PSAMMOLITTORAL MARINE TARDIGRADES FROM NORTH CAROLINA AND THEIR CONFORMITY TO WORLDWIDE ZONATION PATTERNS

by

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Résumé

Cinq espèces de Tardigrades, *Batillipes mirus, B. bullacaudatus, Stygarctus bradypus, S. granulatus,* et *Tanarctus arborspinosus* nov. spec., sont signalés des sables de la zone intertidale de Bogue Bank, Caroline du Nord. La nouvelle espèce est caractérisée par la présence d'un cirre médian et par des épines latéro-postérieures très longues avec plusieurs branches secondaires et de nombreuses épines tertiaires plus petites. La répartition de chaque espèce a été étudiée en rapport avec les caractéristiques écologiques de cette plage.

Introduction

Marine Tardigrada are occasionally an abundant component of the meiofauna and recently have been the object of increased ecological and systematic attention. A majority of the species thus far reported are inhabitants of the interstitial spaces on sandy beaches, and their ecology has been studied on the west Atlantic coast (McGinty and Higgins, 1968; Pollock, 1970a), the east Atlantic coast in France (Renaud-Debyser, 1956, 1959a, 1963) and Germany (Schmidt, 1968, 1969), the Adriatic coast of Italy (DeZio, 1964, 1965; DeZio and Grimaldi, 1964a & b, 1966), and the Waltair coast of India (Rao and Ganapati, 1968). Marine tardigrade systematics and ecology is reviewed by Renaud-Mornant and Pollock (1971). Other references have been largely taxonomic surveys or descriptions concerning the thirty-four known marine species.

In the present study the interstitial meiofauna of a sandy North Carolina beach was examined on the ocean side of Bogue Bank (76° 50' 00" W, 34° 41' 30" N). Five species of tardigrades were encountered; two of these (*Balillipes mirus* Richters, 1909, and *Stygarctus bradypus* Schulz, 1951) have a known wide-ranging geographical distribution and have previously been recorded from North Carolina (McGinty and Higgins, 1968). Two species were recently described from the western Atlantic coast (*Batillipes bullacaudatus* McGinty and Higgins, 1968 and *Stygarctus granulatus* Pollock, 1970a) while a fifth species is undescribed. This paper describes the new species and presents a

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survey of tardigrade distributions and some ecological parameters occurring in a high energy tidal beach. Correlations may be possible with distributions of other psammon species and edaphic factors as part of a continuing study of Bogue Bank meiofauna.

Methods

Samples were collected from the beach approximately 250 m west of the "Iron Steamer Pier" (hereafter referred to as ISP beach) on Bogue Bank near Morehead City, North Carolina, March 10-11, 1970, within one hour of seawater low tide.

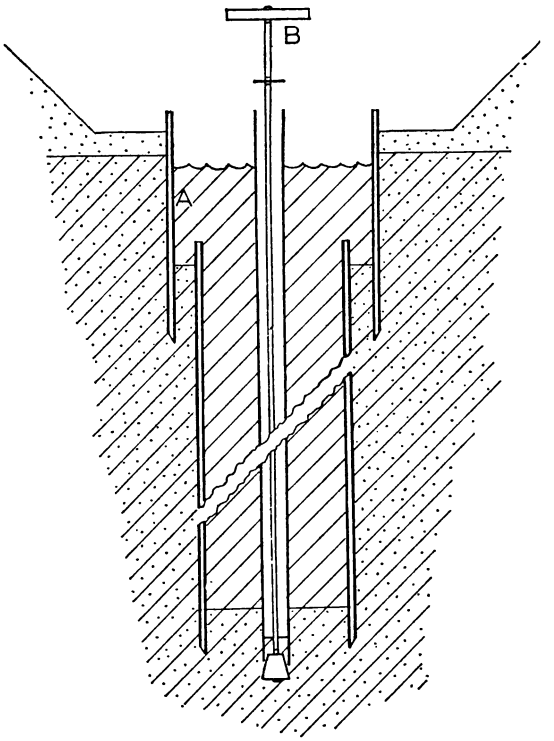

FIG. 1

Diagrammatic view of evacuated casing-tube-set (A) sunk into the coastal ground water sediment with valve-sampler (B) in situ for obtaining interstitial water. The sandy sediment is dotted while hatching indicates saturated condition.

The sampling was accomplished by digging holes with a shovel to the ground water in the beach and pushing a 100 cm^3 coring tube horizontally into the fresh sand at 20 cm vertical intervals. Each sample was placed in a plastic bag, saturated with filtered sea water and preserved in formalin. The transect consisted of duplicate samples at 55 sites among nine holes in the intertidal zone. The lower six holes and the upper three holes were sampled on March 10 and 11 respectively, resulting in a somewhat distorted ground water profile.

Samples in the ground water were collected at 30 and 60 cm depths by hand evacuation with a large polyethylene casing tube sunk to the appropriate level. Casings may also be nested (Fig. 1 A) to reduce external friction. The casing tube-method enables gradual evacuation and sinking of the tube to an arm's length below the ground water. Further evacuation requires more complex equipment. By keeping the water level within the tube equal to the surrounding coastal ground water and by sinking the casing below the evacuation, one avoids upwelling. Care must be taken to sample in undisturbed sediments, 10-15 cm below the sand surface in the tube, when quantitative estimates from exact levels are desired.

