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The state of exploitation of the Norway
lobster stock, *Nephrops norvegicus*,
in the Central North Sea

F. Redant

Fisheries Research Station, Ankerstraat 1,
B-8400 Oostende, Belgium.

ABSTRACT

The state of exploitation of the Norway lobster stock, *Nephrops norvegicus*, in the Botney Gut - Silver Pit area (Central North Sea) was assessed by analyzing the long-term trends in the average carapace length of the *Nephrops* landed by Belgian trawlers. These investigations showed that the *Nephrops* stock in the Central North Sea is not overexploited.

Apparently however, the discarding practice on the *Nephrops* trawlers has slightly changed over the years. Especially in 1982 and 1983 this resulted in a short-term but distinct decrease of the average size of the *Nephrops* in the smallest market class.

An analysis of the long-term trends in the proportion of females in the landings did not yield conclusive results, at least as far as the relationship between state of exploitation and sex-ratio of the catches is concerned.

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RESUME

L'état d'exploitation du stock de langoustines, Nephrops norvegicus, dans la région du Botney Gut et du Silver Pit (Mer du Nord Centrale) a été évalué par une analyse des tendances à long terme de la taille moyenne des langoustines débarquées par les chalutiers belges. Ces investigations ont montré que le stock de langoustines dans la Mer du Nord Centrale n'est pas surexploité.

Cependant, il paraît que la taille minimale des langoustines retenues par les pêcheurs a légèrement changé au cours des années. Notamment en 1982 et en 1983 ceci a entraîné une diminution très nette de la taille moyenne des langoustines les plus petites mises en vente à la criée.

Une analyse des tendances à long terme des proportions de femelles dans les débarquements n'a pas donné de résultats concluants, du moins en ce qui concerne la relation entre l'état d'exploitation et le rapport mâles/femelles dans les captures.

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1. Introduction

Due to the uncertainties on a number of biological parameters, such as sex-ratio, growth rate, natural mortality, mortality of discards, fishing induced mortality and fishing mortality (ICES, 1982), it is very difficult to reliably assess the state of exploitation of Nephrops stocks by means of the analytical methods usually applied to finfish (CONAN, 1984). In fact, the only Nephrops stocks which are currently assessed through analytical methods, viz. by VPA's on catch-at-age data derived from length frequency data of the catches, are those around Iceland (EIRIKSSON, 1979, 1982).

Because of the uncertainties mentioned above most assessments of the state of exploitation of Nephrops stocks are based on much simpler and straightforward methods, such as the analysis of catch per unit effort data (EIRIKSSON, 1968, 1974 ; CONAN et al., 1977 ; ICES, 1984) and the evaluation of long-term trends in the length composition of catches or landings (THOMAS, 1965 ; EIRIKSSON, 1968 ; JORGE, 1975 ; BRIGGS, 1981 ; ARROBAS, 1982 ; HILLIS, 1984 ; ICES, 1984). A decline of the catches per unit effort or of the average size of the Nephrops in catches or landings is generally considered as an indication of overexploitation.

Additional evidence of overexploitation may be obtained from the long-term trends in the proportion of females in the catches. In most Nephrops stocks there is an inverse relationship between body size and the proportion of females in that particular size class (see e.g. THOMAS, 1960 ; THOMAS and FIGUEIREDO, 1965 ; ICES, 1982, 1984). Hence a shift of the length composition of the catches or landings to smaller sizes, resulting from a decline in the relative abundance of larger Nephrops, will be accompanied by a shift of the sex-ratio in favour of the females (EIRIKSSON, 1968).

Data on the composition of the Belgian Nephrops landings from the Botney Gut-Silver Pit area (Central North Sea) have currently been collected by the Fisheries Research Station, as a part of a larger scale research programme on the long-term trends in the exploitation pattern of the Belgian Nephrops fishery. The present paper summarizes and discusses these data, and gives an appreciation of the state of exploitation of the Nephrops stock in the Central North Sea. Additional information on the Nephrops fishery in this area can be found in an earlier paper by REDANT and DE CLERCK (1984).

2. Material and methods

Since 1980 market samples have been taken from the landings of commercial Nephrops trawlers operating in the Botney Gut-Silver Pit area, mainly at the fish-auction of Zeebrugge, where over 95 % of the Nephrops from this area are landed, and occasionally at the auction of Ostend.

