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REVUE ROUMAINE DE BIOLOGIE

SÉRIE DE BIOLOGIE ANIMALE

TOME 34, N° 2 juillet—décembre 1989

SOMMAIRE

CONTRIBUTION TO THE KNOWLEDGE OF THE *CAMPYLASPIS* SPECIES *(CRUSTACEA, CUMACEA)* FROM THE SOUTHERN LITTORAL WATERS OF BRAZIL

MIHAI BĂCESCU and IORGU PETRESCU

On décrit trois nouvelles espèces de *Campylaspis* — *C. brasilianus*, *C. antipai* et *C. holthuisi* — des eaux littorales brésiliennes du sud de Rio de Janeiro.

INTRODUCTION

In a small collection of Cumaceans from the southern littoral waters of Brazil sent to us by Mrs. Orane Falcao de Souza Alves, we also identified several *Campylaspis* species. The material was collected by the Brazilian expedition "Geocosta Rio II" off the Araruama lagoon in March 1986 from a depth of 100 m. The expedition was organized by the University of Rio de Janeiro.

Campylaspis brasilianus n.sp.
(Fig. 1 A—J)

Diagnosis. Cumacean with a more or less glabrous, breakable integument; carapace with slight tubercular round prominences. Maxilliped II with four dactylar spines, much exceeded in length by the spines which prolong the distal corner of carpus. From the distal median corner of ischio-basis a feathered seta starts which is curved over the rest of the articles and is longer than all of them together. Maxilliped III is armed with short and thick spines on the median side of the middle articles. Two short feathered setae start from the outer distal angle of the basis. Pereopod I with finger-shaped dactylus as long as carpus.

Description of the adult female

Material: one ad. ♀ from St. D5 2A collected by the "Geocosta Rio II" expedition, 25 III 1986, 60 m, sand, gravel.

Size: 4.7 mmm.

Integument breakable. Carapace with fine tubercular prominences, is longer than the pleon (Fig. 1A); it shows a deep lateral lower fold which starts near the antennal notch and goes up obliquely exceeding the middle of carapace and a lower fold which is gradually wider being confused for the groove of the lower posterior thicker side of carapace.

Frontal lobe, wide; ocular lobe with three little lens (Fig. 1B). Pleon with sharp extremities of segments — only the last ones are normal.

Antenna common to the genus (Fig. 1J) with two-articulated big flagellum and the little one hardly distinguishable.

Maxilliped I (Fig. 1C) devoid of the little distal article which is present in some species (eg. *C. bulbosa* Jones); it only shows two hairs on the inner edge and punctiform areas on the rest.

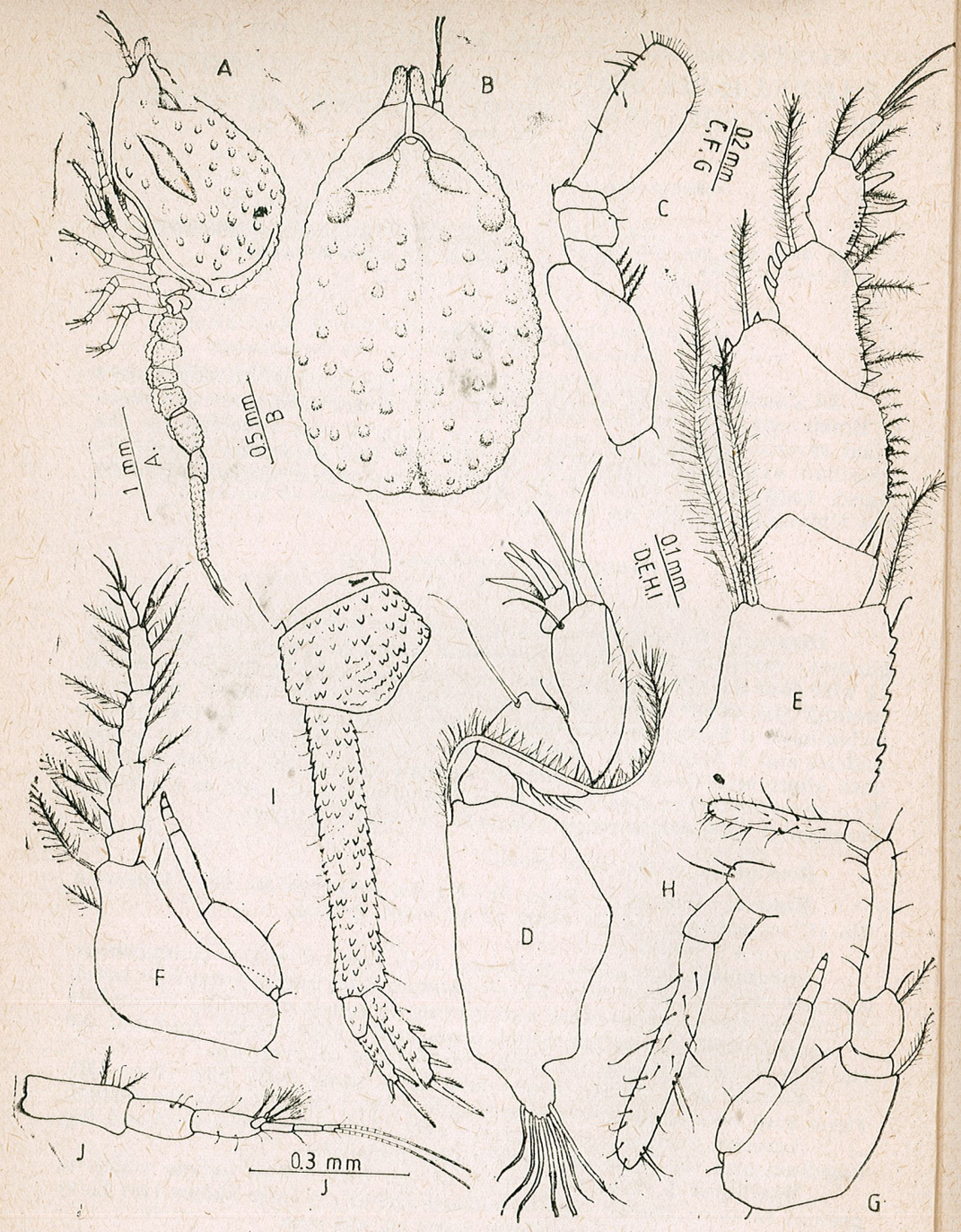

Fig. 1. — *Campylaspis brasilianus* n. sp. ♀
A, female, in lateral view; B, carapace, in tergal view; C. maxilliped I; D, maxilliped II; E, maxilliped III; F, pereopod I; G, pereopod II; H, its dactylus, magnified; I, left uropod and telson; J, antenna.

Maxilliped II (Fig. 1D) with an enormous feathered seta which starts from the median distal corner of ischio-basis, describes an "S" and ends in long barbs at the level of carpus. Stretched, this seta exceeds the rest of the articles, phanera included. Carpus with one simple seta, not two as in most *Campylaspis* species. Dactylus with four subequal spines, the spine of carpus is thick and its dorsal seta exceeds the dactylar complex of spines (Fig. 1D).

Maxilliped III armed with short and thick spines on the median edge. Carpus and merus with only several outer spines. Two short feathered setae start from the outer distal angle of the basis. (Fig. 1 E)

Pereopod I (Fig. 1F) shorter than pereopod II and shows nothing special. Pereopod II has the characteristic curvature of the terminal articles, (Fig. 1G) with cylindrical dactylus (finger-shaped), almost as long as carpus and provided with various phanera (Fig. 1H) but devoid of an apical apophysis.

Pereopods IV and V, each with one inner seta on the middle; carpus, merus and ischium, each with a short seta on the outer sides. On the long ischium four feathered setae which do not exceed in length its diameter.

On pereopods III—V, there are nine hairs on basis and dactylus is continued by a straight proximally swollen claw and a much thinner seta — parallel and equal in length; their tip is also reached by the long seta of propod.

Uropods massive (Fig. 1J); the peduncle, six times longer than their diameter, slightly exceeds in length the last two pleonites and is 2.6 times longer than its exopodite. The latter exceeds the endopodite and shows five growing spines (Fig. II).

Holotype: ♀ deposited in the Crustacean Collection of the "Grigore Antipa" Museum of Natural History under no. 737.

Derivatio nominis: the name is given after the collecting place — the southern littoral waters of Brazil.

In the same sample with *C. brasilianus* were also collected many *Leptostylis elegans n. sp.* and 2 *Diastylis geocostae n. sp.* (1)

Remarks. The dactylus of the pereopod 2-cylindrical and as long as carpus-and the long seta of ischio-basis remind of *C. tuberculata* Muradian, 1976 (3); the uropodal peduncle, short and thick, hardly longer than the rami as well as the morphology of maxilliped II remind of *C. bacescui* Muradian, 1976. The ratio between the caudal parts and the long feathered seta of the ischio-basis resemble the one in *C. bulbosa* Jones, 1974 (2).

Campylaspis antipai n. sp.
(Fig. 2A — K)

Diagnosis. Integument elastic, smooth, non-calcareous. Carapace finely reticulate with a lateral fold that starts from the base of A_2. Maxilliped II with 4 equal spines whose length is exceeded by the apical spine of propod. Pereopod 2 with dactylus of finger-shaped type, but short (not even as long as half the carpus) and with a special apical microstructure. Uropods massive; peduncle 4 times thicker than its diameter, about as long as the last two pleonites and a little longer than its endopodite.

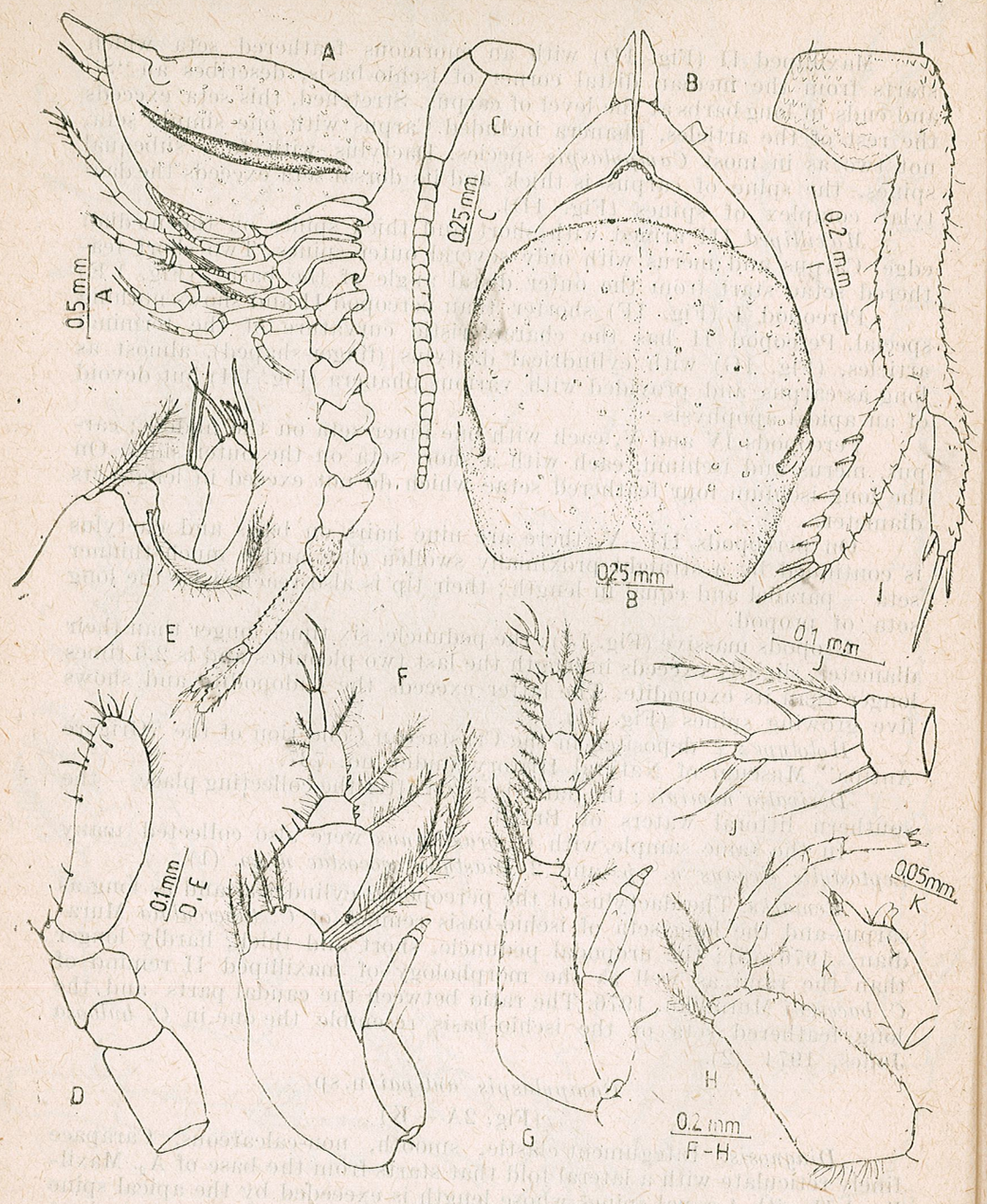

Fig. 2. — *Campylaspis antipai* n. sp. ♂
A, male, in lateral view ; B, carapace, in tergal view ; C, antennule ; D, maxilliped I ; E, maxilliped II ; F, maxilliped III ; G, pereopod I ; H, pereopod II ; I, right uropod and telson ; J, dactylus of pereopod I, magnified ; K, dactylus of pereopod II, magnified.

Material : one p♂ of 2.6 mm from St. D2 3A, 40m, 25 III 1986, from sandy bottom.

Description of the semi-adult male

Integument elastic, non-calcareous. Carapace finely reticulate, a bit shorter than pleon ; it shows (Fig. 2A) a lateral fold (sulcus) which starts at the level of the antennal insertion and goes up obliquely growing deeper so that in frontal and ventral view the carapace seems to be slightly strangled towards its middle, but in tergal view, the extremities of sulci are hardly seen (Fig. 2B). Optic lobe small and poorly marked. Antenna of common type, with two-articulated big flagellum, with short aesthetascs and one-articulated little flagellum. Antennule (Fig. 2C) is typical of the developing male.

Maxilliped I as in Fig. 2D, without apical apophysis. Maxilliped II with four more or less equal dactylar spines which are much exceeded by the thick propodal spine and by the seta which starts from the side of propod. Carpus with two long naked setae common to the genus. Merus with a curved feathered seta ; ischio-basis with a straight feathered seta (Fig. 2E). Maxilliped III common to the genus (Fig. 2F) ; worth mentioning are only the two strong feathered setae that start from the distal median angle of ischio-basis, one of them reaching the level of dactylus.

Pereopod I, almost as long as the second one, armed with many feathered setae with long barbs on the outer side of the articles and only simple setae on their median side, except for two feathered setae on the median angle of ischio-basis (Fig. 2G ; dactylus Fig. 2 J).

Pereopod II also with finger-shaped dactylus which does not reach even half the length of the article ; it is only a bit longer than the propod and the special morphology of the apex makes dactylus seem broken. In fact, it ends in an elongate and sharp outer part which bears two tiny spines and a short one provided with even shorter spinules and a weak apophysis. For the rest of phanerotaxy, see Fig. 2H and K.

Pereopod III and IV show incompletely developed exopodites (still embrionary—juv.♂) ; in exchange, the exopodites of anterior pereopods and those of maxilliped III are well developed, each with three feathered setae as long as the whole endopodite.

Uropods thick, massive, with little hairs on the median side and a slight serration all over ; peduncle, 4 times longer than thicker, exceeding a little the length of the last two pleonites taken together ; it is only a little longer than its endopodite and is naked (ratio 8 : 6). Exopodite shorter, but relatively wide. Endopodite with 7 inner spines which gradually grow up to the apical one (Fig. 2 I).

Holotype : ♂ deposited in the Crustacean Collection of the "Grigore Antipa" Museum of Natural History under no. 788.

Derivatio nominis : the species is dedicated to the memory of the great Romanian hydrobiologist Grigore Antipa who organized and for 50 years led the Museum which bears his name.

Remarks. Maxilliped II with moderately long ischio-basis and an enormous apical feathered seta which exceeds in length the rest of segments. It might be only compared to *C. aculeata* Jones or to *C. bulbosa*

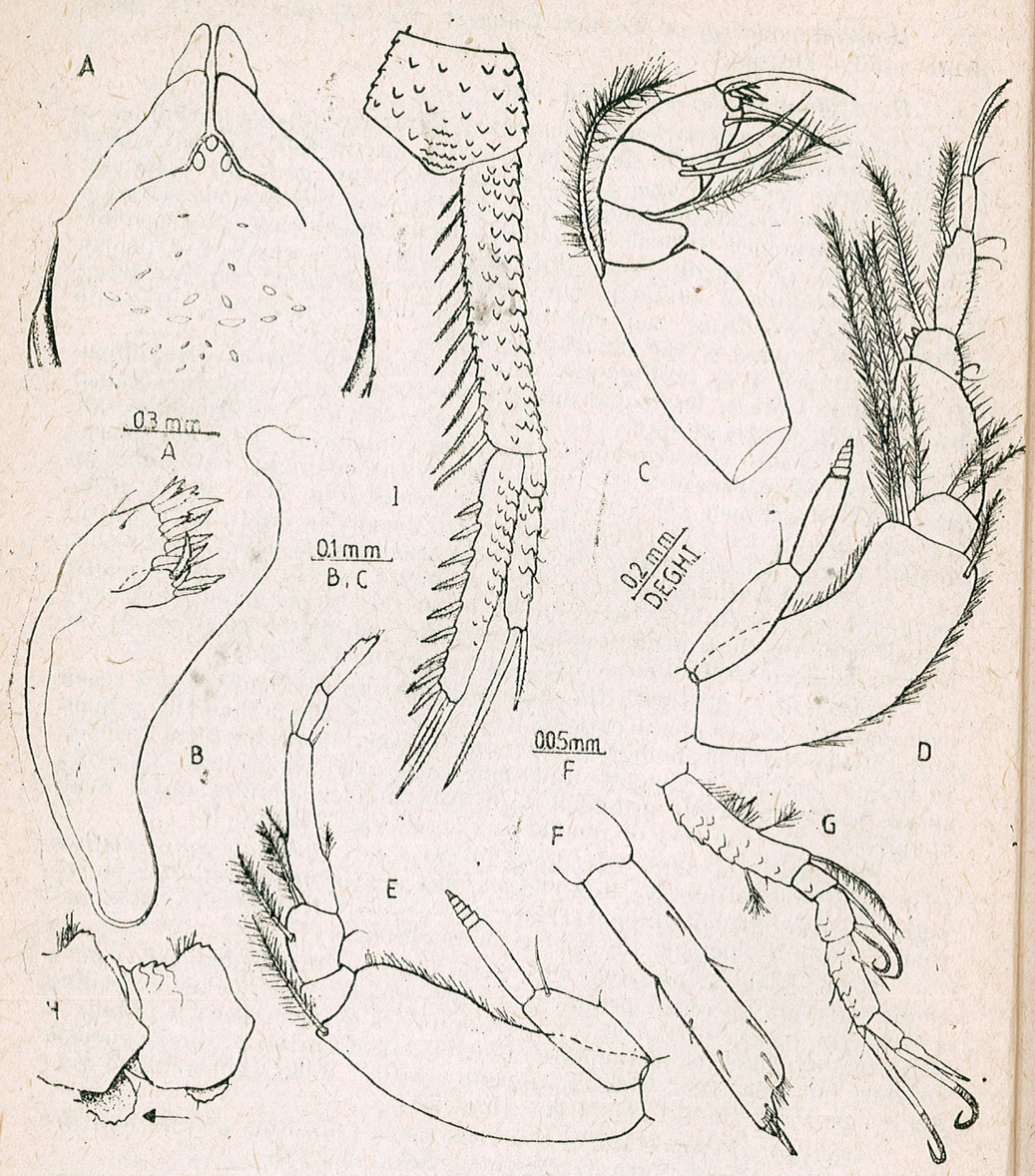

Fig. 3. — *Campylaspis holthuisi* n. sp. ♂

A, carapace, in tergal view; B, maxilla I; C, maxilliped II; D, maxilliped III E, pereopod II; F, its dactylus, magnified; G, pereopod IV; H, first two pleonites, in lateral view; the arrow indicates the medio-sternal apophysis of the first pleonite; I, uropod and last pleonite.

Jones (4). Few species show such a wide uropodal endopodite like the one of *C. antipai* and a peduncle 4 times thicker than its diameter.

Both *C. brasilianus* and *C. antipai* belong to the group of the species with a short and thick uropodal peduncle and with a finger-shaped dactylus on pereopod II; the same applies to *C. holthuisi*.

Campylaspis holthuisi n. sp.
(Fig. 3A — 1)

Diagnosis. Cumacean belonging to the group of the previous species, that is with dactylus of pereopod 2 twice shorter than carpal article and with a special microstructure of apex. Maxilliped II with a short feathered seta on median apex and one on merus; only two little dactylar spines, 3—4 times shorter than the long apical spines of propod. The base of uropod, as long as the last three pleonites taken together, is much finer (6 times its diameter) and 1/3 longer than its endopodite Maxilla II with one flagellum which is more than twice longer than its base.

Holotype: ad. ♂ ibid no 789.

Derivatio nominis: Dedicated to the distinguished Dutch Carcinologist, Prof. L. B. Holthuis.

Campylaspis holthuisi are collected in station E 1, 1 A, 60 m.

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Received May 19, 1989

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ON THE PRESUMED COMPATIBILITY BETWEEN VICARIANCE BIOGEOGRAPHY AND HOLOGENESIS AND THE SIGNIFICANCE OF "DISPERSION" VERSUS DISPERSAL

PETRU M. BĂNĂRESCU

It is unjustified to try to couple Rosa's old theory of hologenesis, based on the erroneous belief that species split automatically, within their whole ranges (even if disjunct) into two daughter species with sympatric ranges, with vicariance biogeography, that starts from the fact that speciation is usually a consequence of geographical isolation, sister species having initially vicariant ranges. The term "dispersion", i.e. the moving of individuals within the established range of the species has a different significance than dispersal (range extension) only if the range is continuous, not interrupted by barriers.

In his major works (4, 5), Croizat as well as the leading proponents of vicariance biogeography (6, 7, etc.) assert that their biogeographical conceptions bear similarity with Rosa's (9, 10) theory of hologenesis and consider Rosa a forerunner of their own ideas.

Actually, vicariance biogeography and hologenesis share a single common viewpoint: that ranges of species and of lineages become gradually smaller. This is but a minor similarity. Much more important is the manner in which the two biogeographical schools explain the relations between ancestral and descendant species.

Croiziatians and vicariance biogeographers start from the undisputable fact that speciation normally is, at least in biparental organisms, a consequence of the appearance of a discontinuity in the range of the mother species (a barrier, wide-scale extinction, etc.) that interrupts the gene-flow and determines divergent evolution of the isolated populations or groups of populations. This opinion is fully consistent with the achievements of population genetics and with the synthetic theory of evolution, in spite of the fact that many of the founders of this theory (G. G. Simpson, E. Mayr etc.) are dubbed "dispersalists" by croizatians and by vicariance biogeographers. Actually, proponents of the dispersal biogeography school emphasize the importance of geographical isolation and the evolutionary significance of vicariant species, too, differing from vicariance biogeographers only by accepting that geographical isolation is often the consequence of dispersal across a preexisting barrier, or that barriers often isolate colonies from recently occupied areas, etc.

Just on the contrary, Rosa's hologenesis theory is based on the quite strange opinion, not supported by any facts, that speciation is a consequence of some misterious inner factors, which determine an instantaneous splitting of the mother species within its whole range into two daughter species. Has the mother species a disjunct range, does each of the daughter species inherit the same range? Rosa cleary asserts this on p. 290 of the French translation (10) of his book first printed in Italian (9): "Donc pour nous chaque espèce a nécessairement apparu sur toute

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l'étendue de l'aire qui était occupée par son espèce-mère et cette aire pouvait être treès vaste et même largement discontinue". Two sister species have, in the light of both vicariance and dispersalist biogeography allopatric (vicariant) range ; partial or total sympatry obligatorily results from the later range extension (dispersal). In the light of hologenesis, the ranges of two sister species are, from the very beginning, totally sympatric.

The distribution pattern of any large lineage results, according to vicariance biogeographers, from the successive appearance of barriers which split the wide range of the ancestral species, followed by partial range extensions (after the disappearance of barriers) and by local extinctions. According to dispersalists, the phenomena are more complex, successive appearances and disappearance of barriers alternate rather rapidly, the general range of the lineages normally increases, crossing of barriers often takes place, extinctions play an important role.

But how could one explain the complex distribution patterns of the members of any lineage in the light of hologenesis ? If each daughter species automatically inherits the range of its mother species (either continuous or disjunct), the only phenomenon which may modify the ancestral range is extinction from a part of this range (and eventually local range extension). In the absence of extinctions, all members of a monophyletic lineage would have wholly sympatric ranges. It is especially difficult to explain, accepting the theory of hologenesis, the very frequent cases of closely related species, having totally vicariant ranges. Let us consider that the ancestral species of a lineage, A, has a disjunct range, encompassing two distinct and distant areas, a and b. At a

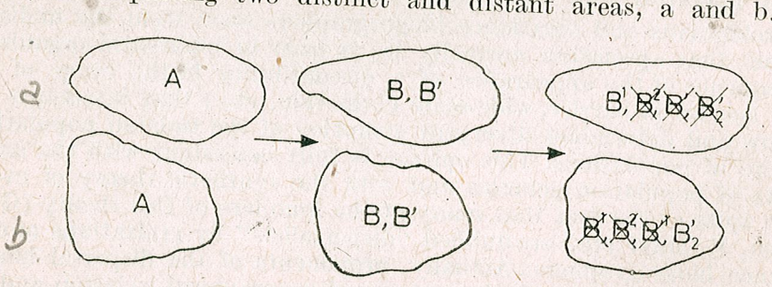

Fig. 1. — Schematic represenation of the only possible manner to explain the origin of allopatry of two related species in the light of hologenesis : a, b = disjunct parts of range of the ancestral species and of the descendant ones ; A — ancestral (mother) species ; B, B′ = descendant species of the first generation (daughters of A) ; B^1, B^2, B'^1, B'^2 = descendant species of the second generation. Note that three extinctions in each part of the disjunct range are necessary in order to produce allopatry (vicariism).

certain moment A splits into two daughter species, B and B′, each inheriting the same range (a & b). In the next step, B splits into B^1 and B^2 and B′ in B'^1 and B'^2. Each of them must inherit, according to Rosa, the disjunct range (a & b). The only possibility to get vicariant ranges would be the extinction of three of them from range a and the survival of a single one (say B^1) and the survival of another species (say B'^2) accompanied by the extinction of the three others in area b (Fig. 1). Could one

accept that such a complex phenomenon often takes place in nature? Accepting hologenesis this phenomenon offers the only possible explanation of the very numerous cases of sister species with vicariant ranges.

Populations genetics was inexistent in 1918 when Rosa wrote his book (9), and very little was known about speciation mechanisms ; Rosa is justified in having emitted his theory. It is on the contrary unjustified to resurrect itin the 1960s and 1970s and to try to couple a theory strictly based on the exclusive acceptance of sympatric speciation with one based primarily on allopatric speciation.

It is curious to note that vicarianists are more concerned in denying or at least minimizing the biogeographical role of dispersal than in emphasizing the primordial importance of geographical isolation in speciation. Croizat (4, 5) criticizes or ridiculizes Mayr's "double colonizations" — which are among the more serious arguments in favour of the role of geographical isolation in speciation, as well as the circular overlap without interbreeding of the extreme members of a continuous chain of intergrading subspecies (the case of *Parus major/cinereus/minor*) — another beautiful example of geographical speciation. On the contrary, he more or less endorses Rosa's hologenesis that is totally incompatible with geographical speciation and mentions Bouvier's (3) work on **Atyidae** as worth consideration. Bouvier's classification is far from being phyletic : he asserts that several extant genera derive from *Xiphocaris* (another extant genus), that various species of *Ortmannia* and of *Atya* originated from distinct species of *Caridina*. No biogeographical conclusions can evidently be based on such non-plyletic systematics.