Extraction of the organisms from the sediment was accomplished by vigorous agitation of the sample in two liters of waters, allowing the sediment to settle and pouring the supernatant through a 62 µm sieve. Three such extractions removed most meiofauna from the sediment. Contents of the sieve were preserved in a vial (4 % buffered formalin). Harpacticoid copepod and tardigrade species were identified later.

Sorted animals were treated according to the histological techniques of McGinty and Higgins (1968). Measurements and drawings were made using a camera lucida and phase microscopy.

Interstitial water for salinity analysis was obtained with a simple device called a valve-sampler (Fig. 1 B). This consists of a 1.5 m pipe with an inner diameter of 2.5 cm through which a thin threaded rod is centered. A rubber stopper, attached to the end of the thin rod, seals the pipe bottom. The handle on the top of the threaded rod enables the operator to open the seal between the stopper and the pipe. The pipe is calibrated and marked to show depth when placed below the surface. However, care must be taken to avoid noticeable disruption of the sediments while pushing the pipe 10-20 cm into the sand. By quickly opening and closing the seal within the sediment, about 25-100 ml of interstitial water is obtained. The sample was immediately placed in a beaker and onto a Goldberg refractometer for analysis. Samples from deeper levels were obtained using the valve-sampler within the casing tube after appropriate evacuation.

Temperature checks were made with a standard laboratory thermometer and redox measurements with a Kiethley 600B electrometer. Sediment samples were collected for granulometric and water content analyses.

Environmental parameters

The ISP beach on Bogue Bank is part of a high energy sandy strand running almost east-west for 40 km, fully exposed to the Atlantic ocean and prevailing south-westerly winds. The transect site with a slope of 4% had a tidal range of about 1.1 m vertically and 45 m laterally.

Standard granulometric analysis of 18 sediment samples representing all areas of the beach gave a median diameter of 255 µm with a range among samples of 183-505 µm. Trask's (1932) sorting coefficient ($S_0 = Q_1/Q_2$) for the above samples averaged 1.38 with a range

between 1.07 and 2.45. The standard deviation of each of the curves in terms of Wentworth units ($0\phi = \frac{\phi 84 - \phi 16}{2}$; Inman, 1952) ranged between 0.42 and 1.29 with a total sample value of 0.85. Sediment was generally well-sorted with few grains > 2 mm and < 37 μm. Silt and clay averaged 3.32% of the sediment. No correlations between granulometric characteristics and tardigrade distributions were noted.

Ground water and sea salinities were in the same range (34-36‰). Temperature of the water was at a winter low of 14°C, while summer measurements may reach 28°C. The sediment was highly oxidized (Eh $>$ 400 mV) at all depths measured (i.e., down to 1 m below ground water surface). Water saturation varied from 25% at the beach surface to 100% at depths approximately 20 cm above standing ground water.

Common meiofaunal inhabitants of the beach included approximately 35 spp. of Turbellaria, 44 spp. of Nematoda, 16 spp. of Harpacticoida, a mystacocarid, polychaetes, numerous gastrotrichs, ostracods, and acarines. Macroscopic endopsammon are characterized by *Donax*, *Emerita*, and numerous amphipods.

SYSTEMATICS

TARDIGRADA

Order: Heterotardigrada Marcus, 1927

Family: Halechiniscidae Thulin, 1928

Genus: *Tanarctus* Renaud-Debyser, 1959b

Emended diagnosis.

Median cirrus present or absent, internal buccal cirri long, external buccal cirri much shorter, lateral cirri exceed the length of the body, and clava very small. Cuticle thin, with two strong dorso-lateral spines between the third and fourth legs, two caudal lobes which terminate in very long spines, legs support four toes having terminal claws.

Type species.

Tanarctus tauricus Renaud-Debyser, 1959b. No more individuals of the genus have been reported subsequent to the original description based on a single female from Sharktown beach at the entrance to the lagoon of Bimini, Bahamas.

Tanarctus arborspinosus nov. spec.

Diagnosis.

Tanarctus with dorsal median cirrus; posterior-lateral spines extremely long with several secondary side branches and many smaller tertiary projections.

