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Notes on the history of brackish water biology at the universities of Rostock and Greifswald*

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Abstract

On the occasion of the celebrations of the 50th year of existence of the biological station at Hiddensee (1982), the 150th jubilee year of the Zoological Institute of the Ernst-Moritz-Arndt-University in Greifswald (1986), and the 25th year of existence of an independent marine biological research and training facility at the University of Rostock (1985), a short overview is given of the development of biological science in the Baltic Sea in the Hither Pomerania and Mecklenburg region. It will become clear that the initiative for brackish water research arose at the University of Greifswald, with algological studies concentrated at Hiddensee and zoological-ecological work in Greifswald itself. Effective and successful marine biological research and teaching at the University of Rostock started with the establishment of the Department of Marine Biology (1960), where university marine biological activities are now concentrated as a result of the university reform (1968).

History

Often just small things can inspire a scientist, and therefore usually a whole institute, to follow a new line of research. But in Greifswald it was a ten tons whale that aroused the interest of the anatomist ROSENTHAL and of the botanist HORNSCHUCH in marine biological problems. This rather voluminous sensation – the stranding of a whale in the inland Bodden of Rügen in 1825, its transport to Wiek near Greifswald, and its preparation there – is now considered to mark the birth of hydrobiological research in Western Pomerania.

Another all-round biologist typical of those days, JULIUS MÜNTER (1863), director of Greifswald Botanical Garden, which was then 100 years old, wrote an extremely interesting article on herring. Besides describing the anatomy and biology of the fish, which was then a staple food, this important work described methods of catching, processing and marketing herring, and even called for the protection of herring stocks. His work "Zur Fauna der süßen und salzigen Gewässer Vorpommerns, Rügen und Hinterpommern vom nationalökonomischen Standpunkt" published in 1871, is not only the first comprehensive faunistic inventory, but also a valuable benchmark against which

* Dedicated to Prof. em. Dr. sc. nat. Rolf Keilbach on the occasion of his 80th birthday.

much discussed but elusive, long term changes in the Baltic can be assessed. REINHOLD BUCHHOLZ, who started work as curator of the Zoological Museum in 1864, continued the marine zoological work and broadened it to cover the Mediterranean Sea and the Atlantic Ocean. Apart from his many descriptions of species, he published the first detailed work on balanid larval forms.

Of his successor GERSTÄCKER (1876–1894), it is sufficient to note that, although a specialist in arthropods, he also contributed to “Die Fische der Ostsee” (1882) by MÖBIUS and HEINKE, the first German book devoted to species identification.

Research into biological aspects of brackish waters reached its second zenith at Greifswald University, under G. W. MÜLLER (Institute Director from 1895 to 1923), who is still cited as an authority on ostracods (e.g. MÜLLER 1900). Regular visits to anchor stations in the boddens made him an outstanding authority on the bodden flora and fauna and induced him to join in the dispute going on at that time concerning the decline of the herring fisheries.

Of MÜLLER’s many doctorands and assistants we shall mention only THIENEMANN and STAMMER. During his stay at Greifswald (1901–1907), AUGUST THIENEMANN received the stimulus that shaped his whole future scientific work. The chance discovery of *Planaria alpina* in creeks on the Stubbenkammer on Rügen and the “transplantation experiments” performed with other planarians formed the starting point of his lifework, “Die Verbreitungsgeschichte der Süßwassertierwelt Europas” (THIENEMANN 1950) – a monograph that must be of great interest to every brackish water ecologist. Another “early love”, which started with the discovery of a new chironomid (later described by KIELJER as *Orthocladius thienemanni*) led to the new description of 30 (!) species and became almost a second “marriage”, culminating in his standard work “Chironomus” (THIENEMANN 1954). THIENEMANN himself remarked: “I doubt that I would have had the courage to study chironomids so intensively if I had known that these midges would repeatedly occupy my attention throughout my life.”

MÜLLER’s second pupil, H.J. STAMMER (1921–1927 in Greifswald) concentrated on brackish water ecology. His work concerning the effects of salinity on the distribution of the fauna in Greifswalder Bodden (e.g. STAMMER 1928) formed an important basis for the first attempts undertaken with REDECKE (e.g. 1922) to introduce a nomenclature for brackish waters.