Another example how denial of dispersal finally leads to denial of geographical speciation and acceptance of sympatric speciation is offered by the papers of Balon et al. (1) who record for the first time the occurrence of the fish *Gobio albipinnatus* in the upper Danube basin. Balon et al. do not claim any adherence to the vicariance biogeography school, but express an opinion similar to that of extreme vicarianists who oppose any acceptance of dispersal. They suggest that the *G. albipinnatus* population of the upper Danube did not originate through upstream dispersal from the basin of the middle and lower Danube (where the species actually is much more frequent than in the upper reach of the river), but originated in situ (sympatrically) from the population of *G. gobio*. It is worth mentioning not only that there is no barrier between the upper, middle and lower Danube preventing the free movement of specimens, but also that *G. albipinnatus* is not endemic to the basin of the Danube, being present also in the basins of the Dnjester, Dnjeper, Don, Volga, Vistule rivers and in lake Ilmen (2). And it is not very closely related to *G. gobio*, its presumed "ancestor" according to Balon et al. ; its closest relative is *G. kessleri*, a species present in the basins of the Danube, Dnjester, Vistule and Vardar rivers (in the three former it lives sympatrically, but in a large measure not syntopically with *G. albipinnatus*). Other close relatives inhabit eastern Tanscaucasia and the north of East Asia (2) ; *G. gobio* is more distantly related to this group of species. If *G. albipinnatus* originated in the upper Danube basin through sympatric speciation from *G. gobio*, did it originate in the same manner in

the middle and the lower reach of the same river and in the six other river basins in which it lives? Can the same species have originated in at least nine distinct areas from the same ancestor that is not its closest relative? By refusing to accept any dispersal, one become sforced to adopt such absurd explanations.

Trying to deny or to minimize the biogeographical significance of dispersal, Platnick (8), one of the leaders of the vicariance biogeography school, restricts this term to the spread of a taxon "from its previous established range to a different range", i.e. to range extension. He proposed the alternative term "dispersion" for the "property of individuals ... to spread from their place or origin to other locality", i.e. the movement of individuals within the established range of the species, including recolonization of localities in which the species had initially lived and later disappeared. He exemplified this distinction with the case of the Krakatau island that was recolonized after the 1883 volcanic explosion by species which had been present on the island, prior to the explosion and the coloninzation of the recently emerged Surtsey island by species present in the surrounding islands.

Actually, "dispersion" has another biogeographical significance, viz, that of dispersal, only if the established range is continuous, not interrupted by barriers. The example of the Krakatau island is not to the point. Prior to the volcanic explosion the island was inhabited by numerous species of animals and plants present also in Sumatera, Jawa, etc. and other islands of western Indonesia; the apparently continuous ranges were actually interrupted by the numerous sea arms separating these islands. And how did the species become established in all these island? There were two possibilities: (1) during the sea-level lowerings in the glacial periods of the Quaternary, when all the islands of the Sonda shelf were confluent with one another and with the Indo-Chinese mainland (the vicariance model); (2) in the present-day geographical conditions, by crossing the water barriers between the various islands (the dispersal model). The species which colonized Krakatau after the volcanic explosion proved to be able of trans-marine dispersal; if they could cross the water barriers after 1883, they were able to do it also before that year and their older occurrence in the various Indonesian islands can be a consequence of trans-marine dispersal. If, on the contrary, certain species had been formerly present in Krakatau and did not yet recolonize the island, one is justified in considering them unable of trans-marine dispersal and they former occurrence proves that they were relicts at least from the last (Würm) connection of the Indonesian islands with the mainland.

Numerous species of primary freshwater fishes, crayfishes, unionacean mussels and large-sized prosobranciates, unable of active or passive dispersal through salt water or by land, are present in the drainage areas of several river basins on the same continent. Their ranges seem, when plotted on a map, to be continuous; actually, however, they are disjunct, being interrupted by the watersheds between the river basins, which, even if very narrow, are uncrossable barriers for these animal groups. The occurrence of the same species in two or more river basins proves that the species were extant and present in the area before the establishment of the present hydrography, i.e. that after the establishment of the species the riverine net has been modified through river captures, confluences of the lower reaches, etc., allowing the spread of the species in rivers which belong now to distinct drainage basins.

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Received May 18, 1989

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LE PROBLÈME DE LA SPÉCIATION COMME RÉSULTAT DU CROISEMENT DE CERTAINES ESPÈCES DU GENRE *ALOPIA* (FAMILLE *CLAUSILIIDAE*, *GASTROPODA*, *PULMONATA*)

ALEXANDRU V. GROSSU

The paper enumerates some changes in the gastropod shell, torsion, noticed at certain species both in nature and in laboratory which can raise for discussion the existence of amphidromia. But these are presented as sporadical appearances and do not lead to the formation of new species. The author insists on some observations from nature and laboratory experiments, when some dextral and senestral species of the *Alopia* genus can interbreed among them creating bastards which can subsequently become half-species or sub-species — therefore a speciation phenomenon. The author insisted on these interbreedings and on bastard creation as there were some contrary opinions concerning this problem as well.

Selon la conception actuelle, l'espèce représente une formation surindividuelle, donc une population, à certains caractères morphologiques, pshysiologiques et biochimiques communs ; c'est une unité génotypique à un certain métabolisme, capable de se conserver pendant le processus de reproduction et par l'accouplement il en résulte des descendants fertiles avec le même aspect. Pourtant, à cause de certaines modifications du milieu ou par l'isolement géographique, souvent, une partie de la population qui forme une espèce peut recevoir de nouveaux caractères en créant ainsi des sous-espèces ; celles-ci peuvent devenir de nouvelles espèces par l'accentuation de certains aspects morpho-physiologique et par la selection. C'est le processus de la spéciation qui a conduit à l'explication de l'origine et de l'évolution des êtres vivants. Mais celui-ci n'est pas le seul phénomène qui se trouve à l'origine des espèces.

On sait déjà que toute espèce a une certaine aire géographique. A la limite de cette aire, dans les zones de tangence avec les espèces allopatriques, mais aussi chez quelques espèces simpatriques, on peut trouver des croisements entre les espèces appartenant parfois même à des genres différents, soit des plantes, soit des animaux, ayant comme résultat des hybrides ou des bâtards. D'habitude ceux-ci vont avoir des caractères des deux parents, mais parfois des caractères dominants d'un seul parent. Les nouvelles formes apparues sont capables de s'adapter spécialement au milieu, en obtenant de nouveaux caractères et formant des populations spéciales, donc de nouvelles espèces en cours de transformation, nommées des *formes spécifiques latentes* selon l'expression de Zavadski (13). Les individus résultés peuvent se croiser fertilement entre eux s'avérant complètement stériles avec les deux formes parentales d'où ils proviennent. Selon l'affirmation de Zavadski, on a obtenu de telles formes constantes aussi expérimentalement, à savoir des formes autoreproductrices. On peut conclure donc que la spéciation peut être obtenue à la suite de croisements d'espèces différentes et sur ce problème nous allons faire quelques considérations.

A partir de ces affirmations à caractère général, nous allons comprendre les croisements qui ont lieu en nature, vérifiés et expérimentés

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en laboratoire, concernant le comportement de certaines epèces du genre *Alopia* H. et A. Adams 1855. Les espèces de ce genre sont répandues dans les Carpates Roumaines ; elles ont a coquille à torsion dextre et senestre, sont isolées du point du vue géographique, mais on peut les trouver rarement ensemble. Quelques-uns de nos travaux (3—4) ont montré que cette torsion a généré de nombreuses discussions contradictoires. E. A. Bielz, S. Clessin et A. J. Wagner ont considéré dans leurs études que certaines espèces peuvent avoir la coquille tant dextre que senestre, donc amphidromique. La plupart des spécialistes tout de même, parmi lesquels E. A. Rossmässler, J. Charpentier, A. Schmidt, O. Boettger, M. Kimakowicz, L. Soós et beaucoup d'autres, au contraire, ont considéré les formes dextres et celles senestres comme appartenant à des espèces différentes.

Après observation et détermination des espèces, des caractères conchyliologiques, anatomiques et biochimiques (4—6), tout comme après les observations en nature et les expériences de laboratoire faites par M. I. Szekeres (12) et H. Nordsieck (9), on a constaté que vraiment il y a deux catégories d'espèces, les unes dextres, les autres senestres, à distribution déterminée bien géographique et avec un contenu ou présence riches et divers dans les Carpates. Ce problème était considéré définitivement solutionné, bien documenté et accepté par les spécialistes. Il y a pourtant une étude écrite par Dochița Lupu et Maria Blujdea (7) qui apporte quelques hypothèses opposées, contraires, conservant l'origine et l'évolution des espèces du genre *Alopia*. Ces auteurs arrivent à la conclusion qu'aujourd'hui il n'y a que des espèces provenues des formes ancestrales et admettent aussi leur amphidromie. Ces auteurs sont à leur unique et premier travail sur le groupe des Clasiliidés ; elles abordent un problème très difficile de phylogénie prouvant ne pas connaître les espèces de ce genre ; elles font de nombreuses erreurs et leur arguments sont complètement non fondés.

Le problème de l'amphidromies non seulement chez le genre *Alopia*, a préoccupé pourtant certains chercheurs et on est arrivé à des résultats très intéressants ; on sait, par exemple, que chez de nombreuses espèces, dans une population homogène, il peut apparaître des exemplaires à torsion inverse, soit chez les formes aquatiques, soit chez les formes terrestres. De telles apparitions sont rares pourtant sporadiques, et on ne connaît pas encore les causes qui les déterminent. A. Franc, dans le Traité de Zoologie P. P. Grassé (1968), cite plusieures observations et expériences faites par de nombreux spécialistes sur le problème de l'amphidromie. Cette torsion inverse de la coquille apparaît aussi chez les espèces élevées en laboratoire. Ainsi — un cas parmi beaucoup d'autres (N. Botnariuc, Al. Negrea et Șt. Negrea) (12), observant dans un aquarium l'espèce *Fagotia esperi* Fér. (dextre) ont signalé l'apparition de certaines formes senestres. Ainsi, la population présente les deux formes, sans autres modifications de la coquille, comme dimension, couleur, ou ornementation. D'une valeur particulière sont également les observations et les expériences génétiques faites par Ed. Degner (1) sur *Laciniaria biplicata* Mtg. (= *Balea biplicata*), senestre, élevée dans un terrarium. Il a constaté qu'à l'intérieur de la population apparaissent des exemplaires

à torsion inverse. En étudiant ensuite les deux catégories de formes, il observe le croisement des formes dextres avec celles senetres sans aucune difficulté, les descendants ayant toutes les deux formes de torsion, en certains pourcentages. Degner a démontré donc qu'au laboratoire peuvent apparaître des formes à torsion inverse et que ces formes peuvent se croiser, donnant des descendants. On a constaté aussi que, bien qu'à torsion inverse, les animaux n'ont pas d'autres caractères différents.

L'apparition dans une popula'ion, soit en nature, soit en laboratoire, de certains exemplaires à torsion inverse et la possibilité du croisement de ceux-ci conduiraient certainement à la possibilité de l'existence des formes amphidromiques. Mais ces apparitions sporadiques, spontanées ne forment pas de populations homogènes ; elles représentent des ébranlements de l'hérédité seulement chez certains individus et il ne s'agit pas de l'existence de nouvelles espèces. Quant aux espèces du genre *Alopia*, il s'agit d'un aspect particulièrement différent qui conduit au phénomène de spéciation. Pour expliquer et comprendre ce phénomène, on va partir de certaines observations faites en nature et puis en laboratoire.

Dès 1936, nous avons collecté du massif Bucegi, de la vallée de la Ialomița, à Cheile Tătarului, certains exemplaires du genre *Alopia* à caractères particuliers, variés, non stables. Ici on rencontre les aires de distribution géographique de deux espèces bien connues : *Alopia straminicollis* Charp. (senestre) et *Alopia livida* Menke (dextre). Elles diffèrent beaucoup, non seulement par la torsion, mais aussi par d'autre caractères conchylilogiques et anatomiques. Ainsi, *A. straminicollis* a le clausilium et une armature aperturale complexe, pendant que chez *A. livida* le clausilium est absent et la dentition de l'ouverture est beaucoup simplifiée, avec les plis palataux absents (Fig. 1). Il y a aussi certaines différences de l'appareil génital, représentées par le prolongement différent du vagin, du vas deferens et du réceptacle séminal (Fig. 2). Mais, à part ces espèces avec une aire géographique et des caractères bien établis, constants, on a collecté de la même place des exemplaires senestres, chez lesquels l'armature de l'ouverture était beaucoup simplifiée, ayant seulement 1—2 plis palataux variés comme dimension, à clausilium réduit, atrophié ou même absent. R. Kimakowicz (11) a décrit ces formes comme une sous-espèce indépendante, nommée *Alopia straminicollis tumida*. Personnellement, nous n'avons pas accepté l'existence de celle-ci (3) car les exemplaires que nous avons collectés présentaient une grande variation, tant au clausilium qu'aux plis palataux, variation reconnue aussi par Kimakowicz dans sa description. L'apparition de ces formes en nature à caractères non stabilisés est, selon notre opinion, le résultat d'un possible croisement, au contact de deux espèces. Mais cette hypothèse n'avait aucune base expérimentale. Pour la première fois M. I. Szekeres (12) confirme, à partir de certaines observations répétées en laboratoire, que ces espèces dextres et senestres, collectées de la zone respective peuvent se croiser entre elles donnant des bâtards à caractères particuliers. Plus tard, H. Nordsieck (9) a repris ces expériences et observations en laboratoire, concernant la possibilité de la bâtardisation des même espèces.

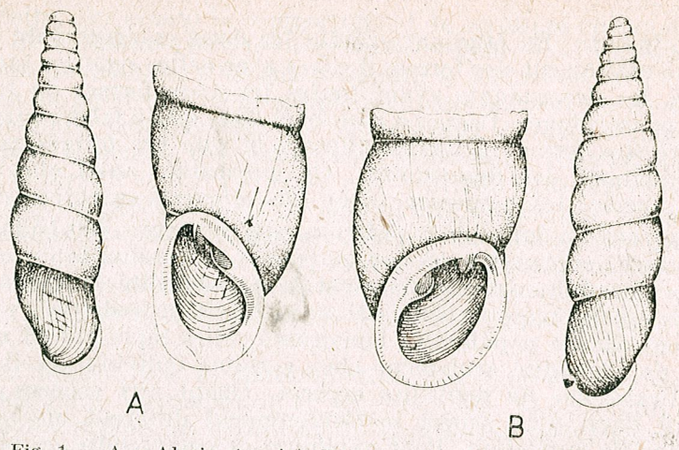

Fig. 1. — A = Alopia straminicollis monacha Kimakowicz; B = Alopia livida livida Menke (la coquille entière et le dernier tour avec l'aperture).

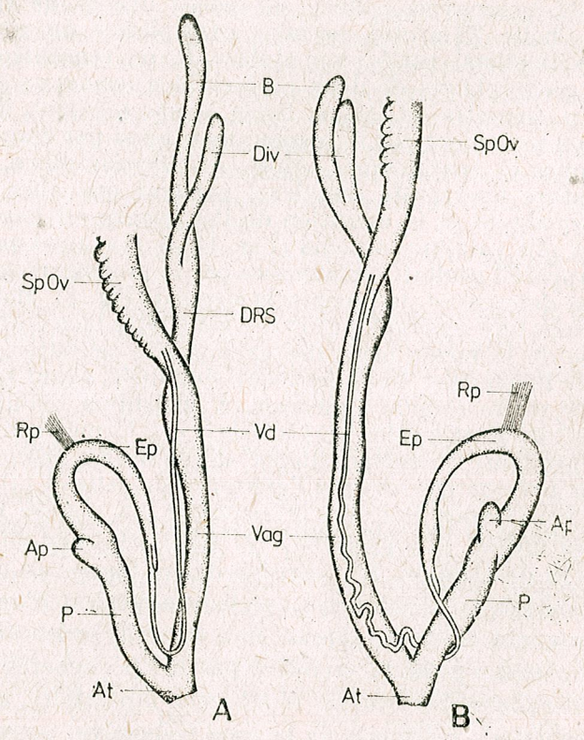

Fig. 2. — Appareil génital de: A = Alopia livida livida Menke; B = Alopia straminicollis monacha Kimakowicz. Ap = apendix du pénis; At = atrium; B = bursa; Div. = diverticulum; P = pénis; DRS = ductus réceptaculum seminis; Ep = épiphalus; Rp = retractor pénis; SpOv = = spermoviduct; Vag = vagina; Vd = vas deferens.

H. Nordsieck (9) a étudié non seulement la possibilité du croisement de ces deux espèces *(Alopia straminicollis* et *Alopia livida)*, mais aussi d'autres espèces. Bientôt, Nordsieck (10), reprenant ce probleme, a constaté l'existence des croisemente entre les espèces *Alopia helenae* et *Alopia canescens mauritii* et il décrit même une nouvelle sous-espèce : *Alopia helenae interjecta*, qu'il considère comme un résultat et descendant de la bâtadisation, la première dextre avec clausilium et plis palataux, la deuxième senestre, sans ces caractères. Donc la bâtardisation peut conduire à l'établissement de certains caractères mixtes et à l'apparition des sous-espèces.

Nous jugeons utile une analyse plus attentive des résultats de Nordsieck (1978) et nous allons citer quelques-unes de ses affirmations : « Szekeres stellt mit Rechtfest, dass es zwischen des linksgewunden (= L — Form) *straminicollis* Charpentier und rechtsgewunden (=R Form) *livida* Menke an verschiedenen Stellen der Bucegi-Gebierge Bastardformen gibt, die sich dank der beträchtlichen Unterschiede bei der Formen in der Ausbildung des Clausiliars leicht nachweissen lassen. Das Auftreten von Bastardformen ist nach meinen Untersuchungen bei weiteren L—R— Paren zu beobachten, z.B. von Piatra Craiului *(glorifica* Charpentier-*lischkeana* Charpentier) und in Ciucaș *(canescens* Charpentier-*nefasta* Kimakowicz) ». H. Nordsieck montre ses observations in terrariums spécialement construits, dans des conditions optimales. Dans ces terrariums on a mis des espèces différentes, dextres et senestres, dans l'un d'eux *A. straminicollis* et *livida* et dans l'autre *A. canescens* et *A. helenae*; on a observé leur comportement pendant sept mois. Voilà ce que Nordsieck dit : « Kopulationen der Tiere wurde mehrfach beobachtet ... Am 31.XII ein Pärchen *canescens-helenae*, und am 18.II ein weiteres dieser Arten. Der Verlauf der Kopulationen unterschied sich, soweit erkennbar, nicht von der normalen. Degner (1) bewies bereits, dass L- und R Individuen von *Balea biplicata* kopulieren können ».

A la suite de ces expériences faites par Szekeres et Nordsieck nous nous sommes expliqué l'existence des formes d'*Alopia* que nous avons rencontrées en nature, présentes dans notre collection et que nous n'avons pas considérées comme des espèces ou sous-espèces. Donc nous avons accepté le phénomène de la bâtardisation comme possible en nature, prouvé expérimentalement, et nous avons introduit dans un de nos derniers travaux (4) l'existence des bâtards. Nous avons insisté sur ces expériences et observations en nature, car il y a certaines opinions contraires. Dochița Lupu (8) n'est pas d'accord avec ces résultats et veut soutenir ses affirmations dans un style polémique, non scientifique. Voilà quelques passages cités de son étude : « Nous nous demandons si, avant d'adopter cette interprétation, l'auteur ...(ici il s'agit de l'étude de 1981 de Al. V. Grossu) ... s'est posé la question si l'accouplement des formes dextres avec les formes senestres est possible sous l'aspect mécanique? Est-ce que l'accouplement est possible entre deux individus qui ont l'orifice génital l'un du côté droit et l'autre du côté gauche, même s'il appartiennent à la même espèce? ». Puis Dochița Lupu dit, très convaincante : « si l'auteur avait poursuivi dans la nature le mécanisme de l'accouplement chez la Gastropodes terrestres, il n'aurait pas émis l'hypothèse de la bâtardision chez *Alopia*, qui ne peut être une réalité. L'affirmation que le phé-

nomène de la bâtardisation aurait été observé en nature et en laboratoire est injuste ... On sait qu'on a fait des tentatives d'accouplement des *Alopia* dans le laboratoire, mais sans résultat ».

A toutes ces questions et affirmations si catégoriques il y avait déjà une réponse dès 1952, donnée par Degner (1) à *Balea biplicata*, et plus tard par Szekeres (12) et Nordsieck (10) qui avaient prouvé la possibilité de croisement entre les espèces dextres et senestres par des observations et des expériences répétées en laboratoire ; bien que dans notre travail (4) on ait indiqué les auteurs et les travaux qui ont été à la base de l'acceptation de la bâtardisation soient tout à fait d'accord avec nos observations faites en nature, Dochița Lupu n'en dit rien, faisant la preuve d'un total manque d'informations et d'exactitude scientifique, soutenant des affirmations erronées sans aucune documentation ou observation personnelle, surtout lorsque cette littérature était à sa disposition pour consultation.

Ce processus de croisement entre espèces différentes, selon certains auteurs est souvent rencontré en nature, les descendants recevant des caractères doubles. Nordsieck leur a donné le nom de sémi-espèces parentales, ou formes spécifiques latentes — c'est-à-dire des espèces en cours de développement selon l'expression de Zavadski (13). H. Nordsieck (10) dit : « ob solche Semispecies als subspecies einzutreffen sind, hängt u.a. vom Umfang der Bastardierung, also des Genfluss ab ». C'est une spéciation lorsque ces formes intermédiaires, les bâtards, restent avec des caractères constants et deviennent des sous-espèces et, ultérieurement, des espèces indépendantes. Il ne s'agit pas de cas isolés ou d'apparitions sporadiques, mais de la formation de certaines populations plus ou moins compactes, qui occupent certaines zones géographiques bien établies.

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Reçu le 19 mai 1989

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SIMILARITY OF COLLEMBOLA FROM SOME MOUNTAIN FOREST ECOSYSTEMS

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Six sites in the Bucegi, Gîrbova and Retezat Mountains have been studied during a two-year period. Species similarity has been established using three procedures : comparison of means and their standard errors, Jaccard index of similarity and Mountford cluster. It was established that similarity of Collembola is related, among other factors, to the structure of the tree and the herbaceus layers as well as to the type of soil. The location of the mountains studied in different parts of the country has its significant influence on the structural organization of Collembola populations.

Our investigations of the ecology of Collembola have raised the problem of studying species similarity from three different types of mountains. Since the differences between these mountains consist, among others, in plant associations, we have tried to find out certain characteristics of species similarity in Collembola, depending on plant associations and type of soils.

MATERIAL AND METHODS

Six sampling sites were selected as follows : Gîrbova Mountain (I-ecosystem with vegetal association Abietum dacicum, soil pH — 6.8, 800 meters altitude) ; Bucegi Mountains, two sites (II-ecosystem with vegetal association Abieto-Fagetum, soil pH = 6.1, 910 meters altitude ; III — ecosystem with vegetal association Fagetum dacicum, soil pH = = 5.4, 1290 meters altitude) ; Retezat Mountains, three sites (IV-ecosystem with vegetal association Festuco (drymeae)-Fagetum, soil pH = 4.5, 850 meters altitude ; V-ecosystem with vegetal association Piceetum carpaticum, soil pH = 3.5 — 4.4, 1250 meters altitude ; VI-ecosystem with vegetal association Pinetum mugi carpaticum, soil pH = 3.8, 1800 meters altitude.

A study area of 1250 square meters (50/25 meters) was sampled in each site, from April to November. Eight samples were taken at random from each site, from litter and humus. The surface area of the sample unit was 33 square centimeters.

As a method for the extraction of Collembola, a Tullgren funnel was modified, with a set of 60 V lights installed at the upper surface of the sample units. The period of extraction was a week.

Based on the theoretical frequences of the species *Folsomia quadrioculata*, the most representative species in all the sites studied, the spatial distribution of Collembola, according to a binomial negative model was established.

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RESULTS

Taking into account the means and their standard errors of the two most representative species in all the sites studied, *Folsomia quadrioculata* and *Onychiurus armatus* (Table 1), all six sites were compared. Analysing the significance of the difference between the mean numbers of these two species, by using the "t" test, the sites which are different and which are similar, at a certain level of similarity were established.

Table 1

The differences between the means and their standard errors for the species *Folsomia quadrioculata* and *Onychiurus armatus*

	AD	AF	FD	F(d)F	Pc
Folsomia quadrioculata (1)	3.27±3.41 0.2	3.89±3.37 0.2	4.09±3.34 0.2	3.86±3.38 0.2	11.49±4.83 0.01 P_{mc}
		2.96±1.93 0.1	1.09±1.8 0.5	1.9 ±1.9 0.2	14.76±3.96 0.001 AD
			1.87±1.8 0.2	1.06±1.8 0.5	11.8 ±3.92 0.001 AF
				0.81±1.8 0.5	13.67±3.89 0.001 FD
					12.86±3.93 0.001 F(d)F

	AD	AF	FD	F(d)F	Pc
Folsomia quadrioculata (2)	9.26±2.94 0.001	5.1 ±3.01 0.05	0.39±3.17 0.5	7.38±3.35 0.025	17.43±4.8 0.001 P_{mc}
		4.16±1.77 0.01	8.87±2.02 0.001	16.6±2.3 0.001	26.69±4.13 0.001 AD
			4.71±2.14 0.025	12.48±2.39 0.001	22.53±4.18 0.001 AF
				7.77±2.59 0.001	17.82±4.3 0.001 FD
					10.05±4.43 0.01 F(d)F

	AD	AF	FD	F(d)DF	Pc
Onychiurus armatus (1)	3.2±2.37 0.1	3.81±2.33 0.1	3.64±2.38 0.1	1.95±2.43 0.5	8.8±3.47 0.01 P_{mc}
		0.61±0.79 0.4	0.44±0.91 0.5	1.25±1.04 0.2	12 ±2.69 0.001 AD
			0.17±0.8 0.5	1.86±0.94 0.025	12.61±2.65 0.001 AF
				1.69±1.05 0.1	12.44±2.69 0.001 FD
					10.75±2.74 0.001 F(d)F

	AD	AF	FD	F(d)F	Pc
Onychiurus armatus (2)	6.07±2.04 0.001	7.71±1.59 0.001	11.15±1.78 0.001	4.01±0.98 0.001	5.13±1.32 0.001 P_{mc}
		1.64±2.37 0.4	5.08±2.51 0.025	2.06±2.02 0.2	0.94±2.2 0.5 AD
			3.44±2.15 0.1	3.7 ±1.56 0.01	2.58±1.8 0.1 AF
				7.14±1.76 0.001	6.02±1.97 0.001 FD
					1.12±1.29 0.2 F(d)F

For the species *Folsomia quadrioculata* the following sites are different: Abietum dacicum (I)-Piceetum carpaticum (V), in which the calculated value of "t" is greater than the theoretical one, at a transgression probability greater than 0.001. That means that these two sites are very significantly different, as far as the mean number of Collembola individuals is concerned; Abieto-Fagetum (II)-Piceetum carpaticum (V), in which the difference between the calculated value of "t" and the theoretical one, corresponds to a probability of transgression smaller than 0.001, which shows a significant difference between the means; Fagetum dacicum (III)-Piceetum carpaticum (V), with a very significant difference; Pinetum mugi carpaticum (VI)-Piceetum carpaticum (V), with a distinct significant difference.

