v. 3, n. 13, 2023

Journal of Agricultural Sciences Research

COMPARATIVE ANALYSIS OF THE WHITE SPOT DEEP SHRIMP FISHING (*PANDALUS PLATYCERUS)* USING TRAWL NETS IN THE PERIOD 2004/2005 AND TRAPS IN THE PERIOD 2022/2023

Jorge Flores Olivares
``Tecnológico Nacional de México``,
Mazatlán Campus, Division of Graduate Studies and Research (DEPI)
Mazatlan Sinaloa
ORCID: 0000-0002-5439-1858

Alfredo Emmanuel Vázquez Olivares
``Tecnológico Nacional de México``,
Mazatlán Campus, Division of Graduate Studies and Research (DEPI)
Mazatlan Sinaloa
ORCID: 0000-003-3819-0797

Osiris Chávez Vargas
``Tecnológico Nacional de México``,
Mazatlán Campus, Division of Graduate Studies and Research (DEPI)
Mazatlan Sinaloa
ORCID: 0009-0003-1669-9354

Heimy Franceline Martínez Sánchez
``Tecnológico Nacional de México``,
Mazatlán Campus, Division of Graduate Studies and Research (DEPI)
Mazatlán, Sinaloa
ORCID: 0000-0001-8268-9072

Abstract: Two artisanal white spot shrimp fishing systems are examined (*Pandalus platycerus*) in the Mexican Pacific, trawling off the western coast of Baja California in the 2004/2005 period and trapping in Rosarito, Baja California in the 2022/2023 period. The following were analysed: fishing yields, size structure, length-weight relationship, bycatch and, in the case of the trap system, yield by type of trap. In the case of the trawl net, the resource was reported between 126 and 252 m deep in a series of fishing days carried out from La Bufadora, San Miguel and Rosarito, Baja California. Together with the target species, nine species of crustaceans (two stomatopods and seven decapods) were collected, of which two (*Sicyonia disedwardsi* and *Lopholithodes foraminatus*) represent a first record for the area.

Besides *P. platycerus* which represents an important fishery resource not yet exploited in Mexico, five bycatch species were collected (*Sicyonia ingentis, Sicyonia disedwardsi, Crangon nigromaculata, Cancer anthonyi and C. gracilis)* rrepresenting interesting secondary fishery resources. In the experimental work on traps, the resource was monitored with two different designs: rectangular and conical/truncated, with the rectangular trap model being the one that achieved the best relative abundance indices with values that fluctuated between 0.165 kg/trap (rectangular) at 0.093 kg/trap (conical), with an average value of 0.129 kg/trap throughout the surveyed area. A relevant aspect in this study is the effectiveness of the traps with respect to trawling, since, as the product is marketed alive, 99% survive with traps, while 40% survive with trawl capture.

Keywords: Fishing, *P. platycerus*, analysis, drag, traps.

INTRODUCTION

This paper compares an artisanal fishery carried out as an exploratory fishery aimed at finding alternative species for the capture and diversification of Mexican fisheries, explicitly trawling carried out in 2004 on the western coast of Baja California and directed at the deep sea shrimp fishing (*Pandalus platycerus*) and, a second method, fishing with traps for the capture of the same species carried out in the area of Rosarito, Baja California in 2022. In order to determine to what extent the nature of the captures, variation of methods, fishing techniques and production management, have an effect on the economic viability of artisanal fishing in their respective geographical area.

In the Mexican Pacific, to date no interest has been expressed for the fishery of: *Pandalidae*, although some species of the genus *Heterocarpus*, they have been abundantly caught in some areas of the Gulf of California (Hendrickx et al. 1984, Hendrickx 1995, 2003a, 20003b 2004). Several known Pandalus species from the Pacific Northwest (USA and Canada) have been reported in southern California, very close to the Mexican border, but there are no published records of the presence of any of these species in Mexico. This is because this region of the Mexican Pacific, between Punta Eugenia and the border with the United States of North America, is not subject to the fishing activities of the country's shrimp fleet. In 2004 the SAGARPA-CONACYT 040 project began **"Exploratory fishing for the capture of shrimp in deep waters of the western coast of Baja California.**as part of a study of the fishing potential on the west coast of Baja California, Mexico. For the 2022 project called **"Evaluation of the relationship between in situ bottom temperature and catch per unit effort (CPUE) of the white spot shrimp (P. platycerus) trap fishery off the west coast of Baja California, Mexico".**two types of traps related to the catch per unit effort (CPUE) and its component with the bottom temperature are evaluated. The purpose of this work is to present a review of the information related to the data obtained in trawling and its evaluation in relation to trap fishing.

MATERIAL AND METHODS

STUDY AREA AND DATA COLLECTION FOR TRAWLING

The area in which the samplings were carried out was divided into three zones: zone 1, between 28º N, 114º17'W and 29º20'N, 114º55'W; zone 2 between 29º21'N, 114º55'W and 30º50'N, 116º08'W; and zone 3 between 30º51'N, 116º08'W and 32º31'N, 117º07'W, Figure 1.

In each sampling zone, we proceeded to recognize the type of bottom by making tours to verify its profile and consistency by means of the echo sounder.

