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Some Observations on Harpacticoid Populations, in Relationship to the Competitive Exclusion Principle

by

R. HAUSPIE & P. POLK*

ABSTRACT

In the field of ecology of populations, two concepts are largely distributed and generally accepted:

- the competitive exclusion principle states that organisms occupying similar ecological niches, come into competition and consequently cannot coexist.
- the more two organisms are close to each other in phylogeny, the more they will tend to occupy similar niches.

The results obtained from the study of populations of Harpacticoids colonizing artificial substrata are somehow an illustration of this principles.

Indeed, these species which coexist belong most of the time to different genera or even to different families.

INTRODUCTION

The competitive exclusion principle, which stated that two species cannot indefinitely coexist in the same locality if they have identical ecological requirements (MAYR, 1970; HARDIN, 1960) is a widely distributed and accepted concept in evolutionary biology. Indeed, numerous cases of conspicuous exclusion have been demonstrated by many authors (LACK, 1945; MAYR, 1963 and SELANDER, 1969).

Nevertheless PIMENTAL and al. (1965) proposed that situations exist in which two species might compete yet still coexist. He states that interspecific competitors may change genetically with the result that competing species can coexist in the same ecosystem. MARSCHALL (1960) also found that two species of towhees coexisted in the same habitat, even though they seemed to use exactly the same resources of the environment.

Laboratorium voor Ekologie en Systematiek, Vrije Universiteit Brussel, 1050 Brussel, Belgium.
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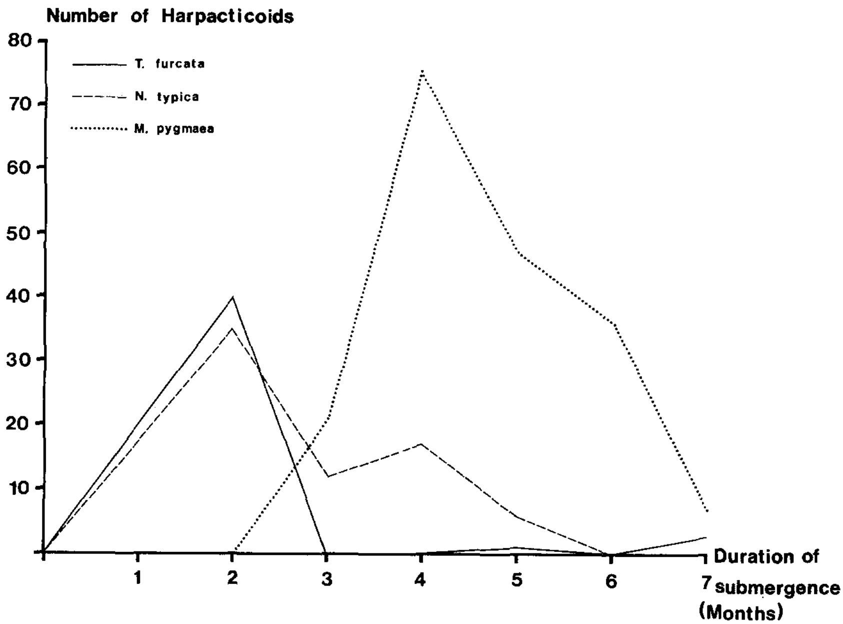

Nevertheless the observations above mentioned, we think that demonstrable exclusion is widely enough distributed among animals so that one cannot omit its importance or validity.

In this paper we want to mention some observations on Harpacticoids which are somehow an illustration of the competitive exclusion principle.

Materials and methods

On the one hand, samples were taken in a shallow brackish water basin (depth 1.5 m) at Ostend, the "Spuikom", which is closed from the open sea by sluices, so that there are no flowing and ebbing waters. Samples were taken from a platform in the middle of the basin (86 ha.). In this experiments we used substrata which were hung in water at this platform (built on piles).

This was made in such a way that no direct contact was possible with the natural substrata of the biotope (bottom, fixed substrata such as stones, pillars, walls, ...).

However, after a certain time, dense populations of Harpacticoids were found on these substrata.

Taking samples every 28 days, during a period of more than six months, beginning on 24-3-1969, one was able to follow the evolution of Harpacticoid populations on this substrata (Hauspie & Polk, 1973). The substrata themselves were made of five pairs of microscope glass-slides ,pinched between two plastic frames, showing a total area of 142 cm^2.

On the other hand, samples were obtained from the rocky-shores in the neighbourhood of the Marine Biological Station at Wimereux (Pas de Calais). Several algae and sponges were collected in puddles of water during low tide and washed in a 4% formalin solution. The Harpacticoids obtained in this way, were examined in the laboratory.