These differences between the sites mentioned, at nearly the same level of significance, were found both in the first and in the second year of study, which means a high stability of numerical dominance.

All the other pairs of sites presented insignificant values of the differences between the means, in the first year of study, which indicate a significant similarity between them. The differences between the means are greater in the second year of study as a result of quantitative changes with relations of the species.

For the species *Onychiurus armatus* the relations between the site with vegetal association Piceetum carpaticum, and the other sites, are nearly similar with those of the species *Folsomia quadrio culata*. The sites with vegetal associations Piceetum carpaticum-Abietum dacicum, Piceetum carpaticum — Abieto-Fagetum and Piceetum carpaticum — Festuco (drymeae) — Fagetum, have suffered changes of numerical densities, which determined insignificant differences between the means and, as a consequence, a higher similarity level.

The similarity of all studied sites, based on the similarity of Collembola, was also established using the Jaccard similarity index (Table 2). In this case the difference between the site with the vegetal association

Table 2

The Jaccard similarity index in the Collembola from the Gîrbova, Bucegi and Retezat Mountains

Sites of study	year of study	
	1	2
Abietum dacicum — Abieto-Fagetum	0.34	0.26
Abietum dacicum — Fagetum dacicum	0.32	0.31
Abieto-Fagetum — Fagetum dacicum	0.47	0.35
Festuco (drymeae) — Fagetum — Piceetum carpaticum	0.32	0.50
Festuco (drymeae) — Fagetum — Pinetum mugi carpaticum	0.27	0.50
Piceetum carpaticum — Pinetum mugi carpaticum	0.31	0.54
Abietum dacicum — Festuco (drymeae) — Fagetum	0.26	0.34
Abietum dacicum — Piceetum carpaticum	0.31	0.36
Abietum dacicum — Pinetum mugi carpaticum	0.24	0.35
Abieto-Fagetum — Festuco (drymeae)-Fagetum	0.31	0.32
Abieto-Fagetum — Piceetum carpaticum	0.32	0.34
Abieto-Fagetum — Pinetum mugi carpaticum	0.27	0.30
Fagetum dacicum — Festuco (drymeae)-Fagetum	0.32	0.32
Fagetum dacicum — Piceetum carpaticum	0.31	0.38
Fagetum dacicum — Pinetum mugi carpaticum	0.27	0.34

Piceetum carpaticum and the other sites is evident through the smallest values of the similarity index, in the first year of study. Similarity index values of the same sites are rising evidently in the second year of study, which could be explained, amoung other causes, through the greater soil humidity, in the sites of the Gîrbova and Bucegi mountains. The greatest similarity index, in the first year of study, is presented by the sites with the vegetal associations of Abieto-Fagetum — Fagetum dacicum (0.47), both being beech forests from the Bucegi mountains, whose organic matter fallen on the ground determines a special structure of the Collembola.

In the same period of time the smallest similarity index was shown by the sites with the vegetal associations of Abietum dacicum (Gîrbova

Mountain) — Festuco (drymeae) — Fagetum (Retezat Mountain (0.26), Festuco (drymeae) — Fagetum — Pinetum mugi carpaticum, both in the Retezat Mountains (0.27) and Abieto-Fagetum (Bucegi Mountains) — Pinetum mugi carpaticum (Retezat Mountain, 0.27). The same similarity index (0.27) is recorded by the sites with the vegetal associations of Fagetum dacicum (Bucegi Mountains) — Pinetum mugi carpaticum (Retezat Mountains). The mountain for each site was specified in order to emphasize the conclusion that the structure of herbaceous and tree layers, characteristic for each site, determine, among other causes, peculiarities in the organisation of Collembola populations, which, in turn, influence the level of similarity. The organic matter fallen on the ground determines a specific diet for the Collembola species. Pairs of sites with small

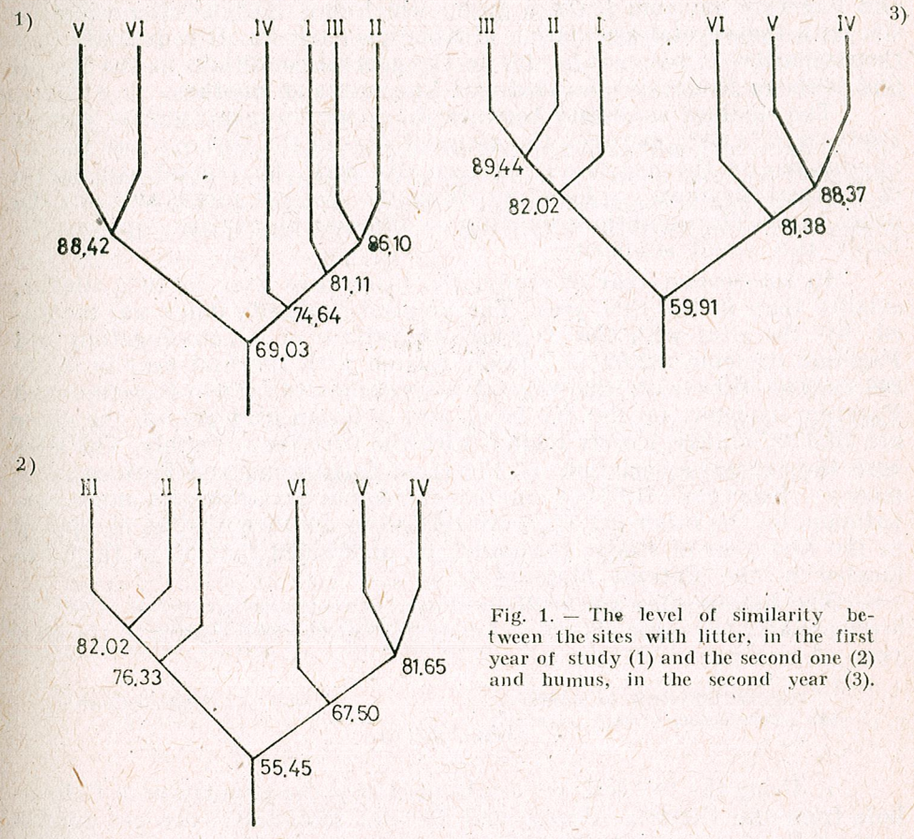

Fig. 1. — The level of similarity between the sites with litter, in the first year of study (1) and the second one (2) and humus, in the second year (3).

similarity indexes are different from this point of view. This organic matter of the site with the vegetal association of Abietum dacicum (Gîrbova Mountain), composed of leaves of spruce fir is different in comparison with the litter with beech and elm leaves, from the site with vegetal association of Festuco (drymeae) — Fagetum, from the Retezat Mountains.

The third procedure used to establish the similarity of Collembola was the cluster system (Fig. 1). According to it, the similarity of Collembola in all the six litter sites was 69.03%, in the first year of study. The sites with the vegetal associations of Piceetum carpaticum and Pinetum mugi carpaticum, both in the Retezat Mountains, are 88.42% similar. Spruce fir is dominant in the tree level of these sites which determines nearly the same organic matter to fall on the ground. As a consequence, very similar decomposition processes are taking place in both sites and the species composition of Collembola are closely related. Sites with the vegetal associations of Abieto-Fagetum and Fagetum dacicum are 86.1 similar. Both are characterised by the dominance of beech, which implies close relations as far as decomposition processes and species composition are concerned. The sites with the vegetal associations of Abieto-Fagetum and Fagetum dacicum make a group which is 81.11% similar with the site with the vegetal association of Abietum dacicum. It is possible that the similarity in this case be due to the general conditions in the Bucegi and Gîrbova Mountains, located at 1 km, near one another.

The smallest similarity between the litter sites, in the first year of study, was 74.64%, between the group of sites in the Gîrbova and Bucegi mountains, on the one hand, and the site with the vegetal association of Festuco (drymeae) — Fagetum, from the Retezat mountains, on the other hand. The conditions existing in different mountains explain probably this small similarity.

In the second year of study, the litter sites were 55.46% similar, smaller than in the first year. The greatest similarity index was recorded by the sites with the vegetal associations of Abieto-Fagetum and Fagetum dacicum (82.02%), closely related with the first year of study (86.1). The sites with the vegetal associations of Abieto-Fagetum and Fagetum dacicum, on the one hand and Abietum dacicum, on the other are 76.33% similar, closely related with the first year of study. The sites with the vegetal associations of Piceetum carpaticum and Festuco (drymeae) — Fagetum (81.65%), on the one hand, and Pinetum mugi carpaticum, on the other (67.5%)) are related in another way, as compared to the first year of study. It should be mentioned that all of them are located in the Retezat Mountains.

The humus sites are 59.91% similar, inside the group of sites following nearly the same classification system of the litter sites, in the first year of study.

CONCLUSIONS

1. Using the "t" test we established that the population of Collembola from the Gîrbova, Bucegi and Retezat Mountains, are not similar in the following pairs of sites : Abietum dacicum — Piceetum carpaticum (the first site is in the Gîrbova and the second one in the Retezat Mountains); Abieto — Fagetum — Piceetum carpaticum (the first site is in the Bucegi and the second one in the Retezat Mountains); Fagetum dacicum — Piceetum carpaticum (the first site is in the Bucegi and the second one in the Retezat Mountains); Pinetum mugi carpaticum — Piceetum carpaticum (both in the Retezat Mountains) and Pinetum mugi carpaticum — Festuco (drymeae) — Fagetum (both in the Retezat Mountains). The general and special conditions created by different mountains are evidently explanations for the small similarities between the first three pair of sites; in the case of the last two pairs, even though they all are located in the Retezat Mountains, the explanation of the few similarities between the Collembola populations, consists probably in the existence of different soil types and pH of these soils. All the other pairs of sites show insignificant differences between the mean numbers of Collembola, that is, they are mostly very similar.

2. The greatest value of the Jaccard similarity index have the sites with the vegetal associations of Abieto-Fagetum — Fagetum dacicum, both from the Bucegi Mountains :

3. According to the cluster system, the similarity index of all the six sites from the Gîrbova, Bucegi and Retezat mountains was 69.03%, in the first year and 55.45% in the second year, in the litter sites, and 59.91%, in the humus sites, in the second year.

4. All the three systems used in this paper in order to establish the similarity of the Collembola from the different mountains of Romania, show that soil type, specific composition of herbaceous and tree layers, apart in each mountain, influenced the specific composition of Collembola and their structural organisation.

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Received April 27, 1989

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Bucharest, Splaiul Independenței 296

THE ROLE OF THE PREDATORY INSECTS IN REDUCING THE ATTACK OF THE CORN GRAIN APHID (*RHOPALOSIPHUM MAIDIS* FITCH) (*HOM.: APHIDAE*) IN ROMANIA

MARIN C. VOICU

In the ecological conditions of Moldavia, Transylvania and Banat (Romania) *Rhopalosiphum maidis* Fitch is controlled by 23 species of predatory insects, i.e. two species of *Anthocoridae*, three of *Nabidae*, two of *Chrysopidae*, one of *Cantharidae*, two of *Malachiidae*, ten of *Coccinellidae* and three of *Syrphidae*. As concerns the percentage distribution of the entomophagous insect groups in the pest colonies, it is the order *Coleoptera* that holds the first place (58.43%), followed by the *Diptera* (15.26%), *Heteroptera* (13.68%), finally coming the *Neuroptera* (12.63%). The following species are of practical importance: *Coccinella septempunctata* L., *Hippodamia tredecimpunctata* L., *Adonia variegata* Goeze, *Propylaea quatuordecimpunctata* L., *Chrysopa formosa* Brauer, *Coccinella quatuordecimpustulata* L., *Chrysopa carnea* Steph., *Episthrophe balteata* Deg. which were found in the aphid colonies permanently and in a large number during the whole vegetation period while *Coccinella conglobata* L., *Halyzia sedecimguttata* L., *Nabis punctatus* Costa, *Calvia 14-guttata* L. and *Semiadalia undecimnotata* L., appear sporadically in cultures and are represented by a small number of species.

The world literature reveals that during this last century, corn (*Zea mays* L.) has been extensively cultivated, given the many proteins (10—14%) and carbon hydrates it contains. Corn is being used in man's food, in industry but especially as a silo fodder plant. Simultaneously with the increase of the areas cultivated with various corn hybrids (autochthonous or foreign), in the last 2—3 decades strong attacks have been produced by the beet root weevil (*Tanymecus dilaticollis* Gyll.), the European corn borer (*Ostrinia nubilalus* Hbn.), by aphids and other insects.

The present paper is dealing with the role played by the predatory insects in reducing the attack of *Rhopalosiphum maidis* Fitch. The pest colonies have mostly attacked the corn cultures. But, usually every 4 or 5 years, when its attacks are less injurious and the male and female inflorescences less damaged, the efficiency levels attained by the entomophagous insects succeed in maintaining the aphid under a detrimental economic threshold (Table 1).

Research was conducted on some corn cultures in Romania, in the 1981—1987 period.

MATERIAL AND METHOD

Observations were made on the predatory insects that control the *Rhopalosiphum maidis* Fitch colonies in the corn colonies and larvae, pupae and adults of these entomophagous insects were collected. The abundance of the species of adult entomophagous insects acting in a

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colony/plant was followed in nature (Table 2) and breedings and identifications of the whole collected biological material was made in the laboratory.

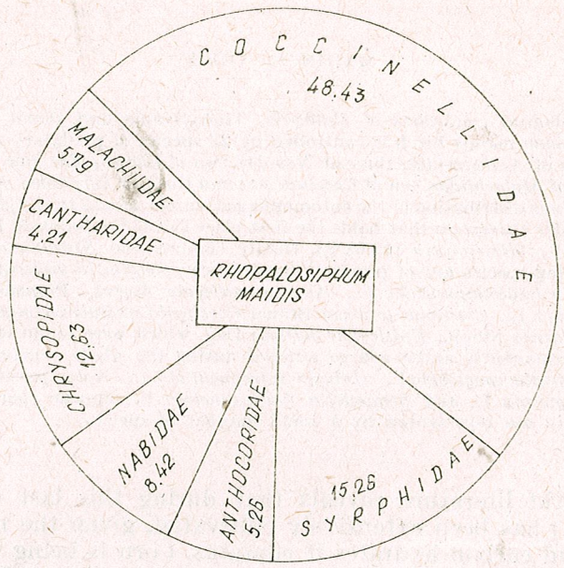

Fig. 1. — The activity of the main predator groups on *Rhopalosiphum maidis* Fitch colonies.

RESULTS

1. *Orius minutus* (L.). The nymphs and adults of this species particularly attack the corn grain aphid as well as the eggs of *Ostrinia nubilalis* Hbn. (Podu-Iloaiei Agricultural Research Station, Popești Agricultural production co-operative, Jassy County and Turda Agricultural Research Station, Cluj County). This is a bug widely distributed in all the agrobiocenoses of Romania. Most authors show that this pest destroys species of mites, thrips and aphids (2, 6, 9).

2. *Orius niger* Wolf. It is a small lively, very voracious bug that attacks the *Rhopalosiphum maidis* Fitch colonies in almost the whole country. This species is mentioned in the literature as predatory of some phytophagous mites, thrips and aphids [2, 6, 7].

3. *Nabis ferus* L. Its nymphs and adults bite and suck the *Rhopalosiphum maidis* Fitch colonies, attack the larvae of *Pieris brassicae* L. as well as the adults of *Lema melanopa* L. and *Lema cyanella* Payk. The predator has a wide polyphagous spectrum, destroying 20 insect species, i.e. aphids, ligeids, myrids, various Coleoptera and Lepidoptera [2, 7].

4. *Nabis pseudoferus* Rem. In the cereal cultures of Romania, the predator's nymphs and adults attack mites, leafhoppers, bugs *(Lygus)*

Table 1

The efficiency levels attained by the entomophagous insects of *Rhopalosiphum maidis* Fitch in the Central Moldavian Plateau in 1984

Culture	Pest	Entomophagous insect	Parasitizing degree; Predator/Pray ratio
Corn	Rhopalosiphum midis	Parasites — Aphidiinae	35—38 % (mummy pupae/plant)
		Predators — Anthocoridae Nabidae Chrysopidae Cantharidae Malachiidae Coccinellidae Syrphidae	1 : 35—1 : 50

caterpillars and aphids, among which the corn grain aphid *(Rhopalosiphum maidis* Fitch). During its life cycle, a *Nabis pseudoferus* Rem. adult destroys from 168 up to 274 specimens of *Acyrthosiphon pisum* Harr. It is a polyphagous species [7].

5. *Nabis punctatus* Costa. It may be found in the company of *Nabis* in a smaller number and with a more limited spectrum of polyphagy. It pseudoferus Rem. but feeds on leafhoppers, phytophagous mites, *Lygus* species and specimens of *Rhopalosiphum maidis* Fitch. In our country, it equally attacks two more aphid species (7).

6. *Chrysopa carnea* Steph. The larve, in particular, and less often the adults, have been permanently recorded in the *Rhopalosiphum maidis* Fitch colonies. At the beginning, it attacks the *Ostrinia nubilalis* Hbn. larvae on the extraearly corn hybrids and then, it extends its attack area to the corn plants invaded by aphids. In the years when the climatic condition are favourable to an earlier appearance of the *Ostrinia nubilalis* Hbn. larvae, once the aphids settle down, *Chrysopa carnea* Steph. simultaneously attacks the pests. Its attack becomes stronger in the aphid colonies only after the *Ostrinia nubilalis* Hbn. larvae get into the corn stalks. This predator is met in the *Rhopalosiphum maidis* Fitch colonies starting with their constitution till late in autumn.

It is a polyphagous species (2, 7).

7. *Chrysopa formosa* Brauer. The larvae and the adults of this species have been permanently found in the *Rhopalosiphum maidis* Fitch colonies (1—2 larvae/colony/plant), only occasionally destroying the *Ostrinia nubilalis* Hbn. larvae (Table 2).

This predator also attacks the following injurious insects : *Eriosoma lanigerum* Hausm., *Aphis rumicis* L. and *Aporia crataegi* L. [2].

8. *Chrysopa* sp. Numerous larvae of *Chrysopa* have been seen attacking specimens of *Rhopalosiphum maidis* Fitch.

9. *Chantharis nigricans* Müll. (?). It is frequently recorded alone and sometimes with species of *Malachiidae (Malachius aeneus* F., *Malachius bipustulatus* L.) in the colonies of *Rhopalosiphum maidis* Fitch and *Acyrthosiphon pisum* Harr. (Agricultural State Farm Tîrgu-Frumos, Jassy

Table 2

The predator insect species in the *Rhopalosiphum maidis* Fitch colonies from Podu-Iloaiei Agricultural Research Station, in 1987

Plant No. / Predator species	Orius minutus	Orius niger	Nabis ferus	Nabis pseudoferus	Nabis punctatus	Chrysopa carnea	Chrysopa formosa	Chrysopa sp.	Cantharis nigricans	Cantharis sp.	Malachius aeneus	Malachius bipustulatus	Hippodamia 13-punctata	Adonia variegata	Adalia bipunctata	Semiadalia 11-notata	Coccinella septempunctata	Coccinella 14-punctata	Coccinella conglobata	Halyzia sedecimguttata	Calvia 14-guttata	Propylaea 14-punctata	Episcaphe baltheata	Sphaerophoria scripta	Lasiopticus pyrastri	Syrphus sp.	Predator total/plant
1	1		1			1							2		1		2					1			1		14
2			1		1							1		2				1									10
3							1				2		1				1	1									10
4	1	1		1		1		1				1	2					1									8
5	1					1	1																				7
6										1							3										8
7			1			1	1						1				1										9
8								1										1									8
9									1																		8
10										1																	6
11											2																12
12												1															8
13													1														9
14														1													11
15															1												10
16																1											11
17																	2										10
18																		1									11
19																			1								10
20																					1		2			1	11
TOTAL	6	4	7	6	3	8	12	4	5	3	5	1	22	16	6	1	22	9	3	3	2	14	8	6	8	7	190
GENERAL TOTAL																											

County and Agricultural production co-operative Huși, Vaslui County). In the literature this species is mentioned as predatory in the *Schizaphis graminum* Rond. and *Acyrthosiphon pisum* Harr. colonies (5).

10. *Cantharis* sp. controls alone or sometimes together with species of *Malachiidae*, the *Rhopalosiphum maidis* Fitch colonies of Moldavia, Oltenia and Banat.

It is a predatory species registered in the colonies of *Acyrhosiphon pisum* Harr., *Schizaphis graminum* Rond. and *Rhopalosipum maidis* Fitch (8).

11. *Malachius aeneus* L. is recorded in the *Rhopalosiphum maidis* Fitch colonies (Agricultural State Farm Popricani, Jassy County and Agricultural State Farm Vaslui, Vaslui County). At the biginning, it appears in the colonies living on wheat and barley and later, it migrates to the corn cultures invaded by aphids. It is mentioned as predatory in the *Schizaphis graminum* Rond. and *Rhopalosiphum maidis* Fitch colonies. It equally attacks the larvae of *Clysia ambiguella* Hbn., *Polychrosis botrana* Schiff., *Meligethes aeneus* F. and *Meligethes* sp. (2, 8).

12. *Malachius bipustulatus* L. controls the *Rhopalosiphum maidis* Fitch colonies ; on a corn plant infested by lice an adult was found.

It is polyphagous, being known as a predator of the following pests : *Schizaphis graminum* Rond., *Acyrthosiphon pisum* Harr., *Phorodon humuli* Schrank, *Sitobion avenae* F., *Polychrosis botrana* Schiff., *Carpocapsa pomonella* L., *Clysia ambiguella* Hbn., *Meligethes viridescens* F. and *Meligethes* sp. (2, 5, 8).

13. *Hippodamia tredecimpunctata* L. This species appears in a small number in *Rhopalosiphum maidis* Fitch populations shortly after the pest settles down on the corn plants. Subsequently, the number of predatory specimens grows, so that late, in autumn, it becomes the most numerous coccinelid present in the pest colonies. The *Hippodamia tredecimpunctata* L. adults which wintered in lucerne cultures, in hayfields, forests, railway embankments etc. are recorded in lucerne cultures first mowing, and partially after the second mowing, from witch they migrate to corn cultures, increasing the efficiency of the predator in its fight against *Rhopalosiphum maidis* Fitch. On an aphid infested corn plant 1—3 *Hippodamia tredecimpunctata* L. adults have been found.

It is a polyphagous species that destroys aphids, ligeids, jassids and coleoptera (2, 4).

14. *Adonia variegata* Goeze is very widely distributed in all the agricultural cultures, occurring permanently and in a large number in the ones attacked by pests, especially by aphids. As practical importance, it comes immediately after *Coccinella septempunctata* L., passing sometimes on the first place. It destroys the *Rhopalosiphum maidis* Fitch colonies, 1—4 adults of this pest being found on a corn plant. In Romania, it is known to destroy the *Ostrinia nubilalis* Hbn. larvae in the colonies of *Aphis fabae* Scop., *Brachycaudus helichrysi* Kalt. and *Acyrthosiphon pisum* Harr. (7), and according to Thompson and Simonds (2), it shows a wider polyphagous spectrum, destroying many aphid species.

15. *Adalia bipunctata* L. The larvae and adults of this species have been found in a small number, sporadically, devouring specimens of

Rhopalosiphum maidis Fitch in Moldavia, Transylvania and Banat (1—2 adults/plant). In our country, it has been mentioned as predatory in the aphid colonies (3) and, according to Thompson and Simonds (2) it is polyphagous, destroying one mite species and 35 species of various insects.

16. *Semiadalia undecimnotata* Schneid. The adults are accidentally recorded in the pest colonies. Thompson and Simonds show that it attacks the aphids *Toxoptera aurantii* Boy. and *Toxoptera graminum* Rond. (2).

17. *Coccinella septempunctata* L. The adults of this species, which feed on *Acyrthosiphon pisum* Harr. specimens of lucerne and pea cultures, migrate to corn field where they occasionally destroy eggs but especially *Ostrinia nubilalis* Hbn. I-st stage larvae. They pass afterwards to *Rhopalosiphum maidis* Fitch infested corn plants where they occur in the company of *Adonia variegata* Goeze and *Hippodamia tredecimpunctata* L. It is the most efficient coccinellid in the fight against the corn pests. Generally, on a corn plant attacked by aphids, 1—3 adults of *Coccinella septempunctata* L. were found (Table 2). The literature mentions it as a polyphagous species (2, 7, 8).

18. *Coccinella quatuordecimpustulata* L. It controls the corn grain aphid, being the fifth as far as practical importance is concerned, after *Coccinella septempunctata* L., *Hippodamia tredecimpunctata* L. and *Adonia variegata* Goeze, *Propylaea quatuordecimpunctata* L. and *Chrysopa formosa* Brauer, respectively. It is a mobile species, occurring in all the agricultural cultures of Romania. On an aphid-infested corn plant were found 1—2 adults and 1—2 larvae of *Coccinella quatuordecimpustulata* L. It has been mentioned as aphidophagous in the colonies of *Aphis fabae* Scop. and *Acyrthosiphon pisum* Harr. (4, 7).

19. *Coccinella conglobata* L. Normally, this species controls the aphid colonies injurious to the sunflower, pea and lucerne cultures. But accidentally, in August-September, *Coccinella conglobata* L. may be found in the company of the species *Hippodamia tredecimpunctata* L. in the *Rhopalosiphum maidis* Fitch colonies, as well as those of *Cerosypha (Aphis) gossypii* Glov., a pest of the cucumber and melon cultures, in Moldavia. The literature shows that it is a polyphagous species (2, 8).

20. *Halyzia sedecimguttata* L. accidentally appears in the corn grain aphid colonies.

It has been recorded in the colonies of *Brachycaudus helichrysi* Kalt., *Acyrthosiphon pisum* Harr. and *Aphis fabae* Scop (8).

21. *Calvia 14-guttata* L., a sporadic predator in *Rhopalosiphum maidis* Fitch colonies. It is specific to *Brachycaudus helychrysi* Kalt. colonies and only occasionally controls the *Aphis fabae* Scop. and *Rhopalosiphum maidis* Fitch ones. The species is mentioned as predatory in the colonies of *Brachycaudus helychrysi* Kalt., *Aphis fabae* Scop. *Rhopalosiphum maidis* Fitch, *Brevicorynae brassicae* L., *Myzodes persicae* Sulz., *Macrosyphum solani* Kittel and *Macrosiphum euphorbiae* Hott. (8).

22. *Propylaea quatuordecimpunctata* L. contributes to the diminishing of the corn grain aphid colonies, 1—2 adults of it being found on an aphid-infested corn plant. It is mentioned as predatory in the colonies of *Aphis fabae* Scop., *Acyrthosiphon pisum* Harr. and *Brachycaudus helichrysi* Kalt. (4).

23. *Epistrophe balteata* Deg. The larvae attack the *Rhopalosiphum maidis* Fitch colonies and other aphid species injurious to cereals. In Romania, it has been mentioned as predatory in the colonies of *Aphis fabae* Scop., *Brachycaudus helichrysi* Kalt. and *Acyrthosiphon pisum* Harr. (4). According to Thompson and Simonds (2) it destroys nine other species of *Aphidae* and one *Asylidae*.

24. *Spahaerophoria scripta* L. Its larvae, in a small and sporadic number, were found in corn grain aphid colonies, at the end of July and the beginning of August, immediately after the harvesting of barley and wheat cultures. This entomophagous insect first diminishes, together with other predators, the greenbug colonies *(Schizaphis graminum* Rond.) and then, its larvae are found in the *Rhopalosiphum maidis* Fitch colonies. It has been mentioned as predatory in the colonies of many aphid species (2, 3, 4).

25. *Lasiopticus pyrastri* L. destroys, together with other syrphid species, the *Rhopalosiphum maidis* Fitch colonies. On an aphid-infested corn plant, 1—3 larvae of *Lasiapticus pyrastri* L. were found. The literature mentions this species as predatory in the colonies of many aphid species (2).