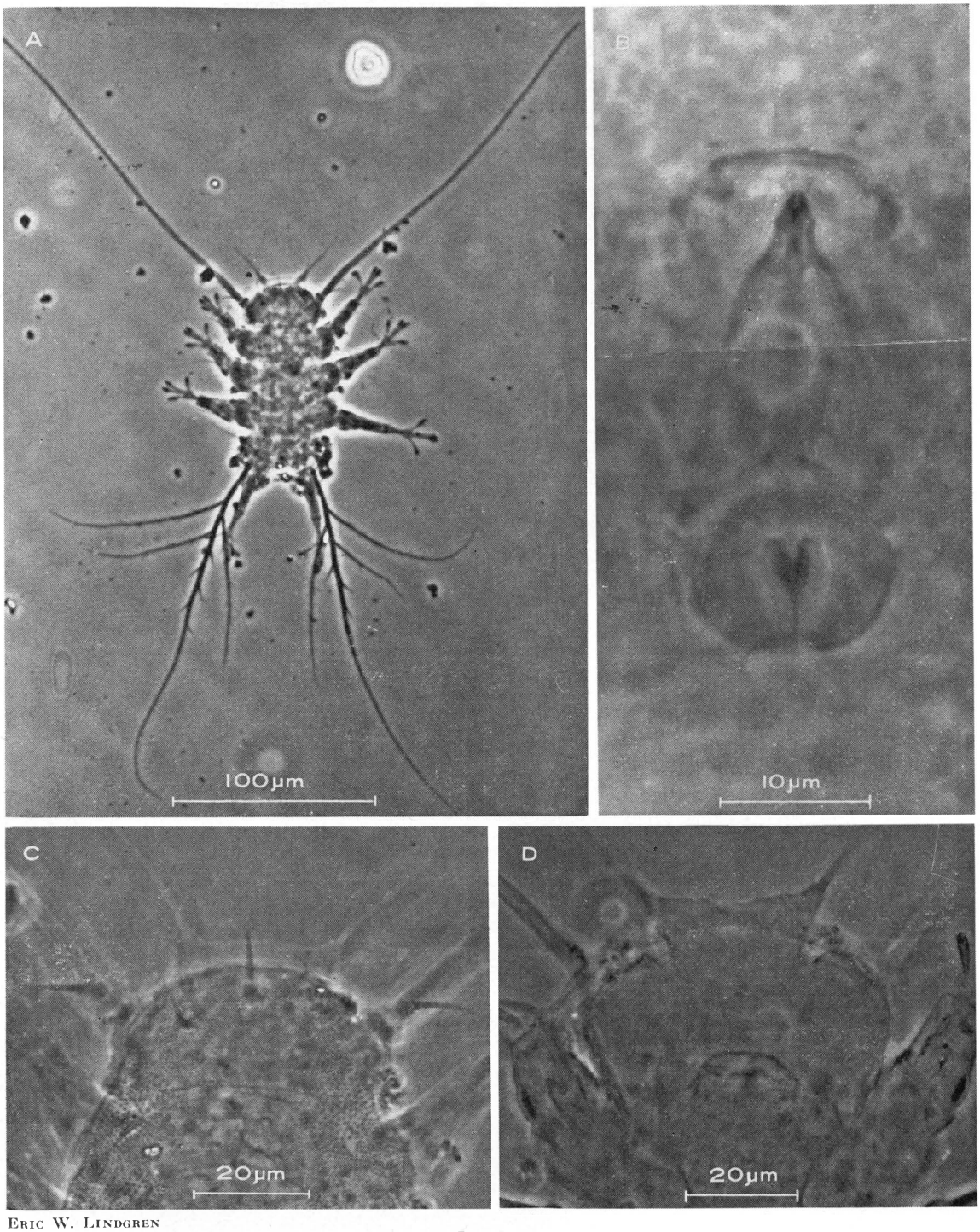

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PLATE I

Tanarctus arborspinosus.

A: dorsal view of whole form; B: mouth, stylets and buccal bulb; C: dorsal view of head; D: ventral view of head.

Types.

The holotype is a preserved adult female collected March 11, 1970 (AMNH No. 1). Five paratypes are deposited in the Department of Living Invertebrates of the American Museum of Natural History in New York; AMNH No. 2.

Etymology.

The trivial name of *Tanarctus arborspinosus* alludes to the unique posterior-lateral appendages. It is derived from the Latin "arbor" and "spinosus" meaning "tree" and "spine" in reference to the tree-like branching of the posterior-lateral spines.

General description.

Tanarctus arborspinosus is small, delicate and flattened in appearance with very conspicuous cephalic cirri and posterior-lateral spines (Fig. 2, Plate I). Preserved specimens have a refractive quality in strong light.

The total body length of the holotype reaches 88 μm from the base of the cephalic appendages to the caudal midline. The width of the head between the bases of the lateral cirri attains 40 μm. A dorsal median cirrus (9 μm) is present and directed anteriorly. The internal cephalic cirri measure 24-25 μm in length and are directed somewhat laterally. The external cephalic cirri are inserted ventrally on cephalic papillae, recurve toward the anterior midline, and measure 16-18 μm in length. The long lateral cirri (205-220 μm) are slightly flattened, have minute bristles throughout their length and are mounted on a common base with the clavae (8 μm long). There is a short cirrus "E" (13-17 μm) on each side between the third and fourth legs. The remarkable posterior-lateral spines have a main stalk reaching 195-210 μm in length while three (sometimes two or four) secondary side branches project laterally and much smaller projections are numerous.

The cuticle is transparent with small uniformly spaced pores visible upon close examination.

The mouth is a ventral slit reaching laterally. Two stylets and a spherical buccal bulb lead posteriorly to an intestine and anus.

The head is large in comparison to the rest of the body. A ridge bounded on each side by the internal cephalic cirri projects anterioventrally.

The legs are telescopic and the first three bear a short spine (6-10 μm). Four toes with claws are borne on an enlarged bulb-like base. The toes differ in length with the median toes longer (11-13 μm) than the external ones (8-10 μm).

Discussion.

