

Length and weight distributions of *Panulirus inflatus* and *P. gracilis* (DECAPODA: PALINURIDAE) in the lower portion of Gulf of California.

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Abstract

The length and weight distributions of spiny lobsters *Panulirus inflatus* and *P. gracilis* was studied in the center-south coast of the state of Nayarit. Specimens were collected using tangle nets and Hooka diving. *Panulirus inflatus* was the most abundant species, comprising 87% (2726 individuals) and *P. gracilis* 13% (417 individuals). The length size of *P. inflatus* and *P. gracilis* was found in the range of 38.0-128.0 mm CL and 42.0-114.0 CL, respectively. In both species, the males sizes were larger than that of the females. The total weight ranged from 40.0 to 1476.0 g for *P. inflatus*, and from 60.0 to 950.0 g for *P. gracilis*. The size distribution of the lobsters fall below that the Minimun Legal Size (MLS) of 82.5 mm CL for these species.

Key words: Spiny lobster, *Panulirus inflatus*, *P. gracilis*, Nayarit, Length and weight distributions

Introduction

The spiny lobsters belonging to Palinuridae family are very important as fishery resources at worldwide, because of high volume of catch and market acceptance. The exploitation of spiny lobsters is fundamentally artisanal along the Mexican coast.

In Mexico, the annual lobster landings are estimated around 2200 t, with a landed value of US \$11.5 million (Anónimo, 2000). This production is mainly support for two species, *Panulirus interruptus* (Randall) in Baja California and *P. argus* (Latreille) in the Caribbean sea, followed by *P. inflatus* (Bouvier) and *P. gracilis* Streets in the Mexican Pacific waters.

Panulirus inflatus (species endemic to Mexico called 'blue', 'prieta' or 'red' spiny lobster) and *P. gracilis* (called 'green', 'arenera' or 'playera' spiny lobster) have a wide geographical distribution and coexist from Bahia Magdalena (Baja California Sur), throughout the Gulf of California and along the west coast of Mexico to the Gulf of Tehuantepec (Holthuis, 1991, Hendrickx, 1995).

Most production of these two species originates in Sinaloa, Michoacán and Guerrero. However, in the state of Nayarit, landings officially registered from 1991 and 2001, the total catch was of 86.4 t, put in 8th place of states of Mexican Pacific coast (Anónimo 2001).

The lobster fishery in the center-south coast of state of Nayarit, is support for *P. inflatus* and *P. gracilis*, however, due to there are not studies on these crustaceans in this area, particularly their biology and fishery, is seldom available. Therefore, this study present basic biological data for organisms caught in the lobster fishery. The aim of this paper is to provide information on distributions of size and weight in the catch samples.

Material and methods

Study Sites.- Fourteen monthly sampling were conducted on the center-south coast of the state of Nayarit, Mexico (21°00'N; 105°30'W), from February 2001 to March 2002 at three sites (Chacala, La Peña de Jaltemba and Punta Sayulita) (Fig. 1).

Sampling Procedures.- Sampling of commercial landings were taken. At Chacala, the lobsters were captured by tangle nets (called 'chinchorros') with stretched meshes of 88.9 and 101.6 mm. In La Peña and Punta Sayulita, the specimens were collected using Hooka diving (a J-shaped metal hook is used to extract lobsters from crevices).

Lobsters were separated for species (Fig. 2) and their sex, carapace length (CL, measured from the rostrum to the posterior margin of the cephalothoracic carapace, in mm) and total weight (TW, in g), recorded.

Frequency distribution was carried out for carapace length and weight (CL, each 2 mm; TW, each 20 g).

Data Analysis.- In the handling of the data, the STATISTICA program, VERSION 5.5 was used in the different tests with a significance level at $\alpha = 0.05$. (StatSoft, Inc., 1995).

Performs a Kolmogorov-Smirnov test to check if the length and weight data for both species are normally distributed. If the data are normal, we apply the t-Student test; if the data does not fit a normal distribution, a non-parametric test (Mann-Whitney) was performed (Zar, 1996). These same tests was used for female and male data for both species.

Results

Species proportion

A total of 3143 specimens were captured. *Panulirus inflatus* was the most important species, comprising 87% (2 726 individuals) and *P. gracilis* 13% (417 individuals). The annual trend in species proportion (Fig. 3) indicated that, *P. inflatus* was the most abundant species during all sampling period. Only a approximation to 50% was found in December, where *P. inflatus* account 50% (19 lobsters) and 50% *P. gracilis* (19 lobsters).