In the years 1980-1984 samples were taken at rather irregular intervals, monthly or even bimonthly at the beginning and at the end of the main Nephrops season (April-May and November-December) and once or twice a month in the period of peak catches (June-October). From 1985 onwards the samplings were scheduled much more strictly at approximately fortnightly intervals throughout the main Nephrops season (April-December). Details on the numbers of samples taken are given in Table 1.

As a rule the landings of Belgian Nephrops trawlers are marketed in three size classes : "small" (≤ 35 mm carapace length), "medium" (30-45 mm carapace length) and "large" (> 35 mm carapace length). The number of Nephrops taken per size class was 50 in the years 1980-1984 and increased to 100 from 1985 onwards. Measurements included total length (from the tip of the rostrum to the distal edge of the uropods, to the nearest mm), carapace length (only since 1985, to the nearest 0.5 mm) and sex.

Because of the differences in seasonal behaviour between males

and females, and because of the particular discarding practice on the Belgian Nephrops trawlers (REDANT, 1987), the data for males and females, and for the market classes "small" and "medium" plus "large" were treated separately. Accordingly, for each Nephrops landing sampled four average lengths were calculated: two for the males and two for the females (viz. for the market classes "small" and "medium + large", provided that all market classes were actually represented in the landings).

Average total lengths (viz. the data for the years 1980-1984) were converted into average carapace lengths by means of the following regression equations:

$$\begin{aligned} \text{for the males} \quad & \text{CpxL} = 0.31134 \text{ TL} - 2.01 \\ & r = 0.984 \\ & n = 656 \end{aligned}$$

$$\begin{aligned} \text{for the females} \quad & \text{CpxL} = 0.32117 \text{ TL} - 3.12 \\ & r = 0.985 \\ & n = 520 \end{aligned}$$

These biometric relationships were calculated from the samples taken in May, August and November 1986.

Precautionary investigations on the data for 1985 and 1986 (the years for which complete time series of monthly averages were available) gave no evidence of seasonal variations in the average carapace length of male or female Nephrops, neither in the size class "small", nor in the size class "medium + large". Hence an adjustment of the data for seasonal variations, or so-called deseasonalization, was not required.

The separate treatment of the data for the market classes "small" and "medium + large" did not affect the results or the conclusions of the present investigations, owing to the fact that the upper size limit of the market class "small" and the lower size limit of the market class "medium" remained almost unchanged throughout the years.

Moreover, in doing so the possible long-term effects of changes in the relative abundance of large Nephrops, on the one hand, and of fluctuations in recruitment or changes in the discarding practice, on the other hand, could be distinguished much more easily. Changes in the relative abundance of large Nephrops (e.g. due to overexploitation) could be expected to alter only the average size of the Nephrops in the "medium + large" group, whereas fluctuations in the numbers of incoming recruits or changes in the discarding of small Nephrops would primarily alter the average size of the Nephrops in the "small" group.

In order to detect possible long-term changes in the male/female ratio of the largest Nephrops as a consequence of fishing, the

monthly average proportions of females in the landings were calculated, especially for the "medium + large" group, taking into account the relations between sample weight and total volume of the landings.

3. Results and discussion

3.1. Long-term trends in the average size of the Nephrops landed

The average carapace lengths of males and females in the landings of Belgian Nephrops trawlers are given in Figures 1 and 2 respectively. Each symbol in these figures corresponds to one sampling (cf. Table 1).

The average lengths of male and female Nephrops vary considerably from one sample to another, even within the same year and size group. In some cases the coefficient of dispersion (i.e. the relative dispersion, $s/\bar{x} \cdot 100$ %, around the average of the averages for a particular sex, size class and year) was as high as 8.5 %. Mostly however the relative dispersion was between 1.5 and 5.5 %, which is an acceptable level of variation. Similar and even higher degrees of dispersion have been found by BRIGGS (unpubl. data in ICES, 1984) for the average carapace lengths of Nephrops in the catches of Northern Irish Nephrops trawlers.

These variations can be attributed to the combined effect of sampling errors and the patchy distribution of Nephrops in small stocklets, each with its own sex-ratio and size composition (CO-NAN, 1984 ; ICES, 1984).

Notwithstanding these variations it is possible to draw some general conclusions from the main trends in the data, with regard to the state of exploitation of the stock.