Under ERNST MATTHES (1927–1937), a name known to all biologists, and SEIFERT (e.g. 1933) who will later be mentioned again in connection with Hiddensee, continued the faunistic ecological research into brackish waters. Although primarily a comparative anatomist, MATTHES was fascinated by the Baltic fauna and introduced a form of co-operation that could still be useful today: the use of routine mine sweeper patrols in the Northern Baltic to collect samples. He also found the first (and only) specimen of the crab *Eriocheir sinensis* in the catchment area of Greifswalder Bodden (MATTHES 1932).

The fishery biologist MEYER-WAARDEN who was simultaneously director of the Institute of Fisheries in Swinemünde and represented hydrobiology at Greifswald in 1944/45, marked the end of an important period of brackish water research at Greifswald University.

The subsequent period, which started in 1948 initially still under SEIFERT, but in which KEILBACH later played an increasingly prominent role, and which ended in 1969 with the reform of higher education in the GDR, will be outlined thematically and not chronologically.

The move to Rostock, where research continued under ARNDT who was later joined by SCHNESE, also had its origin during this period.

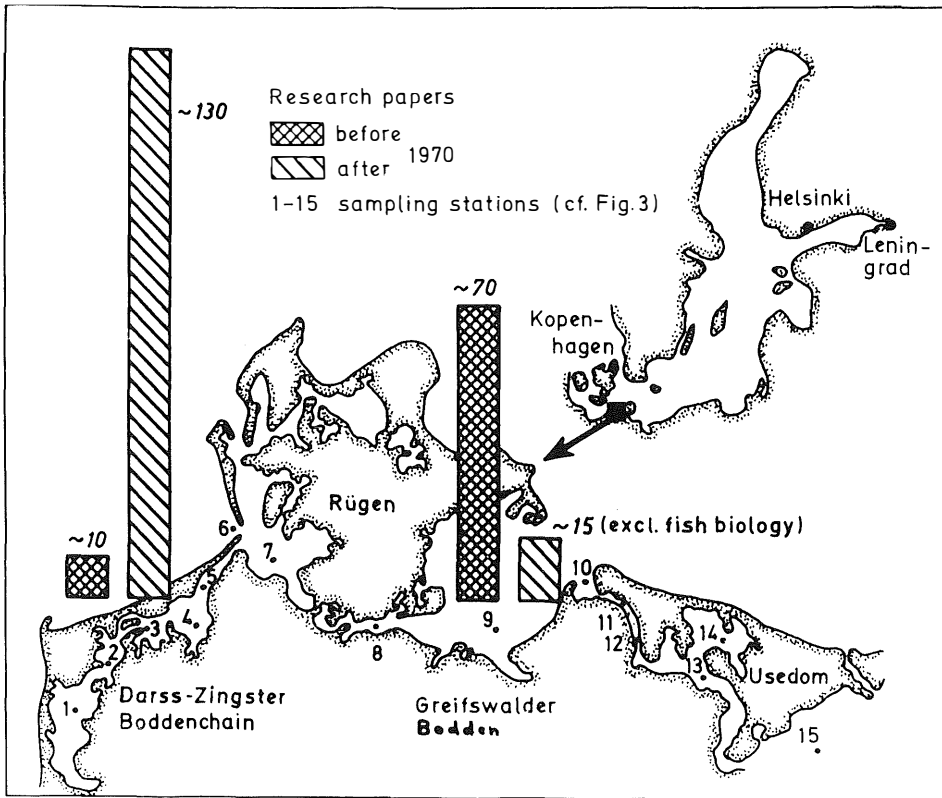


Figure 1

The GDR's principal inshore coastal waters with particulars of research activities undertaken in the areas of the Greifswalder Bodden, the North Rügen Bodden and the boddens south of the Darss-Zingst peninsula before and after 1970. The station numbers are the same as those of the sample collection sites in Fig. 3.

The considerable scientific potential of Greifswald and Rostock Universities is now focussed on their respective home waters, the Greifswalder Bodden and the boddens south of the Darss-Zingst Peninsula as shown in Fig. 1. Although the terms ecosystem analysis and, even more, modelling were naturally unknown in Greifswald during the fifties and sixties, it is nevertheless evident that even then efforts were being made to conduct systematic biological and ecological research in the boddens in line with past traditions. Fig. 2 represents an attempt to illustrate the main biotopes and some of the scientists studying them.

At this point tribute should be paid to the important contribution to brackish water ecology made by WERNER SCHNESE – a name inseparably linked with hydrobiology in both Greifswald and Rostock.