26. *Syrphus* sp. Several syrphid larvae found in the pest colonies were brought to the laboratory and fed on aphids. No adult resulted from their pupae.

DISCUSSION

The research carried out in some aphid-invaded corn cultures of Romania permitted to discover the predatory insects in the *Rhopalosiphum maidis* Fitch colonies, to appreciate their abundance on the plant and their evolution during the vegetation period. The predatory insect species identified in the pest colonies belong to the order *Heteroptera*, *Neuroptera*, *Coleoptera* and *Diptera* (Fig. 1, Table 3).

Amoung the *Heteroptera*, two species have been identified in the corn cultures, i.e. *Orius minutus* L. (3.15%) and *Orius niger* Wolf. (2.11%) of the family *Anthocoridae*, known in the literature as predatory of the phytophagous mites, of thrips and aphids as well as three species of *Nabidae*, i.e. *Nabis ferus* L. (3.68%), *Nabis pseudoferus* Rem. (3.16 %) and *Nabis punctatus* Costa (1.58%), agile, slender, predatory insects of mites, aphids, *Lygus* bugs and even of Lepidoptera caterpillars (Table 3).

The *Neroptera* were represented by two species: *Chrysopa formosa* Brauer (6.32%), *Chrysopa carnea* Steph. (4.21%) and *Crysopa* sp. (2.10%), family *Chrysopidae*, which feed on larvae, aphids and other species of pests.

The most important predatory insect species occurring in the *Rhopalosiphum maidis* Fitch colonies belong to he order *Coleoptera*. Among the *Coleoptera*, besides the prevailing *Coccinellidae* species there were also recorded *Cantharis nigricans* Müll. (?) (2.63%) and other *Cantharis* sp.

Tabïe 3

The activity of the predatory insects in *Rhopalosiphum maidis* Fitch colonies

No.	Predatory species	Predators (No.)	Predators %
	I. Order *HETEROPTERA* Family *ANTHOCORIDAE*		
1	Orius minutus L.	6	3.15
2	Orius niger Wolf.	4	2.11
	Family *NABIDAE*		
3	Nabis ferus L.	7	3.68
4.	Nabis pseudoferus Rem.	6	3.16
5	Nabis punctatus Costa	3	1.58
	Total	26	13.68
	II. Order *NEUROPTERA*		
	Family *CHRYSOPIDAE*		
6	Chrysopa carnea Steph.	8	4.21
7	Chrysopa formosa Brauer	12	6.32
8	Chrysopa sp.	4	2.10
	Total	24	12.63
	III. Order *COLEOPTERA*		
	Family *CANTHARIDAE*		
9	Cantharis nigricans Müll.	5	2.63
10	Cantharis sp.	3	1.58
	Family *MALACHIIDAE*		
11	Malachius aeneus F.	5	2.63
12	Malachius bipustulatus L.	6	3.16
	Family *COCCINELLIDAE*		
13	Hippodamia tredecimpunctata L.	16	8.42
14	Adonia variegata Goeze	16	8.42
15	Adalia bipunctata L.	6	3.16
16	Semiadalia undecimnotata L.	1	0.53
17	Coccinella septempunctata	22	11.58
18.	Coccinella quatuordecimpustulata L.	9	4.74
19.	Coccinella conglobata L.	3	1.58
20	Halyzia sedecimguttata L.	3	1.58
21	Calvia 14-guttata L.	2	1.05
22	Propylaea quatuordecimpunctata L.	14	7.37
	Total	90	58.43
	IV. Order *DIPTERA*		
	Family *SYRPHIDAE*		
23	Epistrophe balteata Deg.	8	4.21
24	Sphaerophoria scripta L.	6	3.16
25	Lasiopticus pyrastri L.	8	4.21
26	Syrphus sp.	7	3.68
	Total	29	15.26
	General total	190	100.00

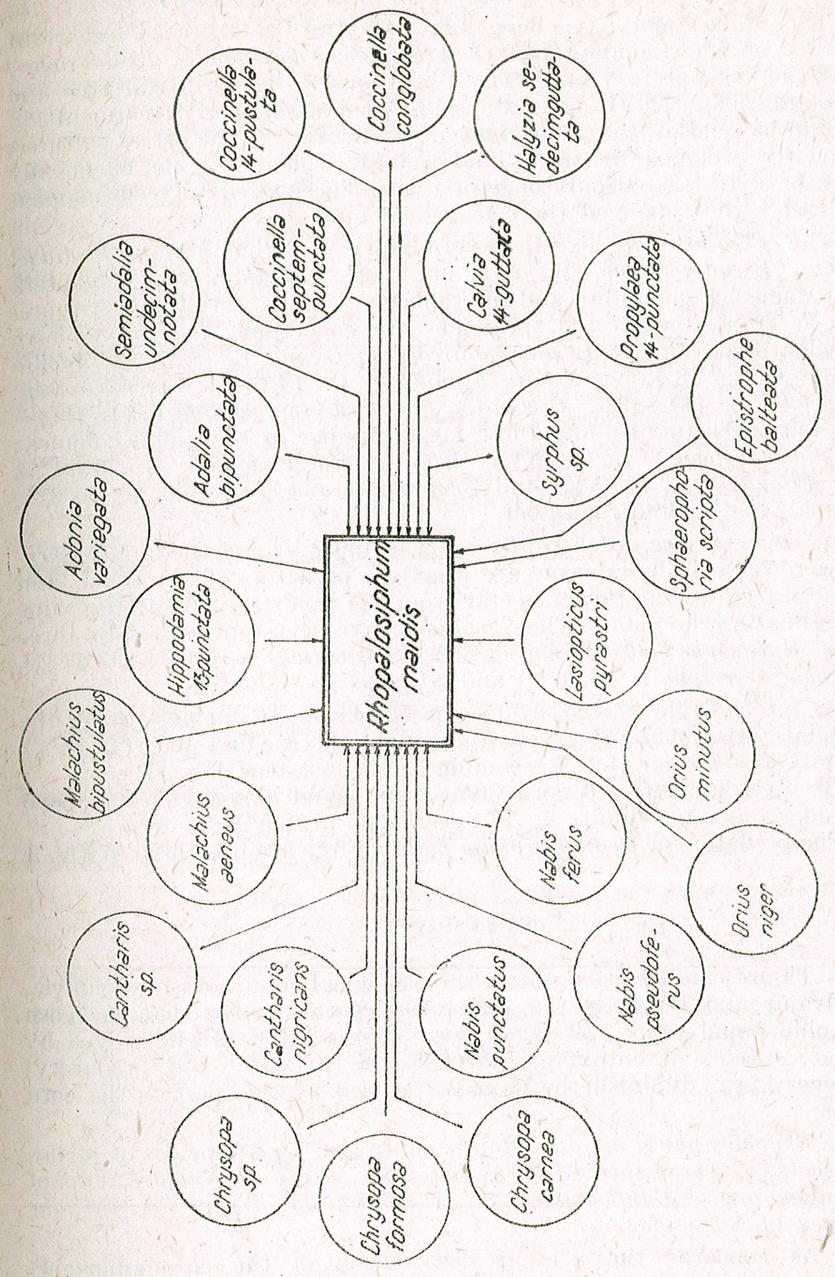

Fig. 2. — The predators of *Rhopalosiphum maidis* Fitch in Romania.

specimens (1.58%) of the family *Cantharidae*, *Malachius aeneus* F. (2.63%) and *Malachius bipustulatus* L. (3.16%) of the family *Malachiidae*.

The *Malachiidae* have been known in the literature as important predators of the Lepidoptera *(Olethreutidae, Tortricidae, Phaloniidae)* and of the Coleoptera *(Nitidulidae)* injurious to forests, fruit tree and vine plantations. The exaggerate application of chemical treatments in these agrobiocenoses made the *Malachiidae* migrate to the cereal cultures, particularly attacked by thrips and aphids, which were not chemically treated or were treated only once or twice. These predatory entomophagous insects thus changed their ecological niche.

The *Coccinellidae*, excellent predators of Homoptera *(Psylidae, Coccidae, Pseudococcidae, Aphidae* etc.) of Thysanoptera, Coleoptera (larval stages), Lepidoptera and phytophagous mites were the best represented as far as species and specimens are concerned. Ten species have been identified, i.e. *Hippodamia tredecimpunctata* L. (8.42%), *Adonia variegata* Goeze (8.42%), *Adalia bipunctata* L. (3.16%), *Coccinella septempunctata* L. (11.88%), *Coccinella quatuordecimpustulata* L. (4.74%)— which were permanently found in a large number in the aphid colonies; *Coccinella conglobata* L. (1.58%), *Halyzia sedecimguttata* L. (1.58%), *Calvia 14-guttata* L. (1.05%) and *Semiadalia undecimnotata* L. (0.53%) in a small and sporadic number.

As concerns the order *Diptera*, larvae and pupae of the family *Syrphidae* were found. These larvae are excellent predators of the aphids and the adults feed on the flower nectar from the fields nearby, at the same time pollinating the plants. The *Syrphidae* have been represented by three species: *Epistrophe balteata* Deg. (4.21%), *Lasiopticus pyrastri* L. (4.21%), *Spaerophoria scripta* L. (3.16%) and *Syrphus* sp. (3.68%).

As for the role played by the predatory insects in destroying the corn aphids, it is the family *Coccinellidae* that holds the first place (48.43%), the family *Cantharidae* (4.21%), coming on the last one (Fig. 1).

On an aphid infested corn plant were found 9.50 predatory specimens, on an average (limits 6—14 specimens) (Table 2).

The predators of *Rhopalosiphum maidis* Fitch are presented in Fig. 2.

CONCLUSIONS

1. The research carried out in the ecological conditions of Moldavia, Transylvania and Banat in the 1982—1987 period shows that the corn grain aphid populations *(Rhopalosiphum maidis* Fitch) are destroyed by numerous species of entomophagous insects (parasitic and predatory) which every year diminish the damages caused by this pest to the corn cultures.

2. *Rhopalosiphum maidis* Fitch is controlled by 23 species of predatory insects, i.e. two species of *Anthocoridae*, three of *Nabidae*, two of *Chrysopidae*, one of *Cantharidae*, two of *Malachiidae*, ten of *Coccinellidae* and three of *Syrphidae*.

3. As concerns the present distribution of the entomophagous insect groups in the pest colonies, it is the order *Coleoptera* that holds the

first place (58.43%), followed by the *Diptera* (15.26%), *Heteroptera* (13.68%) and, finally, the *Neuroptera* (12.63%).

4. The following species are of practical importance: *Coccinella septempunctata* L., *Hippodamia tredecimpunctata* L., *Adonia variegata* Goeze, *Propylaea quatuordecimpunctata* L., *Chrysopa formosa* Brauer, *Coccinella quatuordecimpustulata* L., *Chrysopa carnea* Steph., *Epistrophe balteata* Deg. which were found in the aphid colonies permanently and in a large number during the whole vegetation period, while *Coccinella conglobata* L., *Halyzia sedecimguttata* L., *Nabis punctatus* Costa, *Calvia 14-guttata* L. and *Semiadalia undecimnotata* L. sporadically appear in cultures and are represented by a small number of specimens.

5. *Malachius aeneus* F. and *Malachius bipustulatus* L. (Col.: *Malachiidae*) which in the past were controlling the pests of the forests, fruit, tree and vine plantations, were forced by the chemical treatments applied all over the world to migrate to the cereal cultures particularly attacked by aphids and thrips (the modification of the ecological niche).

6. Generally, the predators and the parasites do not succeed in maintaining the pest under the detrimental economic threshold. Nevertheless, every 4—5 years, when the corn fields are phenologically later infested by *Rhopalosiphum maidis* Fitch and the colonies are less numerous, the efficiency levels attained by the entomophagous insects maintain the pest under the detrimental economic threshold (Table 1).

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Received February 2, 1989

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GAMMA RADIATION STERILIZATION OF *OSTRINIA NUBILALIS* Hb., AN IMPORTANT PEST OF MAIZE CROPS IN ROMANIA

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The inherited sterility of the European Corn Borer (*Ostrinia nubilalis* Hb.) irradiated with substerilizing doses of 20, 25 and 30 krad has been studied at Fundulea, Romania. The irradiated male parents were substerile and females were almost fully sterile. The females were more sensitive to radiation. The F_1 generation was more sterile than the parents and the sex ratio was chagend.

The European Corn Borer (*Ostrinia nubilalis* Hb.) is considered n Romania the most important pest of maize crop after panicle emergence, eing spread throughout the maize cultivating zone of the country. Losses aused by this pest can sometimes reach 40% of the grain yield (8).

Average data for several years indicated 44% attacked plants, .1. larvae/plant, 23,180 larvae/ha, 550 kg/ha yield loss or 7.5%, and 34 g naize kernels lost for each larva reaching diapause (9).

Due to the economic significance of this pest for maize crop in Romania, intensive research has been performed particularly regarding ts chemical (15) and biological control (6, 10, 11, 12, 13), and develop- nent of hybrids resistant to attack (2, 3, 4, 5). During the recent years pecial attention has been paid to the study of pheromone traps (14), nd since 1988 to investigations on radiation sterilization of *O. nubilalis* nales.

Since performing this research was depending on the availability of the biological material, mass rearing of this insect was a prerequisite.

Disposing of sufficient biological material it was possible to carry ut experiments on radiation sterilization of *O. nubilalis* males, some of he data resulted being exposed below.

During the past 25 years genetic methods for pest reduction or radication have become a reality.

The genetic control is unique among the methods of biological ontrol, since this implies releasing insects genetically altered, to control he same species, in this way the genetic methods are autocidal.

The best known autocidal method of control is the technique of eleasing sterile insects, used at present to control some pest species (7), he method of inherited sterility gaining ground.

Applying this technique involves a good knowledge of the method, of adiation dose and biological parameters of the material exposed to radia- tion, so that sterility or the required degree of substerility should be ensu- red, with minimum biological side-effects on the irradiated material.

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MATERIAL AND METHOD

Irradiation was performed at I.F.I.N. — Măgurele with a ^{60}Co source delivering 1,805 roentgen/h/m, in containers with 23 mm in diameter, 125 mm height, placed at 15 cm from the ^{60}Co source. This type of container included 300 pupae.

Irradiation was applied on the 6th day, while on the 7th-8th days the adults usually emerged, subsequently being used in experiments.

The insects involved in these experiments originated from a laboratory strain, maintained in agreement with individual and mass rearing techniques previously described (1).

RESULTS AND DISCUSSIONS

Within some preliminary investigations the effect of pupal age and radiation dose on adult emergence was established.

Pupae were irradiated at 1—6 days of age, to this end being daily collected during 5 days; then they were kept separately by age, at 30 ±0.5 °C temperature and 60%—80% relative humidity. The adults emerged from the irradiated pupae on the 7th to 8th day.

The experiment with irradiated pupae showed that their hatching depended on their age during the treatment. The emergence from older pupae was less affected than that from younger ones, as compared to the untreated control pupae (Table 1). This table demonstrates that adult emergence was negatively influenced in a ratio direct proportional to the increased radiation dose.

In subsequent experiments 6-day-old pupae were used for irradiation, the adults emerging in the following 48 hours.

Table 1

Hatching percentage of irradiated pupae

Age of pupae (days)	Control	Dose of irradiation (krad)				
		10	20	30	40	50
1	96.5	5.5	1.0	0	0	0
*2	95.25	12.5	9.25	0.5	0	0
3	91.5	65.75	55.5	41.75	30.25	10.25
4	93.25	93.0	90.25	88.5	74.5	68.75
5	94.0	92.75	91.5	90.25	86.75	84.5
6*	96.25	94.5	94.0	94.0	90.75	86.25

* 12.5% of moths emerged during transport and irradiation.

Sterility of the Corn Borer was induced in various degrees by gamma irradiation 24—48 hrs before adult emergence; the higher the radiation dose, the greater the sterility obtained. Males were more resistant to radiation than females.

Table 2

Effect of various gamma radiation doses on the fertility of *O. nubilalis* eggs

Dose (krad)	Egg fertility (%)	
	♂I × ♀N	♂N × ♀I
10	68.2	8.4
20	30.8	2.01
25	19.1	1.25
30	13.5	0.0
40	0.06	0.0
50	0.0	0.0
Control (♂N × ♀N)	91.7	

I = irradiated; N = normal

A major obstacle for successful utilization of full sterilization in Lepidoptera is the use of some relatively high doses, lessening competitiveness of the released insects.

The method of inherited sterility involves rearing and releasing insects partially sterilized with lower doses, however their offsprings are fully or partially sterile, depending on the radiation dose.

As well-known, sexing pupae is particularly difficult in practice, therefore it is required that sterile insect releases use both males partially sterile, whose competitiveness is close to that of normal ones, and females unable to produce larvae to attack maize plants.

Our results, as shown in Table 3, confirm the occurrence of a higher sensitivity to radiation of females, and their full sterility at 30 krad, 98.75% at 25, and 97.99% at 20. At the same time, a lower fertility of the irradiated males was recorded.

Normal *O. nubilalis* females were paired with males irradiated with 20, 25 and 30 krad, and produced the F_1 generation. F_1 males were mated with normal females, egg-hatching being 0.4% for 20 krad, 0.2% for 25 krad and 0 for 30 krad (Table 4).

These data stress that in F_1 sterility is complete for 30 krad and nearly total for 20 and 25 krad.

It was noticed that F_1 larvae developed more slowly and the sex ratio was altered (Table 5).

Investigations under way and subsequent ones will contribute largely to clear up various aspects of F_1 sterility.

Table 3

Effect of gamma radiation on egg fertility

Dose (krad)	Variant	Egg fertility (%)
Check	N♂ × N♀	91.7
20	I♂ × N♀	30.8
20	I♂ × I♀	1.35
20	N♂ × I♀	2.01
25	I♂ × N♀	19.1
25	I♂ × I♀	0.3
25	N♂ × I♀	1.25
30	I♂ × N♀	13.5
30	I♂ × I♀	0.0
30	N♂ × I♀	0.0

I = irradiated ; N = normal

Table 4

Inheritance of sterility of parents irradiated in F_1

Dose (krad)	Egg fertility (%)	
	F_0	F_1
20	30.08	0.4
25	19.1	0.2
30	13.5	0.0
Check	91.7	89.2

Table 5

Sex ratio in F_1

Dose (krad)	♀	♂
20	1	2.1
25	1	1.75
30	1	2.0
Check	1	1.24

CONCLUSIONS

Irradiation with gamma photons of *O. nubilalis* pupae induced the appearance of various sterility degrees in adults, depending on the radiation dose used.

The hatching extent of irradiated pupae depended on their age and radiation dose.

Males were more resistant to radiation than females.

A higher sterility in F_1 as against parent generation can be obtained when substerilizing radiation doses of 20, 25 and 30 krad are applied.

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Received May 8, 1989

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MODIFICATIONS IN THE LIVER AND THYMUS OF WISTAR RATS INTOXICATED WITH LEAD

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The effects of lead on male Wistar rats were studied. The applied dose was 10 mg per rat; the experiment lasted for 28 days. Two intoxicated groups were used: one housed in normal light-dark cycle, the other kept in darkness for the whole duration of the experiment. The results show an involution of the thymus (weight loss, lowering of the protein content, increase in the glycogen amount and DNA contents); the liver was also affected: glycogen and DNA contents were lowered, the protein and RNA contents were enhanced. In the liver, the effects of lead-intoxication were stronger in the dark-housed rats.

Lead has complex metabolic and toxic effects on man and animals (5), (6), (7), (10), (11); among the most affected organs is the liver, which is involved in the detoxification mechanisms (1). On the other hend, lead intoxication results in the inhibition of the immune system, lowering the resistance of organisms to infections (3), (4), (7).

Taking into consideration the above mentioned effects, we have studied the biochemical actions of lead intoxication at the level of rat liver and thymus. Since lead intoxication usually appears in people working underground, a group of lead-intoxicated rats were kept in the dark.

MATERIAL AND METHODS

The experiments were performed on white Wistar rats weighing 160 ± 5 g. The animals were kept in proper zoohygienic conditions; food and water was given *ad libitum*. The following groups were used: control group; a group intoxicated with lead; a group intoxicated with lead and kept in the dark for the whole duration of the experiment. The number of animals in each group was 8.

Lead was given as acetate-salt in the fodder, the daily dose being 10 mg per rat. The treatment lasted 28 days, lead being administered in the morning, before foraging.

The animals were killed by decapitation, after a 16-hour fasting. The following parameters were determined both in the liver and the thymus: total protein content (TP), (2): glycogen amount (G), (8); and nucleic acid concentration (DNA and RNA), (12).

Statistical evaluation of differences was made according to the Student "t" test; aberrant individual values were eliminated according to Chauvenet's criterion. The differences were considered statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

The liver accumulates lead and it is very sensitive to the action of this heavy metal; it is also involved in the detoxification of the organism.

REV. ROUM. BIOL. — BIOL. ANIM., TOME 34, Nº 2, P. 113—115, BUCAREŞT, 1989

The hepatic enzymes are affected in lead intoxication ; the ferrochelatases and dehydrogenases involved in the synthesis of porfirins are inhibited ; there appears also a lowering in tissue respiration and a decrease in the rate of oxidative phosphorylation (1), (6), (7), (9), (10), (14). The latter effects can explain the marked decrease in liver glycogen, noticed by us in both experimental groups. Since oxidative phosphorylation is inhibited, one may presume that the liver produces energy by enhancing glycolysis.

It is well known that lead forms complexes with nucleic acid proteins, this phenomenon inhibiting cellular multiplication and DNA-dependent RNA synthesis (13). We noticed a lowering of DNA content, while the RNA content was enhanced in both groups, the difference being significant only in the animals housed in the dark. The protein content of the liver was enhanced in both groups. All these effects appeared to be more intense in the third group, which was intoxicated with lead and kept in the dark.

Lead produces stress-like effects in the thymus : the weight of this organ was reduced, its protein content was also diminished, while its glycogen content was enhanced. We noticed an increase in the DNA content in both groups. The RNA content was not modified significantly. The immunesupressor effect of lead is known. Hoffman et al. (4) have

Table 1

Effects of lead upon the thymus, liver and adrenal weight in rats

Groups	CONTROL	LEAD	LEAD + DARK
		THYMUS	
TP $\bar{x}\pm$SE	289.2±2.22	255.4±20.4	199.5±12.2
(mg/) D %	—	−11.72	−31.05 p<0.01
RNA	4.8±0.59	5.8±0.45	5.6±0.40
(mg/g)	—	+17.74	+15.50
DNA	2.9±0.46	15.5±1.37	12.4±0.65
(mg/g)	—	+420.47 p<0.001	+316.44 p< 0.001
G	1.8±0.20	2.4±0.19	2.6±0.19
(mg/g)	—	+36.00 p<0.01	+44.75 p<0.001
OW	277.2±50.34	165.00±19.18	206.8±19.88
(mg)	—	−40.49 p<0.01	−25.42
		LIVER	
TP	188.4±13.70	256.31±7.90	268.0±11.95
(mg/g)	—	+36.04 p<0.001	+42.25 p<0.05
RNA	4.5±0.79	5.46±0.50	7.0±0.65
(mg/g)	—	+19.74	+53.51 p<0.05
DNA	11.8±2.58	2.9±0.33	4.13±0.49
(mg/g)	—	−75.30 p<0.001	−65.06 p<0.05
G	3.3±0.60	1.4±0.14	0.8±0.16
mg/g)	—	−55.76 p<0.001	−73.03 p<0.001
		ADRENAL WEIGHT (mg)	
	21.7±1.66	21.5±1.14	25.6±1.63
	—	−0.80	+18.06

$\bar{x}$ = mean values ; ±SE = standard error ; D % = percent differences versus control ; TP = total proteins ; G = glycogen ; OW = organ weight ;

shown that in lead-intoxicated pigs infected with *Salmonella choleraesius* var. *Kunzendorf* a 93% mortality appeared, while in the control group (infected but not intoxicated) the mortality was only 50%. Similar results were obtained also in mice (3).

The weight of the adrenal gland was not significantly modified ; we therefore suppose that the involution of the thymus was not the consequence of an adrenal activation by stress-stimulus, rather a direct effect of lead may be supposed. It is well established that lead can affect directly some endocrine glands : thyroid, hypophysis, adrenals a.s.o. (11). It seems probable that the dose applied by us does not affect the adrenal gland, but produces a direct thymolytic effect.

In conclusion, the administration of 10 mg lead acetate per animal for 28 days in rats, affects the liver (glycogen and DNA contents were reduced, protein and RNA content increased), the modifications being more pronounced in the animals which were kept in the dark. The effects upon the thymus were : a reduction of its weight, paralleled by a lowering of its protein content and an increase of the glycogen amount.

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Received May 6, 1989

The Biological Research Center, Cluj-Napoca, Clinicilor 5—7

EFFECTS OF OXPRENOLOL UPON THE GLYCOGEN CONTENT, GLUCOSE UPTAKE AND ^{14}C(U)-GLUCOSE CONVERSION INTO GLYCOGEN IN THE AORTA WALL OF DOCA-SALT TREATED WISTAR RATS

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The glycogen content, glucose uptake,as well as the rate of ^{14}C(U)-glucose incorporation into the glycogen of the isolated thoracic aorta wall were determined in adult male Wistar rats after chronic DOCA-salt administration and after treatment with oxprenolol against the background of DOCA-salt administration. It was established that the initial glycogen content of the aorta wall decreased, its "in vitro" glucose uptake was enhanced and the incorporation rate of radioactive glucose into aortic glycogen was intensified under DOCA-salt action. When oxprenolol (a beta-adrenoceptor-blocking drug) was applied in either small or large doses against the background of DOCA-salt administration, the initial aortic glycogen content and the "in vitro" incorporation of glucose into aortic glycogen were normalized, while the "in vitro" glucose uptake by the aorta wall was even more intensified. It is concluded that in DOCA-salt-evoked changes of aortic glycogen and glucose utilization the beta-adrenoceptor-mediated influences of catecholamines are essentially involved.

It is well established that salt and mineralocorticoid excess in white rats elicit arterial hypertension (17), (22), (23), (24), (26) and systemic hypertension significantly affects the glucose and glycogen metabolism of the aorta wall (8), (20), (30). On the other hand, it is well known that the beta-adrenoceptor mediated influences of catecholamines are appreciably involved in the pathogenesis of arterial hypertension (2), (10), (11), (25) and systemic hypertension essentially modifies the contractile activity (5), (7), (9), and glucose metabolism of the aortic smooth muscle (3), (4), (6), (8), (19), (20).

Taking into consideration the above findings, in the present study we tested the dynamics of glycogen content, glucose uptake, and the rate of ^{14}C(U)-glucose conversion into glycogen in the isolated thoracic aorta wall of DOCA-salt hypertensive rats after treatment with oxprenolol, an antihypertensive drug, widely utilized in human therapeutics.

MATERIALS AND METHODS

The experiments were carried out on thoracic aorta rings (with intact intima, media and adventitia), isolated from male Wistar rats of 210 ± 4.6 g b.w., reared in the stockfarm of our laboratory and kept under standardized feeding and bioclimatic laboratory conditions. The animals were divided into four groups: normal group; group treated with DOCA and sodium chloride; group treated with DOCA, sodium cloride and small oxprenolol doses; group treated with large oxprenolol doses against the background of DOCA-salt administration.

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To obtain moderate arterial hypertension (30), in the first period, natrium cloride (30% solution) was administered by gastric tubage in daily doses of 300 mg/100 g b.w. for 30 days, and DOCA (desoxycorticosterone acetate, "Mincortid") was injected s.c. in daily doses of 1.4 mg/100 g animal during this period. For maintaining the evoked hypertension, in the second period 1% Na Cl was added to the drinking water and the treatment with DOCA was continued for 30 days more. In the second period, against the background of DOCA-salt administration the animals were treated with oxprenolol (1—/2—(allyloxy)phenoxy/—3—/isopropylamino/—2—propanol)-hydrochloride), administered intragastrically in daily doses of 0.36 and 2.88 mg/100 g b.w., respectively. DOCA was a commercial product of "Terapia" Cluj-Napoca, and oxprenolol of I.C.C.F. Bucureşti.

