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International Council for the
Exploration of the Sea.

C.M. 1983/K : 19
Shellfish Committee

In vitro experiments on the predation by the swimming crab, *Macropipus holsatus*, on brown shrimps, *Crangon crangon*.

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Abstract.

In vitro experiments on the predatory behaviour of the Portunid crab *Macropipus holsatus* indicate that it is not a very efficient predator of brown shrimp, *Crangon crangon*. Only about 2 % of the shrimps in the test units were killed and partly eaten by the crabs. These findings are compared to the results of earlier investigations on the food composition and feeding behaviour of *Macropipus holsatus* by AMROM (1961). Previous assumptions on the detrimental effect of the swimming crab on the shrimp stock and fishery should be attenuated.

Résumé.

Des expériences in vitro sur le comportement prédateur du crabe nageur, *Macropipus holsatus*, ont démontré que cette espèce n'est pas un prédateur habile de la crevette grise, *Crangon crangon*. Seulement 2 % des crevettes dans les aquariums fûrent tuées et dévorées en partie par les crabes. Ces observations sont comparées aux résultats des recherches par AMROM (1961) sur la composition de la nourriture et le comportement nutritif de *Macropipus holsatus*. L'hypothèse sur l'effet nocif du crabe nageur sur le stock et la pêche crevettiers, mentionnée antérieurement par différents auteurs, doit être atténuée.

This study was subsidized by the Institute for Scientific Research in Industry and Agriculture, Brussels, Belgium.

1. Introduction.

At the end of the fifties AMROM (1961) investigated the food of the swimming crab, Macropipus holsatus, from the Belgian coastal waters, by analyzing the contents of about 800 crab stomachs. Shrimp remains, without exception identified as Crangon crangon, were found in 53 % of the stomachs. AMROM also performed in vitro experiments on the predation by crabs on live shrimps. She concluded that the brown shrimp, Crangon crangon, was a major food source for the swimming crab and that it constituted a real danger to the shrimp stock and fishery. Later on, this assumption has been adopted by other investigators (e.g. REDANT, 1980), although the predation by crabs on brown shrimp never was quantified.

The swimming crab is a very common denizen of the Belgian coastal waters. Its biomass averages almost 2,000 tons (i.e. almost 300 million individuals). It is obvious that such a species, if it would regularly prey on shrimp, could be very harmful to the shrimp population. Therefore, as a part of a study on the population dynamics of the swimming crab (BORREMANS, 1982), a programme was started to quantify its predation on brown shrimp.

Preliminary in vitro experiments to determine the digestion time of shrimps in crab stomachs however yielded surprising results. The crabs were found to be almost unable to catch live shrimps. Moreover, they were unwilling to eat dead shrimps if these were not broken into small pieces. These findings forced us to reconsider the problem. Therefore, in vitro experiments were set up to study the predatory behaviour of the swimming crab with respect to the brown shrimp.

2. Methods.

Live swimming crabs and brown shrimps were collected in April 1982 from inshore waters and transferred to storage tanks (volume 240 liters, temperature 12 °C, salinity 30 °/₀₀) for a one week acclimation period. The shrimps and part of the crabs were fed with sprat and mussel, the other part of the crabs were isolated in small netting cages within the storage tanks and were starved.

Two experiments were performed, the first one to study the predation by starved crabs on live brown shrimps, the second one to study the predation by fed crabs on shrimps.

The set-up of these experiments consisted of rectangular PVC containers (33 x 55 x 36 cm), with a 4-5 cm bottom layer of fine sand and filled with 40 liters of seawater (temperature 12 °C, salinity 26-30 °/₀₀). Oxygen was supplied by air bubbling. Illumination approximated natural conditions, with dim light during daytime and complete darkness during night.

Each of these test units was provided with about 10 shrimps (size 35-70 mm) and one swimming crab, either fed or starved (one week starvation period). After 48 hours the numbers of surviving shrimps were counted. These experiments were repeated with 43 starved and 16 fed crabs. A blanco test unit, without crab, was introduced to evaluate the mortality of shrimps due to the experimental conditions.

3. Results.

3.1. Starved crabs.

At the end of the experiment only 9 shrimps out of 406 (2.2 %) had been killed and (partly) eaten by the crabs. Mostly only the head and the tail of the shrimp were recovered, whereas the posterior part of the cephalothorax and the anterior part of the abdomen were missing (table 1).

