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Artisanal fishing and its relationship with the environment in the central Pacific of Nicaragua (Masachapa and Casares).

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ABSTRACT

The critical analysis of fishing activities is of interest due to their influence and interaction with the environment. In this sense, it was proposed to study the fishing zones of the central part of the Pacific of Nicaragua (Masachapa and Casares), under the scheme of a case study through a triangulation, which allowed us to know the fishing activities, as well as to develop a critical analysis of these and the surrounding environment. It is concluded that the conditions of both study zones are particularly similar to each other, they respond to beaches with little amplitude, are relatively flat, and are organized according to the feasibility of the land; 11 groups of people (n=52) were approached through which it was found that, at present, artisanal fishing is still imposed in both fishing communities,

in addition to counting mainly six fishing gears. It was evident that there is poor control and monitoring of marine species that are captured in various ways, whether or not they are target species, including species in some degree of threat, and that there is poor management of organic waste and other direct contaminants from fishing activities. There were similarities in the fishing activities, but differences in the man-resource relationship, showing a marked change in behavior between the fishermen of Masachapa and Casares.

1. INTRODUCTION

Fishing activities had an important role in many aspects of ancient society, according to Rodriguez Bernardo (2017) since the Paleolithic; it is known that this activity along with hunting was one of the first activities that human beings carried out to get food on their own, to this day this activity is an indispensable part in the nutrition and economy of many people around the world.

Throughout history, the importance of fishing activities has been recognized:

> Today, countries widely recognize the importance of using fishery and aquaculture resources responsibly and give them a priority. However, responsible resource utilization has not always been the central focus of development strategies in the sector. For much of history, it was assumed that resources were infinite and after World War II, scientific and technological advances drove an intensive development of fisheries and fishing fleets, over time, the fallacy of infinite resources was set aside when it was realized that fishery resources, although renewable, are not infinite (FAO, 2020).

Because of the above, FAO (2018) indicates that there are latent problems:

> Human societies face the immense challenge of having to provide food and livelihoods for a population that, by the mid-21st century, will far exceed 9 billion people, while having to address the disproportionate effects of climate change and environmental degradation on the resource base.

This, "economically healthy fisheries are fundamental to achieve accepted objectives of the fisheries sector, such as improved livelihoods, food security, increased exports and the restoration of fish stocks" (World Bank, 2009), so it is imperative to know the status of fishing activities and how they influence the available resources.

The case of Nicaragua is not far from the reality of many countries on the continent. The artisanal fishing sub-sector in Nicaragua is particularly important from different points of view: social, economic, and environmental (Cotto & Marttín, 2008). "It is estimated that Nicaragua

has a total of 226 fishing and aquaculture communities in 40 municipalities in addition to generating 27, 746 jobs, within which 11, 595 artisanal fishers stand out" (INPESCA, 2019). In the country, the main fishing production sites are along the Atlantic and Pacific coasts followed by inland waters. Fishing activity in Nicaragua is concentrated in industrial fishing in the Caribbean region and artisanal fishing is more representative in the Pacific region (AECI, 2002).

The critical analysis of fishing activities is of interest due to their influence on the surrounding environment. In the case of the central Pacific zone, it is important to analyze the fishing zones and to know in more detail the particular activities and situations that are carried out daily in fishing.

2. METHODOLOGY.

The study areas are located in the central part of the Pacific coastal strip of Nicaragua, the first is located in the department of Carazo, municipality of Diriamba, in the fishing zone of Casares at the geographical coordinates 11°38'47" N, 86°21'32" W. The second study area is located in the department of Managua, municipality of San Rafael del Sur, in the fishing zone of Masachapa located at the coordinates 11°47°12" N - 86°31°00" W.

This study was carried out under the case study scheme since it is a useful methodological strategy for scientific research, besides being suitable for the development of research at any level (Martínez Carazo, 2006), on the other hand, Stake (1999) describes that it consists of looking for the merits and defects of a particular case. The research approach is qualitative while encompassing a descriptive-comparative level.

The universe was constituted by the fishermen who were in both fishing zones, according to the sampling method, those proposed by (Otzen & Manterola, 2017; Porras Velázquez, 2017) were followed as non-probabilistic sampling, by convenience because there is no public information available, likewise, the sample was of voluntary participant (Sampieri et al., 2014). The study is based on triangulation which, according to Okuda & Gómez-Restrepo (2005) is an enriching tool that allows for reducing biases and increasing the understanding of a phenomenon, this helps to improve the research process (Betrián Villas et al., 2013), likewise, its application requires obtaining information on the object of research, through various sources that allow contrasting the data collected (Alzás et al., 2016).