The animals were sacrificed by cervical dislocation and decapitation after a fasting period of 16 hours, and 24 hours after cessation of the above treatments, drinking water being allowed *ad libitum*.

The aortas were quickly excised and immersed for 20 minutes in ice-cold Krebs-Henseleit saline (without glucose, pH = 7.4). From each aorta a ring of 30—40 mg was used for testing the initial glycogen content (16) and on the remaining ring (60—80 mg) the "in vitro" glucose uptake, the post-incubation glycogen content, as well as the rate of ^{14}C(U)-glucose incorporation into aortic glycogen were determined.

For incubation, 0.5 ml glucose (16.7 mM) and gelatine (200 mg/100 ml) containing Krebs-Henseleit bicarbonate solution (pH = 7.4) were used in the case of each aorta ring. The medium also contained ^{14}C(U)-glucose (I.F.I.N., Bucharest), with a final concentration approximating 400.000 DPM/ml, its specific radioactivity being 4.5 mCi/mM ± 5%

The incubation of tissues was performed for 2 hours at 37.6° C in an original device (12), with a gas phase of 95% O_2 + 5% CO_2 and a shaking velocity of 90 oscillations/min and 5 cm amplitude.

The initial and final glucose content of the incubation medium were determined enzymatically using a Test-Combination Glucose Kit ("Boehringer, GmbH, Mannheim, Germany), according to Werner et al. (29). The colour intensity of the samples and glucose standards were measured spectrocolorimetrically at 610 nm, using a "Specol" apparatus (Carl Zeiss, Jena, GDR). The rate of glucose penetration from the medium into the aorta wall was expressed in micrograms glucose uptake/100 mg fresh tissue per 2 hrs.

After incubation, each aorta ring was rinsed in a Krebs-Henseleit buffer (without glucose) and thereafter macerated for 30 minutes in boiling KOH 30%. The glycogen was precipitated and separated by two washings with 60% ethanol and two corresponding centrifugation at 4,500 rpm, 60 min each, using a 23-T type Janetzki centrifuge (GDR). The isolated glycogen was solved in 1.5 ml double-distilled water and its concentration determined in 0.5 ml of this solution according to Montgomery (16). The remaining 1.0 ml solution from each sample was completed with 5 ml Bray's scintillation liquid and its radioactivity was measured in a liquid scintillation spectrometer (type "Beta-szint" BF-5003, Fed. Rep. of Germany; efficacy for ^{14}C = 95%). The specific activity

of ^{14}C(U)-glucose-labelled glycogen by the "in vitro" incorporation was expressed in DPM/2 hrs. per 100 µg glycogen, while the pre-and post-incubation glycogen content of the aorta wall was calculated in µg/100 mg fresh tissue.

All the results were expressed as means ± S.E. Differences were compared by Student's "t"-test; differences of $P < 0.05$ were taken as significant.

RESULTS

From the data summarized in Table 1 it is obvious that the mean value of the initial glycogen content in the aortic wall of normal rats is 51.65 ± 5.41 micrograms/100 mg tissue, while in DOCA-salt treated ones this parameter is markedly diminished (—27.51%; $P < 0.05$). vs. the corresponding normal level.

When the treatment with small or large doses of oxprenolol is applied against the background of DOCA-salt administration, the initial aortic glycogen content remains within the normal range.

After incubation for 2 hrs of the normal aorta wall in the glucose containing incubation medium, its glycogen content is 26.79 ± 3.09 micrograms/100 mg fresh tissue, being reduced by 48% vs. the initial value ($P \leq 0.001$).

Table 1

Glycogen content of isolated rat aorta wall before (A) and after 2-hrs incubation in glucose containing Krebs-Henseleit solution (B), under various experimental conditions (N = normal group; DS = DOCA-salt treated group; $DSOX_1$ = group treated with small oxprenolol doses against the background of DOCA-salt administration; $DSOX_2$ = group treated with large oxprenolol doses against the background of DOCA-salt administration)

Groups	micrograms glycogen/100mg aorta		% differences between A and B
	A	B	
N	51.65±5.41 (8)	26.79±3.09 (8)	—48.13 $P \leq 0.001$
DS	37.44±2.42 (6) —27.51% $P < 0.05$	25.41±4.29 (6) —5.15% $P > 0.50$	—32.13 $P < 0.05$
$DSOX_1$	50.18±3.36 (6) —2.84% $P > 0.50$	41.25±3.56 (6) +53.97 $P = 0.01$	—17.79 $P = 0.10$
$DSOX_2$	56.30±4.18 (6) +9.00% $P > 0.50$	37.21±4.92 (6) +38.89% $P < 0.05$	—33.90 $P < 0.02$

(The values represent means ± S.E. Number of experiments is given in parentheses. % — differences and P are calculated vs. the normal and vs. A values, respectively).

In the case of DOCA-salt treated animals, under the above incubation conditions, the aortic glycogen level decreases by 32.13% ($P < 0.05$) vs. its initial concentration, but ranges within normal values (−5.15%; $P > 0.50$).

It is remarkable that after the treatment with small oxprenolol doses, against the background of DOCA-salt administration, the post-incubation aortic glycogen content decreases appreciably as compared to that found in the initial state (−17.79%; $P = 0.10$), but it increases markedly over the corresponding level found in the normal group (+53.97 %; $P = 0.01$). In the DOCA-salt treated group, after applying large oxprenolol doses, although the amount of aortic glycogen decreases by 33.90% ($P < 0.02$) vs. its initial value, the level of this parameter remains increased by 38.89% ($P < 0.05$), as compared to the normal post-incubation level.

The data of Table 2 show that the rate of glucose penetration from the incubation medium into the aorta wall under normal conditions is 800 ± 24.14 micrograms/100 mg tissue per 2 hrs. In DOCA-salt treated animals the aortic glucose uptake increases (+13.0%; $P < 0.05$), and in the case of the treatment of animals with small or large oxprenolol doses against the background of DOCA-salt administration, this phenomenon is markedly intensified (+57.75% and +52.12%; $P < 0.001$) as compared with that observed in normal animals.

Table 2

In vitro glucose uptake by the isolated rat aorta wall and the rate of $^{14}C(U)$-glucose incorporation in vitro into aortic glycogen under various experimental conditions (N = normal group; DS = DOCA-salt treated group; $DSOX_1$ = group treated with small oxprenolol doses against the background of DOCA-salt administration; $DSOX_2$ = group treated with large oxprenolol doses against the background of DOCA-salt administration)

Groups	Micrograms glucose uptake by 100 mg fresh tissue/2 hrs.	Rate of $^{14}C(U)$-glucose conversion into aortic glycogen (DPM/100 µg glycogen/2 hrs.)
N	800±24.14 (7)	893±138.9 (8)
DS	904±44.78 (6) +13.00% $P < 0.05$	1592±99.3 (6) +41.71% $P < 0.01$
$DSOX_1$	1262±70.46 (6) +57.75% $P < 0.001$	1005±143.1 (6) +12.54% $P > 0.50$
$DSOX_2$	1217±56.72 (6) +52.12% $P < 0.001$	940±96.1 (5) + 5.26% $P > 0.50$

(Values are given as means ± S.E.; Number of experiments is given in parentheses; % differences and P are calculated vs. the values obtained in N group).

From the results concerning the "in vitro" rate of $^{14}C(U)$-glucose conversion into glycogen in the aorta wall (Table 2), one can see that, under normal conditions, this process is equal to 893±139 DPM/100 µg aortic glycogen per 2 hrs. Against this value, only in the case of DOCA-salt treated animals one can observe a marked increase of this process (+41.71%; $P < 0.01$), while small or large oxprenolol doses applied against the background of DOCA-salt excess do not influence appreciably the rate of labeled glucose incorporation into aortic glycogen vs. the normal value (+12.54% and 5.26%, respectively; $P > 0.50$).

DISCUSSIONS

As one can see from our experiments, the initial glycogen content of isolated rat aorta wall is relatively small. It decreases significantly only after chronic DOCA-salt administration, due probably to the hypertension-induced aerobic glycolysis linked to the Na—K transport process into the vascular smooth muscle (1), (19), (20), (27). From this point of view, the above observation is in a good agreement with our recent data showing that under the same conditions the arterial tension in Wistar rats moderately increases (30). At the same time, this observation corroborates the findings that during isotonic contraction of the vascular smooth muscle, the utilization of ATP increases simultaneously with the lactate production, a major product of aortic glycogen and glucose catabolism (1), (19), (20). On the other hand, there is evidence that the lactate production from glycogen is in a strong correlation with the Na^+ and K^+ transport into vascular myocytes and that the oxidative metabolism at this level is strongly correlated with the active isometric contraction force of the vascular smooth muscle (19), (20).

From our investigations it is obvious that the depletion of glycogen in the aorta wall of DOCA-salt treated rats during a 2-hr incubation period in glucose-containing Krebs-Henseleit solution is associated with an enhanced glucose uptake and an intensified conversion of $^{14}C(U)$-glucose into aortic glycogen. These changes suggest the possibility that during DOCA-salt induced systemic hypertension the enhancement of vascular glycolysis and glucose transport is associated with an intensified glycogen synthesis and glycogen breakdown. In fact, it has been established that glucose and glycogen are the main metabolic and energy substrates of rat thoracic aorta wall (8), (13), (14), (19), (20) and that the intensity of aortic glucose utilisation and glycogen depletion may reflect both an age-induced (8), (19), (20) and a DOCA-salt-elicited arterial hypertension status (30).

As results from the present study, after the treatment of rats with small or large oxprenolol doses against the background of chronic DOCA-salt administration, the initial quantity of aortic glycogen remains at a normal level, but its post-incubation level increases over the normal one. At the same time, under these conditions, the "in vitro" aortic glucose uptake significantly increases vs. the normal values, but the rate of $^{14}C(U)$-glucose incorporation into aortic glycogen remains at a normal level. It seems very probable that the above effects of oxprenolol are due to

its beta-adrenoceptor blocking property, leading to the decrease of the vascular smooth muscle contraction and vasodilatation (7), (18). In fact, we observed that under these conditions the DOCA-salt evoked moderate arterial hypertension of the rats is abolished both by small or large oxprenolol doses. It is well established that in systemic arterial hypertension the activation of beta-adrenoceptors by catecholamines at the level of cardiac and vascular myocytes is mainly involved, and that under this conditior the cytosolic cAMP production in vascular smooth muscles significantly increases (3), (4), (21). On the other hand, it is well known that the activation of beta-adrenergic cAMP-dependent cytosolic protein-kinase in the cardiac myocytes and vascular smooth muscle fibres leads to the increase of the disposable channels for Ca^{2+} penetration (3), (4), (15), (21), (28), and the increased cytosolic cAMP and Ca^{2+} lead to the activation of phosphorylase system involved in glycogen breakdown and hexose-monophosphate formation, with important role in cell energy (31). On this basis, it is pertinent to assume that oxprenolol applied in small or large doses against the background of chronic DOCA-salt administration, normalizes by its beta-adrenoceptor blocking activity, the aortic glycogen utilization and glycogen synthesis from glucose, and at the same time stimulates the glucose uptake by the aorta wall.

In summary, our results demonstrate that in adult male Wistar rats after chronic DOCA-salt administration the initial glycogen content of the aorta wall decreases, the "in vitro" glucose uptake is enhanced, and the rate of glucose incorporation into aortic glycogen is intensified. Small or large oxprenolol doses applied against the background of DOCA-salt administration maintain the initial aortic glycogen content within normal levels, normalize the rate of $^{14}C(U)$-glucose incorporation into aortic glycogen and intensify the "in vitro" glucose uptake by the isolated rat aorta wall. These results support the conclusion that in DOCA-salt evoked changes of aortic glycogen and glucose utilization the beta-adrenoceptor mediated influences of catecholamine excess are essentially involved.

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Received March 18, 1989

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NEW ANTIBIOTICS WITH IMMUNODEPRESSIVE EFFECTS

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The action of some new semisynthesis antibiotics, namely, Valurin-1 and Valurin-2, upon serum (total and fractions) proteins, upon circulating immune complexes, as well as upon the leukocytary series has been investigated, as against the action of Antifolan. The agents to be investigated have been administered, as i.m. injections, to laboratory rabbits, for 6 weeks, in two different doses (12.5 mg/kg body/day and 20 mg/kg body/day), while the standard drug in therapeutical dose (0.083 mg/kg body/day). The results obtained indicate that both drugs show depressing effects upon the humorally-mediated immune response, stronger than those of Antifolan, Valurin-1, being more efficient than Valurin-2. It was observed that, with both antibiotics, such effects are enhanced as the administered dose is being increased. Nevertheless, such products do not induce a depression of the cell-mediated immune response, as is the case of Antifolan. None of these three agents has modified the level of the circulating immune complexes.

The immunemodulating action of low-molecular-weight substances has been explained by their capacity of combining with some reactive groups of tissue proteins (3), (12), (15), (18), yet, for the time being, the intimate mechanism of such drugs is still obscure.

Some antibiotics, such as methramicyn, mythomicyn, meractynomicyn, cyclosporin, adriamicyn etc. (5), (10), (14), (16), whose specific immunedepressive effects have been evidenced, are supposed to act in the same manner.

With a view to thoroughly studying this aspect, following preliminary screening, we focused our investigation upon two new semisynthesis antibiotics, namely Valurin-1 and Valurin -2, showing also immunedepressive properties.

MATERIALS AND METHODS

The effects of the above-mentioned antibiotics upon the humorally- and cell-mediated immune response were investigated upon administration as i.m. injections to laboratory rabbits, in two different doses (12.5 mg/kg body/day and 20 mg/kg body/day), for six weeks. The results were evaluated as against the effects evidenced by Antifolan (whose immunedepressive action is known) the latter being administered in therapeutical dose (0.083 mg/kg body/day).

The influence upon the humorally-mediated immune response was followed by determining the time-variation of total serum proteins (the method of O. H. Lowry) (7) and that of the protein fractions (on taking tests of serum lability and electrophoresis on polyacrylamide gel) (1), (2), (9), (11).

The effects upon the leukocytic series were followed by the classical method (4), (6), (13), while those upon the circulating immune complexes by applying the modified Haskova method (17).

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RESULTS

In the case of Valurin-1, 17% reduction of total serum proteins, which was observed at the end of the treatment period, in the case of a high-dose treatment, is explained mainly through the decrease of gamma-globulins (73%) and beta-globulins (49.50%). Alpha-2-globulins also decrease (15%), while alpha-1-globulins and albumins remain practically unchanged. The effects of a low-dose treatment were of the same nature, yet quantitatively lower. Data obtained by electrophoresis were close to those yielded by serum lability tests. The antibiotic had no influence upon circulating immune complexes, whose serum level remained constant.

Nevertheless, on the other hand, the (high dose) treatment with Valurin-1 led to a slight stimulation of the cell-mediated immune response, expressed by the increase of total leukocytes (17.18%), which is mainly explained through the increase of monocytes (113.40%) and lymphocytes (40%). Eosinophiles increased very slightly (3%), while basophiles and neutrophiles decreased (19% and 5%, respectively). At low doses, similar effects, yet, generally less ample, were noticed.

The treatment with Valurin-2 also resulted in a reduction of total serum proteins (13%), due mainly to the decrease of gamma-globulins (55%) and beta-globulins (40%). Alpha-2-globulins decreased by only 8%, while alpha-1-globulins and albumins were slightly modified. In this case, too, electrophoresis data were confirmed by serum lability tests, while the variations induced by the low-dose treatment were of the same kind, although less ample. The level of the circulating immune complexes remained also unchanged, even after Valurin-2 treatments.

As to the effects induced upon the leukocytic series, Valurin-2, administered in high doses, induces also a slight stimulation, expressed by the increase of total leukocytes (by 14%) mainly through the increase of monocytes (38%) and neutrophiles (25.35%). Lymphocytes and eosinophiles increased only slightly (3.50 and 7.50%, respectively), while basophiles decreased (almost 30%). In the case of a low-dose treatment with Valurin-2 rather similar results upon the leukocytic series were recorded; in some situations (total leukocytes, lymphocytes, monocytes, eosinophiles) they were even better than those recorded with a high-dose treatment.

DISCUSSIONS AND CONCLUSIONS

The depressive effects of Valurin-1 upon the agents of the humorally-mediated immune response are generally stronger than those exhibited by Antifolan (8) (about four times, in the case of total proteins, two times with gamma-globulins, ten times with beta-globulins, and seven times with alpha-2-globulins)

Noteworthy, Antifolan neither modifies sensibly the value of serum albumins and alpha-1-globulins, nor does it exercise a significant influence upon circulating immune complexes.

Nevertheless, Antifolan leads to a reduction in the number of total leukocytes (16%), due mainly to the decrease of lymphocytes (46.50%). In this situation, there is a lower increase in monocytes (only by 25%) and

a higher one in basophiles (by 37%). Eosinophiles and neutrophiles remain practically unchanged in the Antifolan treatment.

Valurin-2 shows a lower immunedepressive action upon the humorally-mediated immune response than Valurin-1, yet stronger than that induced by Antifolan (three times in the case of total serum proteins, 1.75 times with gamma-globulins, 8 times with beta-globulins and 4 times in the case of alpha-2-globulins). Its effects are closer to those of Antifolan in the case of serum albumins and alpha-1-globulins or circulating immune complexes.

As to the action exerted upon the leukocytic series, as evident from the above-mentioned data, sensible differences do exist between the two agents, Valurin-2 exhibiting a slightly stimulating action, while Antifolan obviously depressing leukocytes and, especially, lymphocytes.

In conclusion, two antibiotics, Valurin-1 and Valurin-2, exhibit an evident immunedepressive action upon the humorally-mediated immune response (stronger in the former case, weaker in the latter), both products being more efficient than Antifolan in depressing the synthesis of serum immunoglobulins. Nevertheless, such antibiotics have rather a stimulating effect (although not very strong) upon the leukocytic series, while Antifolan's in this case is depressing, too.

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Received May 8, 1989

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SPECIFIC ACTION OF SOME BIOSYNTHESIS PRODUCTS UPON THE BODY'S DEFENCE CAPACITY

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The action of A.37.4 and A.12.3 antibiotics upon (total and fractions) serum proteins, upon serum complement, circulating immune complexes and upon leukocytic series, has been followed, as compared with the action of Rodilemide. Experiments were performed on laboratory rabbits, the antibiotics being administered in two different doses by i.m. injections, while Redilemide was given in therapeutical dose. The results obtained point out that the A.37.4 product shows immunostimulating effects — enhanced as the administered dose is increasing — obviously higher than those of Rodilemide. The A.12.3 possesses weaker immuno stimulating effects, as compared with A.37.4, yet still higher than those of Rodilemide, in case of the humorally-mediated immune response. Its effects upon the leukocytic series are weak, decreasing as the dose increases, even below those of Rodilemine.

An extremely interesting problem, largely discussed lately by several specialists in the field, is that of the control of the immune response by the physician or by the researcher with the help of techniques, methods and substances known to stimulate or inhibit the body's defence capacity (9), (13), (15), (22).

Among the agents showing an immunomodulating action (21), (25) are a series of substances with low molecular weight, such as steroids, hormones, some alkaloids, alkylated substances, certain antibiotics, a.s.o. (5), (14), (20), (23).

The present paper discusses the above-mentioned effects of some new biosynthesis antibiotics (A.37.4 and A.12.3) upon the humorally-or cellulary-mediated immune response.

MATERIALS AND METHODS

Experiments were performed on laboratory rabbits, both antibiotics (A.37.4 and A.12.3) being administered by i.m. injections, in two doses (0.010 mg/kg body-day and 0.105 mg/kg body-day) for 6 weeks. The results were compared with those yielded by the treatment with Rodilemide, characterized by an immunostimulating action, administered in a 10 mg/kg body/day, for the same period of time.

Animals subjected to these treatments were periodically (once a fortnight) analyzed as to their serum gamma-globulins, by taking the Kunkel and Huerga Popper tests (1), (4), (16), (17), gamma-globulins together with serum beta-globulins, by the Mac Lagan test (1), (16) total serum proteins, by the Lowry method (11); protein fractions by electrophoresis on polyacrylamide gel (12); the leukocytic formula by the classical method (6), (8), (10), (18), (19); serum complement by the Hartman-Brecy method (7), and the immune circulating complexes, by the modified Haskova method (24)

REV. ROUM.. BIOL. — BIOL. ANIM., TOME 34, Nº 2, P. 129—132, BUCAREST, 1989

RESULTS

The A.37.4 product induced a stimulating effect upon the humorally-mediated response, expressed, at the end of the treatment period, by the increase (38.86%) of total serum proteins, when administered in a high dose, which is attributed mainly to gamma-globulins (145.0% increase) and beta-globulins (218.93%). A moderate increase was to be observed in the case of alpha-2-globulins (18.00%), while albumins recorded a 10.20% reduction. The effects of the low-dose treatment were similar, yet less ample. Electrophoretic data supported the results yielded by serum lability tests.

The experiment performed also indicated that A.37.4 has a stimulating effect on the serum complement (a 67.76% increase being recorded with the high dose) which is intensified, too, with the increase of the administered dose. The level of the circulating immune complexes is not modified by such treatments.

Also, the product is seen as showing a stimulating effect upon the cell-mediated immune response expressed, in the case of the high dose, by the increase (by 73.74%) in the number of total leukocytes, especially through the increase of monocytes (by 218.07%) and neutrophiles (by 90.11%) but also of lymphocytes (56.14%) and eosinophiles (31.21%). Basophiles registered a 39.80% reduction.

The treatment with A.37.4, administered in a low dose, induced a lower increase of total leukocytes, somehow differentiated in the case of different leukocyte types.

The A.12.3 product also shows a stimulating action of humorally-mediated immune response, expressed, at the end of the treatment period, through the increase, in the case of the high dose, of total serum proteins (26.57%), due especially to gamma-globulins (94.0%) and beta-globulins (107.90%), and also to the alpha-1-globulins (23.45%) and alpha-2-globulins (13.48%). The level of serum albumins was not changed.

The effects of the low-dose treatment were similar in nature, yet less ample, while electrophoretic data supported serum lability test findings. In the case of the serum complement, an increase was also recorded, yet slighter (21.87%) with the high dose than with the low dose (124.44%).

The treatment with the A.12.3 antibiotics did not affect the level of circulating immune complexes.

On the other hand, this antibiotics have much weaker effects in stimulating the cell-mediated immune response, which is evident especially with the low dose, when total leukocytes show an increase of 23.86%, due mainly to lymphocytes (50.33%) monocytes (43.99%) and basophiles (43.70%).

In the case of the high dose, this effect is much reduced, the increase of total leukocytes (6.56%) occurring only due to lymphocytes (25.29%), while the other types of leukocytes are slightly decreasing.

DISCUSSION AND CONCLUSIONS

The stimulating action of the A.37.4 antibiotic upon the specific, humorally-mediated, immune response is stronger than that of Rodilemide (3), as compared with the standard agent, inducing, with high doses, increases of over three times in the case of total serum proteins and beta-globulins, and five times in the case of gamma-globulins. Nevertheless, Rodilemide does not modify the level of either serum albumins or alpha-globulins.

On the other hand, stimulation of the serum complement synthesis is stronger (about three times) in the case of Rodilemide, than with a high A.37.4 dose; yet, neither with Rodilemide was any modification of the level of circulating immune complexes recorded.

In their turn, the effects of A.37.4 (when administered in a high dose) upon the leukocytic series are generally stronger than those of Rodilemide, in the latter case total leukocytes increase three times less, neutrophiles six times less, lymphocytes 1.7 times less while monocytes 1.3 times less. Nevertheless, Rodilemide induces an almost twice greater reduction of basophiles, concomitantly with a decrease of the eosinophile level. A.12.3, although having a lower stimulating effect upon the humorally-mediated immune response than A.37.4, has nevertheless stronger effects than Rodilemide, the protein increase being over two times higher, that of gamma-globulins over three times, while that of beta-globulins over 1.5 times that of Rodilemide-induced taken as standard. In exchange, Rodilemide does not sensibly modify the level of serum alpha-globulins.

Yet, the effect of A.12.3 upon the serum complement is almost twice lower, even with low doses, than that of Rodilemide.

As to the action of A.12.3 (low dose) upon the leukocytic series, it generally equals, at the level of total leukocytes, that of Rodilemide, yet various types of leukocytes are being influenced differently. Lymphocytes increase almost twice, monocytes four times less, basophyles and eosinophiles rise, although they decrease in the case of Rodilemide, while neutrophiles remain actually unchanged.

Starting from the obtained experimental data, one can conclude that the A.37.4 shows an obvious simulating action both upon the humorally-and cell-mediated immune response, its effects being augmented with increasing the administered dose and being slightly higher than those induced by Rodilemide.

The A.12.3 product has stimulating effects upon the humoral immune response, which are enhanced with dose increases and are superior to those of Rodilemide, yet slightly lower than those induced by A.37.4. The stimulating effects upon the leukocytic series are, generally, weak and decrease, becoming much lower with increasing doses much below those of Rodilemide.

Characteristically, both antibiotics induce a weaker increase of the serum complement than Rodilemide does; in the case A.12.3, this increase is depleted as the dose is increasing, but neither antibiotic influences the level of the immune circulating complexes.

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Received May 8, 1989

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BIOELECTRICAL EFFECTS OF SOME PROCAINE ANALOGUE PRODUCTS

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The action of some derivatives, in the form of salts, of the diethlylaminoethanol (DEAE) (glutamate, acetylglutamate, acetylglycinate and acetylparaaminobenzoate) upon the membrane potential of the sartorius muscle fibre of frog has been studied, on applying the technique of glass intracellular microelectrodes. These products show bioelectrical effects similar to those of procaine and DEAE, inducing either a slight hyperpolarization of normal membranes, at a pH of 7.2 (and a concentration of 2.5 mM) or their slight depolarization at a pH = 6 and 1 mM concentration, as well as the removal of the cholesterol deposited in the structure of membranes. Results obtained evidence a series of significant pharmacological characteristics of such products indicating also that they may be used as analogues of procaine in certain pharmacological products.

The complex effects exhibited by procaine and procaine-based drugs (Gerovital and Aslavital), at various levels in the human body, have been studied in several papers (4), (5), (6), (16), (23), (28). As a diethylaminoethyl ester of the *para* aminobenzoic acid, procaine was also evidenced as being split within the organism, in *para* aminobenzoic acid (PABA) and diethylaminoethanol (DEAE), each metabolite having its own pharmacodynamic actions (1), (6), (7), (24), (28). At the same time, a series of aspects concerning the distribution of procaine metabolites at cell level have been, nevertheless, less studied.

In some previous investigations of ours, we have observed that a series of bioelectrical effects of DEAE and of some of its derivatives are similar to those of procaine (16), (19). Thus, starting from this, the present paper deals with the action of some new DEAE derivatives, in the form of salts, upon the electrical potential of normal or cholesterol-loaded cell membranes, having in view that, in ageing phenomena, as well as in certain diseases, the cholesterol proportion in the membrane is modified (15), (16), (24).

MATERIALS AND METHODS

Experiments were made on membranes of sartorius muscle fibres of frog (*Rana ridibunda* Pall.), the modification of the membrane potential (MP) being followed under the action of various agents, at room temperature, by the technique of intracellular glass microelectrodes.