Although there are some indications of a feeble downward trend in the average carapace lengths of "medium + large" male and female Nephrops (1.0 mm over the whole period of seven years for the males and 0.5 mm for the females ; cf. the dotted trend-lines in Figures 1 and 2) there is no evidence that the relative abundance of large Nephrops has severely decreased since 1980. As compared to the major changes which have been reported for several other Nephrops stocks, such as in the Irish Sea and off Galicia (BRIGGS and FERNANDEZ, unpubl. data in ICES, 1984) the reduction of the average carapace length of Central North Sea Nephrops appears to be almost negligible.

The average carapace lengths of "small" Nephrops, on the other hand, clearly declined, especially from 1980 up to and including

1983 (Figures 1 and 2). The overall decrease was about 3-4 mm, for the males as well as for the females, which is rather impressive in relation to the relatively short period of time over which this decrease occurred. Since then the average carapace lengths have slightly risen again, and from 1985 onwards they seem to have been stabilized at a level between 30.0 and 32.5 mm. The data for 1987 (8 samplings on a planned total of 18) provisionally confirm this trend.

It is difficult to ascertain whether the decline of the average size of "small" Nephrops in 1982-1983 was due to the input of large numbers of small recruits, or to an alteration in the discarding of small Nephrops. The fact however that in 1982 and 1983 almost half of the samples contained undersized Nephrops (<25 mm carapace length) and that the average number of undersized Nephrops per sample was 3-5 times higher than in the years preceding or following them, seems to prove that the decline of the average carapace length of the "small" group was, at least partly, due to a temporary change in the discarding practice of the fishermen.

3.2. Long-term trends in the sex-ratio of the landings

The analysis of the long-term trends in the proportions of females in the landings of the market classes "medium" and "large" did not yield conclusive results (Table 2).

It should however be emphasized that the sex-ratios of catches and landings vary considerably from one month to another, depending on the seasonal behaviour of males, non-berried and berried females (REDANT, 1987). In order to be fully comparable the data, which are to be used to investigate the possible long-term changes in the sex-ratio of catches or landings, should be collected in the same period of time with respect to the course of the reproductive cycle. The most appropriate time to take such samples seems to be during the period of peak emergence of the females between hatching and subsequent spawning. Anywhen else the sex-ratios of catches and landings are determined first of all by the accessibility of the females to trawling or, in other words, by their being berried or not. Since the proportion of egg-bearing females may vary from year to year, depending on the relative success of mating and spawning, samples collected outside the period of peak emergence can not be considered as being fully comparable.

However, even when taken within the period of peak emergence the comparability of the samples is not necessarily guaranteed. Also in this particular period there may be annual differences in the numbers of females emerging from their burrows, depending on e.g. the duration of the egg-bearing condition, the time of moulting, mating and subsequent spawning and their foraging behaviour in the period of time between hatching and spawning.

It is obvious that under these circumstances the long-term changes in the sex-ratios of catches or landings, due to fishing, may easily be outranged by the annual fluctuations in the relative numbers of female Nephrops which are accessible to trawling. This is especially true in the case of Nephrops stocks for which there is little or no evidence of overexploitation, i.e. in Nephrops stocks where the long-term shift of the sex-ratio in favour of the females is likely to be very small in comparison to these annual fluctuations.

4. Conclusions

The results of the present investigations clearly show that, up to now, the Nephrops stock in the Botney Gut - Silver Pit area is not overexploited. Hence they confirm earlier statements on the state of exploitation of this stock, which were based on a preliminary assessment of the trends in landings and landings per unit effort (ICES, 1984).

5. References

- ARROBAS, I. (1982) : Some aspects on the biology and fishery of Nephrops norvegicus (L.) from the south Portuguese coast. ICES, Shellfish Comm., CM 1982/K : 27 (mimeo).
- BRIGGS, R.P. (1981) : Trends in the Northern Ireland Nephrops fishery 1970-1980. ICES, Shellfish Comm., CM 1981/K : 9 (mimeo).
- CONAN, G.Y. (1984) : Do assumptions commonly used for modeling populations of finfish apply to shellfish species ? ICES, Shellfish Comm., CM 1984/K : 49 (mimeo).
- CONAN, G.Y., DEPOIS, M.N. and CHARUAU, A. (1977) : Relations entre la biomasse et la production du stock de langoustines de la région Sud Bretagne. ICES, Shellfish and Benthos Comm., CM 1977/K : 35 (mimeo).
- EIRIKSSON, H. (1968) : The effect of fishing on catch per effort, size and sex-ratio of the Norway lobster (Nephrops norvegicus L.) in Icelandic waters during the years 1962 to 1967. ICES, Shellfish and Benthos Comm., CM 1968/K : 4 (mimeo).
- EIRIKSSON, H. (1974) : A method for assessing the fishing potential of the Nephrops stock at Iceland. ICES, Shellfish and Benthos Comm., CM 1974/K : 28 (mimeo).