T. arborspinosus agrees with the diagnosis of *Tanarctus* Renaud-Debyser (1959b) with the exception of a dorsal median cirrus which is lacking in *T. tauricus*. The one other species of Halechiniscidae (*Halechiniscus guitelii* Richters, 1908) which also lacks a dorsal

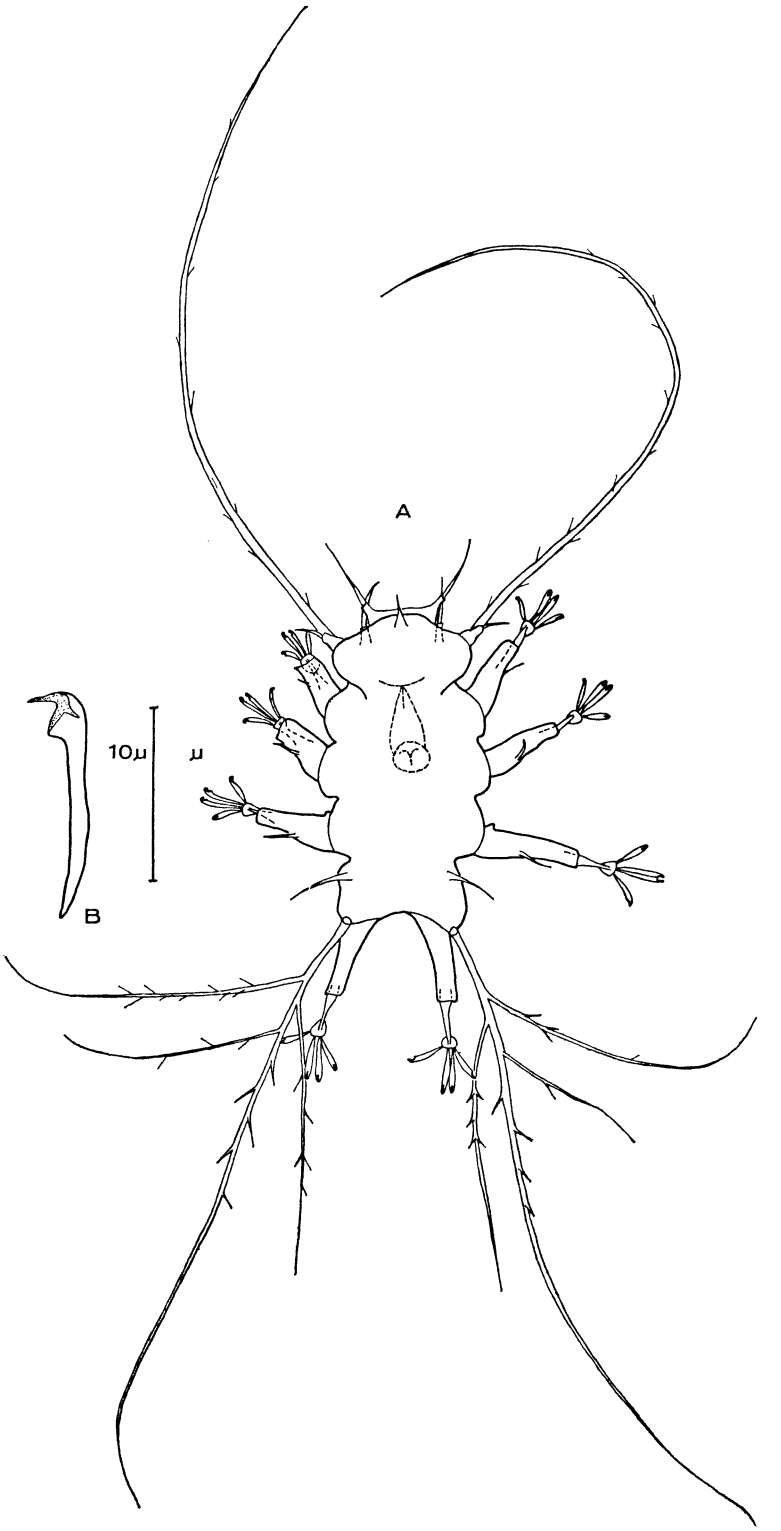

FIG. 2

Tanarctus arborspinosus, dorsal view of whole form (A) and lateral view of external toe (B) from fourth pair of legs.

median cirrus is retained in its respective genus and it is felt that the exception does not warrant generic status.

Renaud-Debyser (1959a) described, from the *T. tauricus* specimen, a lateral cirrus exceeding the total body length and a short round clava inserted in a common cephalic base. These were felt to be important in the diagnosis of the genus. The short pointed cirri-like "clavae" and the long "lateral cirri" of *T. arborspinosus* closely resemble the appearance of these appendages in *Florarctus* and some *Halechiniscus*. While the short pointed appendages are mounted dorsally on distinct papillae as are the rest of the cephalic cirri, the long supple "lateral cirri" are mounted ventrally on the common bases and are thinner than the other cirri. It is probable that the long cephalic appendages in *T. arborspinosus* are in fact the clavae and the relatively short appendages on the same base are lateral cirri. However, it is felt that more information regarding these appendages in several *T. tauricus* specimens is necessary before the generic diagnosis is reexamined.

T. arborspinosus is also differentiated from *T. tauricus* by the unique branching posterior-lateral projections. The distinctive tertiary branching of these appendages is not reported in any other tardigrade, although secondary branching on cirri has been noted in *Batillipes bullacaudatus* McGinty and Higgins, 1968, and *Pseudoechiniscus tridentifer* Bartos, 1935. The interstitial environment in which these species are found suggests that these structures may have a sensory and/or holdfast function as such modifications are common in other psammon taxa.