Normal Ringer solution (NR) with a pH = 7.2 (bicarbonate buffer) or a pH = 6 (phosphate buffer) was administered under continuous current to the muscle. The bioelectrical effects of some solutions of DEAE glutamate, acetylglutamate, acetylglycinate and acetylparaaminobenzoate (GLU-DEAE, A. GLU-DEAE, A. GLY-DEAE and A-PAB-DEAE, respectively), in concentrations of 2.5 mM or 1 mM were followed; they were prepared by substances addition to NR. A series of membranes were treated with 0.1 mM cholesterol solution (CHOLEST.), obtained

through its dissolution in ethyl alcohol and addition of the alcoholic solution to NR, so that 1 % concentration of the alcohol should be obtained yet without significant effects on the MP (16), (17). In each experiment, measurements were performed each time on five muscles from various animals. Statistical treatment of the data was performed by Student's test.

RESULTS

The normal resting potential (NPR) recorded during the experiments registered values ranging between 90.70 mV and 94.03 mV (ES being about 0.5 mV).

In the NR solutions with a pH = 7.2, all substances investigated, at concentrations of 2.5 mM, induce a membrane hyperpolarization with an average amplitude of 4.54 mV in the case of GLU-DEAE, 6.63 mV in the case of A. GLU-DEAE, 4.42 mV in the case of A. GLY-DEAE and 1.13m V in the case of A. PAB-DEAE (Fig. 1 : A, C, E, F). Such an effect is similar to that of procaine (average hyperpolarization of 4.5 mV) and DEAE (average hyperpolarization of 2.85 mV), being much stronger than the PABA one (a hyperpolarization of 0.66 mV), under the same conditions (16), (17). At a pH = 6, 1 mM GLU-DEAE induces, nevertheless, a membrane depolarization, having an average amplitude of 3.45 mV (Fig. 1—B), similar to 1 mM procaine (depolarization of 4—8 mV) (4), (16), while 1 mM A. GLU-DEAE (Fig. 1 D) shows a much weaker effect (average depolarization of 0.58 mV).

The maintenance of muscular fibres in a NR solution containing 0.1 mM cholesterol determines a membrane hyperpolarization with an average amplitude ranging between 5.16 mV and 6.53 mV, which is irreversible when washing the fibres with NR (Fig. 2A), which evidences a strong cholesterol binding in the membrane structure.

The treatment of these fibres — hyperpolarized through the action of cholesterol — with NR containing DEAE derivatives causes a NRP recovery (Fig. 2 : B—E), as procaine and DEAE, in the same concentration, or the hypocholesterolemiant drug Clofibrate, do(16), (18), which indicates a mobilization of the cholesterol deposited in the membrane structure. Washing with NR of the fibres thus treated determines NRP maintenance, which evidences the recovery of the structure and of the normal properties of the membrane.

DISCUSSIONS AND CONCLUSIONS

It is known that, in the human body, procaine is split, after a relatively short time, by PABA and DEAE, each metabolite showing its own pharmacodynamic actions (1), (5), (6), (7), (24), (28).

In a series of previous researches of ours (4), (16), (17), (18) we have observed that, under conditions of normal pH and anaesthetic concentrations (25), procaine induces a slight membrane hyperpolarization, while, in the case of an acid pH, and underanaesthetic concentrations (1 mM), it induces its slight depolarization. On the other hand, we have

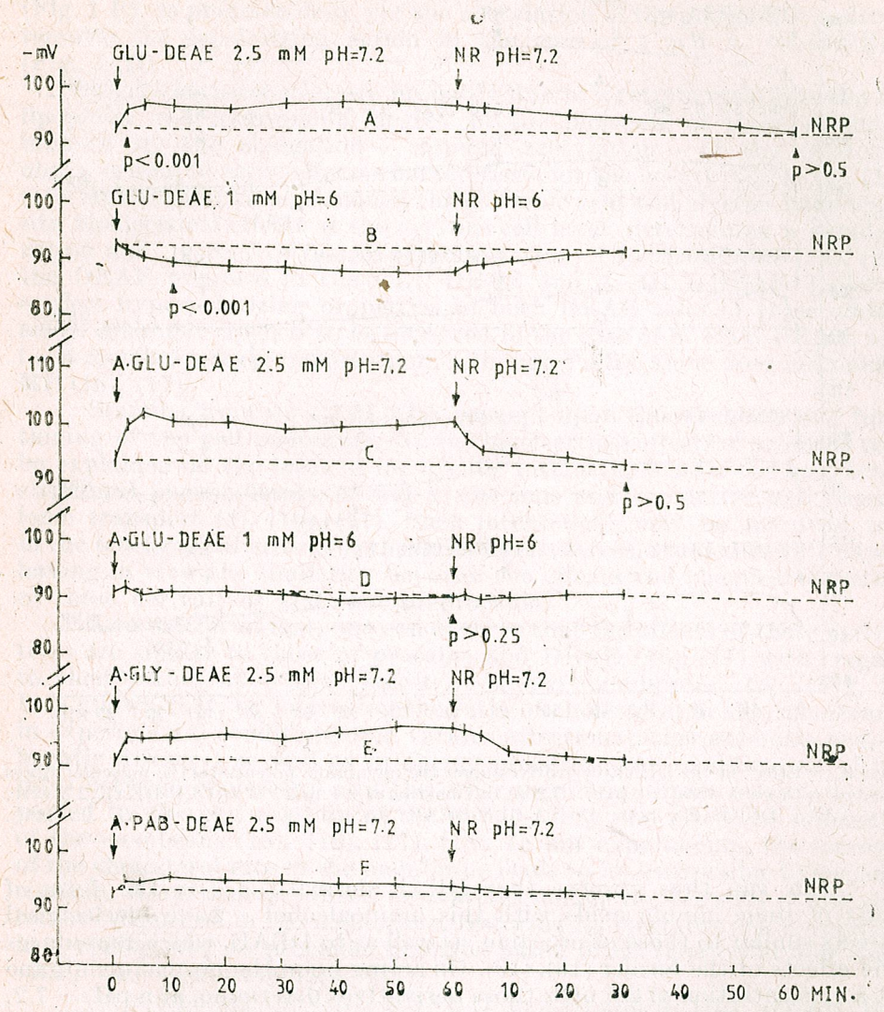

Fig. 1. — Effect of DEAE derivatives upon the membrane potential of normal muscular fibres (A = GLU-DEAE 2.5 mM, pH = 7.2; B = GLU-DEAE 1 mM, pH = 6; C = A.GLU-DEAE 2.5. mM, pH = 7.2; D = A.GLU-DEAE 1 mM, pH = 6; E = A.GLY-DEAE 2.5 mM, pH = 7.2; F = A.PAB-DEAE 2.5 mM, pH = 7.2).

observed that, among procain metabolites, only DEAE shows bioelectrical effects similar to those of the whole molecule, in the form of an ester (16), (17), which suggests the possibility of obtaining some DEAE derivatives manifesting their effects — similar to those of procaine — at the level of the cell membrane. The results presented in this paper, as well as previous data (16), (19), support this assumption.

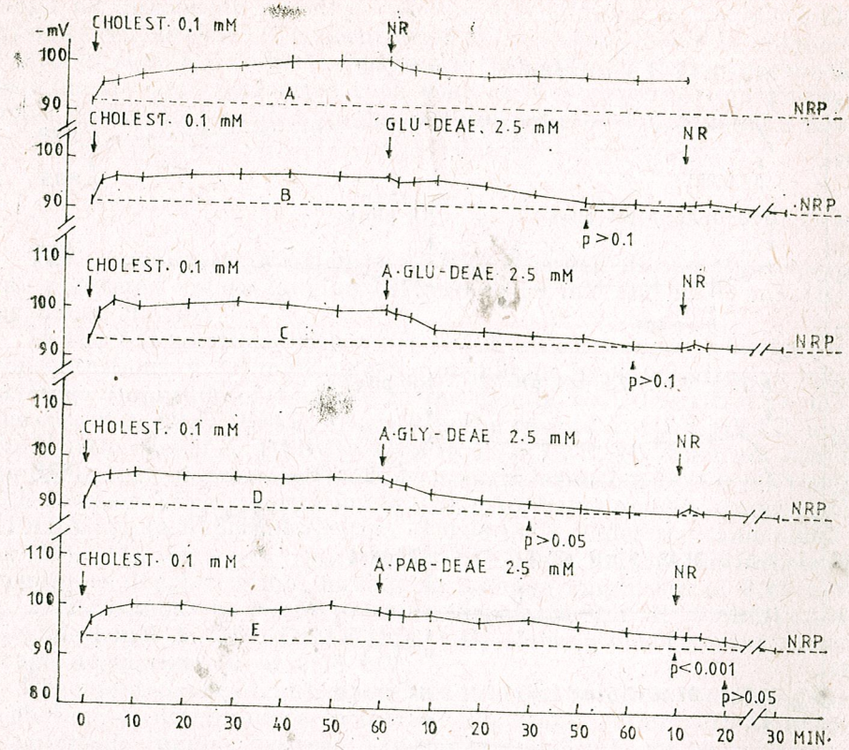

Fig. 2. — Effect of the DEAE derivatives upon the membrane potential of the muscular fibres treated with cholesterol, at pH = 7.2 (A = Cholesterol 0.1 mM; B = GLU-DEAE 2.5 mM; C = A.GLU-DEAE 2.5 mM; D = A.GLY-DEAE 2.5 mM; E = A.PAB-DEAE 2.5 mM).

One can thus observe that DEAE derivatives — in the form of salts of some aminic acids with this aminoalcohol — have bioelectrical effects similar to those of procaine, as well as to DEAE, which reproduces the effects of the former (16), (19). On acting upon the normal membrane at a concentration of 2.5 mM, those derivatives determine, at a pH = 7.2, a membrane hyperpolarization, while, at a concentration of 1 mM and acid pH, provokes its depolarization, as procaine does, under the same conditions. Nevertheless, one can also observe some differences among the effects of the various derivatives upon MP. Thus, at a normal pH, the GLU-DEAE effect is more persistent (Fig. 1 A), which is indicative of its stronger binding in the membrane structure, while the A. GLU-DEAE effect is more pronounced (Fig. 1 C), yet easily reversible, which evidences that the presence of the acetyl radical in the molecule of the product strengthens its action, also determining its weaker binding in the membrane. The same phenomenon is to be observed in the case of A. GLY-DEAE, too (Fig. 1 E). Another observation is that, in the case of an acid pH, 1 mM GLU-DEAE also induces membrane depolarization

(Fig. 1 B), as procaine does, yet the acetylation of the glutamate molecule removes the depolarizing action in the case of 1 mM A. GLU-DEAE (Fig. 1 D).

Such characteristics are probably due to a certain ratio between the lipophilia and hydrophilia degree of the molecule of these products, induced by the elongation — through acetylation — of the molecular chain, or/and to some effects characteristic for the acetyl radical (9), (11), (16). At the same time, although the glutamic acid and glycine have opposite bioelectrical effects at the nervous cell level, determining a depolarization and, respectively, a hyperpolarization of its membrane (14), (23), the DEAE presence in the GLU-DEAE and A. GLY-DEAE molecule confers hyperpolarizing properties to both DEAE salts of these amino-acids. A similar effect is to be observed in the case of A. PAB-DEAE, too, i.e. a membrane hyperpolarization, although PABA alone does not modify MP (16), (17).

Starting from the "2 M.S.I." concept upon the structure and functioning of the cell membrane (3), the bioelectrical effects of procaine may be explained on the basis of its specific interactions with the membrane structural phospholipids, as wel as the ions and the active and passive ionic transport (4), (16), (17). Such interactions may be involved, too, in the bioelectrical effects of the DEAE derivatives, studied in this paper, having in view the similarity between the effects and chemical structure of these derivatives and that of procaine.

As a matter of fact, one can observe that the effects of these derivatives are similar to those of procaine and DEAE (16), (17) with regard to their action upon the cholesterol-loaded membranes, too, (Fig. 2). It is known that, by increasing the ratio of cholesterol in the membrane, in experimental conditions or in various affections (atherosclerosis, cancer, hepatic diseases) as well as in ageing processes, the modification of the ratio between cholesterol and the other membrane lipids occurs, accompanied by the perturbation of the permeability and electrical properties of the membrane (15), (16), (17), (18). In our experiments, the increase of the cholesterol rate in the membrane leads to its irreversible hyperpolarization. Nevertheless, DEAE derivatives induce the removal of the cholesterol deposited in the membrane, restoring its structure and properties, in a similar way to procaine, procaine-based drugs (Gerovital and Aslavital) and Clofibrate (16), (17).

On comparing the GLU-DEAE (Fig. 2 B) and A. GLU-DEAE (Fig. 2 C) effects, it is to be observed, here too, that the presence of the acetyl radical in the molecule of the product increases the action rate and efficiency. At the same time, it is to be seen that A. PAB-DEAE, too, has similar effects to those of procaine upon the membrane deposited cholesterol, although PABA alone does not exhibit such effects (16), (17). This is based on the presence of DEAE in the structure of the product, having similar effects to those of procaine (16), (17).

For a more exact estimation of the positive effects of DEAE derivatives at the level of the cell membrane, one has to consider both their bioelectrical effects and their interactions with the ions and membrane structure, the complex role played in the organism by the acetyl radical, from their molecule (12), the role and distribution of DEAE and PABA

at various levels in the organism (1), as well as their action of restoring the normal structure and functions of the cholesterol-loaded membrane, or of the hepatic cell (16), (24). Having in view all these aspects, as well as the similarity between the structure and effects of these DEAE derivatives and procaine, there appears the possibility of the utilization of such products as procaine analogues in certain pharmaceutical preparations (10), (20), showing stimulating, eutrophic, antiatherosclerotic or hepatoprotective effects. Actually, in a series of previous papers, the pharmacological properties of products having a similar structure (derivatives of aminoalcohols) which evidenced their positive effects in nervous and hepatic affections, as well as in fatigue, geriatry (13), (21), (22), (26), (27) or anaesthesia (8) were discussed.

Starting from these results, we can also assert that the procedure of testing the capacity of removing the cholesterol deposited in the membrane structure, through MP measurements, may be used in the rapid selection of some new products, probably possessing antiatherosclerotic properties, as already evidenced in other studies (16), (17).

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Received March 4, 1988

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THE EFFECT OF SELECTIVE PRESSURE ON THE BIOPRODUCTIVE CAPACITY OF *STREPTOMYCES RIMOSUS*

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Application of a selective pressure on the individuals of a certain population results, in time, in the deviation of the reaction norm, improvement of the studied characteristics, (bioproductive quality, resistance, precocity, prolificity) as well as in changing the initial genotype structure. Such an action assumes a thorough knowledge both of heritability of the characteristics under study and of the amplitude of individual variability, the action field of selection (1, 2, 3, 4, 5).

MATERIAL AND METHODS

The experiment discussed in the present paper was performed on the I.T.II strain of *Streptomyces rimosus*, which is naturally employed in production processes at The Antibiotics Factory of Jassy.

The starting biological material was characterized by a bioproductive capacity of 26 mm (the American Variety of the *Baccilus subtilis* germ test being used for microbiological dosing). At the same time, biochemical, microscopical and sterility tests were performed.

The main objective of this melioration programme of the *Streptomyces rimosus* species was to obtain a strain with a high biosynthesis capacity and also a high stability in time. In this respect, selection was applied as working method (on studying the 10^{-7}, 10^{-8}, 10^{-9}, 10^{-10} dilutions) by perpetuation and multiplication of plus-variants during the five selection steps (cloning). The vegetative phase was kept on the MAO maintenance medium.

RESULTS AND DISCUSSIONS

The starting biological material, stored on the MAO medium, and tested by the above mentioned methods, through 860 colonies, evidenced a variability of the bioproductive activity ranging between 12—28 mm. 200 plus-variant colonies resulted from this cloning, evidencing values of the biosynthetic activities ranging between 24—28 mm and minus-variant colonies. For subsequent cloning two plus-variant colonies, characterized by an activity of 27 mm and 28 mm were studied; these two plus-variants were cloned separately, within five selection steps.

1. For the first cloning, from the 27 mm plus-variant, 88 plus-variants (representing a percentage of 35%) were obtained, by testing 250 colonies, which evidenced activities ranging between 24—29 mm and a 22% increase of activity (biochemical dosage), as compared with the initial material.

2. The 29 mm plus-variant colony was the biological material utilized in the second cloning, performed by testing 170 colonies; it evidenced 55 plus-variant colonies (32%) showing activities ranging between 24 and 30 mm, and a 32% higher U/ml, versus the starting one.

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3. The third cloning assumed the testing of 200 colonies of the 30 mm plus-variant, 50 plus-variant colonies (25%) resulting thereof. These plus-variant colonies were characterized by activities ranging between 24 and 31 mm and a 36% higher U/ml.

4. The fourth cloning was performed on the 31 mm plus-variant by testing 200 colonies. 40 plus-variant colonies resulted, showing a 38% higher U/ml activity and activities between 26—31.5 mm.

The same method was used in the descendant of the 28 mm plus-variant colony.

1. The first cloning assumed testing of 250 colonies, out of which 70 plus-variant colonies representing 28% were selected, with activities ranging between 24—29 mm and 33% higher U/ml, as compared with the initial biological material.

2. The second cloning was made by testing 170 colonies resulted from the 29 mm plus-variant; 60 plus-variant colonies (35%) resulted, characterized by activities ranging between 24—30 mm and a 36% U/ml.

3. The third cloning employed the 30 mm plus-variant colony, tested through 200 colonies, out of which 40 plus-variant colonies (20%) with activities ranging between 24—31 mm and 37% higher U/ml were selected.

4. The 31 mm plus-variant colony was cloned by testing 200 colonies; there resulted 38 plus-variants (representing 19%) with activities ranging between 24—32 mm and an increase of activity of 37%.

CONCLUSIONS

1. Selection of plus-variant colonies, by five clonings and by testng 2,500 colonies, led to an increase in the bioproductive activity of 26% and 23%, respectively, depending on the biosynthetic activity of the starting plus-variant (27 mm in the former and 28 mm in the latter case).

2. Compared with the initial biological material (with which the experiment began) the increase of the biosynthetic activity was of 38% and 37%, respectively.

3. Increase of the biosynthesis activity over a certain limit is inversely proportional to the number of plus-variant colonies. This process is natural in a normal distribution of the individuals, within the population reaction norm, the number of those showing maximum values (of one parameter) decreasing continuously, highly significant positive deviations becoming thus impossible over a certain limit.

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Received March 12, 1988

Centre of Biological Researches
Iași, 23 August, 20 A

ÖKOLOGISCHE UNTERSUCHUNG ÜBER THYSANOPTEREN AUS DEM GÎRBOVA-MASSIV (RUMÄNIEN)

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Die ökologische Untersuchung unter stationären Bedingungen stellt die einzige komplexe und moderne Modalität des Studiums der verschiedenen pflanzlichen und tierischen Zönosen d r. In diesem Sinne führten wir eine weitgespannte Untersuchung über die Synökologie der Thysanopteren aus den Gebirgswiesen des Gîrbova-Massivs aus, indem wir die Struktur und Dynamik der Populationen in Zusammenhang mit den stationären mikroklimatischen Faktoren berücksichtigten.

Die vorliegende Arbeit behandelt lediglich einige Populationsindices, wie die Diversität und Aquität.

1. MATERIAL UND METHODE

Zum qualitativen und quantitativen Studium der Thysanopteren verwendeten wir parallel zwei für diese Insekten spezifische Methoden und zwar die Methode der Abschüttlung und die Fangnetzmethode. Im Rahmen der ersten Methode wurden je 10 Proben von jeder sich in der Blüte befindenden Pflanzenarten genommen, während bei der zweiten Methode je 3 Proben von jeweils 50 Abstreifungen eingesammelt wurden. Diese Sammeltechniken, die zweimal pro Monat während 2 Jahren ausgeführt wurden erlaubten die Aufstellung des vollständigen spezifischen Spektrums der Thysanopteren, deren strukturelle Besonderheiten, die zahlenmässige Fluktuation sowie die kausale Auslegung derselben. Die notwendige Zahl der eingesammelten Proben wurde statistisch bestimmt, wobei die Abschätzung der Gesamtzahl mit einer Genauigkeit von 0,2—0,3 stattfand.

2. CHARAKTERISIERUNG DER STATIONÄREN ÖKOLOGISCHEN FAKTOREN

Unsere Untersuchungen über die Thysanopteren wurden im Gîrbova-Massiv auf ungemähten und nicht abgeweideten Gebirgswiesen an 6 Orten mit einer Höhe zwischen 800—1375 m vorgenommen, und zwar: Setu Station (800 m), dann in Bogdan-Tal Station I (900 m), Station II (1170 m), Station III (1205 m), Station IV (1285 m) und Station V, gelegen auf einem alpinen Rücken (1375 m).

Das untersuchte Gebiet von Setu besass eine komplekte meteorologische Station, während durch simultane Ablesungen von klimatischen Faktoren bei 3 Untersuchungsgebieten innerhalb von 12 Stunden, die periodisch wiederholt wurden, die mikroklimatischen Bedingungen für sämtliche Untersuchungsgebiete durch Anwendung des thermischen Gradienten berechnet werden konnte. Das Klima ist im allgemeinen typisch für die supramontanen-subalpinen Gebirgsgegenden.

Die charakteristische Assoziation ist durch *Festuca rubrafallax* mit *Nardus stricta* dargestellt. Die Bedeckung des Gebietes ist 100%-ig. Von

der Gesamtzahl der Arten, welche die Wiesen bedecken stellen 15 Gramineae, 5 Leguminosae, 5 Cyperaceae und Juncaceae und der Rest verschiedene andere Pflanzenarten dar.

Die klimatischen, bodenbedingten, pflanzlichen und Höhenunterschiede verleihen jeder untersuchten Oberfläche eine bestimmte Eigenheit, die sich charakteristisch in der Struktur und Dynamik der Thysanopterenzönosen widerspiegelt.

3. DIVERSITÄT UND ÄQUITÄT

Im Laufe der 2 Jahre wurde ein reichhaltiges Untersuchungsmaterial gesammelt, welches in 15 010 Exemplaren bestand, die 79 Arten angehörten (Tab. 1). Die spezifische Zusammensetzung, die vorherrschende,

Tabelle 1

Die Thysanopteren aus dem Girbova-Massiv (2 Jahre)

	Fangnetz-methode	Abschüttlungsmethode
1. *Melanthrips fuscus*	21	34
2. *Melanthrips gracilicornis*	3	11
3. *Melanthrips pallidior*	180	232
4. *Melanthrips knechteli*		1
5. *Rhipidothrips gratiosus*	1	
6. *Aeolothrips fasciatus*	45	67
7. *Aeolothrips intermedius*	230	349
8. *Aeolothrips albicinctus*	8	
9. *Aeolothrips ericae*	5	11
10. *Sericothrips circumfusus*	4	
11. *Sericothrips bicornis*	9	
12. *Aptinothrips rufus*	115	11
13. *Aptinothrips elegans*	37	1
14. *Aptinothrips stylifer*	412	43
15. *Prosopothrips vejdovski*	2	
16. *Anaphothrips obscurus*	13	2
17. *Anaphothrips euphorbiae*	1	21
18. *Oxythrips brevistylis*	5	
19. *Apterothrips secticornis*		1
20. *Frankliniella tenuicornis*	1	
21. *Frankliniella intonsa*	94	929
22. *Frankliniella pallida*		2
23. *Parafrankliniella verbasci*	1	4
24. *Kakothrips dentatus*		1
25. *Kakothrips robustus*	6	67
26. *Odontothrips uzeli*	8	37
27. *Odontothrips loti*	202	580
28. *Odontothrips phaleratus*	6	
29. *Odontothrips confusus*	1	4
30. *Rhopalandrothrips annulicornis*	2	
31. *Taeniothrips trybomi*	3	13
32. *Taeniothrips vulgatissimus*	35	50
33. *Taeniothrips atratus*	56	92
34. *Taeniothrips montanus*	110	121
35. *Taeniothrips inconsequens*	12	513
36. *Taeniothrips picipes*	134	

	Fangnetz-methode	Abschüttlungsmethode
37. *Taeniothrips firmus*	40	2
38. *Taeniothrips discolor*		1
39. *Taeniothrips frici*	24	12
40. *Taeniothrips minutissimus*	3	4
41. *Taeniothrips montivagus*	7	41
42. *Thrips hukkineni*	21	60
43. *Thrips pillichi*		13
44. *Thrips pelikani*	27	221
45. *Thrips physapus*	114	1337
46. *Thrips incognitus*		1
47. *Thrips flavus*	12	21
48. *Thrips tabaci*	78	441
49. *Thrips nigropilosus*	1	27
50. *Thrips validus*	23	214
51. *Thrips euphorbiae*		9
52. *Thrips crassicornis*	1	
53. *Thrips major*	3	5
54. *Thrips dilatatus*	1	
55. *Sminiothrips biuncatus*	1	
56. *Stenothrips graminum*		2
57. *Chirothrips manicatus*	1807	38
58. *Chirothrips aculeatus*	12	
59. *Limothrips denticornis*	16	
60. *Limothrips schmutzi*	4	1
61. *Nesothrips bicolor*	2	
62. *Haplothrips reuteri*	36	115
63. *Haplothrips seliger*	8	2
64. *Haplothrips distinguendus*	37	34
65. *Haplothrips tritici*	40	12
66. *Haplothrips alpester*	196	327
67. *Haplothrips leucanthemi*	75	889
68. *Haplothrips augusticornis*	505	720
69. *Haplothrips niger*	206	1601
70. *Haplothrips aculeatus*	62	12
71. *Haplothrips acanthoscelis*	19	37
72. *Haplothrips kurdjumovi*	2	1
73. *Haplothrips subtilissimus*	3	1
74. *Haplothrips phyllophilus*		1
75. *Phlaeothrips pillichianus*	4	
76. *Hoplandrothrips bidens*	4	
77. *Phlaeothrips coriaceurs*	1	
78. *Liothrips austriacus*	1	
79. *Liothrips setinodis*	2	1

relative zahlenmässige Häufigkeit, die nach Geschlecht strukturierten Thysanopteren, bezogen auf das jeweilige untersuchte Gebiet, wurden im Mai 1983 auf dem Entomolgen-Symposium in Iași (Rumänien) vorgetragen (5).

Die Diversität ist einer der ältesten und gleichzeitig auch am meisten disputierten Indices. Ihre Untersuchung ist von grösster Bedeutung, da sie den ökologischen Prozess der Beziehungen, die zwischen der Anzahl der Arten und der Anzahl der Individuen besteht, synthetisch ausdrückt. Die Grundidee der Diversität erscheint zum ersten Mal in den biozöno-

tischen Prinzipien von Thienemann (1939). Der α-Index von Fisher, Corbet, Williams tritt 1943 auf, der Simpson Index (1949), dann die Formel von Shannon-Weaver, die von MacArthur (1957) angewendet wurde, der Brillouin-Index, etc.

Der von Lloyd-Ghelardi (1964) eingeführte Index erlaubte die getrennte Analyse der beiden Quellen der Diversität und zwar die Anzahl der Arten und die Äquität, eine Arbeitsweise, die unserer Meinung nach, die vernünftigste ist. Die Anzahl der Arten ist ein quantitatives, für ein gegebenes Biotop charakteristisches Kennzeichen, das sich entlang längen- und breitenmässigen Gradienten verändert.

Die Äquität ist ein quantitatives Kennzeichen, welches die Organisierug des betreffenden Biotops und die bestehenden Beziehungen, zwischen den hier angepaßten Arten widerspiegelt, das heisst (nach Ashby, 1970) die Begrenzungen, denen die betreffenden Arten im Wettkampf mit anderen Arten unterworfen sind.

Bei der qualitativen und quantitativen Charakterisierung der Thysanopterenzönosen in den untersuchten Gebieten verwendeten wir den α-H (Brillouin)-Simpson und den E-Index.

Der α-Index

Da die von jeder einzelnen Art übermittelte informationelle Botschaft für eine kürzere Zeitspanne von ökologischen Faktoren und biologischen Eigenheiten abhängt, werden diese Einflüsse durch längere Intervalle, Jahres- und Mehrjahresdaten ausgeschaltet, wobei die übermittelte Informationsmenge sich der Durchschnittsinformation der jeweiligen Art nähert.