2.1. Interviews Application.

Semi-structured interviews were conducted with fishermen (Sampieri et al., 2014). The method used at the time of the interview that was most feasible was group interviews (Amezcua, 2003), within the groups interviewed varied the number of participants, as well as the age range and experience of the interviewees.

2.2. Survey application.

The method used for the application of the surveys was face-to-face, which allows the person asking the questions to have physical contact with the respondent (Casas Anguita et al., 2003), through a questionnaire that allowed open-ended answers to obtain the most conclusive notes possible.

In addition to the interviews and surveys, on-site visits were conducted in both study areas, using the non-participatory observation method during the field process. Field sheets (interview guide, survey, and field guide) were provided by the biology department of the UNAN-Managua to learn about the fishermen's fishing activities, in addition to essential equipment such as a field notebook, GPS (Garmin GPS map 62sc) and camera (SONY DSC-H400 Cyber-shot).

A critical analysis of ecological aspects of the areas influenced by fishing was carried out, as well as an attempt to identify the species that are related to the fishing activity, these were identified through keys and documentary review based on documents such as identification guides and checklist of marine species in the region such as those of Orellano, (2010), Angulo et al, (2021), Navia & Mejía-Falla, (2011), SICA, (2019) and SICA, (n.d.), we also collated information from previous studies carried out in the Pacific of Nicaragua such as those of Martínez Urbina et al. (2008) and Gutiérrez et al: World Register of Marine Species and consultations with some diving experts in the country and foreign identifiers. In addition to the identification of species, we determined those that are subject to some degree of threat, according to the official IUCN website, in addition to those contained in the CITES regional list (CCAD, 2010), the Nicaraguan red list (CICFA, 2018) and those described in the national closed season regulations (MARENA, 2020).

The analysis consisted of grouping, ordering, and assessing the data obtained (surveys, interviews, photographs, and notes) for analysis and making a critical review of the activities involved in fishing in both areas, subsequently detailing the current situation and specifying the environmental aspects linked to fishing activity.

3. RESULTS.

During the field phase, we tried to involve mostly fishermen who, at the time of the field visits, were engaged in their fishing activities. Upon being approached, they were asked to show their fishing license or captain's license and to be 18 years of age or older, and to have been working in the fishing activity for more than three months.

The groups were divided according to some predominant features at the time of approaching the fishermen, these were: Groups of juvenile fishermen (< 30 years of age), Groups

of adult fishermen (≥ 30 years of age), Multi Groups (of different ages) and a group that consisted of a family of fishermen, with a total of 52 people participating divided into 11 groups.

The participation of women was null as artisanal fisherwomen, this is in agreement with INPESCA (2012) which stated that few women carry out artisanal fishing activities as such, despite this, the activity of women in artisanal fishing is a fundamental task because they contribute to the cleaning and preparation of the fish that will be marketed, as well as the classification of its size and quality.

3.1. Conditions of the study areas.

Both fishing zones are located within the Pochomil marine ecological unit, which is located between the departments of León and Rivas with an area of 2,699.8 Km^2 (MARENA, 2011); it has sandy beaches, where the presence of sea turtle nests stands out, particularly to the south, adjacent to the Escalante River, and also has areas with geographical features such as cliffs (in the case of Casares) and intertidal zones. In addition, SINAC (2009) reinforces the importance of Central America's marine coasts and affirms that 34 regions of high species diversity have been identified in the world, including Mesoamerica.

The conditions of the fishing areas are particularly similar to each other, they are relatively flat beaches with little width, which facilitates fishing, and are organized according to the feasibility of the terrain, the contamination of organic waste from the fishing activity was evident, as well as the presence of solid waste, which is abundant on the beaches and easement paths.

Within the repertoire of marine species we were able to observe at least 10 species of different genera in a single boat, this was at the time when the fishermen were returning from their fishing activities, and we also documented species previously caught.

3.2. Situation of fishery exploitation.

The situation of marine resources in the country is precarious due to many anthropogenic factors, as TNC-MARENA (2009) reiterates "poverty, increased demand for food and increased demand for tourist resources on the Pacific coast, puts pressure on the use of beaches and coasts".

