Tools and Rules for Catch Control in the White Shrimp Fishery *Litopenaeus vannamei* in the REBIEN, Chiapas

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I. Introduction

Shrimp fishing represents one of the most important fisheries in Mexico, with the Mexican Pacific being the region where the largest total shrimp catch (~92%) is extracted in Mexico (SAGARPA, 2021). This fishery ranks third in terms of its fishery production volume, however, in terms of commercial value, it ranks first in Mexico. Shrimp catches in the Mexican Pacific are mainly composed of three species, blue shrimp *Litopenaeus stylirostris* (Stimpson 1871), white shrimp *L. vannamei* (Boone 1931), and brown shrimp *Farfantepenaeus californiensis* (Holmes (1900), as well as other species of penaeid shrimp. Shrimp of the genus *Litopenaeus* spend most of their time in areas influenced by or closely related to river deltas, estuaries or coastal lagoons. Migratory movements are due to the nature of their life cycle, which is dependent on estuaries or coastal lagoons, which are used as protection, feeding and growth areas.

L. vannamei , the white shrimp, is distributed from Sonora, Mexico to Peru. In Mexico, the highest catch values in the marine zone and protected waters are obtained in southern Sinaloa, Nayarit and the Gulf of Tehuantepec (Chiapas). It is a species that also inhabits sandy and clayey bottoms (Hendrickx , 1996). Data from the industrial fleet indicate that this species has been caught at depths of up to 50 fathoms, although the greatest abundance is found between 5 and 15 fathoms deep at sea.

The fishing activity carried out in REBIEN is based on the use of four groups of species: shrimp, scalefish, crab, and mollusks. Shrimp and scale fish catches are multispecific because other species that are not targeted by directed fishing are also caught in fishing gear. However, despite this high diversity, from an economic point of view, only a few species are exploited and considered of commercial importance, the most notable being the white shrimp (*Litopenaeus vannamei*). Regarding the group of fish or scalefish species, there are the mullet (*Mugil curema* , *M. cephalus* and *M. hospes*), Striped Mojarra (*Gerres cinereus*), Sea Bass (*Centropomus Robalito* and *C. nigrescens*), Snappers (*Lutjanus colorado, L. argentiventris* and *L. aratus*), Cuatete (*Arius guatemalensis*), Pelonas (*Oligoplites altus* and O. saurus), horse mackerel (*Caranx caninus*) Cook (*Caranx caballus*), Machete Sardine (*Pliosteostoma lutipinnis*), Corvina (*Cynoscion) phoxocephalus*), Popoyote (*Dormitator latifrons*).