Once the existence of a flat bottom was verified, they returned to cast a test net (small net with 30 feet of headrope) for one hour (see Flores et al. 1995) in order to verify the presence of the species of interest and proceed to fishing. In total, 58 trawls were carried out (zone 1: 21; zone 2: 2; zone 3: 35) with diving-type shrimp nets at depths of 90 to 350 m, with the participation of the "Don Agustín II" vessels, length 21.98 m, (30 drags) and "Pez de Acero III", length 23.98 m, (28 drags), Figure 2 and 3.

Figure 1. Trawling was carried out for the year 2004/2005 from Punta Eugenia to the Coronado Islands, borders between Mexico and the USA.

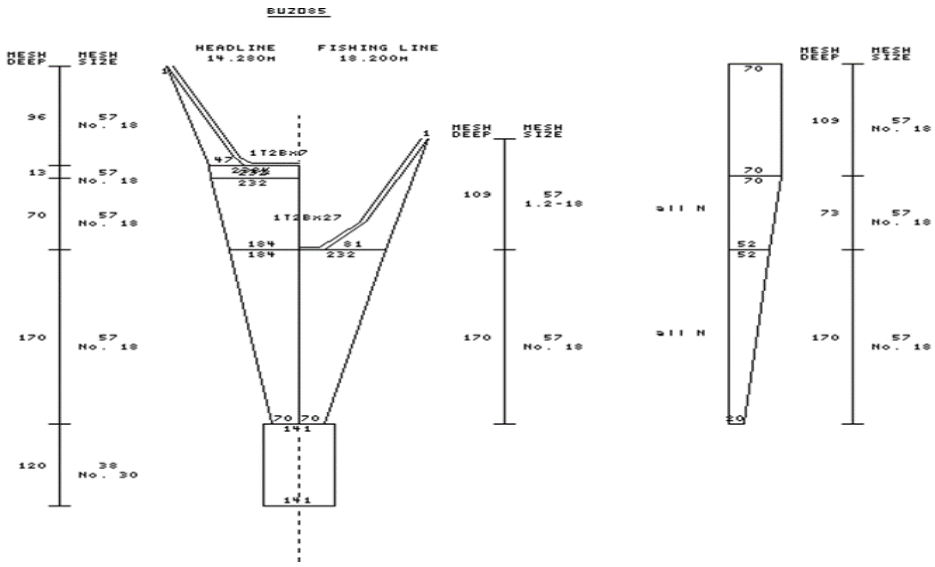

Figure 3. Characteristics of the diver-type trawl used in fishing operations. Toprope length = 14.20 m, footrope length = 15.62 m, mesh size at wing: 571 mm, mesh size at codend: 444 mm.

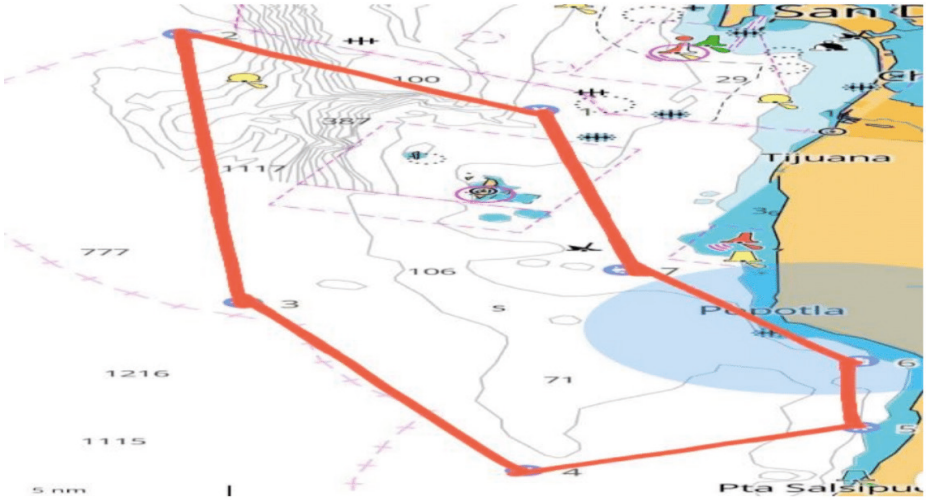

Figure 4. Study area north of Rosarito Baja California for trapping *P. platycerus*.

Figure 2. Vessels used in trawling of *P. platycerus*: **"Pez de Acero III"**: Length=20.42 m, Beam= 6.10 m, Draft=3.30 m, main engine=402 Hp. **"Don Agustín II"**: Length 22 m, Beam 6.40 m, Draft= 3.50m, main machine: 450 HP.

Once on deck, the catch was separated into two groups: the pandalids and the accompanying fauna. Each group was weighed (Ohaus 5000 digital scale, precision ± 0.01 g) and a sample of the pandalids was selected and the specimens were measured (AC, carapace width; LT, total length; LC, cephalothorax length) with a shrimpometer (precision ±1mm). The fresh weight/length relationship of P. platyceros was established (least squares) and the level of fit of the equation was estimated (residue assumptions and Durbin Watson test). The species of crustaceans of the accompanying fauna with the highest incidence in the catches were identified, using various guides and identification keys (Hendrickx 1984, 1995, Hendrickx & Salgado-Barragan 1991).

STUDY AREA AND DATA COLLECTION FOR TRAP FISHING

The fishing area was developed in the polygon to the north of Rosarito, B.C., which is located at the first extreme point: geographic point 1: 32°31.328 117°16.276, point 2: 32°34.341 117°29.062, point 3: 32°12.6507 117°16.8972, point 4: 32°01.2918 117°02.5948, point 5: 32°07.9848 116°55.0682, point 6: 32°13.4653 116°57.6746, point 7:32°18.8626 117°07.751 6. Figure 4.

