

Effects of the El Niño Events on the  
Brown Shrimp Fishery in the Gulf of  
California, Mexico

J. López-Martínez<sup>1</sup>,  
F. Arreguín-Sánchez<sup>2</sup>,  
S. Hernández-Vázquez<sup>3</sup>,  
E. Herrera-Valdivia<sup>1</sup>,  
M. O. Nevárez-Martínez<sup>1,4</sup>,  
R. Morales-Azpeitia<sup>1</sup>,  
S. Lluch-Cota<sup>2</sup>, D. B. Lluch-Cota<sup>2</sup>

<sup>1</sup>Centro de Investigaciones Biológicas del Noroeste,  
S.C. Apdo. Postal 349 Guaymas, Sonora. C.P. 85454,  
México, E-mail: [jlopez@gys.megared.net.mx](mailto:jlopez@gys.megared.net.mx)

<sup>2</sup>Centro Interdisciplinario de Ciencias Marinas. Apdo.  
Postal 592 La Paz, B.C.S. C.P. 23000, México

<sup>3</sup>Centro de Investigaciones Biológicas del Noroeste,  
S.C. Apdo. Postal 128 La Paz,  
B.C.S. C.P. 23000, México

<sup>4</sup>Centro Regional de Investigación Pesquera Guaymas.  
Calle 20 Sur 605 Col. La Cantera, Guaymas,  
Sonora, 85400, México

In the Mexican Pacific, Sonora and Sinaloa states in the Gulf of California contribute most of the national shrimp catch (75%), composed mainly of marine brown shrimp *Farfantepenaeus californiensis* (about 70-80% of the total catch). These shrimp fisheries have a high interannual catch variability, not entirely explained by the effect of the fishing effort. It has been related to regional climatic variability and to the combination of climate and the fishing effort. All of these variables have a great effect on the distribution of individuals and the production of biomass.

In this work we show the effect that the interannual variation of the physical environment has on key population parameters (growth, recruitment, and the reproductive period) of organisms with a short life cycle, using the brown shrimp *Farfantepenaeus californiensis* off the eastern coast of the Gulf of California as a reference, and the effect that large scale events, such as El Niño, have on these processes.

The information used for the present work was derived from daily samplings of the commercial catch at processing plants and declared records of commercial catch in Guaymas, Sonora, Mexico, from 1978 to 2001 and monthly averages of sea surface temperature (SST) and mean sea level (MSL) recorded by the oceanographic institute in Guaymas, Sonora, for the same period.

The results show high interannual variability in the key population parameters, with growth coefficient (K/year) values between 1.55 and 2.32, and asymptotic total length (L<sub>∞</sub>) values between 23.3 and 24.7 cm. Similarly, the recruitment magnitude showed

high interannual variations with values between  $708.14 \times 10^6$  and  $4.21 \times 10^6$  recruits. In the reproductive period analysis, we found two dominant cohorts, a spring cohort (April-July) and an autumn cohort (October-January), with the initial month of the reproductive period highly variable among years.

These interannual variations in the key population parameters were more obvious during El Niño events, in that intense events (1982-1983 and 1997-1998) affected the growth pattern because of the creation of nonoptimal conditions for growth, whereas nonintense events (1987 and 1991-1992) are growth promoting. During El Niño 1982-1983, while the event was becoming stronger and the water temperature increased, growth rate indicated adverse conditions. This fact came out of the relation obtained between growth efficiency and temperature.

Although for brown shrimp reproduction occurs around the whole year, the existence of the two cohorts is very important, because one sustains the capture (spring cohort) and another maintains a healthy reproductive stock (autumn cohort). An extension of the reproductive period in both occurs only under warm conditions. This fact has important repercussions for the catch, modifying the exploitation pattern in seasonal fishing.

The results of the estimates of spawning biomass and recruits show a strong decrease from 1978 to 1980, after which the resource stayed at low levels, with quasiperiodic oscillations, reaching minimal values in 1990-1991, after which there was a recovery of the resource. During 1981 to 2001, recruitment increased in 1982-83, 1986, 1991-1993 and 1997, all El Niño years. The longest increases were during moderate El Niño events (1987 and 1991-93).

These results are probably caused by the increase in precipitation during an El Niño, which can cause increases in the primary productivity of the estuaries, with an increase in the different trophic levels. This in turn yields an increase in food for postlarvae and an increase in nursery areas which will then be reflected in an increase in recruitment.

During El Niño 1982-1983, although there was an increase in mature females during the year, the increase in recruitment was small because growth was affected by high temperatures, and the mortality of the postlarvae and juveniles could have increased because of their longer period of exposure to predators in the early phases of life. Lowest recruitment was observed during 1988, 1995 and 1998-1999, years of La Niña Events.



All the contents of this journal, except where otherwise noted, is licensed under a [Creative Commons Attribution License](https://creativecommons.org/licenses/by-nc/4.0/)

**Casilla 1020  
Valparaíso - Chile**

**Fono: (56-32) 2274276**

**Fax: (56-32) 2274206**

[investmar@ucv.cl](mailto:investmar@ucv.cl)