurel de castilla	Horse mackerel	0.8	R		
Clupeiformes: Clupeidae	*Opisthonema libertate*	(Günther, 1867)	Sardina, Sardina crinuda	Pacific thread herring	0.8	U, R		
Perciformes: Scombridae	*Euthynnus lineatus*	Kishinouye, 1920	Barilette, barrilete negro	Black skipjack	0.8	R		
Perciformes: Istiophoridae	*Makaira nigricans*	Lacepède, 1802	Marlin	Blue marlin	0.4	R	1.7	
Perciformes: Serranidae	*Epinephelus analogus*	Gill, 1863	Garlopa	Spotted grouper	0.4	R		
Perciformes: Carangidae	*Elagatis bipinnulata*	(Quoy & Gaimard, 1825)	Albacora	Rainbow runner	0.4	R		
Pleuronectiformes: Paralichthyidae	*Cyclopsetta panamensis*	(Steindachner, 1876)	Lenguado boca de Dios	Panamic flounder	0.4	U		
Perciformes: Haemulidae	*Microlepidotus brevipinnis*	(Steindachner, 1869)	Sarangola	Humpback grunt	0.4	R		
Perciformes: Scombridae	*Thunnus albacares*	(Bonnaterre, 1788)	Atún, Aleta amarilla	Yellowfin tuna	0.4	R		
Carcharhiniformes: Carcharhinidae	*Carcharhinus limbatus*	(Mûller & Henle, 1839)	Tiburón, mancha negra	Blacktip shark			1.7	U, R
Other[d]								
Cephalopoda: Octopodidae	*Octopus hubbsorum*	Berry, 1953	Pulpo	Hubb's octopus	7.3	U, R	2.6	U, R
Ostreida: Ostreidae	*Striostrea prismatica*	(Gray, 1825)	Ostión	stone oyster, milk oyster, rock oyster	1.9	U	0.9	U
Decapoda:Palinuridae	*Palinurus interruptus*	Randall, 1840	Langosta	Mexican spiny lobster, California spiny lobster	0.4	U	0.9	U, R
Synallactida: Stichopodidae	*Isostichopus fuscus*	(Ludwig, 1875)	Pepino, pepino de mar	Brown sea cucumber	0.4	R		

[a] Espino Barr et al. (2004) and Lucano-Ramírez et al. (2001) were referenced to identify species from local name
[b] www.fishbase.org, Froese and Pauly, Eds. (2019) was employed to confirm taxonomic author reference
[c] www.fishbase.org, Froese and Pauly, Eds. (2019) was referenced to identify the English common name from the scientific name
[d] Espino Barr et al. (2004) was used to identify non-finfish species and taxonomic author from local name

Table 2
Urban and rural artisanal fishers' perception of catch: past, present, and future.

Time period	Perception of catch	Urban (%)	Rural (%)	Mann-Whitney U test, *p*-value[a]
Five years ago	Better than now	86.5	62.1	**658.0, *p*=0.036**
	Same as now	10.8	17.2	
	Worse than now	2.7	20.7	
Present	Better than average	34.2	16.7	**732.5, *p*=0.026**
	Average	23.7	13.3	
	Worse than average	42.1	70.0	
Five years in the future	Better than now	7.9	6.7	659.0, *p*=0.129
	Same as now	7.9	20.0	
	Worse than now	84.2	73.3	

[a] Statistically significant differences given in bold text.

while 7.3% and 5.6% stated they should release females with eggs. There were several instances when a number of urban or rural fishers indicated a role that the other group did not mention at all; all of these answers pertain to following fishing regulations: for example, 9.8% of urban fishers reported that they should obey closed fisheries, while 8.3% of rural fishers stated that they should collaborate with the government and the same percentage that they must follow fishery regulations.

We then asked the participants what can be done to improve fisheries. Again, we received many different answers, 26 in total (n=114), although 14 are only given by one fisher. There is no statistical difference in the variety of answers between the two groups (M-W U=1103, p=0.363). The most common response for both groups was to ban "chinchorros" (urban, 32%; rural, 21.2%). Other important comments included to increase environmental consciousness (12%; 6.1%) and that there would be more concern on the part of the government (12%; 6.1%). Interestingly, 16% of urban fishers would like to see a ban on "trasmayos," while rural fishers did not mention this issue at all, which may indicate a different in fishing methods between the two groups. Some of the less common answers included a desire for fishers to respect the rules, government investment in aquaculture, to get rid of "cimbras", and that fishers should release small fish.