This fishery used two smaller fiberglass boats equipped with a cobralineas machine to handle the traps, considering the operational times of setting, resting and hauling carried out under ideal conditions, the maximum number of traps that a boat could set and haul in one day of operation was 25 units per vessel. Measuring 30 cm high, 95 cm long and 60 cm wide, with 22.5 cm conical side inlets. Made with 1x1 inch wire mesh and held together with biodegradable staples, Figure 5.

Figure 5. Rectangular trap design proposed for the experiment for the capture of *P. platycerus*.

The setting time of the traps in the line of 25 traps is between 15 and 18 minutes, that is, one trap every 20 seconds. The draft downwind allows better bottom resolution, the working platform is more stable, Figure 6.

To analyze the distribution of the white spot shrimp, the catch per unit effort formula was used:

$$CPUE_1 = \frac{\sum_{i=1}^{n} CT_i}{\text{n trap}}$$

Where:

TC = Total catch in kg

n trap = Number of traps used in each of the operating variables.

STATISTICAL ANALYSIS

A statistical analysis was performed to assess the normality of the data using Lilliefors (Conover, 1999) with normal data, the Bartlett homoscedasticity test (Zar, 1984) was applied. To evaluate if there was a significant difference ($P<0.05$) between the catches. A one-way and one-factor Fisher "F" ANAVA analysis was performed if the data were not parametric, the Kruskal-Wallis rank ANAVA.

RESULTS IN TRAWLING

The material was collected in the geographical area located between Salsipuedes (approx. 31° 55' N) and Rosarito (approx. 32°20' N), Baja California. It consists of 12 females (Lc 47.3-58.4 mm; Lc 221-245 mm), including two ovigerous (EMU6358; ITMAR, Mazatlán). Among the specimens measured on board but not preserved and that all came from the same capture area, females up to 250 mm TL were found. These values indicate that the material caught in Mexico is close to the maximum size known for the species. Considering the total catches, the species was collected only in zone 3, at depths between 126 and 252 m. Considering all the samplings, the capture of P. platyceros reached 796.4 kg, which represents 57.7% of the total number of organisms captured during the exploration. The analysis of the size distribution of the specimens measured in trawling indicates a predominance of specimens in the size interval of 145 to 220 mm (TL) (83.5%). Specimens with a size equal to or less than 130 mm (TL) were very scarce in the samplings. When comparing the size structure for the case of capture with traps, organisms with larger sizes are observed than those reported in trawling, three groups stand out, the first group of sizes of 190-210 mm, the second group of 200-235 mm and third 240-280 mm. (Figures 7a and 7b).

The length-fresh weight relationship obtained using the available data (Figure 8) provides a satisfactory fit ($r = 0.7571$). A better relationship could possibly be obtained by eliminating the data corresponding to female specimens with eggs (proportionally higher fresh weight). The residual assumptions method gave a mean square error of the regression of 0.7868 and the Durbin Watson test gave a value of 0.95.

Considering the three trawling zones during the study, the total catches (P. platyceros