- EIRIKSSON, H. (1979) : A study of the Icelandic Nephrops fishery with emphasis on stock assessments.
Rapp. Proc.-verb. Réun. CIEM, 175, 270-279.
- EIRIKSSON, H. (1982) : A trial VPA on the Nephrops stock at Iceland with comparisons to catch and effort data.
ICES, Shellfish Comm., CM 1982/K : 17 (mimeo).
- HILLIS, J.P. (1984) : Compositional changes in the Nephrops catch in the Western Irish Sea, 1969-84.
ICES, Shellfish Comm., CM 1984/K : 37 (mimeo).
- ICES (1982) : Report of the Nephrops Working Group.
ICES, Shellfish Comm., CM 1982/K : 3 (mimeo).
- ICES (1984) : Report of the Nephrops Working Group.
ICES, Shellfish Comm., CM 1984/K : 4 (mimeo).
- JORGE, I.M. (1975) : Catches, length and sex composition of trawl and tangle nets landings of Norway lobster, Nephrops norvegicus (L.), from the central Portuguese coast.
ICES, Shellfish and Benthos Comm., CM 1975/K : 17 (mimeo).
- REDANT, F. (1987) : Reproduction and seasonal behaviour of the Norway lobster, Nephrops norvegicus, in the Central North Sea.
ICES, Shellfish Comm., CM 1987/K : 32 (mimeo).
- REDANT, F. and DE CLERCK, R. (1984) : Diurnal variations in CPUE and length composition of the catches in a Nephrops directed fishery in the Central North Sea.
ICES, Shellfish Comm., CM 1984/K : 3 (mimeo).
- THOMAS, H.J. (1960) : Nephrops III - The biology of the Norway lobster.
ICES, Shellfish Comm., paper n° 178 (mimeo).
- THOMAS, H.J. (1965) : The distribution of the Norway lobster around Scotland and the stock composition in the areas of different fishing intensity.
Rapp. Proc.-verb. Réun. CIEM, 156, 176-183.
- THOMAS, H.J. and FIGUEIREDO, M.J. (1965) : Seasonal variations in the catch composition of the Norway lobster, Nephrops norvegicus (L.), around Scotland.
J. du Conseil, 30 (1), 75-86.

Table 1 - Details on the numbers of market samples taken from the landings of Belgian Nephrops trawlers, per month and per year, 1980-1986.

	1980	1981	1982	1983	1984	1985	1986
Sample size (*)	50	50	50	50	50	100	100
April	-	-	1	-	1	2	2
May	-	-	2	1	2	2	2
June	2	2	2	2	2	2	2
2nd quarter	2	2	5	3	5	6	6
July	1	1	1	2	2	2	2
August	2	2	1	2	2	2	2
September	1	1	1	1	2	2	2
3rd quarter	4	4	3	5	6	6	6
October	2	2	2	2	2	2	2
November	1	1	-	-	1	2	2
December	1	1	1	-	-	2	2
4th quarter	4	4	3	2	3	6	6

(*) Number of Nephrops taken per market class, viz. "small" (if landed), "medium" and "large".

Table 2 - Proportions of females (in percentages) in the market classes "medium" plus "large" landed by Belgian Nephrops trawlers, per month and per year, 1980-1986.