In the particular case of incidental fishing, in the Casares area, interviewees stated that their fishing gear includes: Sea turtles and manta rays, the latter are sacrificed for their meat, however, the vast majority of fishermen agree that they do not commercialize the meat of aquatic reptiles, despite this, during our visits, we observed the sale of small plastic bags containing between 11 to 14 sea turtle eggs per bag in the fishing zone of Casares and between 15 to 20 eggs per bag in the fishing zone of Masachapa.

Meanwhile, the people interviewed in Masachapa affirm that they usually get bycatch every three days. A notorious aspect of Masachapa is the involvement of marine mammals in their fishing gear, such as the spotted dolphin (*Stenella attenuat*), which they try to release quickly for them to survive, however, most of the turtles and manta rays caught incidentally are sacrificed.

Figure 1: Spotted dolphin (*Stenella attenuat*).

On the subject of discarding species, fishermen in Casares maintain that most of the organisms with small sizes are returned to the sea; in Masachapa the subject of discarding species is different, most comment that most of the small sizes are not returned to the sea and are retaken for their consumption or sale and exchange. Finally, it was noted that the discarded product is not always released with the least possible damage and there was evidence of a greater lack of environmental sensitivity on the part of most fishermen in Masachapa.

The trade of crustaceans and mollusks of different species was evident in both markets. On the other hand, large cartilaginous species stand out for the sale of their meat, especially in Masachapa, where we found species such as Manta devilfish, Guitarfish, and Bull Shark.

Figure 2: From left to right: Bull Shark (*Carcharhinus leucas*), Manta Ray (*Mobula thorstoni*), and Guitarfish (*Pseudobatos glaucostigmus*).

It is necessary to emphasize that there are irregularities and gaps regarding the fishing of some species, in previous studies such as OSPESCA (2018) reflect this problem:

Abuse of licenses and fishing permits by vessels that devote effort to other species that are not those granted in the fishing permit, it is also very frequent that, due to ignorance and lack of knowledge of the established legal procedures, fishermen fail to comply with certain aspects of artisanal fishing.

In Nicaragua's marine environments there are approximately 584 species of marine fish, approximately 3,716 species of mollusks (including terrestrial), and 30 species of crustaceans that could be considered of commercial interest (Cotto A., 2006; MARENA, 2011).

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
MOLLUSCS					
Octopus spp	Octupua				
Dosidicus gigas (D'Orbigny, 1835)	Squid	DD			
Titanostrombus galeatus (Swainson, 1823)	Cambute (Eastern Pacific giant conch)	VU			
Melongena patula (Broderip & Sowerby, 1829)	Caracol grande (Pacific crown conch)				
Anadara tuberculosa (G. B. Sowerby I, 1833)	Concha (Pustulose Ark)	VU			VPN
Crassostrea spp	Ostiones (Eastern oyster)				
Holothuria spp	Pepino de mar (sea cucumber)				VPN