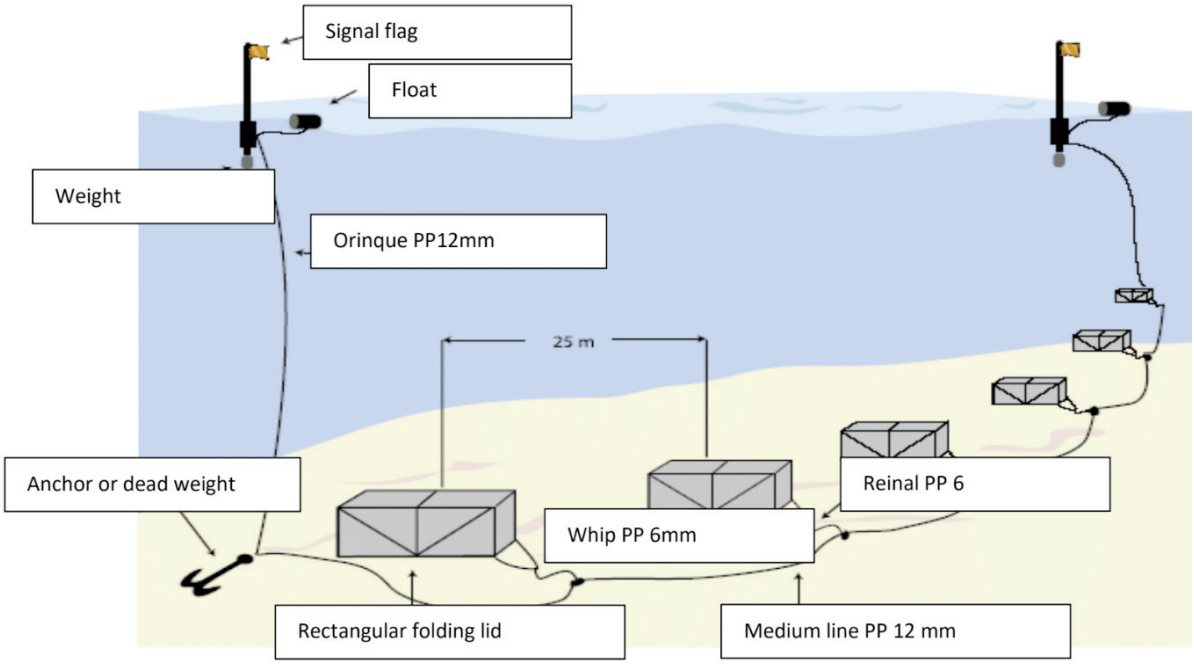

Figure 6. Scheme of distribution of traps ready to catch longline

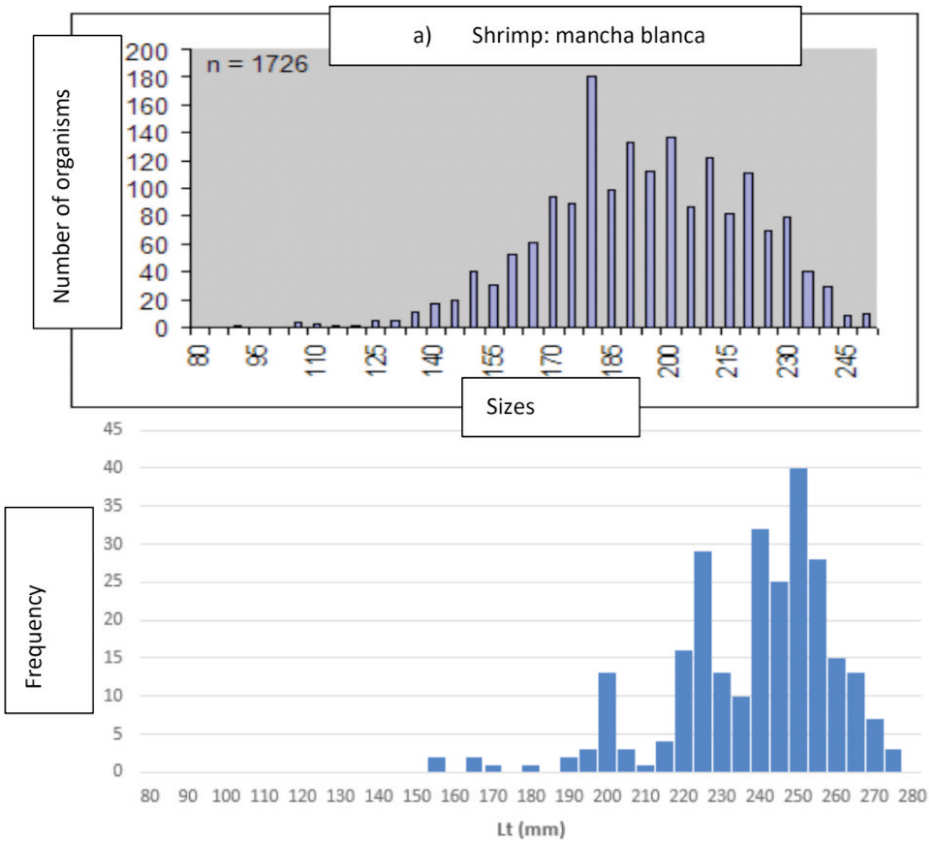

Figure 7a and 7b. Size structure of the white spot shrimp fished with trawls (a). Capture with traps (b).

and its accompanying fauna) obtained during the operations were highly variable and much higher in zone 3 (1278 kg) than in zones 1-2 (93.5 and 11.8 kg, respectively). Zone 3 clearly stood out as the most productive zone, with catches of 53.8 kg/h and 15.09 kg/h depending on the vessel (Table 1).

The analysis of shrimp fishing yields *(P. platyceros* and *S. ingentis*) per trawl hour (per vessel and in total; in zone 3 (the only zone where P. platyceros came out) indicates catch values of the same order (approximately 26 kg/h) for both shrimp species in this zone, Table 2. Considering the total of the three zones, the figures are also comparable (approximately 17 and 10 kg, per species, respectively). P. platyceros per hour of trawling in three depth intervals (Table 3) and considering the catches of both vessels, reflects marked differences for this species with an increase towards greater depths in zone 3, which clearly contrasts with the catches of Sicyonia ingentis that tend to decrease at greater depths, both in zone 1 and zone 2 (Table 4).

Based on the material preserved and identified in the laboratory, it was possible to recognize nine species of crustaceans (two stomatopods, four crabs and three shrimps), Table 5.

RESULTS IN THE CAPTURE WITH TRAPS OF *P. PLATYCERUS*

A total of 17,049 traps were set. Each set in the experimental phase corresponded to the setting of 81 lines of 42 traps of two types, 21 collapsible rectangular and 21 truncated conical. Average distance between the traps 6,12, 18 m. Subjected to three rest times: 12, 18 and 24 hours. Two types of bait were arranged in them, one with sardines and the other with pieces of mackerel.

The experimental fishing tasks were carried out in the range between 100 to 360 m., depth. The choice of said range is related to the bathymetric distribution of the target resource. During the prospecting operations carried out in October and November 2022 and December-August 2022/2023, a total of 1,500 and 2,015 traps were set, respectively. From these tasks, *P. platycerus* was located on the seabed between 100 and 351 m deep, being captured in almost the entire surveyed area (Figure 9).

Figure 9. Capture of white spot shrimp in trap fishing in the 2023 period.