Comparison between five *T. arborspinosus* individuals and *T. tauricus* taxonomic characters is given in Table I. Measurements for

TABLE I

Comparison of taxonomic characters (measurements in μm)

Character	*T. tauricus*	*T. arborspinosus*	
		Range	Mean + S. D.
Body length	98-100	85-108	94±8.2
Head width	35	38-44	40±2.7
Dorsal median cirrus	0	8-14	11±2.4
Internal cephalic cirrus	24-25	20-26	23±1.7
External cephalic cirrus	12-14	11-18	13±2.2
Clava	4-5	8-13	9±1.8
Lateral cirrus	95-100	160-220	190±19.5
Cirrus « E »	50-55	23-30	25±2.9
Posterio-lateral spines	220	180-225	201±14.0

the latter specimen are taken from the original description and figures (Renaud-Debyser, 1959b). The significantly longer clavae and lateral cirri as well as the shorter cirrus "E" further differentiate *T. arborspinosus* from *T. tauricus*.

Distribution.

Tanarctus arborspinosus was primarily found inhabiting the coastal ground water between the berm and extreme low water (Fig. 3). No population density center was evident and the 100 cm^3 sediment

samples contained an average of only three *Tanarctus* individuals when the species was present. Low population densities and the difficulty in sampling in ground water sediments probably hindered the discovery of this species.

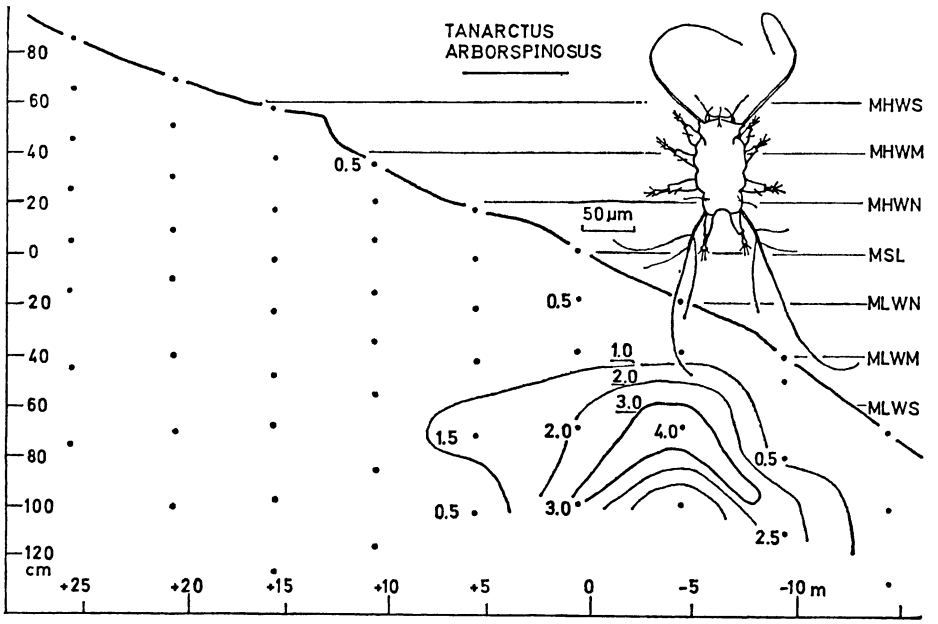

FIG. 3

Distribution of *Tanarctus arborspinosus* at ISP beach, Bogue Bank, March 10-11, 1970.

Numbers near sampling points and isopleth lines represent average individuals per 100 cm^3.

Family: Batillipedidae Riggin, 1962

Genus: *Batillipes* Richters, 1909

Diagnosis.

Batillipedidae with four to six toes composed of tubular pedestals of varying lengths terminating in disc-shaped adhesive enlargements.

Type species.

Batillipes mirus Richters, 1909.

Discussion.

One or more species of *Batillipes* appear to be present in the intertidal zone of nearly all exposed sandy beaches thus far investigated. The eleven species make this genus the most diverse of marine genera. These include: *B. pennaki* Marcus, 1946; *B. similis* Schulz, 1955; *B. carnonensis* Fize, 1957; *B. phreaticus* Renaud-Debyser, 1959a; *B. littoralis* Renaud-Debyser, 1959a; *B. friaufi* Riggin, 1962; *B. annulatus* DeZio, 1962; *B. bullacaudatus* McGinty and Higgins, 1968; *B. gilmartini* McGinty, 1970 and *B. dicrocercus* Pollock, 1970a. A key to the *Batillipes* species has been prepared by Pollock (1971).

Batillipes mirus Richters, 1909

Diagnosis.

Batillipes with a single caudal spine inserted directly on body, simple narrow clavae, and spines on all four pairs of legs.

Distribution.

Reported from the coasts of the North and Baltic Seas (Fenchel, 1967; Fenchel et al., 1967; Freidrich, 1963; Jägersten, 1952; Hondt, 1970; Karling, 1954; Pollock, 1971; Purasjoki, 1953; Remane, 1933, 1940; Richters, 1909; Schmidt, 1968, 1969; Schulz, 1950, 1951; Swedmark, 1951, 1955, 1956 and Tambs-Lyche, 1939-1940); Irish Sea (Boaden, 1963, 1966); eastern Atlantic (Baudoin, 1952; Guérin, 1960 and Renaud-Debyser, 1956, 1963); Mediterranean Sea (Papi, 1952; Swedmark, 1956a and Rodriques-Roda, 1948); Black Sea (Valkanov, 1950, 1954 and Rudescu, 1962, 1969); western Atlantic (Hay, 1917; McGinty and Higgins, 1968 and Pollock, 1970a & b); Gulf of Mexico (King, 1962); South China Sea (Renaud-Mornant and Serene, 1967); and found on ISP beach, Bogue Bank, North Carolina.