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
CRUSTACEOUS					
Penaeus vannamei (Boone, 1931)	Camarón Blanco (Whiteleg shrimp)	LC			VPN
Farfantepenaeus brevirostris. (Kingsley, 1878)	Camarón Rojo (Crystal shrimp)				VPN
Callinectes spp	Jaiba (blue crab)				
Ucides occidentalis (Ortmann 1897)	Punche (Mangrove ghost crab)				
Ocypode gaudichaudii (H. Milne Edward & Lucas, 1843)	Cangrejo (Painted ghost crab)	LC			
Panulirus gracilis (Calles, 1871)	Langosta (Green Spiny Lobster)	DD			
Calappa spp	Baúl (Box crabs)				
FISHES					
Prionace glauca (Linnaeus, 1758)	Tiburón Azul (Great blue shark)	NT			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
Carcharhinus limbatus (Müller & Henle, 1839)	Tiburón aleta negra (Common Blacktip Shark)	VU			
Carcharhinus leucas (Müller & Henle, 1839)	Tiburón toro (bull shark)	VU		CR	VNI
Sphyrna lewini (E. Griffith & C. H. Smith, 1834)	Tiburón Martillo (Scalloped hammerhead shark)	CR			
Rhinobatos glaucostigma (Jordan & Gilbert, 1883).	Pez Guitarra (Slaty-spotted guitarfish)	VU			
Mobula birostris (Walbaum, 1792)	Mantaraya Gigante (Giant oceanic manta ray)	EN			
Mobula thurstoni (Lloyd, 1908)	Mantaraya (Bentfin Devil Ray)	EN			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
Aetobatus narinari (Euphrasen, 1790)	Manta-raya – Gavilán (Spotted eagle ray)	EN			
Thunnus albacares (Bonnaterre, 1788)	Atún aleta amarilla (Yellow-fin tuna)	LC			VPN
Thunnus alalunga (Bonnaterre, 1788)	Atún blanco (Albaco-re tuna)	LC			
Thunnus obesus (Lowe, 1839)	Atún Patudo (Bigeye tuna)	VU			VPN
Lutjanus cam-pechanus (Poey, 1860)	Huachi-nango (Red snapper)	VU			
Lutjanus argen-tiventris (Peters, 1869)	Pargo amarillo	LC			
Lutjanus colorado (Jordan & Gilbert, 1882).	Pargo colorado (Yellow snapper)	LC			
Lutjanus guttatus (Steindachner, 1869)	Pargo de Mancha (Spotted rose sna-pper)	LC			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
Hoplopagrus guentherii (Gill, 1862)	Pargo moco (Mexican barred snapper)	LC			
Lutjanus novemfasciatus (Gill, 1862)	Pargo dientón (Pacific dog snapper)	LC			
Epinephelus quinquefasciatus (Bocourt, 1868)	Mero del pacífico (Pacific goliath grouper)	DD			
Epinephelus acanthistius (Gill, 1863)	Mero rojo (Gulf coney)	VU			
Epinephelus analogus (Gill, 1863)	Cabrilla (spotted grouper)	LC			
Epinephelus labriformis. (Jenyns, 1840)	Cabrilla Pintada (Starry grouper)	LC			
Sphyraena ensis (Jordan y Gilbert, 1882)	Barracuda (Mexican barracuda)	LC			
Istiophorus platypterus (Shaw 1792).	Pez vela (Indo-Pacific sailfish)	LC			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
Lile sp	Sardina (Bony Fish)				
Coryphaena hippurus (Linnaeus, 1758)	Dorado (Dolphinfish)	LC			
Scarus perrico (Jordan & Gilbert, 1882)	Pez lora (Bumphead parrotfish)	LC			
Cynoscion spp	Curvina (Tonkin weakfish)				
Scomberomorus sierra. (Jordan y Starks, 1895)	Macarela (Pacific sierra)	LC			
Caranx caninus (Günther, 1867)	Jurel Toro (Pacific crevalle-jack).	LC			
Centropomus nigrescens (Gunther, 1864)	Robalo negro (Black snook)	LC			
Diapterus peruvianus. (Cuvier, 1830)	Palometa (Peruvian mojarra)	LC			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
Selar crumenophthalmus (Bloch, 1793)	Ojon (Bigeye scad)				
Bothus spp	Pez hoja (Peacock flounder)				
Acanthurus spp	Pez Cirujano (Surgeonfish)				
Acanthurus xanthopterus (Valenciennes, 1835)	Cirujano Aleta Amarilla (Yellowfin surgeonfish)	LC			
Citharichthys spp	Pez lenguado (Sanddab)				
Mugil curema (Valenciennes, 1836)	Lisa (white mullet-silverside)	LC			
Bagre marinus (Mitchill, 1815)	Bagre (Gaff-topsail Catfish)	LC			

Scientific Name	Common Name	UICN Global	CITES Appendices	National Red List	National Bans
REPTILES					
Lepidochelys olivácea (Eschscholtz, 1829)	Tortuga Paslama (Olive Ridley Turtle)	VU	I		VNI
Eretmochelys imbricata (Linnaeus, 1766)	Tortuga Carey (hawksbill sea turtle)	CR	I	CR	VNI
Dermochelys coriácea (Vandelli, 1761)	Tortuga Tora (Leatherback sea turtle)	CR	I	CR	VNI
MAMMALS					
Stenella attenuata (Gray, 1846)	Delfín moteado (Spotted Dolphins)	LC	II		

Note: IUCN Global/National Red List: (**CR**: Critically Endangered) (**EN**: Endangered) (**VU**: Vulnerable) (**NT**: Near Threatened) (**LC**: Least Concern) (**DD**: Deficient Data). CITES Appendices: I, II, and III. National Bans: (**NIV**: indefinite national ban), (**PNV**: partial national ban). Source: Own elaboration.

Of these, 15 are under some degree of threat according to IUCN Global, four are in the CITES appendices at the regional level, three are evaluated in Nicaragua's red list and 10 are included in the bans and legal provisions at the national level; emphasis is placed on fishing pressure, especially on sea turtle species (mostly in the extraction of eggs) and the sale of cartilaginous species for both fishing zones.