In total, the vessel made 588 sets of experimental and promotional fishing, in which the limitation was referred to adverse weather conditions and maintenance of the vessel. Table 6 shows the total monthly catch of deep-sea shrimp (P. platyceros) recorded

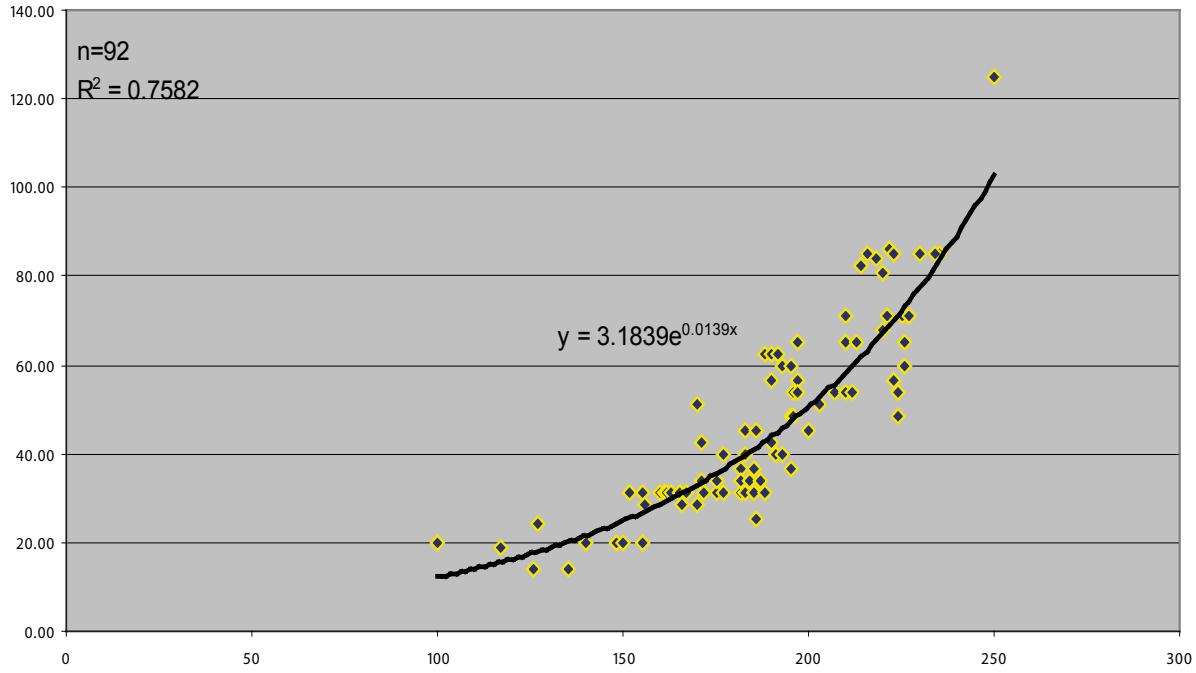

Figure 8. Length-weight relationship of the deep-sea shrimp Pandalus platycerus in the 2004/2005 trawl fishery.

Number of throws		Hours of fishing	Throw duration	Swept area	Depth		
					Min.	Max.	Med.
Pez de acero III	28	24.35	0.57	382928.1	50	103	77.26
Don Agustin II	30	39.47	1.19	445458.42	51.8	136	112.6
Total	58	63.82	1.06	828386.52	50	136	95.57

Table 1. Fishing effort and operating depth of trawling

Zone	Capture (kg)			Towing hours			Capture /Towing hours		
	PA III	DA II	Total	PA III	DA II	Total	PA III	DA II	Total
1	78	15.5	93.5	8.24	8.4	17.4	9.47	1.85	5.37
2	4	7.8	11.8	2	4	6	2	1.95	1.97
3	834	443.7	1277.7	15.5	29.4	45.3	53.81	15.09	28.21

Table 2. Fishing effort (trawling hours) total catch and per trawling hour (kg) in each fishing area in the two vessels used PA III and DA II

Name of the fish:	Pez de acero III		Don Agustin II		Total	
Zona	Spot	Roca	Spot	Roca	Spot	Roca
1	0	8.617	0	1.917	0	5.351
2	0	1	1.5	0.463	1	0.642
3	26.968	26.839	12.66	2.425	17.439	10.757

Table 3. Yield (kg/h trawl) per species caught (rock =Sicyonia ingentis; spot= P. platycerus) per vessel.

	50-80 fathoms		81-110 fathoms		111-140 fathoms	
	Roca	**Spot**	**Roca**	**Spot**	**Roca**	**Spot**
Zone 1	6.44	0	3.8	0	2.3	0
Zone 3	20.16	14.5	17.97	20.96	5.52	31.54
Total	11.31	5.5	14.28	16.46	4.16	19.41

Table 4. Yield (kg/h dragged) by depth stratum and by species (rock =Sicyonia ingentis; spot= P. platycerus)

Species	Number	Sizes	EMU
Hemisquilla californiensis	2M	LT, 145 y 181 mm	6359
	2H	LT, 145 y 152 mm	
Schmittius politus	1H	LT, 74 mm	6360
Sicyonia disedwardsi	1H	LT, 100 mm; LC, 26.4	6361*
Sicyonia ingentis	26 M	LT, 141-178 mm; LC, 28.2-37.5 mm	6362*
	8H	LT, 170-192 mm; LC, 37.3-44.2 mm	
Crangon nigromaculata	1 HH	LT, 73 mm; LC, 10.9 mm	6363
	1H	LT, 64 mm; LC, 14.2 mm	
Lopholithodes foraminatus	1M	AC, 77 mm	6364
Neolithodes sp.	1H	AC, 55.5 mm (1)	6365
Cancer anthonyi	1H	AC, 138.2 mm	6366
Cancer gracilis	1M	AC, 86.2 mm	6367

Table 5. Crustacean species collected together with P. platycerus Num., number of organisms; M. males, H. females, HH, ovigerous females; EMU, registration number of the UNAM reference collection (*) and part of the Itmar.