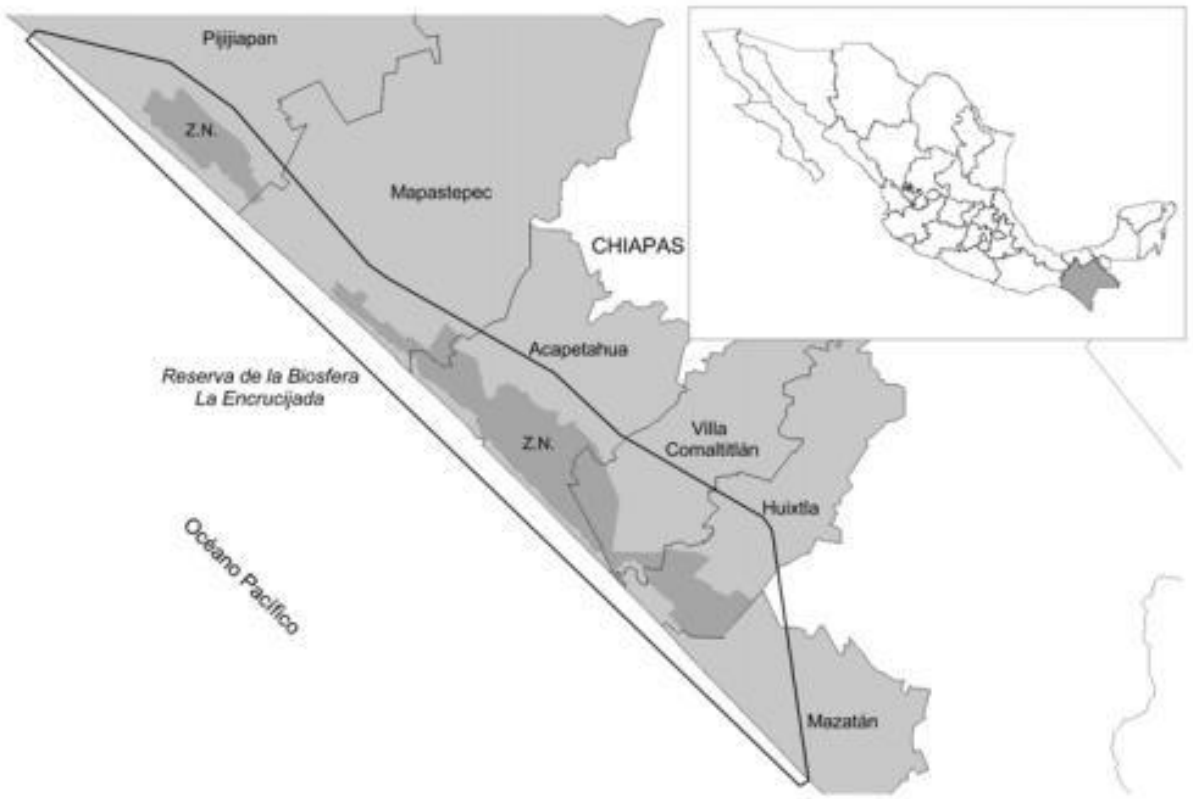

Figure 1. La Encrucijada Biosphere Reserve, Chiapas, Mexico (CONANP-FMCN 2003). and the fishing zones corresponding to the fishing cooperatives participating in the FIP.

Artisanal Fishing Technique

Fishing activities are the main sources of protein and livelihood for the local communities and approximately 18 small-scale cooperatives (600 fishermen) hold permits and/or concessions for shrimp and finfish, in the REBIEN (SEMARNAT-CONANP 2009; Rodríguez- Perafán , 2014; Armengol et al., 2021). White shrimp (Litopenaeus vannamei) is the most important commercial species due to its price and average annual production (~2,800 tons) (SAGARPA 2006).

The artisanal shrimp fishery in REBIEN is carried out in lagoon and estuary systems using smaller vessels (<12 m in length). Shrimp fishing is carried out five to six days a week. Fishermen make an average of 5.7 shrimp trips per week, with an average catch of 8.9 kg per fishing trip. The average crew per fishing trip is two fishermen, the average trip duration is five hours, and the actual fishing time is 3.5 hours.

The cast net is the traditional fishing gear and is made with monofilament nylon thread of 0.20 and 0.25 mm diameter and a maximum height of up to 6 meters (Fig. 2). This is the fishing gear legally authorized for shrimp fishing in lagoon systems and, in accordance with the Mexican Official Standard NOM-002-PESC-93, must work with a mesh opening of 1.5 inches (38.1 mm).

Figure 2. Cast net fishing gear used in the shrimp fishery in the La Encrucijada Biosphere Reserve, Chiapas.

The shrimp fishery has an Official Mexican Standard 002-PESC-1993 (DOF, 1993) and its subsequent modifications (DOF, 1997; DOF, 2006) to regulate the use of shrimp species in waters under federal jurisdiction of the United Mexican States. For the La Encrucijada Biosphere Reserve (REBIEN), Chiapas, there is a legal instrument that regulates the sustainable use and preservation of the natural resources found there, so that they are compatible with obtaining economic benefits, derived from the activities carried out for this purpose by the social nuclei that inhabit it, it will be the General Law of Ecological Balance and Environmental Protection (LGEEPA) and its regulations, in the matter of Protected Natural Areas (ANP).