Hearing that there is perceived conflict between artisanal and commercial sport fishers, we asked the fishers whether they considered a conflict exists. There was statistically significant difference in responses between urban and rural fishers for this issue (M-W U=610.5, p=0.028) in that urban fishers were more likely to agree that a conflict exists between artisanal and sport fishers. Of those that agreed, almost one-third (29.6%) explained that the sport fishers need to respect the artisanal fishers' space and right to fish, while 24% stated that commercial sport fishers are allowed to fish for lucrative species such as "dorado" that artisanal fishers are not, and 20.4% explained that they believed there should be separate fishing zones for the two types of fishers. Almost all of those that responded they did not perceive a conflict to exist did not offer explanations, but one explained that there is no conflict because the two groups fish for different species, again a reference to fish such as "dorado" that artisanal fishers are not allowed to catch.

We then asked whether the fishers thought that artisanal and sport fishing can co-exist. The majority of fishers (85.7% urban; 93.5% rural) stated that they can. The main explanation to this response was similar to the previous question, that as long sport fishers respect the artisanal fishers and their space (22%) there will be no conflict, followed by much lower numbers of fishers explaining that there could be coexistence as long as sport fishing is monitored by the government, artisanal fishers are able to fish for the more lucrative species restricted for sport fishers, because sport fishers do not use "chinchorros", and the two groups fish for different species, for all of which two fishers made each statement. Only three participants, all urban, that responded the two types of fishing cannot coexist provided an explanation: these answers included "sport fishers are too competitive", "sport fishers catch fish species that we are supposed to catch", and "there is always conflict, they fight like cats and dogs."

Finally, we asked "How can managers help with fishing?" There was general agreement between urban and rural fishers regarding this item, so there was no statistical difference between the groups (M-W U=1460, p=0.365). The top three answers, representing 53.7% of the total responses, were all similar, including "Apply the laws" (26.4% urban; 14% rural), "check" or "monitor" catches (18.9%; 16%), and "Do their job" (17%; 12%). Other statements included letting artisanal fishers catch the lucrative fish restricted for sport fishers, banning "chinchorros" and illegal nets, monitoring sport fishing captures, fining those that break the regulations, and developing aquaculture.

3.5. New Ecological Paradigm

Table 3 presents the means and results of Mann-Whitney U-tests between rural and urban fishers for the New Ecological Paradigm (NEP) questions. We followed the recommendation of Hawcroft and Milfont (2010) to report standard deviation and internal consistency of the populations compared. As mentioned in the Methods, even numbered, "anthropocentric" statement scores were reversed so that all questions that scored low indicated an anthropocentric view, while high scores indicated an ecocentric view (Pienaar et al. 2013). Chronbach's alpha tests for internal consistency of NEP scores for urban and rural fishers were 0.837 and 0.807, respectively. Overall, both urban and rural fishers show an ecocentric perception of humans and nature; however, urban fishers held significantly greater ecocentric scores than rural fishers for 12 of the 15 items, as well as the aggregate score.

4. Discussion

Both urban and rural fishers interviewed in this study represent an aging demographic that has a small amount of formal education. Most have also been fishing for the majority of their lives. The majority therefore do not have skilled training. Although fishers reported that the wet season is a more successful time of year for fishing, the majority of fishers fish year-round. Even so, for many fishers in the study area fishing does not provide enough of an income to make a living for their family, forcing 50% of them supplement fishing with a second source of income. This is more prevalent in rural fishers. We weren't able to explore through our questionnaire why this is the case, but we hypothesize that than there are less restaurants and fish markets to sell their catch in rural areas; this is mentioned in FAO (2019b) as an impediment to rural fishers. Indeed, Bravo-Olivas et al. (2015) found that fishers in the city of Puerto Vallarta had a higher income than fishers in more rural areas farther south on the coast of Jalisco. We only collected anecdotal data on the nature of secondary jobs; the majority of rural fishers that disclosed the nature of their second job indicated manual labor, such as working in agricultural fields, while urban fishers identified service-oriented work.

The economic and social difficulties associated with small-scale fishing in the study area (Bravo-Olivas et al., 2015; Andrade Romo, 2010) may be keeping young people from entering the activity, as is evidenced

Table 3
Mean scores and Mann-Whitney U-test results between urban and rural fishers for NEP questions.