Lobster size distribution

The size of lobsters of *Panulirus inflatus* and *P. gracilis* ranged from 38.0 - 128.0 mm CL (Fig. 4a) and 42.0 - 111.0 CL (Fig. 4b), respectively. The mean length was 70.74 ± 12.22 mm CL in the former and 70.28 ± 12.22 mm in the latter.

In *P. inflatus*, the mean size of males is larger (74.20 ± 14.14 mm CL) than that of females (67.03 ± 8.27 mm CL). *P. gracilis* followed a similar pattern, the mean size was of 71.84 ± 11.50 and 68.74 ± 9.83 mm CL, for males and females respectively.

The carapace length data was not normally distributed ($p < 0.01$) for both species. Using the Mann-Whitney non-parametric test, this difference was non-significant ($p > 0.05$). Kolmogorov-Smirnov test for both males and females size of *P. inflatus*, showed a distribution not normal ($p < 0.01$) and significant differences ($p = 0$) to Mann-Whitney test. The males and females size frequency to *P. gracilis*, exhibited a normal distribution ($p > 0.20$). The results for t-Student test ($p < 0.05$) was significant.

Lobster weight distributions

The individuals examined presented a total weight (TW) range from 40.0 - 1476.0 g (mean of 347.71 ± 187.03 g) for *P. inflatus* (Fig. 5a) and 60.0 - 950.0 g (mean of 318.89 ± 140.72 g) for *P. gracilis* (Fig. 5b).

Results for male and female lobsters indicated that the males (mean weight of 388.06 ± 229.93 g for *P. inflatus*; mean weight of 325.59 ± 151.28 g for *P. gracilis*) in both species are slightly more weighty than females (mean weight of 304.50 ± 110.63 and 312.30 ± 129.51 g TW for

P. inflatus and *P. gracilis*, respectively). Kolmogorov-Smirnov test indicated that the weight distribution ($p < 0.01$) are not normal in both species. Mann-Whitney test ($p < 0.05$) illustrating a significant difference. For males and females of *Panulirus inflatus* and *P. gracilis*, the weight distribution ($p < 0.01$) are not normal in both cases. The Mann-Whitney test for both sexes to *P. inflatus* revealed differences highly significant ($p = 4.9147\text{E-}15$). The differences between males and females weight data to *P. gracilis*, ($p > 0.05$) was not significant.