3.3. Logistical and technical aspects of the artisanal fishery.

The exclusive practice of artisanal fishing was determined for both zones and it was concluded that the most appropriate type of boat for fishing is the pangas, and it was determined that the main construction material of the boats is fiberglass.

Despite this, OSPESCA (2012) states that "outboard engines are the most commonly used in Central America, but there are no mechanics specialized in the maintenance and repair of outboard marine engines".

Regarding the engine displacement of the boats, these vary from 15 to 150 HP for the Casares area and from 5 to 150 HP for the Masachapa area, with the 75 HP being considered the most appropriate for offshore work, the most representative engine brands were MARINER, SUZUKI, EVINRUDE, and YAMAHA.

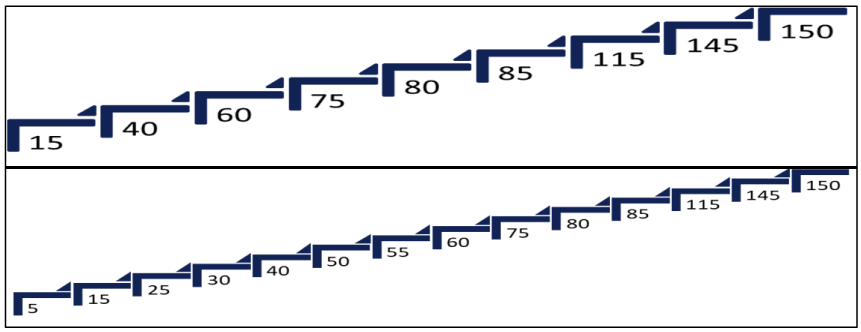

Figure 3: Outboard engine displacement capacity. Above: cylinder capacity in Casares. Bottom: displacement capacity in Masachapa. Source: Own elaboration.

The use of energy, particularly fossil fuels, is an aspect of fisheries that is related to the environment, due to the consumption of the resource itself, which is relevant because all vessels consume fossil fuels, depending on the engine displacement and varies considerably according to the different fishing gear and methods they use. ECLAC (2019) recommends two measures that would reduce pollutants from marine transport, such as the need to improve international regulation and promote reflection on the responsibility of emissions.

The system for beaching fishing vessels was the same in all the responses; which is utilizing trawling with wooden rollers, made from trees such as Cedro (*Cedrela odorata*) and Guanacaste (*Enterolobium cyclocarpum*), which represent consumption of timber species from the Pacific of Nicaragua (Faurby et al., 1998).

Respondents consider that there are no specific criteria or processes to go out fishing, except for the provisions of the weather and the due permits and legal provisions; An irregular aspect commented by some respondents was the mention of bilateral incursions between Nicaraguan fishermen into Costa Rican waters and Costa Rican fishermen into Nicaraguan waters, although they are fortuitous cases these have been previously registered by OSPESCA (2018).

Artisanal fishing in the Pacific of Nicaragua is an answer to the lack of employment and is profitable for people living along the Pacific coast. Artisanal fishing work has not been greatly affected by the current health crisis, with industrial fishing being more affected, as mentioned by

FAO & ECLAC (2020) that "the pandemic has affected the operation of the sector, but especially industrial extractive fishing, interrupting the normal circulation and operation of its crew".

Another aspect to highlight about artisanal fishing is that it is guaranteed the use of fishing techniques or gear that has an ancestral heritage and is culturally identitary (León-Valle et al., 2017).

3.4. Characterization of fishing gear.

Fishing gear is defined as the instruments, equipment, structure, or systems of different natures that are used to capture or extract resources (Norma Técnica Obligatoria Nicaragüense Para Artes y Métodos de Pesca, 2009).

Fishing gears are generally classified into two categories: passive and active. This classification is based on the relative behavior of the target species and the fishing gear. Passive fishing gears are among the oldest methods of capture, often used by artisanal fisheries, on the contrary, capture with active fishing gears is based on a directed pursuit of the target species (Ross et al., 2014; NTON Artes y Metodos de Pesca, 2009).