Batillipes mirus was found only in the low intertidal zone on Bogue Bank, seaward to the mean sea level tide mark (Fig. 4). It was most common in the coastal ground water and population density increased with depth to the lowest level sampled, i.e., 60 cm into the ground water. The maximum density of *B. mirus,* 29 individuals per 100 cm^3 of sediment, occurred at extreme low tide and may have increased subtidally although this was not investigated.

Batillipes bullacaudatus McGinty and Higgins, 1968

Diagnosis.

Batillipes with caudal spine terminating in bulbous structure; fourth leg spines long; median, internal, and lateral cirri, and fourth leg spines frayed at tip, generally trifid.

Distribution.

Reported from Yorktown, Virginia (McGinty and Higgins, 1968); Woods Hole, Massachusetts (Pollock, 1970b), and found on ISP beach, Bogue Bank, North Carolina.

Batillipes bullacaudatus was found in nearly all samples taken between the berm and low water (Fig. 4). It was most common in the saturated or partially saturated sediments just above the ground water between the berm and mean tide level. Population density was slightly lower than *B. mirus* with the maximum numbers reaching 15 individuals per 100 cm^3 of sediment.

Family: Stygarctidae Schulz, 1951

Genus: *Stygarctus* Schulz, 1951

Diagnosis.

Stygarctidae with cuticle thickened to form three unpaired body plates between a one-piece cephalic plate and a caudal plate ; caudal spikes present ; legs bend only at junction with body and at foot.

Type species.

Stygarctus bradypus Schulz, 1951.

Discussion.

The recent description of *S. granulatus* Pollock, 1970a, has further defined this formerly monotypic genus of wide geographical distribution. The original illustrations of *S. bradypus* lacked morphological detail and restudy of reported collections may prove valuable. Comparison of specimens from Bogue Bank, North Carolina, with original descriptions and illustrations of both species as well as the excellent study of *S. bradypus* by Renaud-Mornant and Anselme-Moizan (1969) showed both species to be present in the same profile transect.

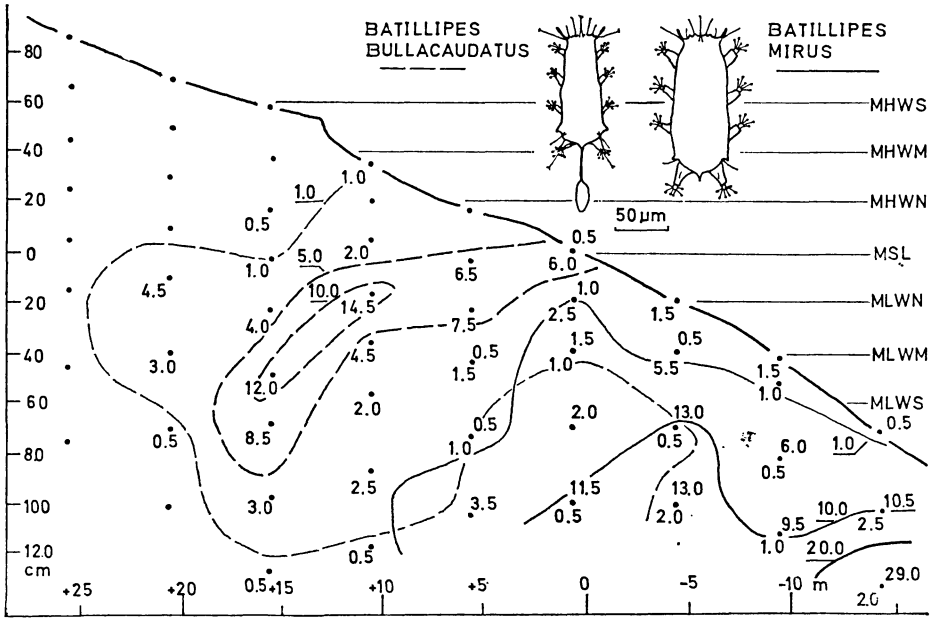

FIG. 4

Distribution profile of *Batillipes* at ISP beach, Bogue Bank, March 10-11, 1970. Numbers above/right (*B. mirus*) and below/left (*B. bullacaudatus*) from the sample points as well as solid (*B. mirus*) and broken (*B. bullacaudatus*) isopleth lines represent average individuals per 100 cm^3.

Stygarctus bradypus Schulz, 1951

Emended diagnosis.

Stygarctus with a pair of distally bifurcate processes passing posterio-laterally from the posterior edge of body plate II ; anterior clavae twice the length of the lateral clavae and a single set of acute processes along the posterior rim of the cephalic plate.

Distribution.

Reported from the coastal ground water of the North Sea coast of Germany (Schulz, 1951; Schmidt, 1968, 1969); French Atlantic

(Renaud-Debyser, 1956, 1959a; Hondt, 1970); Bimini, Bahamas (Renaud-Debyser, 1959b, 1963); Woods Hole, Massachusetts; York River, Virginia; Bogue Bank, North Carolina; and Ocho Rios, Jamaica (McGinty and Higgins, 1968); Woods Hole, Massachusetts (Uhlig, 1968); Mediterranean (Papi, 1952); Waltair Coast, India (Rao and Ganapati, 1968); and found on Bogue Bank, North Carolina.