In diesem Sinne habe ich die Werte des α-Indexes für beide Methoden, wie auch in bezug auf die Gesamtzahl der Thysanopteren berechnet.

Die Fangnetzmethode ergibt eine mannigfaltigere Ausbeute von Thysanopteren (30—40 Arten), indem die Werte des α-Indexes zwischen 10,1 — 9,1 schwanken (Seţu = 10,1; I = 9,3; II = 9.7; III = 9,75; IV = 9,3; V = 9,1). Die Werte des Indexes sind also vom Klima und der Höhenlage beeinflusst (sie sinken mit dem Ansteigen der Höhe ü. M. ab).

Mit der Abschüttlungsmethode erhält man viel kleinere Werte des α-Indexes, die zwischen 5,3 — 7 liegen (Seţu = 6; I = 6,2; II = 5,5; III = 7; IV = 6,4; V = 5,3); auch die Zahl der gesammelten Arten ist niedriger (20—30).

Eine Erklärung für die Schwankungen dieses Indexes besteht darin, dass die Blüten von einer kleineren Pflanzen Anzahl von Thysanopterenarten, die sich in grossen Anhäufungen gruppieren, bevölkert sind, so dass der α - Index in diesem Fall ganz besonders von der Pflanzenzusammensetzung beeinflusst ist.

Der Unterschied zwischen den beiden Methoden geht auch aus der Analyse der Gesamtzahl der gesammelten Thysanopteren (15.010 Individuen, 79 Arten) hervor.

Mittels der Fangnetzmethode wurden 69 Arten (87%) gesammelt von denen nur 20 Arten spezifisch sind, während mittels der Abschüttlungsmethode nur 59 Arten (74,6%) von denen lediglich 10 Arten spezifisch sind, gesammelt wurden, die übrigen 49 Arten waren gemeine Arten.

Die Fangnetzmethode ist also klar überlegen. Um aber ein korrektes zönotisches Bild zu erhalten, habe ich die Ergebnisse der beiden Methoden summiert (Tabelle 2). Der Mittelwert sämtlicher α-Indeces betrug 8,4, er ähnelte dem von Tansky in der *Stipa penata* beherrschten Steppe gefundenen Wert (nach Lewis, 1973). Es scheint, dass in den gemässigten Zonen die Wiese das am meist mit Thysanopteren bevölkerte Ökosystem darstellt, was daraus zu erklären ist, dass die Gramineen die von diesen Insekten am häufigsten besuchten Wirtspflanzen sind.

Ich verwendete den α-Index darum weil die Häufigkeit der Thysanopterenarten sich in eine logarithmische Serie einschreibt; vorherrschende Arten sind gering an der Zahl, zahlreich sind aber die Arten mit weniger Individuen, also mit geringer Äquität.

In der Tabelle 2 sind auch die Werte des H-Indexes (Brillouin) und die Äquität sowie die Mittelwerte, die Standardabweichung und der Variationskoeffizient für jeden einzelnen Index enthalten.

Der E-Index

Aufgrund des E-Indexes schuf MacArthur ein matematisches Modell, nach welchem die Individuen nicht gleichmässig auf sämtliche Arten verteilt sind, sondern gemäss eines theoretischen Verteilungsmodells, in welchem sich die ökologischen Nischen der verschiedenen Arten berühren wobei die Gesamtzahl der Individuen ungefähr konstant bleibt. Im Falle der untersuchten Biotope sind die Häufigkeiten der Arten vom MacArthur-Modell weit entfernt, indem die Äquität ziemlich kleine Werte aufweist (wegen der Anordnung der Häufigkeiten in logarithmischen Serien, Tab. 2).

Der H-Index (Brillouin)

Der H-Index weist ziemlich hohe Werte auf (Tab. 2), kleinere Werte weist er nur in Biotopen bei grösseren Höhenlagen auf. Sowohl die Jahres- als auch die Mehrjahreswerte weisen darauf hin, dass die Thysanopterenzönosen aus den untersuchten Gebieten eine komplexe Organisierung mit zahlreichen Arten, aber, zahlenmässig unterschiedlich vertreten, aufweisen, von denen nur wenige gemein und häufig sind, die meisten aber selten oder sehr selten sind.

Aus den erhaltenen Ergebnissen geht auch hervor, dass die untersuchten Wiesen sich durch abwechslungsreiche Lebensbedingungen mit einem breiten trophischen Netz auszeichnen, was sich in der gross en Zahl der gesammelten Arten wiederspiegelt.

Der Simpson-Index

In Tabelle 3 sind die Werte des Simpson-Indexes und dessen Äquität nach Sammelmethode, in monatlicher Dynamik im Laufe der 2 Jahre und in Abhängigkeit der untersuchten Station wiedergegeben.

Tabelle 2

Diversität und Äquität der Thysanopteren aus dem Gîrbova-Massiv

Biotopen	1					2					1–2		
	Arten	Ind.	α	H	E.	Arten	Ind.	α	H	E	α	H	E
Seţu	47	1366	9,4	1,2294	0,7500	43	1604	8,2	1,1189	0,6900	8,8	1,1741	0,7200
I	44	1338	9,0	1,1832	0,7700	39	863	8,4	1,2177	0,7830	8,7	1,2004	0,7765
II	36	1106	7,2	1,1434	0,7590	39	1192	7,8	1,1788	0,7390	7,5	1,1611	0,7490
III	41	1021	8,5	1,2839	0,8180	50	1848	9,5	1,0879	0,6530	9,0	1,1859	0,7355
IV	42	1443	8,1	0,9533	0,5968	58	1173	8,0	1,077	0,6820	8,05	1,0151	0,6394
V	38	983	8,0	1,1056	0,7180	37	537	9,1	1,0956	0,7100	8,5	1,1006	0,7140
	Für α $\bar{x}$ = 8,37			Für H $\bar{x}$ = 1,1395					Für H $\bar{x}$ = 1,1395		Für E$\bar{x}$ = 72,23 %		
	D = 0,715			D = 0,0832					D = 0,0832		D = 5,85		
	cv = 11,70 %			cv = 7,30 %					cv = 7,30 %		cv = 8,10 %		

Tabelle 3

Simpson-Indices und Äquität

Biotop			IV	V	VI	VII	VIII	IX	X
Seţu	1***	Netz.*	—	0,88	0,92	0,87	0,84	0,15	—
			—	0,92	0,97	0,94	0,91	0,18	—
		Absch**.	—	0,86	0,80	0,78	0,74	0,63	0,58
			—	0,91	0,85	0,84	0,80	0,68	0,69
	2***	N.	0,72	0,83	0,86	0,75	0,68	0,18	0,44
			0,84	0,92	0,91	0,81	0,75	0,24	0,89
		Ab.	0,55	0,79	0,81	0,58	0,86	0,51	0,81
			0,64	0,84	0,84	0,61	0,92	0,57	0,94
I	1	N.	—	0,85	0,87	0,87	0,76	0,14	—
			—	0,90	0,92	0,93	0,85	0,18	—
		Ab.	—	0,43	0,62	0,84	0,83	0,15	0,05
			—	0,47	0,65	0,90	0,90	0,17	0,10
	2	N	0,71	0,83	0,84	0,69	0,77	0,28	0
			0,85	0,90	0,92	0,77	0,88	0,43	0
		Ab.	0,66	0,72	0,87	0,86	0,84	0,78	0,61
			0,83	0,78	0,92	0,90	0,92	0,89	0,81
II.	1	N.	—	0,87	0,90	0,82	0,20	0,08	0,44
			—	0,93	0,95	0,87	0,23	0,12	0,88
		Ab.	—	0,36	0,55	0,72	0,55	0,74	0,44
			—	0,43	0,59	0,79	0,61	0,83	0,88
	2	N.	0,74	0,89	0,80	0,63	0,49	0,43	0,44
			0,92	0,94	0,85	0,69	0,59	0,58	0,22
		Ab.	0,72	0,86	0,74	0,86	0,77	0,67	0,58
			0,90	0,94	0,78	0,92	0,83	0,80	0,70
III.	1	N.	—	0,87	0,90	0,76	0,82	0,41	0,74
			—	0,92	0,94	0,80	0,91	0,52	0,92
		Ab.	—	0,80	0,77	0,73	0,85	0,89	0,70
			—	0,87	0,83	0,81	0,92	0,95	0,93
			0,83	0,95	0,92	0,86	0,24	0,48	0,44
	2	N.	0,97	0,94	0,97	0,90	0,27	0,64	0,22
		Ab.	0,471	0,668	0,807	0,847	0,882	0,699	0,54
			0,538	0,698	0,852	0,897	0,934	0,8158	0,805
IV.	1	N.	—	0,87	0,86	0,76	0,79	0,03	0,07
			—	0,95	0,93	0,81	0,88	0,07	0,15
		Ab.	—	0,62	0,75	0,52	0,82	0,77	0,62
	2	N.	0,55	0,88	0,70	0,53	0,72	0,17	0
			0,67	0,95	0,77	0,58	0,79	0,23	0
		Ab.	0,65	0,81	0,70	0,32	0,89	0,66	0,52
			0,82	0,86	0,73	0,33	0,95	0,75	0,77
V.	1	N.	—	0,83	0,51	0,89	0,35	0,09	0
			—	0,95	0,53	0,95	0,36	0,12	0
		Ab.	—	0,75	0,90	0,74	0,83	0,65	0,65
			—	0,93	0,93	0,80	0,89	0,75	0,78
	2	N.	0,72	0,53	0,80	0,08	0,77	0,39	0
			0,96	0,58	0,85	0,86	0,86	0,52	0
		Ab.	—	0,70	0,84	0,78	0,70	0,64	0
				0,75	0,92	0,91	0,76	0,85	0

* = Netzmethode ; ** = Abschüttlungsmethode ; *** = erstes und zweites Jahr

Die Werte des Indexes schwanken mit dem Monat des Einsammelns, also mit dem Klima, mit der Höhenlage und der Reichhaltigkeit der Pflanzendecke.

4. SCHLUSSFOLGERUNGEN

1. Die Thysanopterenzönosen aus den untersuchten Stationen besitzen eine komplexe Organisierung, bestehen aus zahlreichen Arten, die aber zahlenmässig verschieden vertreten sind und von denen nur wenige gemein und häufig, die Grosszahl aber selten oder sehr selten sind.

2. Die untersuchten Diversitätsindizien weisen auf das Vorhandensein unterschiedlicher Lebensbedingungen im Gîrbova-Massiv und auf ein reichhaltiges trophisches Netz hin, was sich in der grossen Zahl der gesammelten Arten widerspiegelt (79).

3. Im Falle der untersuchten Biotope sind die Häufigkeiten der Arten in logarithmischen Serien angeordnet und unterwerfen sich darum nicht dem mathematischen Modell von MacArthur.

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Eingegangen am 10. Mai 1989

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Bukarest, Splaiul Independenţei 296

DAS BAKTERIEN-BENTHOS ALS AUSDRUCK DES TROPHISCHEN ZUSTANDES VON ÖKOSYSTEMEN DES DONAU-DELTAS

DOINA PEPTEA-IONICĂ

The work presents the total number of heterotrophic germs in the sediment of some aquatic ecosystems in the Danube Delta within a period of three years consecutively. The dynamics of this structural parameter of the bacteriobenthos is characterized by an ascending evolution of a numerical density of the heterotrophic bacteria from year to year in each ecosystem. If we compare our results with those in the literature, we find that all ecosystems fall into the category of eutrophic lakes — the upper limit. The value scale given by the multiannual average of each ecosystem determines a priority order which shows the eutrophy steps in which each ecosystem lies.

Die heterotrophen Mikroorganismen spielen eine wichtige Rolle bei der Zersetzung und Mineralisierung organischer Stoffe; sie stellen jenes Glied dar, welches die Funktionstüchtigkeit der anderen produzierenden und verbrauchenden trophischen Glieder beeinflusst und gleichzeitig den ständigen Lieferer von Nährstoffen der hydrochemischen Komponenten bildet. Aus diesem Grunde befassen wir uns in dieser Arbeit mit der Dynamik der Gesamtmenge der heterotrophen Bakterien in den See-Komplexen Roşu-Porcu-Puiu in den Jahren 1976—1978 und Matiţa-Merhei in den Jahren 1980—1982.

MATERIAL UND METHODIK

Als Nährboden diente Agar; Einimpfung oberflächlich; Inkubationsdauer 48 Std. bei 22° C. Es wurde monatlich die Gesamtzahl heterotropher Bakterien in der Sedimentschicht 0—5 cm bestimmt. Die Ergebnisse werden in Keimzahl/g feuchten Schlicks angegeben.

ERGEBNISSE UND DISKUSSIONEN

Aus der allgemeinen Entwicklung der zahlenmässigen Dichte der heterotrophen Bakterien ergeben sich gewisse wichtige Charakterzüge, welche einerseits auf allgemeine jahreszeitliche Vorgänge zurückgehen, andererseits auf gewisse Charakteristika des Sediment-Typus beruhen, wobei beide Einflüsse die zeitliche und räumliche Entwicklung der heterotrophen Mikroflora bestimmen. In dem Seen-Komplex Roşu-Porcu-Puiu zeigt die auf grund der monatlichen und jährlichen Durchschnittswerte (Abb. 1) abgeschätzte numerische Dichte ein stätiges Anwachsen in jedem Ökosystem vom Frühjahr bis im Herbst; demzufolge stiegen die Werte in der Beobachtungsperiode von Jahr zu Jahr zusehends an. Die Grenzwerte des Schwankungsbereichs liegen bei $10^6 - 10^{11}$. Im Seen-Komplex Matiţa-Merhei sinkt die zahlenmässige Dichte von Jahr zu

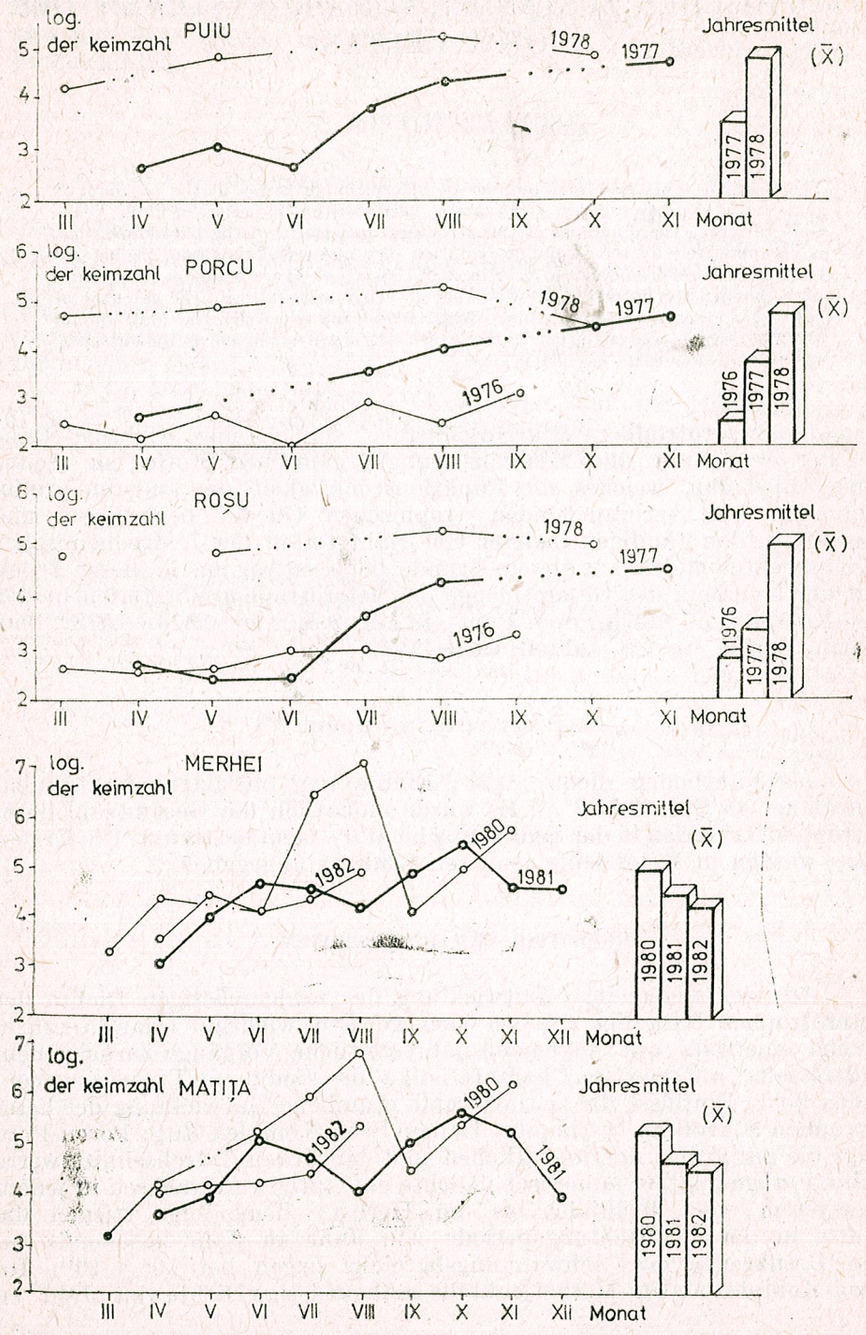

Abb. 1. —Die monatliche Dynamik der heterotrophen Bakterien im Sediment

Jahr und erreicht 1982 die niedrigsten monatlichen Mittelwerte von der Grössenordunng $10^6 - 10^7$. Die Schwankungen befinden sich zwischen $10^6 - 10^{14}$ (Abb. 1).

Die untersuchten Gewässer-Ökosysteme vom Strom-Meere (Roșu-Porcu-Puiu) und vom Stromdelta abstammend (Matița-Merhei) zeichnen sich durch eine hohe biologische Produktion und durch eine starke Anhäufung organischer Stoffe aus; unter diesen Bedingungen kommt es zur Entwicklung einer üppigen heterotrophen Mikroflora. Wegen diesen Eigentümlichkeiten gehören diese Ökosysteme demselben Stadium von Trophizität und Eutrophie an, das sich aber auf verschiedenen Stufen befindet. Vergleichen wir unsere Ergebnisse mit denjenigen aus der Literatur (Tab. Nr. 1), so ergibt sich die Einreihung unserer fünf Ökosysteme

Tabelle 1

Die Abundanz des Bakterien-Benthos in Seen verschiedener Trophizität

See-Typus		Keimzahl/g feuchten Schlicks	Autor
Oligotroph	Baikal	$5,12 \times 10^5$	Gorlenko, 1977
	Onega	$5,12 \times 10^5$	Kuznețov, 1970
	Dolgoi	$4,15 \times 10^5$	Kuznețov, 1970
	Ostrovo	$3,5 \times 10^5 - 2 \times 10^6$	Ocevski, 1970
Mezotroph	Perieslavscoe	$1,5 \times 10^6$	Gorlenko, 1970
	Glubocoi	$4,72 \times 10^5$	Kuznețov, 1970
	Bicaz	$1 \times 10^3 - 5 \times 10^6$	Măzăreanu, 1977
Eutroph	Beloi	5×10^5	Dubinina, 1977
	Yukonoka	1×10^6	Tezuka, 1975
	Kojima	1×10^7	Kawai, 1975
	Roșu	$1,29 \times 10^6 - 6,71 \times 10^{10}$	Peptea, 1977
	Porcu	$7,44 \times 10^5 - 6,71 \times 10^{10}$	Peptea, 1977
	Puiu	$3,13 \times 10^7 - 2,46 \times 10^{10}$	Peptea, 1977
	Matița	$4,49 \times 10^9 - 1,76 \times 10^{11}$	Peptea, 1980
	Merhei	$1,64 \times 10^9 - 7,64 \times 10^{10}$	Peptea, 1980

Zwischen den Seen Roșu und Puiu bestehen geringfügige Unterschiede, so dass diese beiden Ökosysteme als zu derselben Trophizitätsstufe angehörend betrachet werden können.

in die Kategorie der eutrophen Becken, an der Grenze der Polytrophie, wobei die Werte anderer Becken derselben Trophizitätsstufe stark überschritten werden. In Abb. 1 erkennt man zwei verschiedene Gruppen von Ökosystemen mit unterschiedlicher Entwicklung der Gesamtzahl heterotropher Keime, und zwar: zur ersten Kategorie gehören die Ökosysteme Roșu-Porcu-Puiu, welche sich durch eine von Jahr zu Jahr steigende Entwicklung kennzeichnen; zur zweiten Kategorie gehören die Ökosysteme Matița und Merhei, welche durch eine absteigende Entwicklung der Anzahl heterotropher Bakterien gekennzeichnet sind. Die fünf Ökosysteme

unterscheiden sich durch den Wert des vieljährigen Mittelzahl für jedes einzelne Ökosystem, wodurch sich die Einordnung der Eutrophiestufen der Ökosysteme ergibt (Abb. 2).

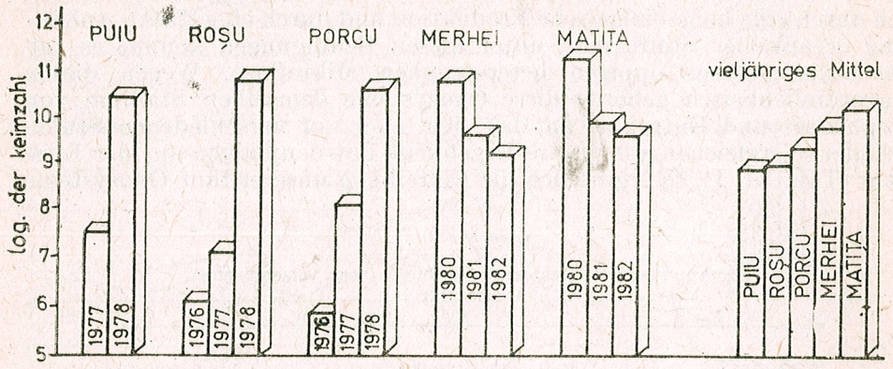

Abb. 2.— Die Gesamtzahl heterotropher Keime im Sediment der fünf Ökosysteme.

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Eingegangen am 18. Januar 1989

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Bukarest, Splaiul Independenței 296

LA STRUCTURE NUMÉRIQUE ET GRAVIMÉTRIQUE DU ZOOPLANCTON DANS LE SECTEUR ROUMAIN DU DANUBE AU COURS DES ANNÉES 1984—1987

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On fait l'analyse, pendant 4 années (1984—1987) dans 24 sections fluviales, de la structure numérique et gravimétrique du zooplancton du secteur roumain du Danube. Le travail présente des données concernant la densité numérique et la biomasse, l'abondance et la dominance. On met en évidence de grandes différences par rapport à la situation existante il y a 25—30 années. Parmi les causes déterminantes il faut mentionner la réduction de la surface inondable, l'augmentation du degré de charge organique et minéral des eaux fluviales, l'apparition des lacs de barrage.

La littérature spécialisée des 30 dernières années contient de nombreuses données concernant la structure du zooplancton dans le secteur roumain du Danube (1), (2), (3), (5), (6), (7), (8). On constate quand même qu'elles proviennent des investigations effectuées dans un nombre assez réduit de points par rapport à la longueur, y compris au degré de complexité du secteur, et qu'elles se rapportent à différentes périodes, ce qui ne peut offrir, par corrélation, une image dynamique de succession dans l'espace et d'évolution en temps.

L'analyse de telles études pourrait offrir des données utiles dans l'appréciation de la qualité des eaux, l'évaluation des ressources nutritives ou l'estimation des effets produits par l'impact antropique.

Un premier essai d'analyse dynamique en temps et dans l'espace de la structure du zooplancton dans l'entier secteur roumain est réalisé à peine au cours des années 1984—1987. Les données concernant la structure taxonomique sont déjà publiées (9) et celles concernant la structure numérique et gravimétrique sont analysées dans le présent travail.

MATÉRIEL ET MÉTHODE

Les recherches ont été effectuées par saison (printemps, été, automne) pendant 4 années (1984—1987) en 24 sections fluviales : 1. Baziaș (Km. 1071) ; 2. en aval de Moldova Veche (Km. 1058) ; 3. en amont de Svinița (Km. 995) ; 4. en amont d' Orșova (Km. 957) ; 5. en amont du barrage de Porțile de Fier I (Km. 944) ; 6. en amont de Drobeta Turnu-Severin (Km. 935) ; 7. Pristol (Km. 834) ; 8. Calafat (Km. 795) ; 9. confluence du Jiu (Km. 694) ; 10. Bechet (Km. 679) ; 11. confluence de l'Olt (Km. 605) ; 12. Turnu Măgurele (Km. 598) ; 13. confluence de la Vidra (Km. 528) ; 14. aval de Giurgiu (Km. 496) ; 15. confluence de l'Argeș (Km. 434) ; 16. Ceatal Borcea (Km. 371) ; 17. en aval de Cernavodă (Km. 300) ; 18. confluence de la Ialomița (Km. 244) ; 19. confluence du Siret (Km. 155) ; 20. confluence du Prut (mille 72) ; 21. Ceatal Izmail (mille 44) ; 22. en aval de Tulcea (mille 39) ; 23. Periprava (bras de Chilia, Km. 18) ; 24. bras de

Sulina (mille 14). Pour chaque épreuve on a filtré 40 litres d'eau (20 litres provenant de la zone du bord et 20 litres du médial).

RÉSULTATS ET DISCUSSIONS

La structure numérique. Des recherches sur la densité numérique du zooplancton fluvial, effectuées dans quelques points du secteur roumain il y a 25—30 années (1), (2), (3), (5), (6) mettaient fortement en relief le rôle de la plaine inondable dans l'évolution de la zoocénose. On remarque un développement ascendent d'amont vers l'aval, qui se trouve en corrélation avec la baisse du courant et surtout avec l'augmentation de l'influence de la plaine inondable. Les variations saisonnières comprises aux eaux moyennes et petites, entre quelques exemplaires/litre et quelques dizaines d'exemplaires, augmentaient au cours du minimum hydrologique à quelques centaines. Le maximum absolu de la période quand le secteur inférieur du Danube disposait d'une zone inondable bien développée (1051 ex/litre) a été enregistré en juillet 1962 en aval de la confluence avec le ruisseau de Nedeia (Km. 697); il faut mentionner qu'en amont de la confluence, la densité numérique était nettement inférieure (82 ex/litre) (2). L'enrichissement graduel du zooplancton d'amont vers l'aval est bien mis en évidence le long du bras de Sulina : 136 ex/litre à Ceatal Sf. Gheorghe, 212 à Gorgova, 461 respectivement 545 ex/litre à Crişan et Sulina-mille 2 (5).