Some test units contained undamaged dead shrimps, together with one or more exuvae. These shrimps probably died during or shortly after having moulted.

Table 1 - Predation on live shrimp by starved crabs.		
Number of crabs studied	43	
Number of shrimps at the beginning	406	100.0 %
Number of survivors after 48 hours	395	97,3 %
Number of dead shrimps after 48 hours	11	2.7 %
of which - undamaged	2	0.5 %
eaten or severely damaged	9	2.2 %

Immediately after the 48 hours test period the crabs were offered freshly killed and sliced shrimp, which they readily consumed.

3.2. Fed crabs.

After 48 hours only three shrimps out of 149 (2.0 %) were eaten by the crabs (Table 2). Some casualties due to moulting and/or the experimental conditions occurred.

Table 2 - Predation on live shrimp by fed crabs.		
Number of crabs studied	16	
Number of shrimps at the beginning	149	100.0 %
Number of survivors after 48 hours	141	94.6 %
Number of dead shrimps after 48 hours	8	5.4 %
of which - undamaged	5	3.4 %
- eaten or severely damaged	3	2.0 %

Also these crabs quickly consumed freshly killed and sliced shrimps immediately after the test period.

3.3. Behaviour of the crabs.

During both experiments we were able to observe the crab's behaviour in its attempts to catch brown shrimps. Usually the crabs were waiting for the shrimps to approach them very closely, before they started to make swinging and snapping movements with their chelipeds. Most attacks were unsuccessful because they were unable to seize the shrimp before it escaped with a rapid jump. Rarely the crab pursued its prey and mostly they abandonned the pursuit after a short while.

4. Discussion.

These results are in sharp contrast to AMROM's findings. She reported multiple in vitro observations on crabs catching and killing live shrimps (AMROM, 1961), and concluded that swimming crabs consume, on average, one shrimp per day.

The set-up of AMROM's experiments however largely favoured the swimming crabs in their capability to catch shrimps. Her test units consisted of small glass jars with a volume of only 2 liters. Each jar contained one crab and several shrimps. These conditions are highly unnatural for both the crab, which should be allowed to swim, and the shrimps, which should be given place to display their typical "sprinting" behaviour to escape their ennemies. The killing of large numbers of shrimps in AMROM's experiments very likely is a consequence of the overcrowding in her test units. It is clear, however, that is was erroneous to consider all these casualties as being "due to predation".

In our experiments this problem was reduced by increasing the surface and the volume of the test units. Yet, the densities of shrimp in the containers (10 per 0.2 m^2) remained much higher than the natural densities (average 4 per m^2, maximum 25 per m^2 ; REDANT, unpublished data). This could provoke an increase in the number of encounters between predator and prey and in the number of predation attempts. In spite of these higher prey densities the swimming crab was found to be very unsuccessful in capturing brown shrimps.

Our findings are confirmed by investigations on the food composition of the Portunid crabs Macropipus puber (GURRIARAN, 1978), Macropipus pelagicus (WILLIAMS, 1982) and Callinectes sapidus (TAGATZ, 1968). They mainly feed on sessile or slowly crawling prey species, such as Polychaeta, Bivalvia, Crustacea (e.g. Anomura and Brachyura), Echinodermata, sea weed and carrion (e.g. fish). Swimming prey species, such as shrimps, were not or only rarely observed in their stomachs. Similarly, laboratory observations on another Portunid species, Callinectes arcuatus, indicated that it was not a very efficient predator of highly swimming organisms, such as penaeid shrimps, even in the confines of laboratory tanks (PAUL, 1981).

5. Conclusion.

The results of our experiments prove that live brown shrimps are not a major food source for the swimming crab, Macropipus holsatus. However, the presence of shrimp remains in the stomachs of the crabs (AMROM, 1961) cannot be neglected. Most probably these originate from diseased, wounded or dead shrimps, in which case the smell of the carrion enables the crab to localize its food. The discarding of large numbers of "undersized" shrimps by the commercial fishery could play an important part in introducing dead or moribund shrimps in the crab's environment.

These investigations also demonstrate that the swimming crab has not such a dramatical harmful impact on the shrimp stock and the shrimp fishery in the Belgian coastal waters as hitherto believed.

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