Results and discussion

All species were determined and the quantitative results are listed in tables 1—3. The figure gives a graphical representation of the data of table I. for three species, over a period of 7 months, beginning on 24-3-1969. The density of the other species was at such a low level that they were not taken under consideration in this problem. Examination of all data has revealed some remarkable facts, which will be discussed now.

TABLE I

Numbers of Harpacticoids on artificial substrata after several months of submergence in a shallow brackish water at Ostend

Duration of submergence (Months)*	2	3	4	5	6	7
Longipedia minor	5	2	3	—	—	—
Canuella perplexa	—	8	—	—	—	—
Ectinosoma melaniceps	6	2	3	—	3	—
Harpacticus obscurus	4	20	7	4	22	8
Tisbe furcata	40	—	—	1	—	3
Amphiascella debilis	—	5	4	—	—	—
Nitocra typica	35	12	17	6	—	—
Mesochra pygmaea	—	21	75	47	36	7
Paralaophonte congenera	2	—	—	7	10	6
Copepodites	9	8	19	22	17	11

* The sample after 1 month of submergence is missing.

Some species of Harpacticoids are present at the same time in the same habitat: *Tisbe furcata* + *Nitocra typica*/*Mesochra pygmaea* + *Nitocra typica*. This is the case for *T. furcata* and *N. typica* during the first three months of submergence of the artificial substrates, and for *M. pygmaea* and *N. typica* during the next months.

It is a fact that in all our observations on samples obtained from the artificial substrates, we found Harpacticoids, present at the same time in the same habitat, to belong at least to different families (see Systematic List).

TABLE II

Numbers of Harpacticoids on artificial substrata after several months of submergence in a shallow brackish water at Ostend, beginning on 19-5-1969

Duration of submergence (Months)	1	2	3	4	5
Longipedia minor	13	3	—	—	—
Canuella perplexa	15	—	—	—	—
Ectinosoma melaniceps	5	1	—	—	2
Harpacticus obscurus	31	—	4	15	16
Tisbe furcata	48	—	—	2	6
Amphiascella debilis	—	3	—	—	—
Nitocra typica	24	3	3	5	3
Mesochra pygmaea	—	25	15	12	6
Paralaophonte congenera	3	—	16	2	—
Copepodites	34	27	11	10	10

TABLE III

Results obtained from samples taken on several algae and sponges at the rocky-shores at Wimereux

	Green Algae Ulva lactuca	Brown Algae Fucus serratus	Red Algae Plocamium cocaneum	Sponges Hali-chondria panicea
Longipedia minor	—	—	—	1 (2.0)
Ectinosoma melaniceps	9 (4.0)	—	8 (3.5)	3 (6.2)
Harpacticus gracilis	—	—	—	4 (8.3)
Harpacticus littoralis	65 (29.5)	11 (10.0)	1 (0.4)	—
Zaus spinatus	115 (51.7)	23 (21.1)	134 (59.5)	3 (6.2)
Tisbe ensifer	10 (4.5)	3 (2.7)	2 (0.8)	7 (14.5)
Sacosiscus littoralis	1 (0.4)	4 (3.6)	—	—
Alteutha intertupta	—	—	—	1 (2.0)
Tegastes falcatus	—	—	1 (0.4)	—
Thalestris longimana	—	—	1 (0.4)	—
Thalestris brunnea	2 (0.9)	46 (42.2)	63 (27.9)	—
Diarthrodes sp.	—	4 (3.6)	—	—
Amphiascus minutus	—	—	—	9 (18.7)
Amonardi normani	—	—	—	1 (2.0)
Ameira scotti	—	3 (2.7)	—	8 (16.6)
Mesochra sp.	—	—	2 (0.8)	1 (2.0)
Eurycletodes similis	—	—	—	3 (6.2)
Laophonte barbata	—	—	—	2 (4.1)
Copepodites	20 (9.0)	15 (13.7)	13 (5.7)	5 (10.4)
Total	222 100%	109 100%	225 100%	48 100%

In "On the Origin of Species ...", DARWIN states: "As the species of the same genus have usually, though by no means invariably some similarity in habitats and constitution, and always in structure, the struggle will generally be more severe between them, when they come into competition with each other, than between species of distinct genera" (DARWIN, 1859).

So, in situations where all species belong at least to different families, competition will be less severe than if they should belong to the same family or the same genus.

In the same brackish water water basin, POLK (1963) found 15 species of Harpacticoids belonging to 13 different genera.

In his samples he recorded *Harpacticus obscurus* T. SCOTT, 1895 and *Harpacticus uniremis* KRÖGER, 1842; but never at the same time. The same thing could be said for *Mesochra pygmaea* (CLAUS, 1863) and *Mesochra lilljeborgi* BOECK, 1864.