Few specimens of *Stygarctus bradypus* were found during the winter, however summer concentrations reached a maximum density of at least 15 individuals per 100 cm³ of sediment. The winter individuals were collected near the surface above the berm (Fig. 5) while the summer population appeared to be deeper and seaward between high and mid-tide levels.

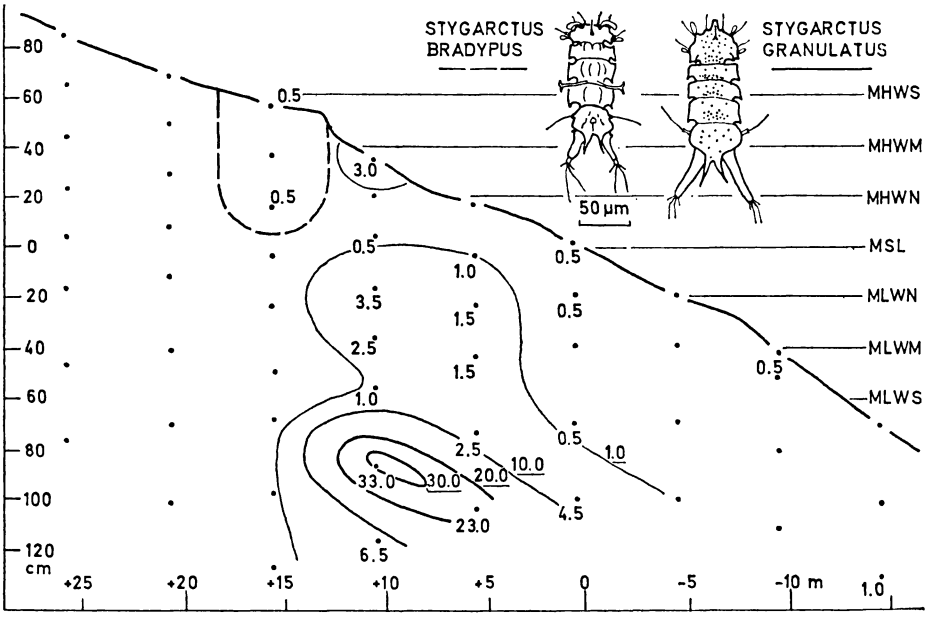

FIG. 5

Distribution profile of *Stygarctus* at ISP beach, Bogue Bank, March 10-11, 1970. Numbers above/right (*S. bradypus*) and below/left (*S. granulatus*) from the sample points as well as isopleth lines (*S. granulatus*) represent average number of individuals per 100 cm³.

Stygarctus granulatus Pollock, 1970a

Diagnosis.

Stygarctus with small refringent bodies scattered over cuticular plates, particularly dorsally; two pairs of acute processes along posterior rim of cephalic plate; 11 cephalic appendages including four clavae of approximately equal size; anal region surrounded by cuticular plates; caudal processes one-half the length of fourth pair of legs in all but smallest juveniles; lateral body cirri with thickened basal section, basal section smooth or annulate; lacking posterior accessory projections from body plate II.

Distribution.

Reported from Wood Neck, Marine Biological Laboratory, Crane's and Nobska Beaches in Woods Hole (Pollock, 1970b); and found on ISP beach, Bogue Bank, North Carolina.

Stygarctus granulatus was found with few exceptions in sediment between high and mid-tide levels (Fig. 5). Maximal population density, 33 individuals per 100 cm^3 of sediment, occurred in the ground water.

COMPARISON AND CORRELATION OF DISTRIBUTION

Even though most of the thirty-five species of marine Tardigrada are psammophilic, only seven have been the subject of detailed distributional studies within sandy beaches. Both Renaud-Debyser (1956, 1959a, 1963) and Schmidt (1968, 1969) have contributed exhaustive reports of *Batillipes mirus* and *Stygarctus bradypus* ecology within the framework of larger and more general meiofaunal investigations, while distributions of *B. pennaki* and *B. annulatus* were correlated with several edaphic factors by DeZio (1964, 1965) and DeZio and Grimaldi (1964a & b, 1966). Recently, Pollock (1970b) included distributional data in his definitive report on the population dynamics of four interstitial species (*B. pennaki, B. bullacaudatus, B. dicrocercus* and *S. granulatus*). Population densities appear to vary with complex interactions of both physical and biological parameters.

The ISP beach tardigrade distributions correspond to Pollock's (1970b) typical pattern of species composition at a single beach. One species of *Stygarctus* (*S. granulatus*) and two *Batillipes* are relatively abundant. The remaining species are much lower in density. This is the only beach, however, from which both species of *Stygarctus* are reported and the second collection site for a *Tanarctus*. Density data from ISP beach may be low due to the extraction techniques designed for slightly larger animals. Reported values are actual counts and represent minimum estimates of individuals present in the samples.

The *Batillipes mirus* winter population in ISP beach was concentrated in the ground water of the lower slope while Renaud-Debyser (1956, 1959a, 1963) on the French Atlantic coast found higher densities near mid-tide in March and a general spreading of distribution with a center of density moving to low-tide by late summer. Schmidt (1968, 1969) from the North Sea reports most *B. mirus* in moderately exposed beaches were encountered in the moist sand of the middle slope with a deeper density center running higher in the beach and lower numbers at the two extremes of the intertidal zone. However, he also found in "Weststrand", an exposed high-energy beach, the population concentrated in the lower slope with many individuals in the ground water near low tide level. Thus, all three studies indicate a similar distribution pattern for *B. mirus* under comparable environmental conditions.