NEP item	Urban fishers		Rural fishers		Mann-Whitney U-test, *p*-value[b]
	Mean[a]	SD	Mean	SD	
1. We are approaching the limit of the number of people the earth can support.	3.87	1.44	4.04	1.38	1122.5, p=0.559
2. Humans have the right to modify the natural environment to suit their needs.	3.89	1.29	4.18	1.17	1203.0, p=0.222
3. When humans interfere with nature it often produces disastrous consequences.	4.72	0.71	4.16	1.18	**766.0, p=0.005**
4. Human ingenuity will ensure that we do NOT make the earth unlivable.	4.49	1.08	4.24	0.86	**807.5, p=0.023**
5. Humans are severely abusing the environment.	4.87	0.61	4.58	0.62	**733.0, p>0.000**
6. The earth has plenty of natural resources if we just learn how to develop them.	4.87	0.61	4.44	0.87	**706.5, p>0.000**
7. Plants and animals have as much right as humans to exist.	4.87	0.61	4.64	0.8	**892.0, p=0.033**
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	3.96	0.91	2.91	1.4	**603.0, p>0.000**
9. Despite our special abilities, humans are still subject to the laws of nature.	4.69	0.8	4.64	0.57	960.5, p=0.222
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	4.64	0.87	4.33	1.04	**833.5, p=0.031**
11. The earth is like a spaceship with very limited room and resources.	4.72	0.69	3.89	1.27	**605.5, p>0.000**
12. Humans were meant to rule over the rest of nature.	3.31	1.21	2.76	1.42	**818.0, p=0.038**
13. The balance of nature is very delicate and easily upset.	4.76	0.79	4.53	0.55	**716.0, p=0.001**
14. Humans will eventually learn enough about how nature works to be able to control it.	4.35	1.06	3.71	1.34	**748.5, p=0.006**
15. If things continue on their present course, we will soon experience a major ecological catastrophe.	4.85	0.67	4.53	0.76	**787.5, p=0.004**
Aggregate Scores	4.45	1.03	4.11	1.19	**192103, p>0.000**

[a] Even numbered item scores were reversed so that for all questions 1.00 = anthropocentric view and 5.00 = ecocentric view
[b] Statistically significant differences given in bold text.

by the age demographic of fishers in this study. One fisher even suggested that this trend restricts fish populations from disappearing, stating that "fishermen are retiring." Nonetheless, small-scale fishers in this study are using a resource for which the majority of both urban and rural respondents feel concerned about with respect to sustainability and expect poorer than average fishing success in the future. This may mean that in the future a greater percentage of fishers will be forced to find a second source of income. Fishers reported primarily targeting snappers ("pargo"; Family *Lutjanidae*), and particularly red snapper (*Lutjanus peru*). While there is concern on the part of the fishers that fish are disappearing and that fishing success will decline, there is little quantitative data to inform this perception. The IUCN Red List of Threatened Species lists all four snapper species identified by the fishers in this study as "Least Concern", but also "Unknown" with respect to population trends. Further, it states that research is needed regarding population size, distribution and trends, harvest, use and livelihoods, and threats for all four species (Besudo et al., 2010; Rojas et al., 2010a; Rojas et al., 2010b; Rojas et al., 2010c). It should also be considered that official catch data in Mexico is of low reliability (Bravo-Olivas, 2014; Torres-Nuñez, 2019), as it is in some other developing countries (Agnewet al., 2009), due to a lack of data resulting from large undeclared and illegal fisheries and variable monitoring methods, in this case neighboring Mexican states such as Jalisco and Nayarit, which share Bahía de Banderas. Comments in this study, such as "little by little the fish populations are disappearing," "no more big schools of fish," and "it is no longer the same as what was previously caught" reinforce both urban and rural fishers' concern regarding sustainability of the local fish stocks and should encourage CONAPESCA to undertake robust population surveys, as well as consideration of quotas and associated monitoring and enforcement. Further, these results suggest that it would be useful to gain a more detailed regional knowledge of the fishers ecological understanding regarding fish population fluctuations and a lack of scientific data on the subject. Bender et al. (2014), Gerhardinger et al. (2009), and Silvano and Begossi (2010, 2012), among others, all demonstrate the benefit of artisanal fishers' local ecological knowledge to inform regional understanding and management. Indeed, Begossi et al. (2011) specifically discuss the links between science and ecological knowledge with respect to *Lutjanidae* in Brazil, including the fact that a portion of the catch is too small and sexually undeveloped, an opinion shared by fishers in this study. This type of study might also shed some light on the reasons why rural fishers in this study reported capture of a greater variety of species than urban fishers.

Perception of an unsustainable fishery due to disappearing fish stocks results in a concern for personal economic and food security for fishers in our study. They stated concerns that included "food support for my family" and "important for income." Secondly, fishers are also concerned about the fish populations and their environment, supported with statements such as "small ones should be released," "there is not enough conservation awareness," and "there are less fish now." Concerns regarding economic and food security, as well as the environment, are identified by authors such as Béné et al. (2015) and Weeratunge et al. (2014) as important considerations in moving towards programs and policies to aid small-scale fishers around the world as described in FAO (2019a,b). Some fishers expressed that the fish are "moving away" and did not consider this to be disappearing. This also provides further support for a study on ecological knowledge of fishers in the area, in this case their perceptions and understanding on the effects of environmental fluctuations and climate change on fish movements and habitat selection.

