

THE FECUNDITY OF THE NORWAY LOBSTER  
(*NEPHROPS NORVEGICUS* (L.)) OFF THE CATALAN  
AND PORTUGUESE COASTS

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INTRODUCTION

The Norway lobster has been the object of many biological studies because of its economic and fishing importance.

Some authors (Farmer, 1974; Alonso-Allende, unpubl.; Chapman & Ballantyne, 1980) estimate the fecundity of *Nephrops norvegicus* from the eggs carried on the abdomen by the females. Others (Thomas, 1964; Fontaine & Warluzel, 1969) estimate the fecundity from the oocytes of the mature ovaries. Others, finally, use both methods (Figueiredo & Nunes, 1965; Eiriksson, 1970; Froggia & Gramitto, 1979; Morizur, unpubl.).

In all the investigations the number of eggs or oocytes has been found to be directly proportional to the female size. Also, in the investigations where both methods have been used, the number of eggs carried on the abdomen by the females is lower than the number of oocytes in the ovaries. In this investigation we have considered it more correct to estimate the fecundity from the eggs carried by the females because very often (Farmer, 1974) the oocytes are reabsorbed during the process of sexual maturation and many eggs fail to adhere to the pleopods at the moment of spawning. However, the number of eggs on the pleopods diminishes during the incubation period due mainly to predation (Morizur, 1979). Trawling also causes egg loss (Chapman & Ballantyne, 1980).

Despite the fact that the different populations belong to the same species, there are differences among them that can be manifested, for example, by the different fecundity.

In this paper we present first data about the fecundity of *N. norvegicus* off the Catalan coast (western Mediterranean) and new data from the north coast of Portugal, trying to give some insight in the fecundity of the species according to the fecundities obtained in different zones of its area of distribution.

We also present a comparison with the results obtained by other authors and a discussion about the estimate of the fecundity in function of the abdominal width.

## MATERIAL AND METHODS

Seventy six ovigerous females were obtained in Portuguese coastal waters during the campaign "Cigala 79" in August 1979, and 62 ovigerous females were obtained from commercial catches landed in the harbour of Barcelona from August to December 1977, August to November 1978 and October 1980. The maximum number of ovigerous females was obtained from September to October. Spawning begins in this zone in August (Sardá, unpubl.).

The eggs were carefully removed from the pleopods. Because of the sampling circumstances, the captures from the Mediterranean were fixed in ethanol 70% and those from the Atlantic in formol 4%. The diameter of the eggs did not present a significant difference.

If the number of eggs did not exceed 1000, all were counted individually. In the other cases, the number was estimated from the dry weight (48 hours at 105°C; precision = 0.01 mg) of a subsample of 50 eggs referred to the dry weight of the whole sample. The maximum error in the calculations was found to be less than 3%.

The results have been expressed in the form of a regression between the cephalothorax length ( $L$ , in mm) and the number of eggs ( $N$ ) according to the potential model in its logarithmic transformation ( $\ln N = b \ln L + a$ ) in the two areas studied, the Catalan coast and the north of Portugal.

## RESULTS AND DISCUSSION

The equations that give the relationship between the number of eggs and the female size are, for the two zones studied, the following (fig. 1): Portugal:  $\ln N = 3.125 \ln L - 3.705$ ,  $r = 0.9346$ . Catalan coast:  $\ln N = 2.488 \ln L - 1.559$ ,  $r = 0.6539$ .

The size of the first maturity is smaller in the Atlantic (about 23 mm of carapace length) than in the Mediterranean (25-27 mm; Sardá, 1980).

The equations of regression obtained by different authors in various zones are summarized in the following table:

TABLE I

Author	Zone	$b$	$a$	$\ln a$	$r$
Figueiredo (1965)	Portugal	3.0557	0.0229	-3.7732	—
Alonso-Allende (1979)	Galicia	2.11	1.20	0.18	0.93
		3.02	0.03	-3.50	0.90
Frogia (1979)	Adriatic	3.1635	0.0177	-4.0290	—
Morizur (1980)	Bretagne	3.194	0.0162	-4.118	0.81
Abelló, Sardá	Catalunya	2.488	0.2103	-1.559	0.6539
(in this investigation)	Portugal	3.125	0.0246	-3.705	0.9346

The graphic representation of this table appears in fig. 2.