	1980	1981	1982	1983	1984	1985	1986
April	?	?	26.4	?	24.6	13.3	16.7
May	?	?	17.6	35.0	24.2	11.5	12.3
June	7.2	14.3	16.6	18.1	11.8	9.8	10.4
July	5.2	7.3	6.5	1.8	7.0	21.9	8.4
August	24.9	12.1	57.2	13.7	37.0	33.8	9.6
September	23.5	17.2	?	35.7	35.8	41.9	42.2
October	27.4	29.6	36.4	22.7	15.3	31.2	39.6
November	12.8	14.8	?	?	18.4	20.3	29.0
December	9.0	9.2	24.4	?	?	9.8	15.1

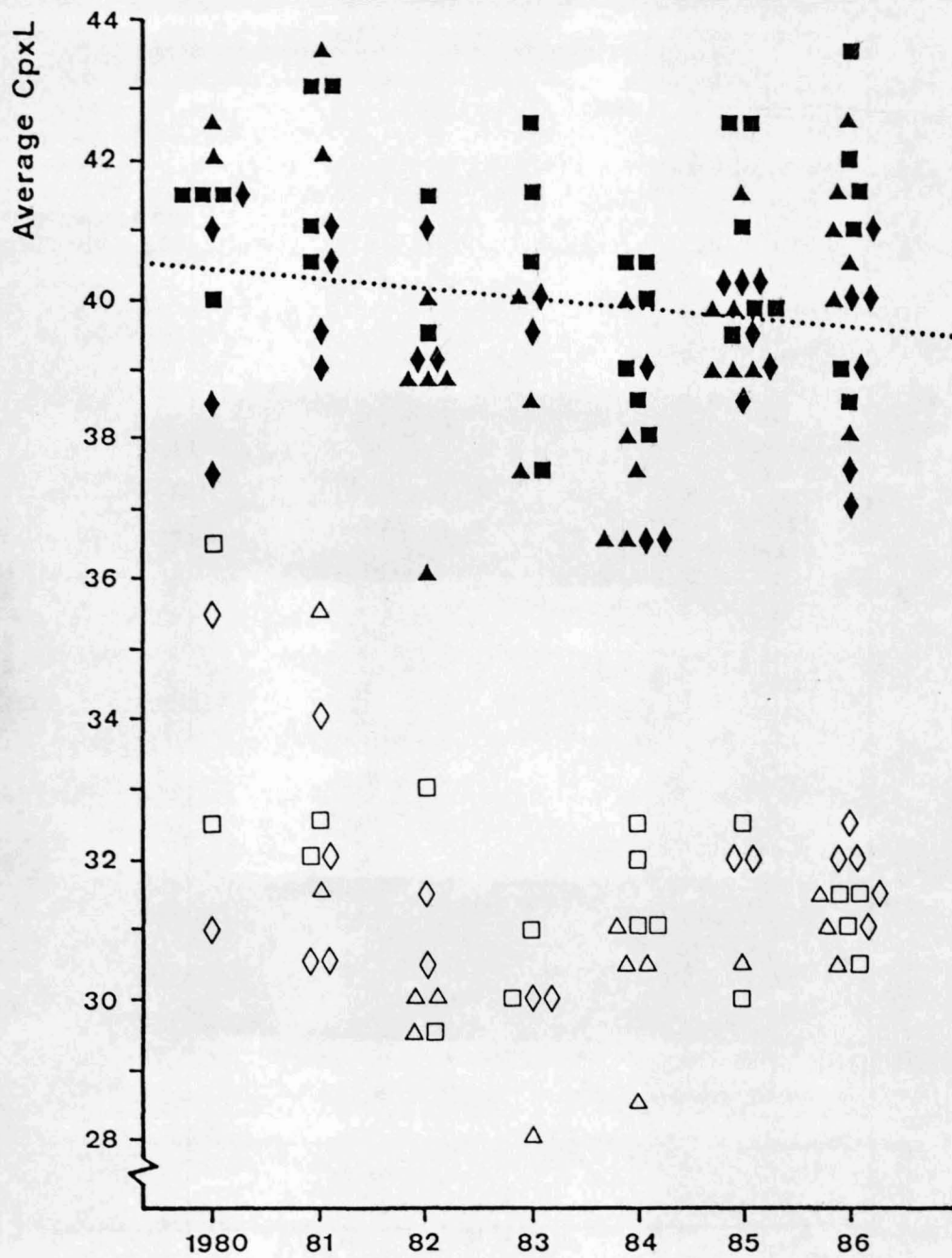


Figure 1 - Average carapace lengths of male Nephrops in the landings from the Central North sea, 1980-1986 (market classes "small" and "medium + large").

△ : 2nd quarter	} "small"	▲ : 2nd quarter	} "medium + large"
□ : 3rd quarter		■ : 3rd quarter	
◇ : 4th quarter		◆ : 4th quarter	