The evident concern for the environment, exemplified in concern for fish population sustainability, was supported in the responses to the New Ecological Paradigm items. There is a high level of internal consistency within the urban and rural fisher groups and low standard deviations (10/15 less than one for urban and 8/15 for rural fishers), indicating a robust sample that is comparable as separate urban and rural samples. Both urban and rural fishers demonstrated an ecocentric viewpoint on the NEP spectrum, with aggregate means both above 4.0, 'slightly agree.' This is consistent with findings of society in general (Hodgkinson and Innes, 2000) and is reflective of pro-environmental attitudes (Noe and Snow, 1990), and a recognition of the negative environmental effects of human activities (Dunlap et al., 2000), including their own fishing activities in this case, as discussed above with respect to sustainable fish populations and below, with respect to fishing techniques and gear. However, urban fishers indicated a greater statistically significant difference of ecocentrism for 12 of the 15 NEP items and the aggregate score. This is consistent with other studies of urban versus rural residents (Berenguer et al., 2005; Chen et al., 2011; Chung and Poon, 2001; Hampel et al. 1995; Tuncer et al. 2004; Yu, 2014), but see (Hinds and Sparks, 2008) and Huddart-Kennedy et al. (2009) so this is not always the case. Rural fishers in this study were also more likely to feel that humans can manipulate the environment without consequence (e.g. "The balance of nature is strong enough to cope with the impacts of modern industrial nations") or that we will find solutions to problems (e.g. "Human ingenuity will ensure that we do NOT make the earth unlivable"). It is difficult to explain why there are differences in NEP between the urban and rural participants in this study. Freudenburg (1991) mentioned that rural populations are more often employed in (and thus dependent on) and witness to extractive industries, and therefore take a more passive stance to environmental issues (Yu, 2014); this does not necessarily apply in this case as both groups are financially dependent on and participating in the same extractive activity of fishing. The theory that urban populations are more educated in environment issues (Hernández-Montesinos, 1990; Tuncer et al., 2004; Yu, 2014) is also difficult to show here as we reported no difference in education levels between urban and rural fishers; however, this does not demonstrate any differences in urban and rural education *quality*, in which there can be a disparity between urban and rural education, as inferred by Yu (2014) in China. Nor does it account for the cultural impacts of living in a rural environment, closer to nature (Hernández Montesinos, 1990); here we cannot account for fishers that may have grown up and been educated in rural areas then moved into urban areas, or vice versa. We may point to affluence as an indicator, as Kemmelmeier et al. (2002) reported that less affluence can be related to lower pro-environmental attitudes and Olivas-Bravo et al. (2015) illustrated that fishers in Puerto Vallarta report higher incomes than rural fishers in our study area; however, the authors do not report whether cost of living is higher in the urban center, which could factor into affluence. The fact that urban fisher residents must pay for mooring in marinas is one higher cost of living for these participants in the study. In the end, however, we have two groups that tend toward the ecocentric end of the NEP spectrum, supported by comments concerned with the sustainability of the industry; there may be other factors involved in differences between the groups, some of which we did not study (cf. Tikka et al., 2000).

Fishers in our study are also concerned with the art of fishing in the area, which may or may not be primarily related to environmental concerns. Respondents stated that small fish are kept and should be released, as well as the use of "incorrect" or "illegal" nets in describing why they are concerned about the health of fish populations. While both urban and rural fishers made reference to "chinchorros" in particular, urban fishers are also concerned with "trasmallos" and ocean corrals in which fishers keep fish for future capture; this may reflect geographical differences in fishing methods within the bay, which is important knowledge for fisheries managers. "Chinchorros," "cimbras," "trasmallos," ocean corrals in which fish are kept captive for future capture, and fishers using scuba equipment were all listed as the biggest problem facing fishing. It is interesting that all the main capture equipment types were listed in response to this question. We hypothesize that fishers that use one type of equipment do not approve of other types; for example, those that use "cimbras" may not approve of "chinchorros," and vice versa. Some may also refer to "chinchorros" in that they feel illegal mesh sizes are common. As all types of fishery gear have some level of ecological impact, whether by-catch or habitat (Chuenpagdee et al., 2003), this is a difficult issue to address and requires more research.