Location	Categoríes	Grab-net	Logline (Linear)	Trammel	Gillnet	Cast-net	Dive
Casares	Passive	X	X	X			X
	Active				X	X	
Masa-chapa	Passive	X	X	X			
	Active				X	X	

Table 2: Identified Fishing Gear Types. Source: Own elaboration:

Three passive fishing gears were determined for both zones, as well as two active fishing gears. Diving was exclusive to Casares and is not included among the fishing gear; however, we consider it to be active because of its implication in the search for specific organisms.

3.5. Treatment, handling, and disposal of fishery resources.

There are 3 ways to sell and/or market fishery products in the study areas, according to the order of sales volume, the first is through the collection, the second is the local market and the third is informal.

1. Collection Center: This consists of distribution channels that can be through verbal or written agreements between collection center workers and fishermen to make the sale feasible. This agreement may include the provision of inputs such as fishing gear, gasoline, food, etc., or the payment of surplus catches and an economic agreement based on the type, volume, and condition of the catch. The collection

center is in charge of selling the fishery resources to its next line of distribution, therefore, the fishermen earn only for the extraction of the resource, in this sense, it is the collection centers that are in charge of the sale of products for export purposes.

2. Fish and seafood market: This market is known as the "Paneras" who are mostly women who sell the products extracted by the fishermen on the coast through verbal or written agreements between those involved, who reach an agreement after the extraction of the resource; the Paneras are a distribution channel for the direct sale of fish products to consumers.

3. Informally, after extracting the resource from the sea, the fishermen take the extracted resources with them to sell it on their own, they decide the price at which they will sell it, according to the investment they made in fishing during their day's work. Another form that fishermen use is that of exchange or barter between community members.

Trade	Advantages	Disadvantages
Collection Center	Better safety control. Greater commercial scope. Better product presentation. Greater productive capacity	Less profit for fishermen. Competition among fishermen. Pressure for fishermen. Less variety of target species.
Market	Fresher products. Better purchase price. Freedom in the sale of products.	Low level of healthiness. Poor product safety. Less flow of buyers due to distance factor.
Informa-lly	Fresh products. Higher profit margin. Freedom in the sale of products.	Low level of healthiness. Less flow of buyers due to distance factor Poor product safety.

Table 3: Advantages and Disadvantages of the Forms of Trade of Marine Resources. Source: Own elaboration.

The treatment and handling of fishery resources begins after capture; When fishermen remove the specimens from their fishing gear, they put them in thermoses or containers with ice until they reach the coast where, once they are extracted from the ice, they remove the entrails that are not of commercial value and the remains are thrown along the coast, without any prior treatment, This attracts a high presence of scavengers such as black-headed vultures (*Coragyps atratus*) and red-headed vultures (*Cathartes aura*), in addition to directly affecting the

surrounding environment, contaminating the soil, water and air, and in some cases becoming vectors of disease.

Neither the safety nor the state of the fish in their post-mortem changes in the study areas is known, which should be monitored and studied in detail due to the causes that can be produced by poor handling of these, in this sense FAO (2014), indicates that "fish muscle, compared to the meat of other animals, is a very perishable product, for this reason, care must be taken during handling and processing so that it reaches the consumer in good and safe conditions"; At the time, this aspect was reflected negatively in a report stating that the conditions for storing and storing fish products were inadequate for maintaining the quality, hygiene and safety of marine resources (Centro Humboldt, 2008).

4. CONCLUSIONS

The triangulation scheme was effective to learn about aspects of fishing activity and its influence on coastal marine resources; as a result, 11 groups of fishermen of different ages, experiences, and positions were approached, all of them male, with a total of 52 participants.

Both fishing zones are located within the Pochomil marine ecological unit (MARENA, 2011), so they are areas that should be better regulated in terms of fishing activities, respecting the fact that they are key fishing points on the Pacific coast. The conditions of both study areas are particularly similar, with relatively, flat beaches that are organized according to the feasibility of the terrain, and there is evidence of poor management of organic waste and other direct and indirect pollutants produced by fishing activities.

In the particular case of incidental fishing in the Casares area, fishing gear includes sea turtles and manta rays, of which the manta rays are sacrificed for their use; however, in the case of sea turtles, most fishermen agree to release them; in terms of discarding species, fishermen maintain that most of the organisms that are small in size are returned to the sea.

Among the fishing gear in the Masachapa area, sea turtles and manta rays are found as bycatch, which are almost entirely sacrificed for their exploitation; The issue of discarded species is different from Casares, 85% of those interviewed in Masachapa commented that most of the small sizes are not returned to the sea and are retaken. Finally, it was noted that the discarded product is not always released with the least possible damage.

