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Stomach content analysis of Norway Lobster, *Nephrops norvegicus*, in the North Aegean Sea (Greece)

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Introduction

Norway lobster (*Nephrops norvegicus*) is a species of high commercial importance. Published information on its food habits are limited (Atlantic and West Mediterranean Sea: THOMAS & DAVIDSON, 1962; FARMER, 1975; SARDA & VALLADARES, 1989). A preliminary study on the biology of the species is available from the Greek seas (MYTILINEOU *et al.*, 1990), but no information exists concerning its diet. This work is a preliminary study on the food habits of the norway lobster from the North Aegean sea.

Material and methods

A total of 1365 individuals (689 females, 676 males) was collected seasonally, between June 1990 and March 1991, by a fishing trawler with a cod-end mesh size of 28mm (streched), in the North Aegean Sea. Carapace length (CL), weight, sex and maturity stages were recorded in the laboratory. Stomach contents were exctracted, weighed and analysed Prey organisms were identified to the lowest possible taxon. The mean individual degree of fullness (LEBEDEV, 1946), the mean individual index of fullness (HUREAU, 1966) and the percentage of empty stomachs were estimated. The importance of different prey types in the diet was expressed as percent frequency of occurrence (%F) (HYSLOP, 1980) and its relationship with length and sex was examined.

Results

Carapace length of norway lobsters taken for food analysis, ranged from 16 to 61mm and from 15 to 48mm for males and females respectively. Over all, 159 stomachs for males and 248 for females were empty. The percentage of empty stomachs was estimated seasonally and was found higher in September and December (Table I). Females had higher percentage than males, especially in September. The mean individual degree and index of fullness were higher in March and June (Table I).

TABLE I. Seasonal fluctuations of the feeding intensity of Norway lobster in the North Aegean Sea.

MALES	June	Sept.	Dec.	March
Stomachs examined	286	145	143	102
Empty stomachs (0/0)	16.1	24.8	41.3	17.7
Fullness index (0/00)	61.1	56.1	34.9	61.6
Fullness degree	2.45	2.25	2.07	2.73
FEMALES	June	Sept.	Dec.	March
Stomachs examined	316	124	125	124
Empty stomachs (0/0)	26.0	57.3	55.2	21.0
Fullness index (0/00)	66.9	30.3	30.8	69.6
Fullness degree	2.04	1.96	1.56	2.70

The examination of the degree of fullness in relation to maturity stage showed that berried females presented very low values (September: 0.53 and December: 0.67).

Stomach contents consisted mainly of particles of crustaceans, fish vertebrae and otoliths, parts of muscles and other organic items, difficult to be identified. Ten taxa, including the digested food and the unidentified organisms, were considered in the graphical representation of the qualitative analysis of the diet (Fig.1). Digested food showed the higher F value (~65%) in the diet of Norway lobster, followed by decapods and other crustaceans (~40%), fish (~15%) and cephalopods (~10%). There was little seasonal variation in the diet; decapods and cephalopods were more frequent in winter, while other crustaceans and fish in autumn and spring. No differences were found in the diet between sexes. However, more taxa (polychaets, foraminifera and unidentified organisms) were identified in the diet of males than females (Fig.1).

The F values of the different taxa showed differences with size. The stomach contents of the young norway lobsters (<20mm CL) contained almost exclusively digested food (80%); decapods, gastropods and cephalopods were also found in the diet of young males, whereas only crustaceans in the diet of young females. The F value of decapods and other crustaceans appeared to increase with increasing length (CL), whereas the F of fish was higher for specimens with CL>40mm.

Discussion and conclusions

The feeding intensity of norway lobster in the North Aegean Sea was low. The maximum intensity appeared in spring and summer while the minimum in autumn and winter. Berried females showed a high percentage of empty stomachs, as FARMER (1975) has also reported. Food items were difficult to be identified. Digested food presented high F values, possibly related to the low ability of the species to ingest large particles of food (THOMAS & DAVIDSON, 1962). Decapods and other crustaceans comprised mainly the food of Norway lobster, followed by fish and cephalopds. However, if the relative digestion rate of the different prey types consumed (polychaets, crustaceans, gastropods etc) had been taken in consideration, a different food composition might be found. Little variation appeared in the diet composition between seasons and sexes. Food of young individuals consisted mainly of detritus and small organic fragments, while adults fed with larger items of crustaceans and fish.

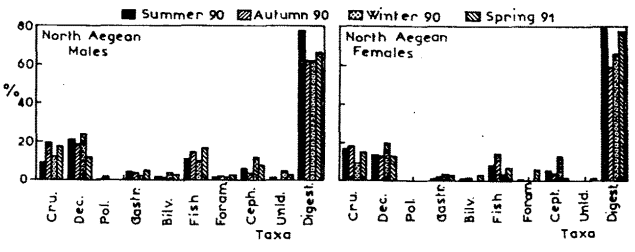

Fig.1. The F of the different taxa in the diet of Norway lobster.