		Capture (kg)	Days	Number of throws	Cap/throw	Cap/day	Cap/trap
Experimental phase	October	207	10	31	6.68	20.7	0.17
	November	447	14	51	8.76	31.93	0.292
Development fishing phase	December	722	14	71	10.17	51.57	0.337
	January	650.5	15	63	10.33	44.86	0.344
	February	511.5	12	47	10.88	42.63	0.359
	March	385.5	10	41	9.40	40.58	0.31
	April	406	16	68	5.97	25.38	0.199
	May	434	10	59	7.36	45.68	0.245
	June	490	8	42	11.67	23.75	0.302
	July	500	12	64	7.81	41.67	0.52
	August	4950.8	136	587			

Table 6. The operational regime used in the capture of deep-sea shrimp, period 2022/2023.

during the period from October 7, 2022 to August 19, 2023, where a total catch of 4651 kilograms was recorded. The maximum capture occurred in the month of January 2023, with 722 kilograms and the minimum in July 2023, with 190 kilograms; an increase of 406 kg is observed in the month of May, in the following month (June) maintaining the production with 434 kg, to rise again in the month of August to 500 kg.

COMPOSITION OF THE POPULATION

The specimens were between 100 and 250 mm in total length. The size-frequency distribution of males is clearly polymodal, with the mode centered around 185, 205 and 225 mm in total length. The low proportion of specimens with sizes smaller than 105 mm and larger than 140 mm stands out in it. In the case of the few females captured, they were distributed mainly at 195 and 255 mm. (Figure 10).

Catch by trap type: For the evaluation of abundance, the capture value per trap obtained by rectangular design traps was used, since this was the model determined to be the most appropriate for fishing this resource.

The CPUE obtained with this gear is considered to be representative of the abundance in the corresponding bathymetric fishing range and equally in all areas around the northern area of the western coast of Baja California. Said CPUE is 7.9 kg/line or 58 specimens/line of traps (Table 7).

Trap type	Total capture (kg)	Number of traps	CPUE (kg/trap)
Truncated conical	207	2,218	0.093
Rectangular	197.3	1,198	0.165

Table 7. Relation of the total catch with the type of truncated conical and rectangular trap.

Figure 11 shows the catches and average yield by type of trap in the experimental fishing of *P. platyceros,* according to lunar effects, highlighting that in the new moon phase a CPUE of 190 (Kg/line) was obtained, while in the third quarter of the lunar phase only a CPUE of 50 (Kg/line) was recorded. Likewise, in the full moon phase the CPUE was 70 (Kg/line).

When comparing the mean sizes of white spot shrimp, captured by depth range, they showed to be statistically similar between 168 and 289 m. However, the averages determined at 107, 168 and 229 m, as well as at 351 m, are statistically different from each other and higher than those observed in the 168 to 228 m range. This shows that the largest specimens are distributed mainly over 290 m and under 351 m depth. Regarding the depth of 107-167 m., P. platycerus 6 kg/l. At the depth of 168-228 m., 5.75 kg/l were observed. In the depth of 229 to 289 m., 2 kg/l were recorded. At the depth of 290 to 351 m, its result was 11 kg/l (Figure 12).

Figure 13 shows the accompanying fauna found. Another species of lobster appears (*Munida quadrispina*), in relation to that reported in trawling cruises I and II, as well as a greater presence of octopus which, according to the research, is in high demand in the US market. It is important to highlight the appearance of abundant juvenile hake (*Merlucius productus*). Another resource is the record of what is known as lupon (*Scorpaena guttata*) of some commercial interest, especially in the area of San Diego, USA. Other species of accompanying fauna are illustrated, highlighting the box crab (*Lopholithodes foraminatus*), the lingcod (*Ophiodon elongatus*) and the king crab (king crab of California).