Although McGinty and Higgins (1968) found *Batillipes bullacaudatus* at the type locality present in only four of 64 collections, it appeared to be the most widely distributed species on ISP beach, lacking in seven of 43 samples containing tardigrades. Pollock (1970b) also found a small but widespread population from high beach stations to seaward stations where it was found at greater depths.

The distribution of *Stygarctus granulatus* within the type locality (Pollock, 1970b) was concentrated at depths of 20-50 cm from mid— to high—tidal levels. This was similar to collections made at ISP beach. *S. granulatus* populations at both sites also show a co-occurrence with the population of *B. bullacaudatus*. Competition is low, however, according to Pollock (1970b) because of differences in

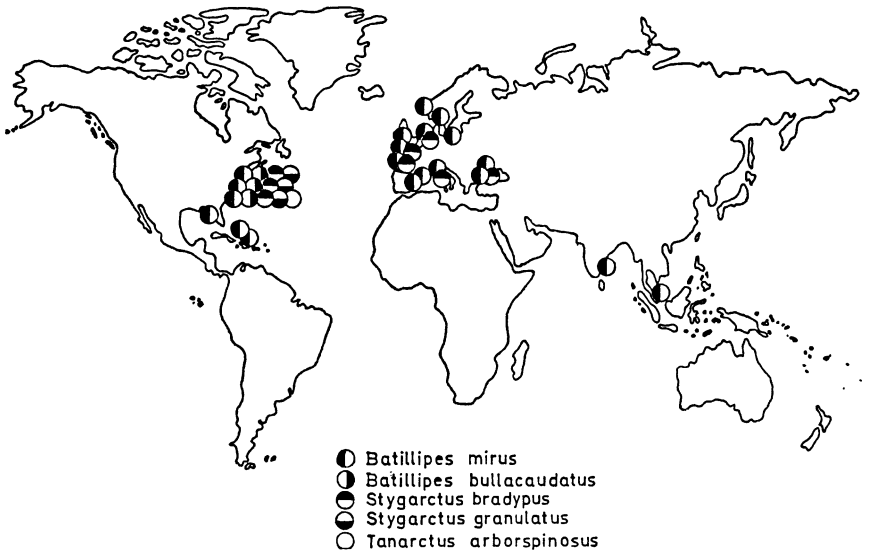

FIG. 6

Known world-wide distribution of *Batillipes mirus, B. bullacaudatus, Stygarctus bradypus, S. granulatus* and *Tanarctus arborspinosus.*

feeding apparatus and possible food preferences. Competition might also explain the apparent seasonal alternation of *S. granulatus* and *S. bradypus* densities present on ISP beach.

The type locality of *Tanarctus tauricus,* Bimini, Bahamas, contrasts markedly from that of *T. arborspinosus.* It was described from the high intertidal zone of a calcareous semi-stable beach at the entrance to the tropical lagoon and found in a core 10-20 cm in depth. Median grain sizes (325-530 μm) and a slope of almost 10 p. 100 are indicative of the passing currents. However it is impossible to attempt to describe the ecology with one specimen and more collections are needed.

Most edaphic environmental parameters within sandy beaches, except possibly for some seasonal changes, can be directly related to wave action and resulting water circulation. In high energy tidal beaches, regular percolation of sea water through the interstices

maintains available oxygen and controls the distribution of food materials. The waves from above and fluctuation of the water table below result in complex currents, saturation, and trophic interactions. Food preferences, biological competition, and saturation requirements may contribute the most to psammophilic tardigrade distributions.

The role of the coastal ground water in the overall beach ecosystem will require more investigation. Many meiofaunal species are thought to inhabit the moist sand above the ground water but it also appears that adequate study will reveal other mesopsammon such as *Tanarctus arborspinosus* which prefer the totally saturated environment.

The geographical record (Fig. 6) of the five species from ISP beach shows a similar pattern for the western Atlantic. The worldwide pattern primarily reflects the locations where tardigrade surveys were conducted. The imbalance is especially evident in reports of *B. mirus*, i.e., about 50 per cent of the records are from the North Sea and Baltic Sea regions. Faunal investigations are particularly needed on the coasts of Australia, Africa, S. America, and western N. America.

Summary

Five species of tardigrades, *Batillipes mirus, B. bullacaudatus, Stygarctus bradypus, S. granulatus,* and *Tanarctus arbospinosus* nov. spec., are reported from the ocean-exposed intertidal zone of Bogue Bank, North Carolina. The new species is distinguished by a dorsal median cirrus and extremely long posterio-lateral spines with several secondary branches and many smaller tertiary projections. Intertidal distributions for each species are discussed and correlated with ecological measurements.

Zusammenfassung

Fünf Tardigraden-Arten, *Batillipes mirus, B. bullacaudatus, Stygarctus bradypus, S. granulatus,* und *Tanarctus arborspinosus* nov. spec., werden vom lotischen Strand von Bogue Bank, North Carolina, beschrieben. Die neue Art ist durch einen dorsalen cirrus medianus und ausserordentlich lange Posterio-lateral-Zirren mit einigen Sekundärästen und vielen kleinen Tertiärstacheln ausgezeichnet. Die Verteilung der Arten im Eulitoral wird im Zusammenhang mit den gemessenen ökologischen Daten diskutiert.

Acknowledgements

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