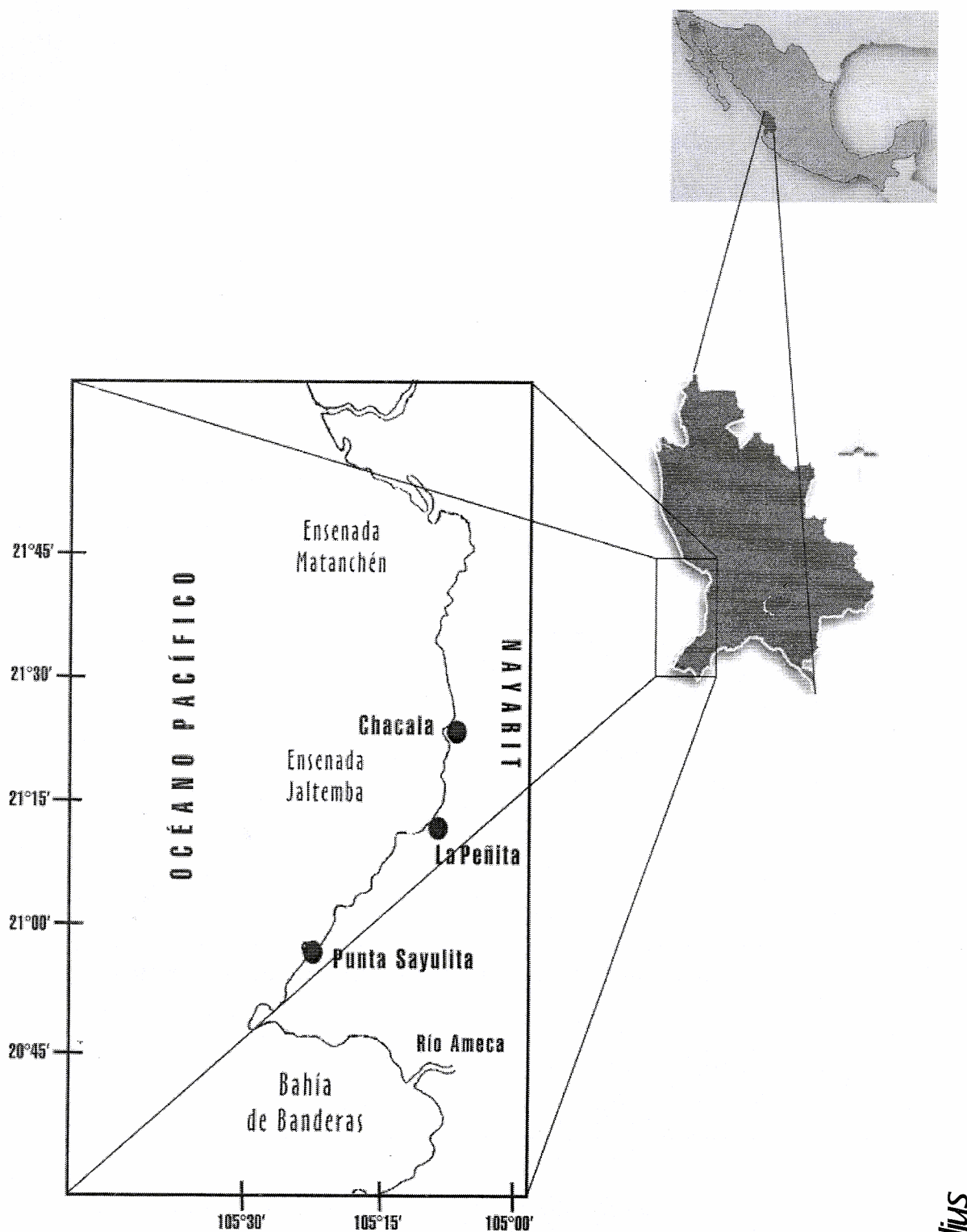


Figure 1: Map of center-south of Nayarit showing the locations of the three sampling sites.

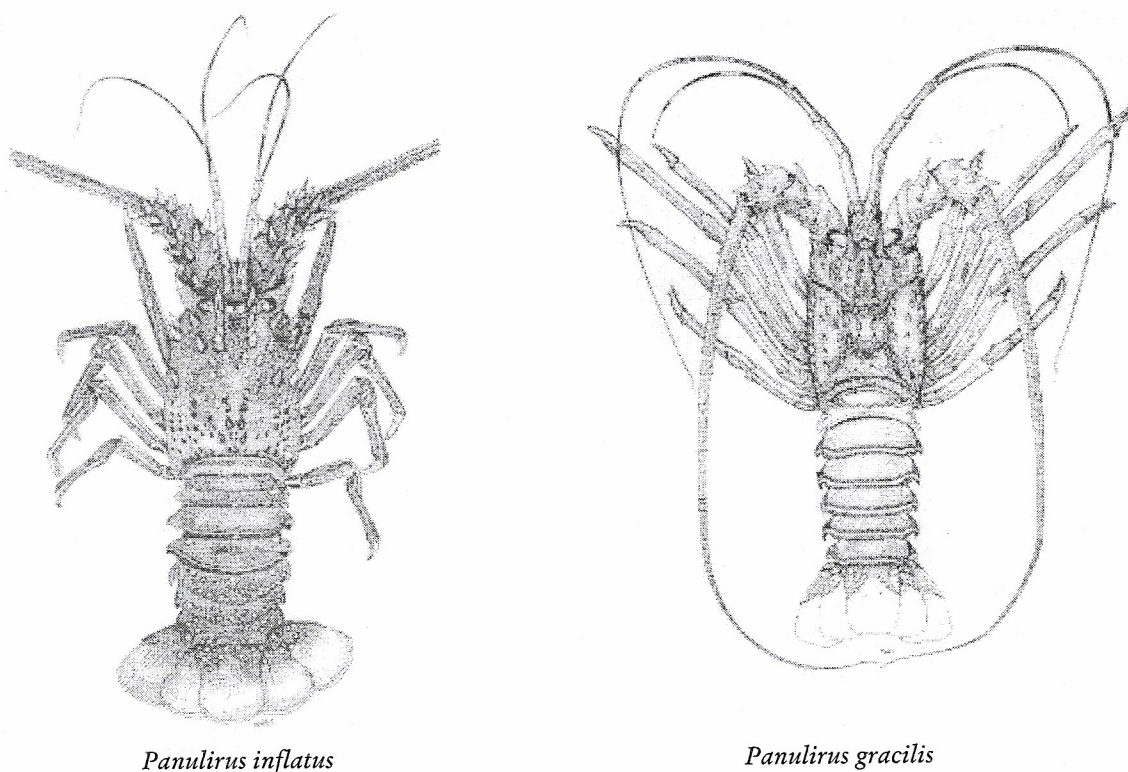


Figure 2: Spiny lobsters species found in center-south coast of the state of Nayarit. Adapted from Hendrickx (1995)