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A new technique for transplantation of red coral *Corallium rubrum* (L.) in laboratory and on artificial reefs

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As far as we know, transplant experiments of Mediterranean Gorgonians already made have consisted of bringing cuttings of ramifications as well as juvenile colonies and placing them in habitats in which the species involved were not usually encountered or had almost disappeared (WEINBERG, 1979). Several transplant techniques were tested (concrete blocks, PVC-racks and transplanted stones) but two main systems of installation were employed :

1 - the branches or the entire ramifications were detached from the colony or from their original substratum and fixed directly to some artificial body (WEINBERG, cit.; F.A.O., 1988);

2 - stones (e.g. coralligenous rocks) bearing juvenile or adult colonies were collected from their environment and firmly transplanted in various sites.

The aim of the method described here is quite different and concerns only the species *Corallium rubrum*. Our object was to find a simple transplant technique for an easy transference of colonies from the laboratory to the field and vice versa. This could be useful to facilitate experiments and biometrical measurements, both in aquaria and at sea, and to have a high survival rate of the branches.

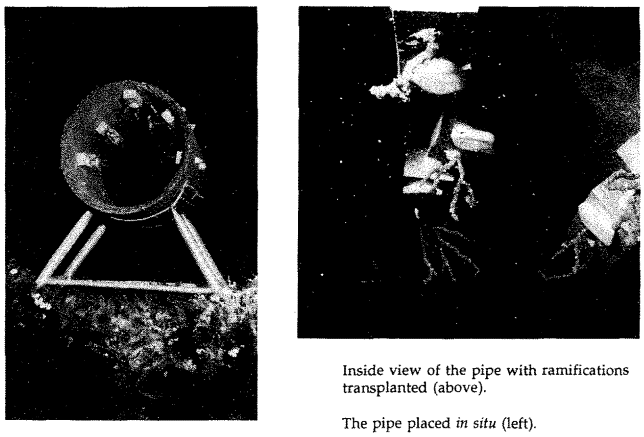
As far as the island of Sardinia is concerned, this must also be considered as the first scientific transplant of red coral onto artificial substratum in shallow waters. A similar experiment was carried out by some of the Authors. However the branches were transplanted directly on natural sustrata (CHESSA, com. pers.).

It is worthwhile mentioning that there has been intensive fishing by divers from superficial rocky bottoms and caves along all the Sardinia coast. In almost all of these biotopes this species has been completely destroyed and very few populations with good densities were observed (CHESSA *et al.*, 1991). For the above reasons this research is to be regarded of pratical interest.

The experiment was carried out in July 1991 along a rocky coast near Alghero (NW Sardinia). A number of small colonies of *Corallium rubrum* were collected in January 1991 from a shallow cave (15 m deep) where a surprisingly high density of the species was found (CHESSA *et al.*, cit.). Some environmental parameters were monitored *in situ* (e.g. temperature, salinity, dissolved oxygen, pH). The ramifications were detached with a little substratum and quickly put in a thermic bag and kept at the constant temperature of 15°C with aeration. Then they were taken to the laboratory and placed in aquarium under controlled environmental conditions.

The colonies were fed with *Artemia salina* nauplii twice a week for 24 hours at a concentration of about 2 nauplii/cc. In the above conditions the coral survived very well, without any regression of the coenenchima.

After 3 months of aclimatization in the aquarium, 11 ramifications were transplanted onto holes in small tiles. The holes had approximately the same diameter of the base of each colony. They were fixed with a quick-settling cement. These colonies were kept under strict observation for 3 months before being transferred to the sea. In this period no significant alterations in the living tissues at the base of the branches were observed.



Inside view of the pipe with ramifications transplanted (above).

The pipe placed *in situ* (left).

The tiles bearing the colonies were fixed underwater to the inside walls and roof of a small concrete pipe which had a metal base. This pipe was placed on a rocky bottom 25m deep close to calcareous outcrops where red coral was still present.

Checks on the red coral in the tunnel were made after 3 and 4 months and the following considerations can be made:

1) all the branches of the colonies survived;

2) the materials employed (tiles, cement, etc.) functioned well;

3) two portions of ramifications, detached by natural causes, transferred to laboratory are still surviving. They are now ready to be retransplanted into the field;

4) the transplant technique seems to be effective and easy to employ.

Even if it is too soon for a technological application of these results, the present experience demonstrated that red coral can be manipulated quite easily and does not seem as delicate as was previously supposed. Taking into consideration all the above reasons we think that a massive transplantation could be undertaken in the near future.

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This work has been supported by a grant of Regione Autonoma Sardegna