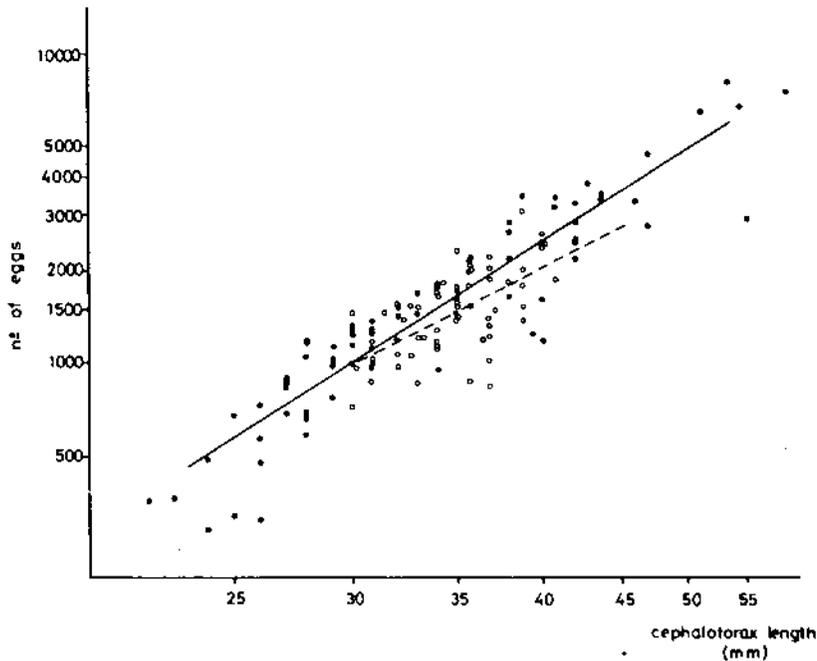


Fig. 1. Relationship between carapace length and number of eggs carried on the pleopods of *Nephrops norvegicus* (L.) from the Portuguese (solid line) and Catalan coasts (broken line).

Our statistic data, together with those obtained by Morizur (1980) are given in table II.

TABLE II  
Results of the regressions

	Portugal	Mediterranean	Brittany (Morizur, 1980)
a	-3,705	-1,559	-4,118
b	3,125	2,488	3,194
N	76	62	101
$\Sigma x$	266,4559	220,2007	336,817319
$\Sigma y$	551,0722	451,1959	659,970395
$\Sigma xy$	1944,0058	1603,5941	2209,419279
$\Sigma x^2$	938,0172	782,5200	1125,898233
$\Sigma y^2$	4038,5437	3290,0098	4354,106230
r	0,9346	0,6539	0,81
var x	3,82318	0,4498	2,6715
var y	42,7469	6,4978	41,622
var b	0,0191	0,1378	0,0541

With  $x$  = neperian logarithm of the cephalothorax length;  $y$  = neperian logarithm of the number of eggs.

None of the slopes of the three lines has been found significantly different from the others (at a 5% significance level), despite the fact that, apparently, the slope of the line obtained in the Mediterranean is lower than the others. The ordinates on the origin of the three lines are significantly different. So, we can say that they are different but parallel. If we consider that the lines are parallel, then that of the Mediterranean would be above the others because it has the greatest ordinate on the origin, something that can not be seen from fig. 2. This difference can be attributed to the small correlation coefficient observed in the line of the Mediterranean. In fact, the correlation coefficients are significantly different among them. The most important difference observed in the three populations is their respective variability. The population of the Mediterranean has the lowest correlation observed between the carapace length and the number of eggs ( $r=0.65$ ); it has a greater variability. The highest correlation corresponds to the Portuguese population ( $r=0.93$ ) whereas the population of Bretagne presents an intermediate correlation ( $r=0.81$ ). The Portuguese population presents the lowest variability in the fecundity.