Current State of the Fishery

The current status of the Mexican shrimp fishery is defined as being exploited to the maximum sustainable level. In general terms, the shrimp fishery in these lagoon systems has been poorly studied, and research conducted has been primarily focused on understanding the biological aspects of the species, neglecting the assessment of the resource and its fishery. For this reason, there are no estimates of mortality and exploitation rates that would define, from an analytical perspective, the status of the resource in terms of its fishery.

It is important to note that, in general terms, shrimp populations in protected waters show signs of deterioration, which is not only due to the effects of fishing activity, but also to factors related to the alteration of growth and feeding areas due to the excessive felling of mangroves, the main source of detritus for the crustacean, as well as their silting. Therefore, in order to contribute to the recovery of shrimp populations in protected waters, it is necessary to implement conservation and protection measures for the resource, such as closed seasons, establishment of no-fishing areas, regulation of fishing gear and the elimination of those unauthorized for harvesting the resource and that are harmful to the fishery. In addition, public awareness programs must be implemented to prevent further deforestation of the mangroves and mitigate the effects through reforestation of the affected areas.

Management Measures Established in the Shrimp Fishery

The current management measures for the Pacific shrimp resource (National Fisheries Charter, 2017) applicable to coastal lagoon systems are listed in Table VII.

Table VII . Current management measures for shrimp capture in REBIEN.
(https://www.gob.mx/cms/uploads/attachment/file/334832/DOF_-_CNP_2017.pdf)

Driving Control	But	Provisions	Livelihood
Mexican Official Standard	Yeah	NOM-002-SAG/PESC-2013	DOF: 11/07/2013
Fisheries Management Plan	No	In the process of development	
Type of access	Yeah	Commercial permit or fishing concession for shrimp	IMIPAS technical opinion
Minimum size	No	Not applicable	
Fishing gear and capture method	Yeah	Larger vessel: Trawl with mesh sizes of 50.8 mm (2 inches) and 38.1 mm (1½ inches) in the bag; with Turtle Excluder Devices (TEDs) and Fish Excluder Devices (FEDs). The top rope must not exceed 36.57 m (120 feet). Smaller vessel: Trawl with a minimum mesh size of 44.4 mm (1¾ inches) and 38.1 mm (1½ inches) in the bag; bottom rope with a maximum of 18.3 m (60 feet). Cast net with a minimum mesh size of 37.5 mm (1½ inches). Suripera net with a minimum mesh size of 31.75 mm (1¼ inches). Line nets with a minimum mesh size of 63.50 mm (2.5 inches) and a maximum length of 200 m, with an overlap of between 50 and 70%.	Sections 4.3.2.1 and 4.3.2.3, NOM-002-SAG/PESC-2013 Regulatory appendices "A", "B" and "C" of NOM-002-SAG/PESC-2013 6/11/2018 DOF
Veda	Yeah	Temporary closure to protect reproduction and growth with variable dates, generally between March and September of each year	Section 4.4, NOM002-SAG/PESC2013 IMIPAS technical opinion
Share	No	Not applicable	
Fishing unit	Yeah	Small boats. 10.5m long fiberglass boats with outboard motors.	IMIPAS technical opinion
Effort	Yeah	15 commercial shrimp fishing concessions	IMIPAS technical opinion

Fishing area	Yeah	Small vessels in: a) inland waters including lagoon -estuarine systems of the Pacific Ocean, b) coastal marine waters in the North Central part of Sinaloa and coastal marine waters of Sonora, and c) marine waters in the Upper Gulf of California	NOM-002-SAG/PESC-2013 DOF: 07/12/2016 DOF: 01/09/2000 DOF: 09/25/2009 DOF: 08/09/2005

***DOF:** OFFICIAL JOURNAL OF THE FEDERATION;

***IMIPAS:** Mexican Institute for Sustainable Fisheries and Aquaculture Research

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