Fifty-six species were identified, of which 15 are under some degree of threat according to IUCN Global, four are in the CITES appendices at the regional level, three are evaluated on Nicaragua's red list, and 10 are under a national ban. It was determined that one of the biggest problems is the control and monitoring of the species that are captured in different ways, whether they are target species or not. This shows that there are still weaknesses on the part

of the competent authorities in the monitoring and control of the organisms that are extracted from the sea for commercialization, in addition to the lack of environmental culture.

Currently, the exclusive practice of artisanal fishing is concluded for both zones, this guarantees the use of fishing techniques or gear that has an ancestral heritage and is culturally identitary (León-Valle et al., 2017). For the fishing work, mainly pangas with outboard motors of different displacements ranging from 5 to 150 HP are used, which represent energy consumption (fossil fuels) and the system of stranding with rods represents consumption of timber species from the Pacific of Nicaragua according to Faurby et al. (1998).

Three passive fishing gears were identified for both zones, as well as two active fishing gears, and diving is highlighted as the exclusive fishing gear in Casares.

There were similarities in the fishing activities of Casares and Masachapa, but differences in the man-resource relationship. There was a marked change in the behavior of the fishermen of Masachapa and Casares, showing a greater environmental sensitivity on the part of the latter and opening new spaces for discussion as to why these changes in behavior are different despite being inhabitants of the same region of the country; therefore, it is concluded that Masachapa exerts greater pressure on the maritime zones of the Pacific coast compared to Casares.

There are three ways of selling and/or marketing fishery products in the study areas, according to the order of sales volume the first is by collecting, the second is in the local market and the third is informally or by exchange, the latter being more frequent in Casares, thus, uncertainty persists regarding the safety of seafood, especially in the "Paneras" markets.

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WORK CITED

AECI. (2002). Diagnóstico de la actividad pesquera y acuícola (p. 390). AECI (Oficina Técnica de Cooperación). http://www.bionica.info/biblioteca/ADPESCA2002.PDF

Alzás, T., Casa, L. M., Luengo, R., Torres, J. L., & Verissimo, S. (2016). Revisión metodológica de la triangulación como estrategia de investigación. Investigación Cualitativa En Ciencias Sociales, v.3, 639–648. https://proceedings.ciaiq.org/index.php/ciaiq2016/article/view/1009

Amezcua, M. (2003). La entrevista en grupo. Características, tipos y utilidades en investigación cualitativa. Enfermería

Clínica, 13(2), 112–117. https://doi.org/10.1016/s1130-8621(03)73791-7

Angulo, A., Ramírez Coghi, A. R., & López Sánchez, M. (2021). Claves para la identificación de los peces de las aguas continentales e insulares de Costa Rica. Parte I: Familias. UNED Research Journal, 13(1), 27. https://doi.org/10.22458/urj.v13i1.3145

Banco Mundial. (2009). Los miles de millones hundidos del sector pesquero (1st ed., p. 105). Banco Mundial.

Betrián Villas, E., Galitó Gispert, N., García Merino, N., Jové Monclús, G., & Maraculla García, M. (2013). La triangulación múltiple como estrategia metodológica. REICE. Revista Iberoamericana Sobre Calidad, Eficacia y Cambio En Educación, 11(4), 5–24.

Casas Anguita, J., Repullo Labrador, J. R., & Donado Campos, J. (2003). La encuesta como técnica de investigación. Elaboración de cuestionarios y tratamiento estadístico de los datos (I). Atencion Primaria, 31(8), 527–538. https://doi.org/10.1157/13047738

CCAD. (2010). Listados Actualizados de las Especies de Fauna y Flora. incluidas en los Apéndices de la CITES, distribuidas en Centroamérica y República Dominicana. In Comisión Centroamericana de Ambiente y Desarrollo (pp. 1–61).

Centro Humboldt. (2008). Informe: Sistemas Productivo Pesca y Acuicultura (Issue July, pp. 1–23). https://simas.org.ni/media/Sistema_Productivo_Pesca_Acuicultura.pdf

CEPAL. (2019). Hacia la descontaminación del transporte marítimo del comercio internacional : metodología y estimación de las emisiones de CO 2. Boletín FAL (CEPAL), 373, 4–11. https://repositorio.cepal.org/handle/11362/45075

CICFA. (2018). Lista Roja 2da Edicion. Especies vertebradas en riesgo de extincion de Nicaragua. (2da ed., pp. 1–50).