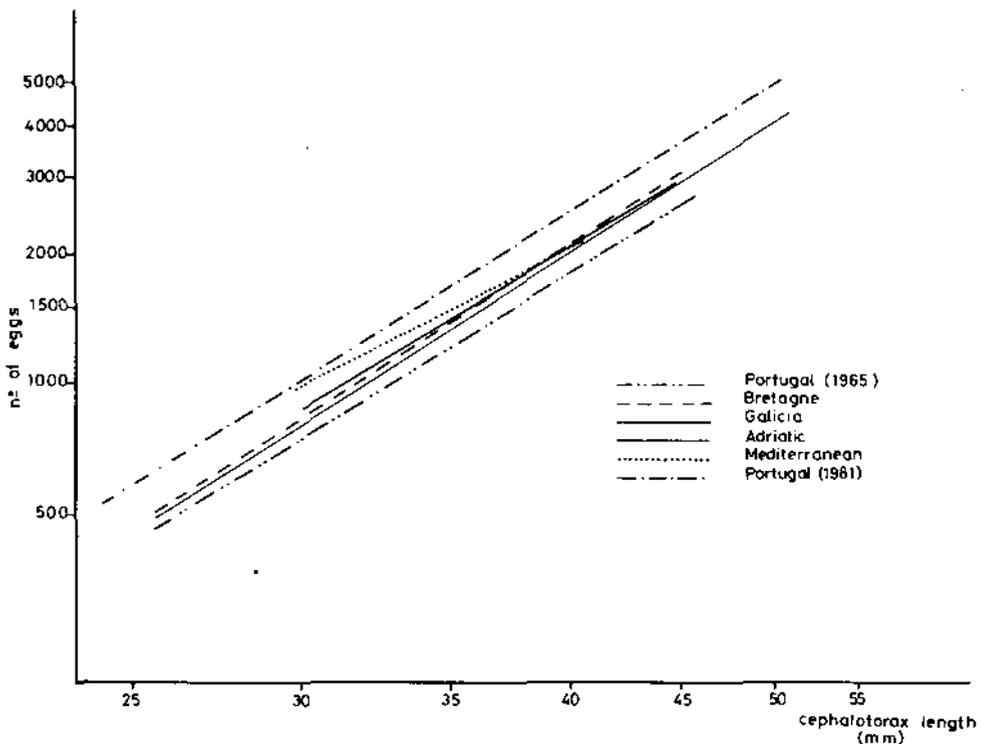


Fig. 2. Comparison among fecundities of female *Nephrops norvegicus* (L.) obtained in different areas.

Farmer (1974a) and Chapman & Ballantyne (1980), all in Scotland, consider that the relationship between the carapace length and the number of eggs adjusts directly to a linear model ( $N = a + bL$ ) so that their data are not comparable with ours.

The fecundity has also been studied by other authors (Thomas, 1964; Figueiredo & Nunes, 1965; Fontaine & Warluzel, 1969; Eiriksson, 1970; Frogli & Gramitto, 1979; Morizur, unpubl.) from the oocytes, considering all of them a potential model.

Figueiredo & Nunes (1965), Eiriksson (1970), Frogli & Gramitto (1979) and Morizur (unpubl.) have calculated the fecundity from both the oocytes and the eggs on the pleopods, finding that both lines are approximately parallel, but that the one calculated from the oocytes has a higher ordinate at the origin.

The main problems that exist in evaluating the fecundity according to the eggs carried on the pleopods by the females are (1) the egg loss during the incubation period, which lasts about 8-9 months and (2) the loss caused by trawling. For most the period of egg-carrying, the ovigerous females remain in their burrows; there is a clear decrease in the number of female caught when spawning finishes.

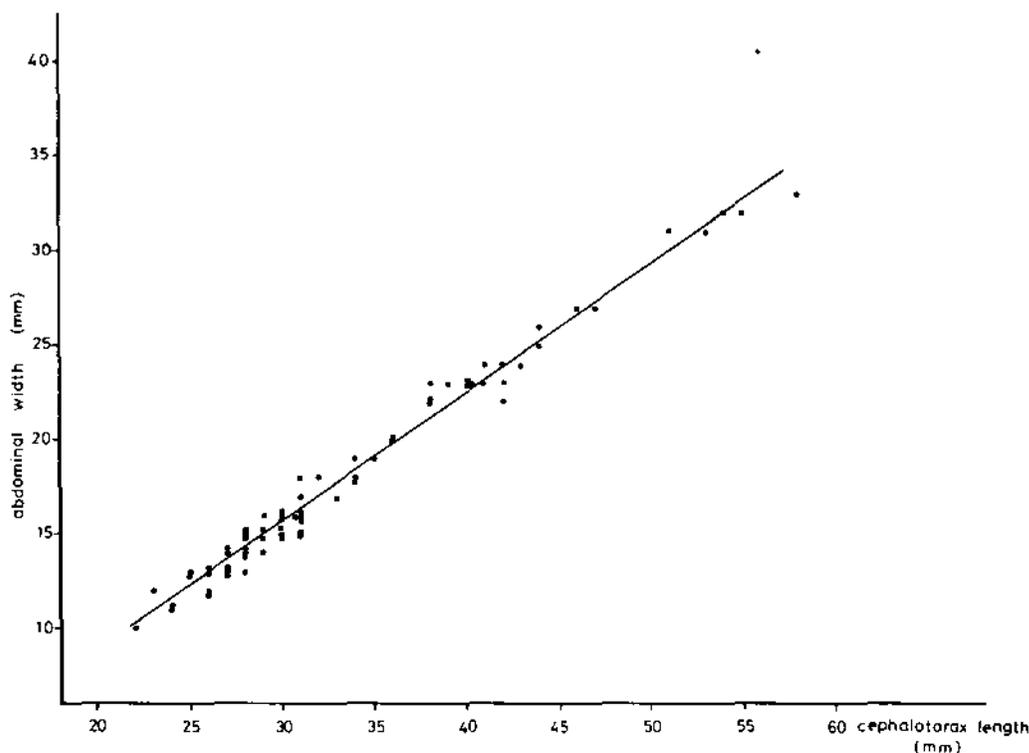


Fig. 3. Relationship between carapace length and abdominal width in female Norway lobsters from the Portuguese coast.