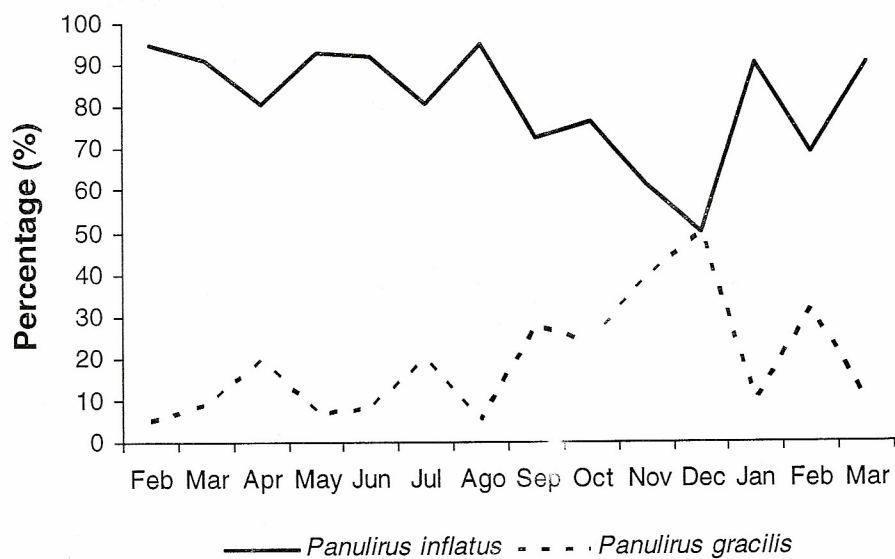


Figure 3: Species percentage by month along the center-south coast of Nayarit.

Discusion

Species proportion

In the center-south coast of Nayarit, the lobster grounds placed in rocky bottom, with rounding-gravel and scarce sand beaches. The prevail of *P. inflatus* over *P. gracilis* during all the study period, probably was determined for benthic habitat features. The two species of lobsters have different habitat preferences. The first one species is restricted to areas of clear water and rocky bottoms, and the second one species has tolerance for a wider range of turbidity and

inhabits both rocky and gravel sand (Gracia and Kensler, 1980). That issue is also addressed in other related works carried out in the south coast of state of Sinaloa (Pérez *et al.*, 2002, Salazar *et al.*, 2003). Another factors such as water turbidity and sites selection by fishermen for lobster capture, probably have influence on species proportion in the catches.

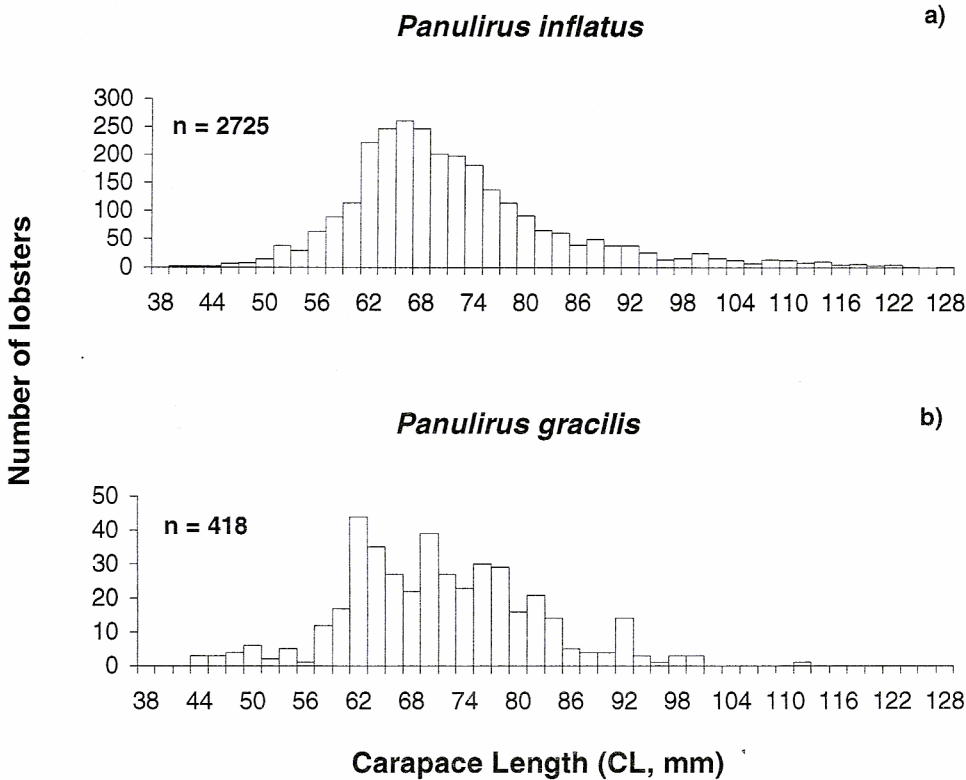


Figure 4: Size frequency distribution of spiny lobsters during the study period. (a) *Panulirus inflatus*, (b) *P. gracilis*.