Somewhat related to the art of local small-scale fishing is the perceived conflict between artisanal and sport-fishers, which primarily manifests itself as a desire that sport fishers respect artisanal fishers and their right to fishing space. This feeling is significantly more prevalent in urban than rural fishers. This may be due to greater numbers of commercial sport-fishing vessels that take tourists out from the city marinas and is significant in that it is a stress felt mainly by one group of fishers and not the other; this is important from a quality-of-life and management point-of-view, and is an example of a perception of marginalization from tourism. Interestingly, Chávez-Dagostino et al. (2018) suggested that quality of life was greater for fishers where there is more tourism development, but this was not restricted to conflict with sport fishers and may instead point to additional opportunities for income. Several respondents suggested there be different areas for the two types of fishing to alleviate the conflict. Zoning is not without precedent with respect to small-scale versus sport fishing and could be considered for the Bahía de Banderas. In Sicily, for example, non-artisanal fishers are excluded from the Gulf of Castellammare (Whitmarsh et al. 2003).

Espinoza-Romero et al. (2014) stated that a lack of government infrastructure in developing countries has often led to poor monitoring practices and McCay et al. (2014) indicated that the centralized management structure of fisheries management in Mexico has not served artisanal, small-scale fishers well. Both of these are evident in the results of our study. First, one quarter of small-scale fishers reported a desire to be able fish for lucrative species such as dorado, that are restricted by law to sport-fishers. They appear to resent the sport-fishers this privilege. This is a further example of marginalization of small-scale fishers by the government, as described by Béné et al. (2015) in general, and specific to local fishers with respect to forced relocation by Andrade-Romo et al. (2010), all of which can have negative economic and concomitant social impacts (Doyon, 2002). Second, supporting the statement by FAO (2019a,b) that lack of government infrastructure can lead to overexploitation of the resource, fishers made statements such as "(there is) too much exploitation," "too much fishing," "illegal mesh-sized nets," and "no government control," in describing their perception that fish populations are disappearing. Third, fishers directly pointed their fingers at the government, with over 50% of respondents stating variations on managers need to "do their job," "apply the laws," or "monitor," while in addition again revisiting the desire to fish for species such as dorado. There is a distinct mistrust of fisheries managers which

may hamper cooperative endeavors to improve fisheries management in the region.

5. Conclusion

There are three important take-aways regarding urban versus rural fishers in our study. First, urban and rural fishers demonstrate an ecocentric ecological worldview and report environmentally sustainable concerns towards their fishery resources while remaining engaged in in extraction activities that may negatively impact those resources. The New Ecological Paradigm does not measure behavior, only attitude; it may be pertinent to explore the relationship of both fishery groups' attitudes between their environmental attitudes and their fishing behaviors. Further exploration into why urban fishers illustrated a statistically greater ecocentric NEP view is also warranted. Environmental concerns are prevalent in that fishers are concerned about the current and future health of fish populations. However, they also recognize that they have a role to play in fisheries conservation. It would be informative to gain a more specific understanding of this perception; for example, if the fishers felt more empowered and less pressured by economic need to catch fish, what would they propose they could do to move towards more sustainable fishing practices?

Second, the economic and social difficulties associated with small-scale fishers in many developing countries are prevalent in our study. Rural fishers are more likely to possess a second form of income than urban fishers, meaning for rural fishers, fishing does not provide a sufficient income. Urban fishers are more likely to perceive a conflict with sport-fishers, which can be interpreted as a form of marginalization by tourism; both groups indicated a frustration with being unable to capture species such as "dorado" that are restricted to sport fishers. More lucrative fish are legally restricted to sport fishers. These types of pressures have been reported for many years but are still present.

Third, in our study the focus on one particular family of fish, snappers, as the most economically lucrative, may not be sustainable (but this is unknown due to lack of scientific knowledge), along with the art of fishing in the area, which are evident in concerns regarding the health of fish population and perception that species are disappearing. There is ample evidence to suggest that an understanding of both urban and rural fishers' ecological knowledge may aid management initiatives in the region.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Christopher D. Malcolm: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing, Funding acquisition. **Myrna L. Bravo Olivas:** Conceptualization, Investigation, Writing - review & editing. **Rosa M. Chávez Dagostino:** Conceptualization, Methodology, Investigation, Writing - review & editing.

Acknowledgments

The authors would like to gratefully thank the artisanal, small-scale fishers of Jalisco who participated in this research. We would also like to thank Universidad de Guadalajara Centro Universitario de la Costa students who helped with data collection. Cartography by W. Van Heyst, Department of Geography and Environment, Brandon University. Funding for this project was provided by the Brandon University Research Committee (grant number 2630).

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