Figueiredo & Nunes (1965) estimated a 75% egg loss during the incubation period, whereas Morizur (1979) calculated it at about 45-50% and Chapman & Ballantyne (1980) at about 32-51%. The latter calculated that 11-22% of the eggs are lost because of trawling.

Females of *N. norvegicus* have a bigger abdominal width than males (Farmer, 1974b). This fact represents an adaptation for the transport and protection of the highest possible number of eggs. We measured the abdominal width, taken at the second segment, in the samples coming from the Atlantic. The relationship between the carapace length ( $L$ , in mm) and the abdominal width ( $W$ , in mm) was found to be the following (fig. 3):

$$W = 0.675 L - 4.484 \quad r = 0.9909$$

The number of eggs depends on the size of the female. The cephalothorax (or carapace) length is the main parameter used to consider the size of lobsters. In the case of fecundity studies it would be convenient to find the relationship between the abdominal width and the number of eggs because that parameter is an external morphologic feature very directly related to the amount of eggs that a female is able to carry. We have found this relationship in the Portuguese lobsters, obtaining the following regression (fig. 4):

$$\ln N = 2.5026 \ln W + 0.0472 \quad r = 0.9375$$

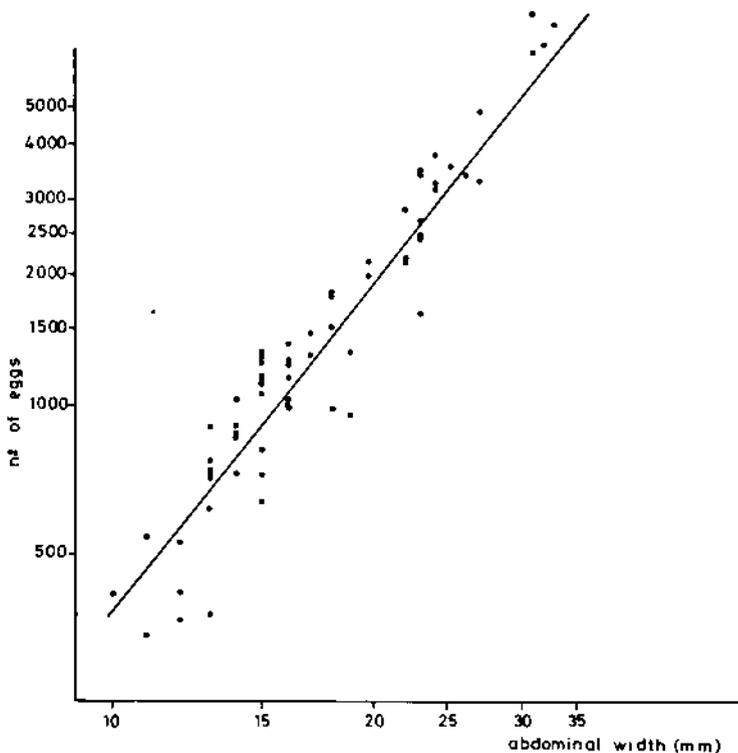


Fig. 4. Relationship between abdominal width and number of eggs carried by female *N. norvegicus* (L.) from the Portuguese coasts.

The abdominal width conditions the number of eggs that a female is able to carry. If the number of eggs that are produced in the ovaries is directly proportional to the general body size of the female, one of the most important factors that will control the potential ability to carry a greater or smaller number of eggs on the abdomen will be the development of the abdominal width and of the pleopods.

The correlation observed by calculating the fecundity referring to the abdominal width ( $r = 0.9375$ ) is slightly higher than the one obtained by using the carapace length ( $r = 0.9346$ ) as a reference. However, we do not consider that this difference is sufficient to believe that fecundity should be estimated in function of the abdominal width.

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#### RÉSUMÉ

La fécondité de la langoustine (*Nephrops norvegicus*) a été étudiée sur les côtes catalanes et portugaises. Il n'y avait jusqu'à présent aucun travail sur la fécondité de la langoustine des côtes catalanes. La principale différence observée entre les diverses populations étudiées (bretonne, portugaise, catalane) concerne la relation entre la longueur de la carapace et le nombre d'œufs. Quelques réflexions sur l'intérêt d'une étude de la fécondité à partir de la largeur de l'abdomen sont aussi présentées.

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