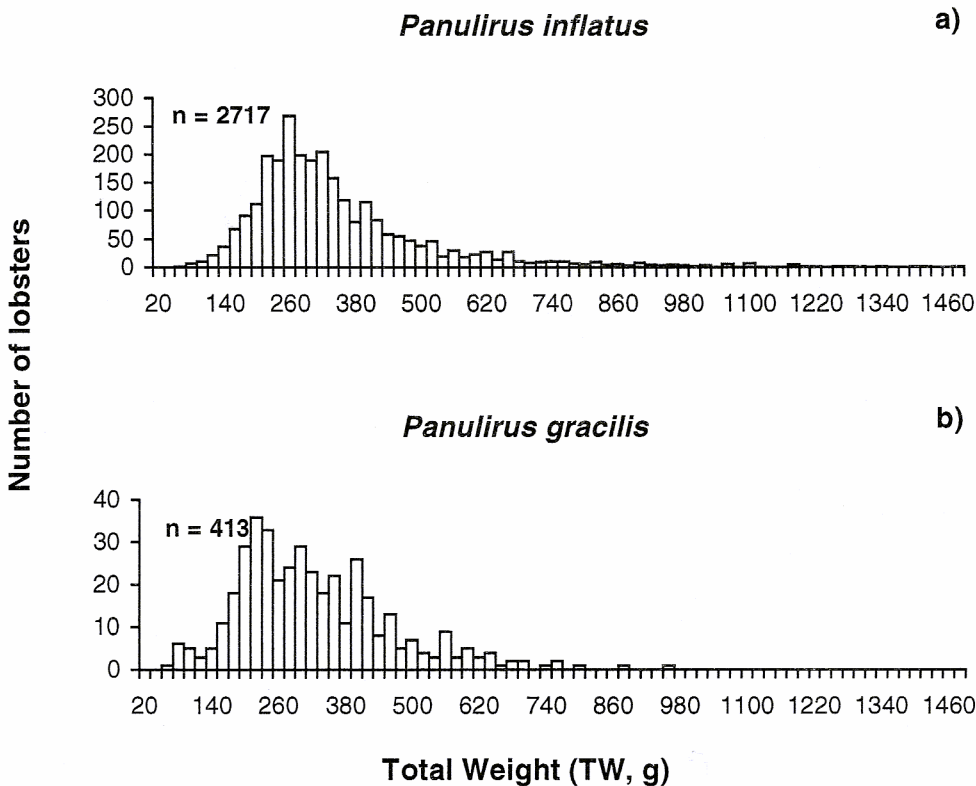


Figure 5: Weigh frequency distribution of spiny lobsters during the study period. (a) *Panulirus inflatus*, (b) *P. gracilis*.

Lobster size distribution

The mean size of *Panulirus inflatus*, 70.74 mm CL, and *P. gracilis*, 70.28 mm CL, fall below that the Minimum Legal Size (MLS) of 82.5 mm CL, according to the fishery regulations in the states of Baja California, Baja California Sur, Sonora, Sinaloa and Nayarit, and the coast of Jalisco and Colima (Diario Oficial de la Federación, 1993, Norma Oficial Mexicana 006-PESC-1993). However, this size was estimated to *P. interruptus* (called 'California spiny lobster'), which is excessive for *P. inflatus* and *P. gracilis* (Briones and Lozano, 1981.), because these species reach lower sizes (Pérez, *et al.*, 1992). Recent research suggest the MLS reduction to 70.0 mm CL, for both species (Gonzalez, 2002, Pérez "unpublished data").

The length size for females for both species is lower than that of males, probably because continual reproduction activity of females (Gracia, 1985).

Lobster weight distributions

In Nayarit, we found organisms over 800.0 g TW. However, lobsters with this TW are rare along the coast of Sinaloa, because the fishermen have a low rate of compliance with fishery regulations (such as return to the sea lobsters below minimum legal size, berried females and violations to closed season) (Pérez *et al.*, 2002).

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