Cotto, A., & Marttín, F. (2008). Estrategia para el Desarrollo sostenible de la Pesca Artesanal, La Seguridad Alimentaria y la Reducción de la Pobreza de las Familias Viculadas 2008-2015 (p. 48). INPESCA. http://extwprlegs1.fao.org/docs/pdf/nic140919.pdf

Cotto, A. 2006. Listado taxonómico de los peces identificados en los océanos Atlántico y Pacífico de Nicaragua. Segunda revisión, Managua, Nicaragua. 35 p.

FAO. (2014). Manual básico sobre procesamiento e inocuidad de productos de la acuicultura. In FAO Fisheries and Aquaculture. https://www.fao.org/3/i3835s/i3835s.pdf

FAO. (2018). El estado mundial de la pesca y la acuicuiltura 2018. Cumplir los objetivos de desarrollo sostenible. (p. 233). https://doi.org/CC BY-NC-SA 3.0 IGO

FAO. (2020). El estado mundial de la pesca y la acuicultura 2020. La sostenibilidad en acción. In Marine Pollution Bulletin (Vol. 3, Issues 1–2, p. 149.). https://doi.org/10.4060/ca9229es

FAO, & CEPAL. (2020). Sistemas alimentarios y COVID-19 en América Latina y el Caribe: Hacia una pesca y acuicultura inclusiva, responsable y sostenible. Boletín FAO/CEPAL Sistemas Alimentarios y COVID-19, 15, 21.

Faurby, O., Barahona, N., & Amaru, T. (1998). Silvicultura de Especies Maderables Nativas del Trópico Seco de Nicaragua. Instituto de Investigación y Desarrollo NITLAPAN-UCA. http://repositorio.uca.edu.ni/1890/1/silvicultura_de_especies_maderables.pdf

Norma Técnica Obligatoria Nicaragüense Para Artes y Métodos de Pesca, (2009). http://inpesca.gob.ni/images/arte de pesca/artes de pesca.pdf

INPESCA. (2012). Plan de Accion de las mujeres de la pesca artesanala en Nicaragua (Vol. 1).

INPESCA. (2019). Estrategia de Desarrollo del Sector Pesquero y Acuícola de Nicaragua 2017 - 2021 (p. 26). http://inpesca.gob.ni/images/2019/ESTRATEGIA DE LA PESCA Y ACUICULTURA 2017-2021 INPESCA.pdf

León-Valle, W., Núñez-Guale, L., Valencia, A., & Cedeño, J. (2017). La Pesca Artesanal un legado del saber ancestral, provincia de Santa Elena. Revista de Investigaciones Sociales, 3(10), 51–63. www.ecorfan.org/republicofnicaragua

MARENA. (2011). Biodiversidad marino-costera de Nicaragua : (potencialidades de los ecosistemas) (1st ed.).

MARENA. (2020). Actualizacion del sistema de vedas. La Gaceta, Nicaragua. http://www.pgr.gob.ni/PDF/2020/GACETA/marzo/GACETA_04_03_2020.pdf

Martínez Carazo, P. (2006). El método de estudio de caso: Estrategia metodológica de la investigación científica. Pensamiento & Gestión, 20(20), 165–193. https://www.redalyc.org/html/646/64602005/

Martínez Urbina, K. P., Somarriba Novoa, M. K., Sobalvarro, A. I., Hernández Somarriba, L., & Molina, A. L. (2008). Diagnóstico de la pesca artesanal y comercialización de los productos del mar procedentes de Poneloya y Las Peñitas en el período comprendido entre enero-octubre 2008. 191.

Navia, A. F., & Mejía-Falla, P. A. (2011). Guía para la identificación de especies de tiburones y rayas comercializadas en el Pacífico colombiano. June 2014, 37.

Okuda, M., & Gómez-Restrepo, C. (2005). Metodología de investigación y lectura crítica de estudios: Métodos en investigación cualitativa: triangulación. Revista Colombiana de Psiquiatría, XXXIV(1), 118–124. http://www.scielo.org.co/pdf/rcp/v34n1/v34n1a08.pdf

Orellano, J. (2010). Peces, crustáceos y moluscos del istmo centroamericano. 174. http://climapesca.org/wp-content/uploads/2018/09/Peces, Crustaceos y Moluscos del Istmo Centroamericano.pdf

OSPESCA. (2012). Guía general para el mantenimiento de motores fuera de borda para la pesca artesanal.