

ITALIAN FRESHWATER DECAPODS : EXCLUSION BETWEEN THE CRAYFISH *AUSTROPOTAMOBIUS PALLIPES* (FAXON) AND THE CRAB *POTAMON FLUVIATILE* (HERBST).

S. BARBARESI (1), F. GHERARDI (1, 2).

(1) Dipartimento di Biologia Animale e Genetica "Leo Pardi", Via Romana 17, 50125 Firenze, Italy.

(2) Centro di Studio per la Faunistica ed Ecologia Tropicali del C.N.R., Via Romana 17, 50125 Firenze, Italy.

ABSTRACT

In Italian freshwater systems, the crayfish *Austropotamobius pallipes* and the crab *Potamon fluviatile* mainly occur in different geographic areas and, when they are in sympatry, in different streams. Four issues are raised : **(1)** the two species once coexisted, **(2)** the two species share the same resources, **(3)** river crab is behaviorally dominant over crayfish, and **(4)** crab influences the habitat occupied by crayfish. These issues suggest a scenario of competitive exclusion in these two species, which is the result of past interspecific competition for common resources. The winner was *P. fluviatile* which had higher levels of aggression and strength than *A. pallipes* ; the latter was forced to migrate to other regions or, when still in sympatry, to remain in less favorable habitats, characterized by a lower temperature regime.

Key-words : competitive exclusion, freshwater decapods, *Austropotamobius pallipes*, *Potamon fluviatile*.

DECAPODES D'EAU DOUCE ITALIENS : EXCLUSION ENTRE L'ECREVISSE *AUSTROPOTAMOBIUS PALLIPES* (FAXON) ET LE CRABE *POTAMON FLUVIATILE* (HERBST).

RESUME

Dans le réseau d'eau douce italien, l'écrevisse *Austropotamobius pallipes* et le crabe *Potamon fluviatile* sont présents dans différentes aires géographiques et, quand ils sont en sympatry, ils vivent dans des cours d'eau différents.

Quatre points sont relevés : **(1)** les deux espèces ne coexistaient qu'à une seule occasion, **(2)** les deux espèces partagent les mêmes ressources, **(3)** le crabe d'eau douce présente un comportement dominant sur l'écrevisse, **(4)** le crabe influence l'habitat occupé par l'écrevisse. Ces observations suggèrent un scénario d'exclusion compétitive entre ces deux espèces, résultant de la compétition interspécifique pour les ressources communes. *Potamon fluviatile*, qui a un niveau d'agressivité plus élevé et qui est plus fort qu'*Austropotamobius pallipes*, a été le vainqueur ; l'écrevisse a été forcée d'émigrer dans

d'autres régions, ou, quand les deux espèces sont encore en sympatrie, elle reste reléguée dans les habitats caractérisés par un régime plus bas de températures.

Mots-clés : exclusion compétitive, décapodes d'eau douce, *Austropotamobius pallipes*, *Potamon fluviatile*.

INTRODUCTION

In crustacean decapods, intraspecific competition has been extensively cited as the main factor conditioning both the access to limited resources and the spatial distribution of populations (BOVBJERG, 1953, 1956 ; LOWE, 1956 ; BOVBJERG and STEPHEN, 1975 ; HAZLETT, 1974 ; HAZLETT, RUBENSTEIN and RITTSCHOF, 1975 ; GHERARDI, GUIDI and VANNINI, 1987 ; GHERARDI, TARDUCCI and MICHELI, 1989). However, only scattered information is available about interspecific competition (exceptions are : BOVBJERG, 1970 ; CAPELLI and MUNJAL, 1982 ; ALMAÇA, 1988 ; SÖDERBÄCK, 1991, 1995), and the mechanisms influencing species segregation and replacement have often been neglected.

MATERIAL AND METHODS

Laboratory studies

Locomotor activity

Experiments were carried out in a thermostatic cell where 5 adult crabs and 5 adult crayfish of both sexes were tested at the same time for 4 days. Before testing, animals were starved for 2 days and acclimated for 24 h to the experimental temperature. During the experiment, each specimen was kept in a transparent tank measuring 10 x 40 cm, and its locomotor activity was recorded by infrared photo-cell interruptions.

RESULTS

Laboratory studies

Competition

There was a positive correlation between the relative size difference of the two opponents (ranging from -10 to +10, e.g. -10 when the smallest crab was opposed to the largest crayfish and +10 for the opposite situation) and the score at the end of the battle (SPEARMAN rank correlation test : $t = 4.914$, $df = 8$, $P < 0.01$), suggesting that a main factor in agonistic contests was the relative size difference between the opposing species (Figure 7). However, when the relative size was the same, the absolute score for the crabs (average = 0.717, SE = 0.078, $n = 187$) was significantly higher than that for the crayfish (average = 0.004, SE = 0.063, $n = 235$; MANN-WHITNEY U test : $z = 5.353$, $P < 0.001$).

DISCUSSION

Interspecific dominance has been investigated in laboratory only for a few freshwater decapods species (e.g. BOVBJERG, 1970 ; CAPELLI and MUNJAL, 1982 ; BUTLER and STEIN, 1985). Generally, the results have been consistent with the observed distribution patterns, one species thought to competitively exclude another by its dominance

(SÖDERBÄCK, 1995). Competitive exclusion, involving a variety of mechanisms, has often been invoked as an explanation for observed replacements (SÖDERBÄCK, 1995), while other authors have assumed that direct aggression is the main factor (PENN and FITZPATRICK, 1963 ; BOVBJERG, 1970 ; CAPELLI and MAGNUSON, 1975 ; CAPELLI, 1982 ; FLYNN and HOBBS, 1984).

1. The two species once coexisted

At present, the two species are found in different distribution ranges, with the exception of a restricted overlap area where they never share the same stream or pond. The historical reconstruction provided by PRETZMANN (1987) suggests that the two species lived in sympatry during the Pleistocene.

CONCLUSION

These issues suggest the following scenario for the competitive exclusion of *A. pallipes* by *P. fluviatile*. The present distribution of the two species in Italy is the result of their past interspecific competition for the acquisition of common resources, such as food and shelter. Competitive interactions began during the Pleistocene, when the two species converged in Italy after migrating from eastern European regions (PRETZMANN, 1987). The winner was *P. fluviatile*, which had higher levels of aggression and strength than *A. pallipes*, and was therefore able to supplant the latter in their overlapping ranges. The crayfish were thus forced to migrate to other regions or, when still in sympatry, to remain in less favorable habitats, characterized by a lower temperature regime.

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Table I

Levels of aggression (mean scores \pm SE, n in brackets) scored during the interactions between the crayfish, *Austropotamobius pallipes* (columns), and the crab, *Potamon fluviatile* (rows), of different size classes (CL = carapace length).

Tableau I

Niveaux d'agressivité (moyenne des points \pm écart type, n entre parenthèses) obtenus lors des interactions entre l'écrevisse, *Austropotamobius pallipes* (colonnes), et le crabe, *Potamon fluviatile* (lignes), de classes de taille différentes (CL = longueur de la carapace).

Figure 1

General distribution of *Austropotamobius pallipes* (top) (LAURENT, 1988) and *Potamon fluviatile* (bottom) (PRETZMANN, 1987) in Europe.

Figure 1

Distribution générale d'*Austropotamobius pallipes* (en haut) (LAURENT, 1988) et de *Potamon fluviatile* (en bas) (PRETZMANN, 1987) en Europe.