This results were confirmed by the results of a nearly parallel experiment, which was started two months later and was run for a period of five months. For the numerical data, see table II.

The samples taken in the puddles of water on the rocky-shores of Wimereux, showed that species which coexist on the specific substrata at the same time belonged most of the time to different genera (see table III and Systematic List).

Only once we have found on the Red Alga *Plocamium coccineum*, a single specimen of *Thalestris longimana* simultaneously with a relative dense population of *Thalestris brunnea*.

SUMMARY

All our experiments demonstrate that species of Harpacticoids that coexist at the same time in the same locality usually belong at least to different genera.

Probably only those species have niches which are different enough to avoid competition and consequently allow coexistence. This observations may be seen as an illustration of the competitive exclusion principle.

SYSTEMATIC LIST

Ordo Copepoda
- Tribus Harpacticoida SARS
  - Sektio Polyarthra, LANG 1948
    - Familia Longipediidae Sars
      - Longipedia minor T. e. A. SCOTT 1893
    - Familia Canuellidae Lang 1948
      - *Canuella perplexa T. e.* A. SCOTT 1893
  - Sektio Oligoarthra
    - Suprafamilia Ectinosomidiomorpha LANG 1948
      - Familia Ectinosomidae SARS
        - *Ectinosoma melaniceps* BOECK 1864

Suprafamilia Tachidiidimorpha LANG 1948
Familia Harpacticidae SARS 1904
Harpacticus gracilis CLAUS 1863
Harpacticus obscurus T. SCOTT 1895
Harpacticus littoralis SARS 1910
Zaus spinatus GOODSIR 1845
Suprafamilia Tisbidimorpha LANG 1948
Familia Tisbidae (STEBBING), LANG 1910
Tisbe furcata (BAIRD 1837)
Tisbe ensifer FISCHER 1860
Sacodiscus littoralis SARS 1904
Familia Peltidiidae SARS 1904
Altheuta interrupta GOODSIR 1845
Familia Tegastidae SARS 1904
Tegastes falcatus NORMAN 1868
Suprafamilia Thalestridimorpha LANG 1948
Familia Thalestridae SARS 1905
Thalestris longimana CLAUS 1863
Thalestris brunnea SARS 1905
Diarthrodes sp.
Familia Diosaccidae SARS 1906
Amphiascus minutus CLAUS 1863
Amonardia normani BRADY 1872
Amphiascella debilis (GIESBR. 1881)
Suprafamilia Ameiridiomorpha LANG 1948
Familia Ameiridae Monard, LANG 1927
Ameira scotti SARS 1911
Nitocra typica BOECK 1864
Familia Canthocamptidae SARS 1906
Mesochra sp.
Mesochra pygmaea (CLAUS 1863)
Suprafamilia Clethodidimorpha LANG 1948
Familia Cletodidae T. SCOTT 1904
Eurycletodes (Oligocletodes) similis (T. SCOTT 1895)
Familia Laophontidae
Laophonte barbata LANG 1934
Paralaophonte congenera (SARS 1908)

REFERENCES

DARWIN, C. - 1859 - On the Origin of Species by Means of Natural Selection, or the Preservation of Favored Races in the Struggle for Life. London, John Murray, 1859.

HARDIN, G. - 1960 - The competitive exclusion principle. *Science* 131: 1291—1297, (1960).

HAUSPIE, R. & POLK, PH. - 1973 - Swimming behaviour patterns in certain benthic Harpacticoids. Crustaceana 1973, in press.

LACK, D. - 1945 - The ecology of closely related species with special reference to cormorant (Ph. carbo) and shag (P. aristotoles). *J. Anim. Ecol.* 14: 12—16 (1945).

MARSHALL, J. T., JR. - 1960 - Interrelations of Abert and Brown towhees. Condor 62, 49—64 (1960).

Mayr, E. - 1963 - Animal Species and Evolution. Cambridge, Massachusetts, Belknap Press of Harvard University Press, 1963.

Mayr, E. - 1970 - Populations, Species and Evolution. Cambridge, Massachusetts, Belknap Press of Harvard University Press, 1970.

Pimental, D., Feinberg, E. H., Wood, P. W. & Hayes, J. T. - 1965 - Selection, spatial distribution, and the coexistence of competing fly specis. The American Naturalist Vol. XCIX, No 906, 97—109, (1965).

Polk, Ph. - 1963 - Some observations on the Crustacean fauna of the Sluicedock (Bassin de Chasse) of Ostend. *Koninklijk Belgisch Instituut voor Natuurwetenschappen. Mededelingen, Deel xxxix*, nr. 20, 1—8 (1963).

Selander, R. K. - 1969 - The ecological aspects of the systematics of animals. In Systematic Biology, Nat. Acad. Sci. Publ. no. 1962. 213—247 (1969).