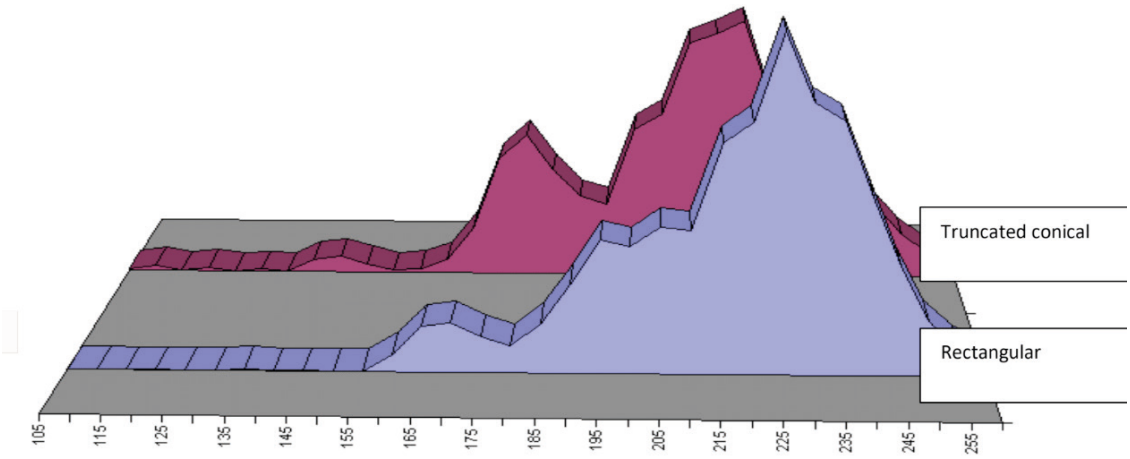

Figure 10. White spot shrimp size structures obtained in the catches using the two types of traps during the development phase (January-August 2023).

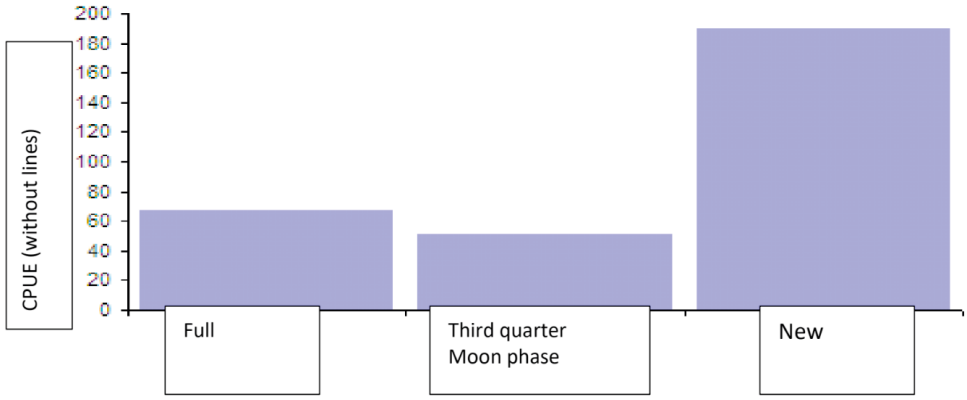

Figure 11. CPUE yield (Kg. /line) of the white spot shrimp and its relationship with the lunar effects obtained in the experimental phase (January and March 2023).

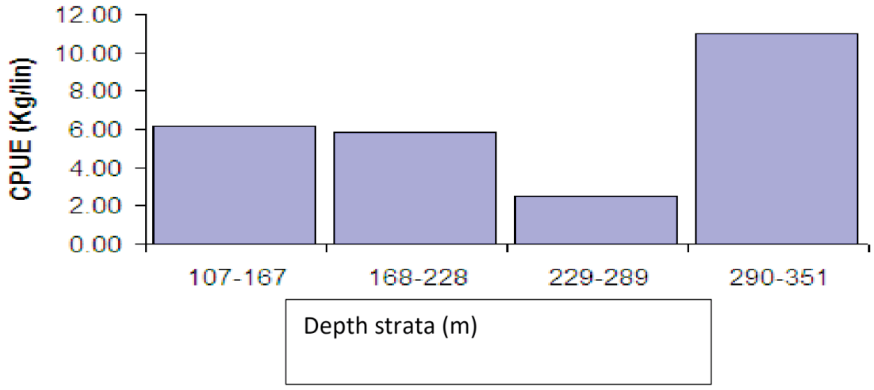

Figure 12. Relationship between the catch per unit effort (CPUE; Kg/line), and the depth strata in trap fishing, period 2022/2023

Figure 13. Photographic relation of fauna accompanying shrimp fishing with traps.

DISCUSSION

This deep pandalid is exploited with some intensity in various parts of the world. Thus, this species is caught off the coast of British Columbia, with 1440 tons in 2003; in California, with 700,000 pounds in 2000 and 200,000 pounds in 2004; For its part, Japan records catches with 3,000 tons in 1993 and 4,000 tons in 2000; and on the coast of Alaska, catches have been recorded with 2,000 tons in 1995 and 1,300 tons in 2003 (Smith, 2013).

The presence of P. platycerus was first described by Flores et. al, (2004), in trawling and exploratory fishing operations carried out on the western coast of Baja California, the depth range in which this species was located between 100 and 360 m. The bathymetric range is consistent with that indicated by Simpson, 1975. In this regard, the presence of this crustacean in these depths would be related to the physical characteristics of the intermediate water mass of California, whose temperature fluctuates between 7.5 and 3.5°C, existing an inverse relationship between the abundance of this species and the intensification of this water mass in the northeastern Pacific.

Trap yields obtained around the western coast of Baja California are similarly in agreement with maximum and minimum values found elsewhere in both California and Alaska (Smith, 2013).

This places at an intermediate level the 0.380 kg/trap determined in these experiences as a general average in the capture of P. platycerus around the western coast of Baja California when using the trap designs with which satisfactory yields were obtained. These correspond to the conical/truncated trap (0.93 kg/trap) and the rectangular (0.165 kg/trap), a design that is currently used by artisanal fishermen for the extraction of this resource.