L'endiguement progressif de la plaine inondable a déterminé, sans doute, la réduction substantielle de l'apport allochtone, de sorte qu'au cours des années 1984—1987, son influence soit ressentie seulement dans le secteur compris entre les deux Ceatal et tout le long des bras du Delta. En échange, la dynamique du zooplancton reflète, dans une grande mesure, les modifications de plus en plus amples de certains paramètres physico-chimiques de l'eau, l'évolution ascendante, en temps, de la base trophique (particulièrement du bactérioplancton) (4), les changements complexes produits par l'apparition des lacs de barrage autant dans leur périmètre (7) que dans les zones situées en aval (9). L'analyse des moyennes multiannuelles (1984—1987) met en évidence des maximums dans les sections de Ceatal Borcea (300, 4 ex/litre), de la confluence de l'Argeş (290, 2), à l'aval de Moldova Veche (263,3), à l'aval de Tulcea (192,5) et de la confluence de la Ialomiţa (157,1) et de sminimums à Cernavodă (8,2), Turnu Măgurele (17,5), Pristol (20,5) Bechet (29,3) et Drobeta-Turnu Severin (29,7). Dans le contexte des modifications de nature biotique ou abiotique ressenties dans tous les secteurs du fleuve, la dynamique multiannuelle de la densité numérique enregistre des valeurs relativement élevées dès l'entrée du Danube sur le territoire roumain (Baziaş) (144,8 ex/litre). Dans les conditions de l'existence des zones à eau peu profonde et courant réduit, la dynamique du paramètre mentionné enregistre un sens ascendent dans la zone supérieure du lac de Porţile de Fier I (avec le maximum en aval de Moldova Veche). En échange, dans la moitié inférieure du lac, le décantage des agrégats détrito-bactériens (4) a une répercussion négative sur le développement numérique du zooplancton qui enregistre la valeur minimale dans la section d'amont d'Orşova (5,7 ex/litre). La régression

de la zoocénose s'accentue en aval du lac, conséquence de l'impact souffert dans la zone du barrage, des agrégats-hydroénergétiques et dans les écluses. Des valeurs réduites ont été enregistrées aussi dans les 350 suivants Km., de sorte que la zone Drobeta-Turnu Severin—Turnu Măgurele puisse être considérée la portion avec le développement numérique le plus réduit de l'entier secteur roumain. Dans les conditions de la baisse graduelle du courant fluvial, de l'influence favorable exercée par des eaux tributaires et de l'existence de certaines zones inondables, les moyennes multiannuelles les plus élevées ont été enregistrées au cours des 500 derniers Km. du trajet fluvial.

La dynamique saisonnière présente une évolution ascendante de printemps vers l'automne. Bien que l'apport de la plaine inondable eût baissé par rapport à la situation enregistrée il y a 25—30 ans, les valeurs totales de la densité numérique sont restées, généralement pareilles dans l'ordre de grandeur. Plus encore, le maximum saisonnier absolu de la période 1984—1987 (1504,3 ex/litre) (en aval de Moldova Veche, en octobre 1986) (tableau 1) est supérieur à celui enrégistré au cours des années 1957—1962.

La dynamique par années présente la valeur maximale en 1984 et celle minimale en 1985.

La dynamique de la densité numérique des groupes d'organismes zooplanctoniques reflète, dans la plupart des cas, l'apport déterminant des rotiphères. Il y a aussi des cas où leur dominance est dépassée par celle des ciliées (le printemps de 1984) ou même par celle des copépodes (le printemps de 1985) (tableau 1).

La dynamique spatiale des rotiphères enregistre dans l'ensemble, un sens descendant de l'extrémité d'amont du secteur roumain vers celle

Tableau 1

La densité (ex/l) et l'abondance (%) numérique du zooplancton du secteur roumain du Danube (1984—1987)

Station	Année	Mois	Total zooplancton	Ciliée	Testacée	Rotiphère	Lamélibranchiée	Copépode	Cladocère
1	2	3	4	5	6	7	8	9	10
1	1984	IV	64,8	77,01	0,77	16,98	—	4,78	0,46
2			83,8	86,75	0,24	10,74	—	2,03	0,24
3			259,7	90,10	0,85	8,32	—	0,73	—
5			12,4	42,74	—	54,03	—	3,23	—
10			29,3	56,66	—	40,95	—	2,39	—
12			17,5	39,43	—	40,57	—	20,00	—
14			25,3	37,15	0,79	54,95	—	5,53	1,58
16			25,9	65,25	—	30,12	—	4,63	—
18			15,8	68,35	1,27	25,95	—	4,43	—
19			32,1	86,60	—	11,84	—	1,56	—
20			12,4	63,71	—	26,61	—	8,07	1,61
21			23,1	60,18	0,43	8,22	—	31,17	—
23			11,4	48,25	—	21,05	—	30,70	—

Tableau 1 suite

1	2	3	4	5	6	7	8	9	10
1	1984	VI	72,9	27,43	—	51,03	12,35	7,82	1,37
2			267,0	25,84	—	58,98	11,24	3,75	0,19
3			106,7	52,49	—	43,58	2,34	1,59	—
5			12,0	25,00	—	70,00	1,67	3,33	—
7			139,6	8,88	1,65	57,45	23,85	6,52	1,65
9			259,5	37,76	0,39	49,32	6,94	4,82	0,77
11			192,5	34,44	0,47	44,73	9,87	10,49	—
13			145,0	14,48	—	64,14	5,52	15,86	—
14			307,8	18,84	1,30	66,93	6,50	5,78	0,65
15			364,1	22,27	—	65,42	4,06	8,24	—
16			575,0	23,30	—	67,82	4,70	3,83	0,35
18			457,9	13,54	—	72,07	5,24	8,71	0,44
19			126,5	5,53	—	32,41	7,91	49,41	4,74
20			106,8	1,22	1,12	26,20	3,65	67,34	0,47
21			116,5	9,61	0,52	25,32	5,06	57,94	1,55
22			58,5	—	0,68	9,06	0,68	78,64	10,94
1	1984	IX	249,1	1,04	—	63,59	3,29	31,96	0,12
5			78,1	0,90	—	13,70	6,40	69,78	9,22
9			48,2	9,34	—	34,23	4,15	46,68	5,60
11			196,9	5,64	0,46	58,15	4,16	29,25	2,34
13			378,4	2,85	—	76,44	2,11	17,97	0,63
14			568,2	0,77	—	86,35	0,70	11,79	0,39
15			1215,6	14,61	—	30,22	0,49	54,29	0,39
18			321,2	10,62	—	38,51	7,47	42,65	0,75
19			328,7	0,70	—	60,18	3,95	33,77	1,40
20			475,0	4,74	0,53	62,10	8,21	24,42	—
21			549,7	7,28	0,45	68,44	6,00	17,83	—
22			499,8	16,01	—	52,52	7,24	24,23	—
23			326,6	2,30	—	51,29	13,78	32,64	—
24			116,2	0,86	—	45,87	8,61	44,49	—
1	1985	IV—V	14,0	15,00	—	75,00	—	8,59	1,43
2			41,7	14,87	—	41,24	—	40,29	3,60
3			6,3	1,59	—	—	3,17	66,67	28,57
4			2,9	—	—	—	—	77,59	22,41
6			2,7	—	—	—	1,82	76,36	21,82
7			1,1	—	—	—	—	27,27	72,73
14			18,0	29,44	—	13,89	—	55,56	1,11
17			8,2	31,71	—	25,61	—	39,02	3,66
20			12,4	72,58	—	8,87	—	15,32	3,23
21			3,5	31,43	—	2,86	—	65,71	—
22			8,4	58,33	—	13,10	—	27,38	1,19
23			4,5	42,22	—	11,11	—	46,67	—
24			6,5	63,07	1,54	13,85	—	20,00	1,54
1	1985	VII	5,7	3,51	12,28	56,14	—	28,07	—
2			18,9	5,29	—	83,07	2,65	8,99	—
3			67,9	0,59	—	62,44	35,35	1,03	0,59
4			14,2	28,17	—	49,30	21,83	0,70	—
6			38,9	8,23	—	48,33	39,07	4,37	—
7			15,5	5,16	—	11,61	70,97	12,26	—
8			35,0	12,86	—	20,00	62,28	4,86	—
9			24,8	6,85	0,81	8,06	81,85	2,42	—
11			36,4	—	1,10	17,58	71,98	9,34	—
13			29,2	13,70	1,71	11,99	71,92	0,68	—
15			91,5	20,44	1,31	66,22	8,20	3,83	—

Tableau 1 suite

1	2	3	4	5	6	7	8	9	10
18			116,2	10,33	—	59,37	23,24	7,06	—
19			16,7	—	—	17,96	26,95	52,10	2,99
20			20,1	34,33	2,99	2,99	8,46	49,74	1,49
21			9,7	31,96	—	3,09	—	51,55	13,40
22			25,0	16,00	4,00	—	—	70,00	10,00
23			25,0	37,60	—	—	2,80	56,80	2,80
1	1985	X—XI	38,6	11,92	—	84,19	—	—	3,89
2			78,4	1,91	—	95,67	—	2,42	—
3			37,2	8,33	—	84,95	—	6,72	—
4			15,1	64,24	—	12,58	—	23,18	—
6			18,3	—	—	91,80	—	8,20	—
7			5,1	56,86	—	27,45	—	15,69	—
8			11,4	37,72	5,26	45,61	—	11,40	—
9			24,9	67,07	5,22	19,28	—	8,43	—
14			3,5	34,29	—	—	—	54,28	11,43
15			10,4	14,42	6,73	21,15	—	57,70	—
18			35,8	22,63	—	52,23	—	20,95	4,19
19			70,3	8,53	—	83,93	—	7,54	—
20			209,3	13,80	77,50	77,50	0,72	6,83	2,15
21			165,0	7,58	—	83,63	—	8,18	0,61
22			283,9	4,40	0,88	86,30	2,64	5,78	—
24			129,7	11,57	—	73,26	—	13,26	1,93
1	1986	IV—V	76,5	38,69	—	49,68	—	11,63	—
2			74,8	13,90	0,53	70,06	—	15,51	—
3			50,6	18,93	—	74,96	—	6,11	—
4			78,2	20,46	—	76,73	—	2,81	—
5			82,4	37,38	—	56,79	—	5,83	—
6			81,3	14,27	0,49	74,79	—	9,47	0,98
7			76,8	11,46	1,04	79,17	—	8,33	—
8			76,8	9,37	1,04	81,26	—	8,33	—
9			44,9	33,85	1,78	49,89	—	14,48	—
11			39,8	12,06	—	72,36	—	13,57	2,01
14			7,0	2,86	—	48,56	2,86	42,86	2,86
15			25,7	3,50	1,17	47,87	33,85	11,28	2,33
18			84,7	7,32	—	71,42	13,70	6,73	0,83
19			197,1	19,48	—	76,31	0,81	1,78	1,62
20			98,0	31,84	—	58,78	4,08	3,67	1,63
21			51,4	44,36	0,78	29,57	3,89	16,73	4,67
23			48,7	17,45	2,05	32,05	4,11	43,54	—
1	1986	VII	25,9	6,95	—	62,16	23,94	6,95	—
2			125,6	16,00	—	72,86	7,80	3,34	—
3			21,8	4,13	4,13	30,27	55,05	6,42	—
4			16,4	—	7,32	32,92	31,71	28,05	—
6			9,9	4,04	—	51,52	23,23	18,18	3,03
7			13,6	1,47	1,47	60,29	22,06	14,71	—
9			21,5	2,79	4,19	34,88	40,93	15,81	1,40
11			47,5	11,37	7,58	41,05	30,95	8,42	0,63
15			34,1	14,08	1,76	54,54	14,08	13,78	1,76
18			95,7	5,02	1,25	70,85	8,78	12,85	1,25
19			34,8	1,72	—	60,34	8,05	26,44	3,45
20			58,6	13,31	—	44,03	11,60	31,06	—
21			92,4	4,50	—	49,46	14,99	30,41	0,64
23			92,2	1,30	0,65	22,13	2,93	71,69	1,30

Tableau 1 suite

1	2	3	4	5	6	7	8	9	10
1	1986	X	755,9	2,65	0,53	96,04	—	0,65	0,13
2			1504,3	0,66	0,27	98,38	—	0,42	0,27
3			329,2	23,82	—	70,59	—	5,47	0,12
4			290,4	24,45	—	65,08	—	10,47	—
6			27,0	4,44	—	57,78	—	37,78	—
7			10,9	1,83	—	16,51	—	71,56	10,09
1	1987	VII	177,5	2,76	0,68	36,45	50,13	9,30	0,68
2			243,1	4,11	2,47	32,91	56,15	4,36	—
3			75,6	1,32	—	43,65	50,80	4,23	—
4			115,4	0,87	—	74,52	20,36	4,25	—
6			60,1	8,32	—	27,45	55,75	7,65	0,83
7			40,1	19,95	4,99	27,43	41,15	4,48	—
15			143,5	9,76	3,48	70,04	11,15	3,48	2,09
18			444,1	6,30	—	79,71	6,76	5,88	1,35
19			222,9	2,69	0,90	84,34	8,08	3,99	—
20			54,0	5,56	2,78	67,58	7,41	13,89	2,78
21			91,5	20,77	1,09	27,32	5,46	39,90	5,46
23			114,1	56,62	3,16	4,65	3,59	24,27	7,71
24			7,4	16,22	6,76	6,76	—	63,50	6,76

d'aval, compensée par la dynamique ascendante des cladocères et des copépodes, corrélée avec l'évolution de la vitesse d'écoulement de l'eau. Dans le cas des ciliées, les variations numériques présentent un caractère en quelque sorte irrégulier, en dépendance probable de la dynamique de chargement organique des eaux (tableau 1).

Du total des 162 éléments du spectre taxonomique (9) 32 sont dominants sous rapport numérique. La majorité de ceux-ci est représentée par les rotiphères (54,55%) et les ciliées (27,27%). 15 de ces éléments manifestent leur fonction écologique au cours d'un seul cycle annuel, 6 se retrouvent dans 2 cycles, 7 pendant 3 cycles annuels et 4 seulement pendant 4 cycles annuels (*Brachionus calyciflorus dorcas spinosa*, *Keratella cochlearis*, *Dreissena polymorpha* et nauples *Copepoda* g. sp.

La structure de la biomasse. Il y a peu de données concernant la biomasse zooplanctonique du secteur roumain du Danube. Sur cette base on peut affirmer quand même que dans les conditions d'un apport augmenté de formes allochtones, le zooplancton fluvial se caractérisait, en général, par des valeurs relativement élevées. Les moyennes annuelles des sections Orşova, Brăila, Tulcea et Sulina variaient entre les limites de 432—4073 µg substance humide/litre, pendant que la moyenne du secteur, calculée sur ces données, était de 2055 µg/litre (3), (5), (6).

L'étude comparative de la structure de la biomasse zooplanctonique au cours des années 1984—1987 et 1958—1962 relève l'existence d'importantes différences.

L'analyse des moyennes multiannuelles (1984—1987) des 24 sections fluviales met en évidence des maximums en aval de Tulcea (540,7 µg/litre) sur le bras Sulina-mille 14 (456,6), dans les zones de confluence avec les rivières de Ialomiţa (352,8) et Argeş (326,1) en aval de Moldova Veche (340,5), et des minima à Bechet (27,8), Turnu-Măgurele (36,1),

en amont d'Orşova (60,2), Drobeta-Turnu Severin (61,7) et Cernavodă (70,5). En concordance avec la dynamique spatiale de la densité numérique, les variations gravimétriques multiannuelles met en évidence des cotes relativement élevées dans l'extrémité d'amont du secteur (Baziaş) (217,1), sens ascendant dans la partie supérieure du lac de Porţile de Fier I (le maximum en aval de Moldova Veche), descendant dans la moitié inférieure de celui-ci (le minimum en aval d'Orşova), des baisses évidentes dans la portion Drobeta-Turnu Severin — Turnu Măgurele et les moyennes multiannuelles les plus élevées sur le parcours des 500 derniers Km. du fleuve.

La dynamique saisonnière de la biomasse présente l'évolution ascendante de printemps vers l'automne, en corrélation, dans l'ensemble, avec l'évolution en temps de la densité numérique (les tableaux 1 et 2). La plupart des valeurs maximales saisonnières s'enregistrent dans la zone d'aval du secteur (confluence avec les rivières de Ialomiţa, Siret et Prut, Ceatal Izmail, les bras de Tulcea, Chilia et Sulina) mais la valeur la plus élevée (2280,3 µg/litre) est mise en évidence dans l'extrémité d'amont (en aval de Moldova Veche). Leur existence témoigne du potentiel zooplanctonique élevé du Danube au point d'entrée dans le pays ainsi que de l'apport par la zone inondable et certains affluents.

La dynamique par années présente des valeurs maximales en 1984 (417,2 µg/litre) et une minimale en 1985 (85,8 µg/litre). Bien que la densité numérique de la période 1984—1987 soit maintenue en général au niveau de celle mis en évidence entre 1958—1962 la biomasse enregistre des baisses considérables justifiées en partie par la modification de la structure taxonomique.

La dynamique de la biomasse zooplanctonique (analysée globalement) dépend particulièrement de celle des copépodes et des rotiphères (tableau 2).

Tableau 2

La biomasse (µg/l substance humide) et l'abondance (%) gravimétrique du zooplancton du secteur roumain du Danube (1984—1987)

Station	Année	Mois	Total zooplancton	Ciliée	Testacée	Rotiphère	Lamélibranchiée	Copépode	Cladocère
1	2	3	4	5	6	7	8	9	10
1	1984	IV	60,3	0,83	9,33	24,88	—	65,67	8,29
2			41,6	10,34	0,14	36,15	—	43,75	9,62
3			50,5	3,76	1,58	68,52	—	26,14	—
5			13,9	5,04	—	62,59	—	32,37	—
10			27,8	0,72	—	66,19	—	33,09	—
12			36,1	0,83	—	28,25	—	70,92	—
14			47,4	0,21	0,42	46,20	—	27,65	25,32
16			35,2	0,57	—	60,23	—	39,20	—
18			14,6	1,39	0,69	50,69	—	47,23	—
19			13,8	2,92	—	40,15	—	56,93	—
20			45,7	0,44	—	12,04	—	16,19	71,33
21			73,3	0,27	0,07	3,95	—	95,71	—
23			28,2	0,35	—	13,12	—	86,53	—

Tableau 2 suite

1	2	3	4	5	6	7	8	9	10
1	1984	VII	102,5	0,39	—	53,95	5,66	25,37	14,63
2			285,0	0,84	—	59,69	6,84	30,88	1,75
3			62,4	4,65	—	63,62	2,56	29,17	—
5			22,0	0,45	—	91,82	0,46	7,27	—
7			281,2	0,18	0,32	64,43	7,83	10,88	16,36
9			372,0	1,64	0,11	26,02	3,15	26,08	43,00
11			237,2	1,35	0,13	50,97	5,19	42,37	—
13			344,4	0,29	—	38,39	1,51	59,81	—
14			412,6	0,68	0,39	66,94	3,15	19,15	9,69
15			702,4	0,56	—	59,35	1,37	38,72	—
16			898,9	0,60	—	68,08	1,95	24,92	4,45
18			1177,5	0,25	—	51,16	1,32	43,87	3,40
19			832,5	0,01	—	2,08	0,78	82,72	14,41
20			340,1	0,01	0,10	2,59	0,74	93,63	2,93
21			645,1	0,02	0,05	2,88	4,28	85,33	7,44
22			604,3	—	0,03	0,26	0,06	62,55	37,10
1	1984	IX	400,8	0,10	—	14,75	1,31	82,34	1,50
5			515,5	0,02	—	0,91	0,62	63,14	35,31
9			239,7	0,17	—	4,59	0,54	69,67	25,03
11			379,9	0,24	0,13	18,35	1,40	55,67	24,22
13			603,9	0,36	—	29,23	0,86	61,60	7,95
14			726,4	0,07	—	41,33	0,36	52,18	6,06
15			968,2	1,71	—	27,91	0,40	25,36	44,62
18			959,5	0,26	—	22,28	1,63	75,66	0,17
19			1116,3	0,02	—	18,24	0,76	72,74	8,24
20			1258,3	0,12	0,17	17,11	2,01	80,59	—
21			627,0	0,38	0,24	23,88	3,41	72,09	—
22			889,8	0,66	—	15,26	2,64	81,44	—
23			1159,8	0,02	—	4,70	2,52	92,76	—
24			744,7	0,01	—	2,20	0,87	96,92	—
1	1985	IV—V	53,2	0,38	—	61,65	—	32,33	5,64
2			300,5	0,13	—	19,07	—	71,48	9,32
3			115,5	—	—	—	0,09	68,74	31,17
4			55,1	—	—	—	—	64,37	35,63
6			61,2	—	—	—	0,08	74,61	25,31
7			23,9	—	—	—	—	56,07	43,93
14			196,8	0,15	—	6,71	—	83,84	9,30
17			70,5	0,15	—	14,89	—	56,17	28,79
20			36,2	1,65	—	14,92	—	61,33	22,10
21			22,7	0,18	—	0,18	—	99,64	—
22			53,7	0,37	—	2,23	—	67,05	30,35
23			32,6	0,25	—	7,06	—	92,69	—
24			22,0	0,91	0,45	21,36	—	68,19	9,09
1	1985	VII	43,71	0,02	0,91	29,51	—	69,56	—
2			21,4	0,14	—	69,53	1,40	29,93	—
3			62,6	0,16	—	34,98	24,92	14,38	25,56
4			9,0	3,33	—	30,00	22,22	44,45	—
6			36,8	0,27	—	32,61	26,90	40,22	—
7			15,6	0,18	—	7,68	45,54	46,71	—
8			30,2	0,66	—	5,30	47,02	47,02	—
9			17,9	0,28	1,11	18,38	73,54	6,69	—
11			73,7	—	0,41	2,58	23,20	73,81	—
13			15,6	0,64	2,56	6,41	87,83	2,56	—

Tableau 2 suite

1	2	3	4	5	6	7	8	9	10
15			101,2	0,59	0,49	56,73	4,84	37,35	—
18			241,6	0,17	—	66,18	7,24	26,41	—
19			55,2	14,31	—	—	5,25	44,21	36,23
20			80,8	0,56	0,37	0,18	1,36	60,40	37,13
21			67,5	0,30	—	0,15	—	38,81	60,74
22			337,5	0,03	0,12	—	—	49,48	50,37
23			67,1	0,45	—	—	0,60	78,09	20,86
1	1985	X—XI	35,4	6,50	—	87,85	—	5,65	—
2			64,4	2,33	—	79,66	—	18,01	—
3			44,1	0,91	—	78,68	—	20,41	—
4			21,8	3,67	—	44,04	—	52,29	—
6			11,0	—	—	50,91	—	49,09	—
7			3,6	5,56	—	11,11	—	83,33	—
8			5,7	3,51	7,02	21,05	—	68,42	—
9			21,0	7,14	2,86	7,62	—	82,38	—
14			42,3	0,24	—	—	—	80,85	18,91
15			66,8	0,15	0,45	4,19	—	95,21	—
18			199,7	0,60	—	11,27	—	73,11	15,02
19			118,1	0,42	—	72,40	—	27,18	—
20			334,2	0,91	—	63,11	0,28	30,48	5,22
21			161,7	1,21	0,31	67,53	0,99	29,96	—
22			331,5	0,33	0,45	71,92	1,48	25,82	—
24			168,6	0,83	—	52,25	—	45,97	0,95
1	1986	IV—V	73,5	4,22	—	57,41	—	38,37	—
2			103,7	1,36	0,19	69,91	—	28,54	—
3			43,4	2,07	—	93,09	—	4,84	—
4			75,2	1,69	—	73,83	—	24,48	—
5			75,5	4,10	—	64,64	—	31,26	—
6			191,4	0,63	0,10	50,78	—	40,13	8,36
7			89,0	0,90	0,56	77,87	—	20,67	—
8			137,4	0,44	0,51	75,76	—	23,29	—
9			91,2	2,08	0,33	62,28	—	35,31	—
11			110,3	0,27	—	47,69	—	37,53	14,51
14			23,5	0,04	—	30,63	0,43	51,89	17,01
15			40,8	0,07	0,49	19,59	13,72	36,74	29,39
18			106,2	0,47	—	44,07	7,06	35,22	13,18
19			251,9	0,95	—	64,03	0,40	9,21	25,41
20			132,4	1,81	—	60,58	1,96	11,48	24,17
21			104,0	3,47	0,20	11,08	1,29	28,51	55,45
23			135,0	1,10	0,44	16,52	0,52	81,42	—
1	1986	VII	17,3	0,58	—	42,77	23,12	33,53	—
2			63,1	1,74	—	61,01	10,15	27,10	—
3			23,8	0,13	2,10	21,40	32,73	43,64	—
4			34,5	1,73	—	4,35	9,86	84,06	—
6			19,9	0,05	—	9,04	7,53	53,24	30,14
7			15,6	0,13	0,64	7,68	12,16	79,39	—
9			38,7	0,52	1,55	9,30	14,73	58,40	15,50
11			61,4	0,49	3,58	16,94	15,47	53,75	9,77
15			77,3	1,81	0,65	30,14	4,01	47,87	15,52
18			272,3	0,47	0,18	26,37	2,02	35,70	35,26
19			110,8	0,02	—	16,42	1,62	27,79	54,15
20			87,9	0,90	—	19,00	5,01	75,09	—
21			177,3	0,11	—	11,05	5,13	56,64	27,07
23			579,5	0,07	0,07	2,15	0,29	85,31	12,11

Tableau 2 suite

1	2	3	4	5	6	7	8	9	10
1		X	1167,4	0,31	0,29	96,11	—	1,58	1,71
2			2280,3	0,06	0,15	96,91	—	1,83	1,05
3			303,9	1,58	—	69,20	—	26,59	2,63
4			205,2	2,24	—	34,80	—	62,96	—
6			87,6	0,11	—	6,74	—	93,15	—
7			48,2	0,02	—	1,24	—	61,40	37,34
1	1987	VII	315,2	0,04	0,32	40,72	18,33	32,98	7,61
2			201,4	0,69	1,59	39,65	44,07	14,00	—
3			58,9	0,05	—	38,69	42,25	19,01	—
4			77,6	0,13	—	47,55	19,59	32,73	—
6			100,9	0,12	—	5,75	21,60	62,62	9,91
7			34,2	2,05	4,97	11,40	31,29	50,29	—
15			395,3	0,33	0,66	22,51	2,63	13,16	60,71
18			919,3	0,57	—	36,13	2,12	22,02	39,16
19			176,9	0,28	0,96	78,24	6,61	13,91	—
20			143,7	0,28	0,41	13,85	1,81	21,02	62,63
21			703,9	0,40	0,11	1,86	0,45	40,35	56,83
23			715,5	0,87	0,26	0,34	0,36	19,06	79,11
24			56,6	0,12	0,53	0,35	—	65,41	33,59

Pareillement au cas de la densité numérique, la dynamique spatiale de la biomasse des rotiphères met en évidence, en général, un sens descendant d'amont vers l'aval et ascendant dans le cas des cladocères et des copépodes (tableau 2).

Dans le spectre taxonomique, un nombre de 26 éléments, dont la plupart copépodes (40,70%) et rotiphères (29,10%), sont dominants sous rapport gravimétrique. Plusieurs d'eux (10) manifestent leur dominance au cours d'une seule année, 8 formes dominantes sont rencontrées pendant 2 saisons, 3 pendant 3 saisons et 5 au cours des 4 saisons (*Brachionus calyciflorus dorcas spinosa*, *Dreissena polymorpha*, *Moina micrura*, *Acanthocyclops vernalis* et nauples *Copepoda* g. sp.).

CONCLUSIONS

— La dynamique spatiale du zooplancton dans le secteur roumain du Danube enregistre, dans les conditions écologiques des années 1984—1987, des valeurs maximales autant dans la troisième partie de celui-ci que dans l'extrémité d'amont, et des valeurs minimales—en amont et en aval du barrage du lac Portile de Fier I.

— La dynamique spatiale analysée à partir de l'extrémité d'amont vers celle d'aval, relève dans son ensemble, une tendance descendante pour les rotiphères, ascendante pour les copépodes et irrégulière dans le cas de ciliées.

— La dynamique multiannuelle met en évidence des maxima en 1984 et des minima en 1985.

— La dynamique saisonnière présente un sens ascendant du printemps vers l'hiver.

— La dynamique numérique est déterminée particulièrement par l'apport des rotiphères et celle gravimétrique par l'apport des copépodes et des cladocères.

— Dans l'ensemble du spectre taxonomique (qui comprend 163 éléments) 32 sont dominés sous rapport numérique et 26 gravimétrique.

— La densité numérique de la période 1984—1987 est maintenue en général au niveau de celle étudiée entre 1958—1962. La biomasse enregistre en échange, des baisses considérables, justifiées partiellement par la modification de la structure taxonomique.

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Reçu le 3 février 1989

Institut de sciences biologiques
Bucarest, Splaiul Independenței 296

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