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NICHE WIDTH AND OVERLAP OF TWO COEXISTING SPECIES OF *Acartia* (COPEPODA: CALANOIDA), IN THE RIA OF VIGO (NW OF SPAIN)

by

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Résumé

Dans la présente note ou a étudié l'ampleur et la superposition des niches écologiques de deux des quatre espèces d'*Acartia* (Copepoda: Calanoida) qui coexistent dans la Ria de Vigo (N.O. d'Espagne). Les deux espèces choisies sont *A. clausi* et *A. margalefi*, qui se trouvent partiellement séparées, la première dans l'embouchure, tandis que la deuxième occupe l'interieur de l'estuaire.

Introduction

From the postulation of the competitive exclusion principle by GAUSE (1934), the idea of one species per niche seemed to be accepted as a dogma: if two species coexisted, they had to accupy different niches.

The ecological niche can be considered as an abstract hypervolume of *n* dimensions, the ecological factors, limited by the range of tolerance of the species with respect to these ecological factors (HUTCHINSON, 1957). This new approach leads to identify the concept of niche with the spectrum of the resources used by the species (McARTHUR, 1972; PIANKA, 1976).

The application of the niche theory to empirical data relative to natural populations, allows to draw critical conclusions concerning the problem of the meassurement of the degree of competition between species, always taking into account that niche overlap is a necessary, but not sufficient condition, for the existence of competitive relationships between species (PIANKA, 1976).

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The spatial distribution of the four Acartia species found in the Ria of Vigo (NW of Spain), suggests the existence of partial segregation along the stuary, following the gradient of some environmental factors (ALCARAZ, 1976, 1977). Two species are concentrated mainly at the ends of the ria: A. margalefi at the head, and A. clausi at the mouth, but coexist in the middle part.

This paper deals with the analysis of the niche width and overlap of these two species and the study of the possible competitive relationships between them.

Methods

Four variables were selected for the calculation of the niche parameters above mentioned: a) Spatial distribution; b) Temperature; c) Salinity and d) Filter-feeding selectivity.

The data about the parameters a, b and c were obtained from April 1972 to June 1973, at a mean interval of 18 days (ALCARAZ, 1977 a, b, 1979). For the study of filter-feeding selectivity, 10-20 females of each Acartia species were introduced in separate 250 ml jars containing sea water obtained simultaneously to the catch of the copepods. The sea water was pre-filtered through a 45 µm nylon filter. A Coulter Counter TA was used in the analysis of the number and volume of the suspended particles. This apparatus gave the concentration of particles, and their relative percent volume distribution, for 16 volume intervals (channels), for which the ratio between the mean volume of the particles included in two successive channels was 2.

Only data corresponding to the channels 5 to 16 (63 μm^3 to 131,049 μm^3) have been taken into account in the calculation of the percent volume of particles removed per individual and day,

$$P_i = \frac{V_i - V_i'}{V_i \cdot n} \cdot 100$$

where P_i is the change in percent volume of particles of channel i caused by feeding activity of one individual in one day; V_i the initial volume of particles at that channel; V_i' the final volume after the feeding activity, and n the number of individuals of the species introduced in the flask. Niche width and overlap have been calculated by means of the formulae of LEVINS (1968):

Niche width $$B_i = 1/\sum_{h=1}^{s} p_{ih}^2 \quad (1)$$

Niche overlap $$\begin{cases} \alpha_{ij} = \sum_{h=i}^{s} p_{ih} \cdot p_{jh} \cdot B_i \\ \alpha_{ji} = \sum_{h=i}^{s} p_{ih} \cdot p_{jh} \cdot B_j \end{cases} \quad (2)$$

where B_i is the niche width of the species i; p_{ih} and p_{jh} the proportion of the species i or j found in a particular environmental condition h, or the proportion of the resource h exploited by the species i or j; α_{ij} and α_{ji}, the niche overlaps, can be assimilated to GAUSES's interaction coefficients.

Results

Because data of the firts three parameters (a, b and c) correspond to coexisting species, they will give estimations of post-competitive or "realized" niches, while data on filter-feeding selectivity (d) correspond to "virtual" or pre-competitive niches (HUTCHINSON, 1957). The values of niche width for A. margalefi and A. clausi, calculated by means of the expression (1) are listed in table I.

It is interesting to note that A. clausi has higher values for the three factors corresponding to post-interactive or "realized" niches (temperature, salinity and spatial distribution), while in the case of filter-feeding selectivity is A. margalefi the species with a wider niche.

The formulae (2) for the estimation of α_{ij} and α_{ji} differ only in the niche with of the species i and j, so they will give assimmetrical values of nich overlap unless $B_i = B_j$; it is important to note that these expressions can give values of $\alpha > 1$. (LEVINS, 1968, PIANKA, 1974). Results of niche overlap between A. margalefi and A. clausi are listed on table II.

As a consequence of the differences in niche width, the overlap (interaction) for A. clausi-A. margalefi is higher than for A. margalefi- A. clausi, in the case of realized niches, and vice-versa for filter-feeding selectivity.

Conclusions

From the comparison of the niche width of the two species with respect to temperature, salinity and spatial distribution, it could be assumed that *A. clausi* is more euryoic than *A. margalefi*; notwithatanding, it must be taken into account the character of realized or post-interactive niches of the mentioned factors. In the case of a virtual niche, as in food selection, is *A. margalefi* the most euryoic species, as could be spected taking into account ist concentration in the inner part of the Ria, the area with the highest degree of ecological instability (ALCARAZ, 1977 a).

The assimmetry observed in the niche overlap of the two *Acartia* species (table II) is a consequence of their differences in nich width. The lowest overlap corresponds to spatial distribution, due to the segregation of the two species along the Ria (1979).

The existence of competitive relationships between *A. clausi* and *A. margalefi* (niche overlap) seems to have lead to the persistence of their spatial segregation throughout the year. The partitioning of the environment between both species is a consequence of their response to different patterns in the temporal variability of the ecological factors.

Table I.- Values of niches width of *A. margalefi* and *A. clausi*, corresponding to the four selected variables, calculated by means of the expression (1).

	Temp.	Sal.	Spatial distr.	Food selec.
B_i, *A. margalefi*	2.41	3.31	1.87	7.79
B_j, *A. clausi*	10.64	6.62	2.96	5.78

Table II.- Values of niche overlap between *A. margalefi* and *A. clausi* corresponding to the four selected variables, calculated by means of the formulae (2).

	Temp.	Sal.	Spatial distr.	Food selec.
α_{ij}, *A. marga.-A. clausi*	0.260	0.430	0.198	0.959
α_{ji}. *A. clausi-A. marga.*	1.149	0.860	0.313	0.723

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