The behavior of the size structure of the target species, were recorded in the maximum and minimum ranges of total length, they were from 104 to 255 mm in total length, specimens with a size of 100 to 140 mm were scarce. Most of the individuals had sizes between 163 and 248 mm in total length, reported mainly in trawling. In fishing with traps, relative larger organisms were found up to 280 mm in total length, a situation that improved the size that was recorded in the exploratory fishing cruises of 2004 and 2005, which on that occasion was 240 and 250 mm in total length. improving with the above the data of asymptotic length of this species that was calculated at 280 mm.

In the event that the exploitation of P. platycerus begins on the western coast, the results obtained allow us to anticipate the absence of immediate problems associated with the conservation of this resource. In addition, the white spot shrimp retained in the traps are large, possibly most of them with lengths greater than the corresponding lengths of first sexual maturity. In this regard, Ronholt, 1974, mention that the California Fisheries Administrative Council uses the equivalent of 135 mm in total length as the minimum catch size for the white spot shrimp, which in the case of the Baja California, Mexico, P. platycerus would correspond to more than 90% of the specimens caught meeting said minimum size.

The presence of P. platyceros in the waters of the extreme portion of NW Mexico, off

the coast of Baja California, suggests that a well-managed fishery could be carried out; some companion species (e.g., Sicyonia ingentis and Crangon nigromaculata) are also of commercial interest despite having a more limited acceptance in the markets, Flores, 2007. The information collected allows defining a distribution area of P. platyceros in the extreme north from the Mexican portion of the California current zone.

As a first capture horizon, a total of 200-250 tons/year could be defined, which would represent a landing equivalent to 25% of the total calculated biomass of this resource, which would have a positive impact on the insular economy and the direct benefit of the fishermen who dedicate themselves to the extraction of this new resource.

CONCLUSIONS

A) Fishing the white spot shrimp target resource with trawls and traps is technically and economically feasible, particularly using the trap catch and both trap designs tested in the 2022/2023 study. Something that adds to this statement, that the market-destination of P. platycerus is to consume it alive, therefore, with the capture method of trawling, only 40 percent of the target capture survives and with trap fishing, the capture survives 97 percent.

B) Of both experimented trap designs, the rectangular trap model achieved the best relative abundance indices (0.165 kg/trap). According to the comparison made between both trap designs, the rectangular one would fish twice the target resource than the conical/truncated trap.

C) It is feasible to start the extraction with amounts that increase gradually over time. This would allow monitoring the effect of fishing on this deep-sea shrimp and confirm various aspects related to the biology of this resource. As a first capture horizon, a total of 200-250 tons/year could be defined.

REFERENCES

Flores, O. J., M. Rodríguez, M. Shimizu, & T. Machii. 1995. Evaluation of Demersal Fishery Resources of the Gulf of California using Mexican Shrimp Trawlers. Vol. 44, No. 1. J. National Fisheries University, Japan.

Flores, J., 2007. El camarón Pandalus spp. (Pandalus platyceros). Una nueva alternativa para el sector pesquero. Industria Acuícola, 3(3): 12-16.

Flores, J., M. E. Hendrickx & H. Chapa-Saldaña, 2004. Capturas del camarón mancha blanca, Pandalus platyceros Brandt, 1851 (Caridea: Pandalidae), en la costa oeste de Baja California, México, con una breve revisión de su biología y su pesca. In: M. E. HENDRICKX (ed.), Contributions to the study of east Pacific crustaceans, 3: 199-211. (Instituto de Ciencias del Mar y Limnología, UNAM, Mazatlán, México)

Hendrickx, M.E. 1984. The species of Sicyonia H. Milne Edwards (Crustacea: Penaeoidea) of the Gulf of California, México, with a key for their identification and a note on their zoogeography.– Revista de Biología Tropical 32 (2): 279-298.

–––––. 2003a. Distribution and size of the deep water Pacific lobsterette, Nephropsis occi- dentalis Faxon, 1893 (Crustacea: Decapoda: Astacidea: Nephropidae) in the SE Gulf of California, Mexico.– Crustaceana. 76 (2): 207-215.

–––––. 2003b. Size and abundance of deep water shrimps on the continental slope of the SE Gulf of California, México. Pp: 227-234 in M.E. Hendrickx, ed., Contributions to the Study of East Pacific Crustaceans 2. [Contribuciones al Estudio de los Crustáceos del Pacífico Este 2]. Instituto de Ciencias del Mar y Limnología, UNAM, 303 pp.

–––––. 2004. Distribution and estimation of body size and weight of four species of deep water shrimps in the SE Gulf of California, México.– Crustaceana 76 (9): 1025-1036.

Ronholt, L.L., 1974. A study of the relative efficiency of shrimp pots for harvesting the spot shrimp, Pandalus platyceros, in southeastern Alaskan waters. M.Sc. Thesis, University of Washington, Seattle, 101 pp.

Simpson, A.C., 1975. Effort measurement in the trap fisheries for crustacea. Rapp. R.-V. Reun. Cons. Int. Explor. Mer, 168: 50-53.

Smith, M., 2013. Trapped by uncertainty? A decision framework for evaluating escapement-based management procedures for the spot prawn (Pandalus platyceros) fishery in Howe Sound, BC: 1-75. (M.Sc. Thesis, School of Resource and Environmental Management, Simon Fraser University, British Columbia, Canada).

Zar, J.H., 1984. Biostatistical Analysis. (Second edition). Prentice-Hall Inc., New Jersey, 718 pp.