SCHNESE was an enthusiastic proponent of modern aquatic research in the GDR not only while at Greifswald. Long before it became "fashionable", for instance, he strove to overcome outmoded regional and systematic barriers and to unite scientists working in different fields under the ecosystem concept. These endeavours culminated in his leadership of Rostock's largest interdisciplinary research group, which was established to

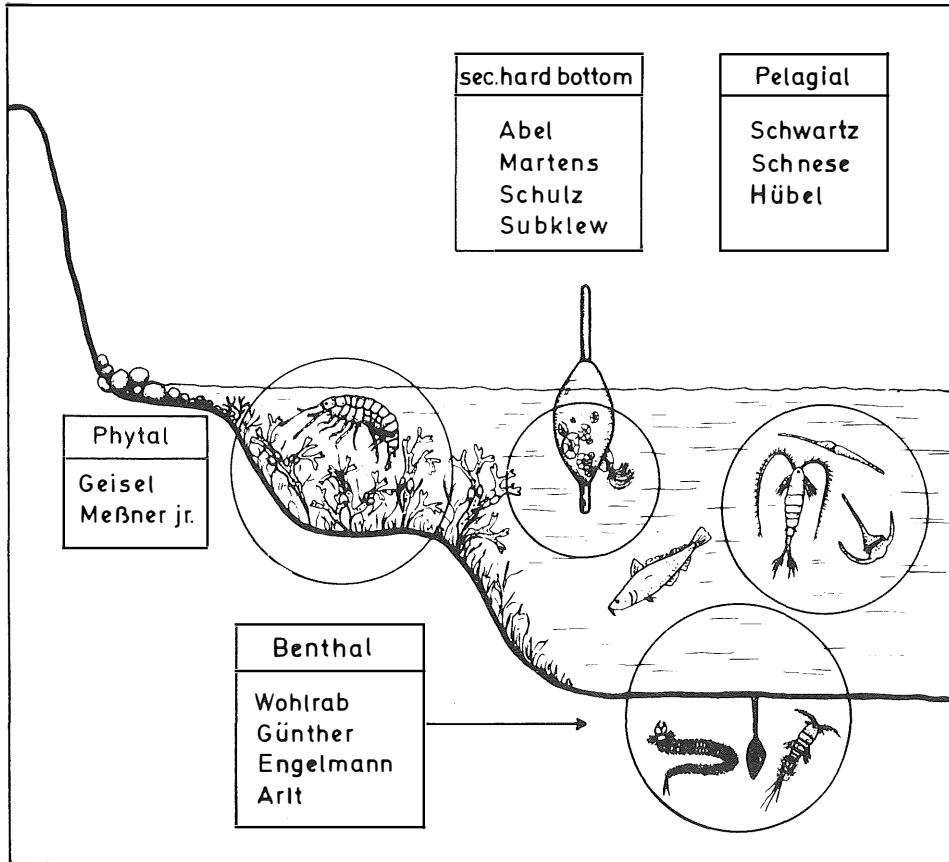


Figure 2

A greatly simplified profile through the Greifswalder Bodden showing schematically the main biotopes and the most important researchers working on them.

undertake complex ecosystem analyses. Numerous publications resulted with, for instance, the botanist H. HÜBEL, the chemist G. SCHLUNGBAUM or the modeller U. VIETINGHOFF as co-authors.

Fig. 3 shows one of the results of SCHNESE's plankton research activities, illustrating clearly the link between eutrophicating factors (only nitrogen in this case) and phytoplankton biomass in relation to the catchment areas and anthropogenic loads of different boddens. These studies provided invaluable baseline data for characterizing the state of the Baltic and trend analysis (SCHNESE 1969).

In connection with zoobenthos research at Greifswald we wish to dwell less upon interesting scientific phenomenon such as the micropatchiness of meiofauna (ARLT 1973) or the substrate specificity of individual macrofauna representatives (ENGELMANN 1964) than upon the decreasing diversity of fauna in our coastal waters that has become apparent in both contexts. By comparing STAMMER's (1928) results with those of SEIFERT (1938) and ENGELMANN (1964), MESSNER and von OERTZEN (1987) showed that many species, particularly of *Turbellaria*, but also of *Cnidaria*, *Gastropoda* and *Polychaeta*, found in the past have vanished or become exceedingly rare.

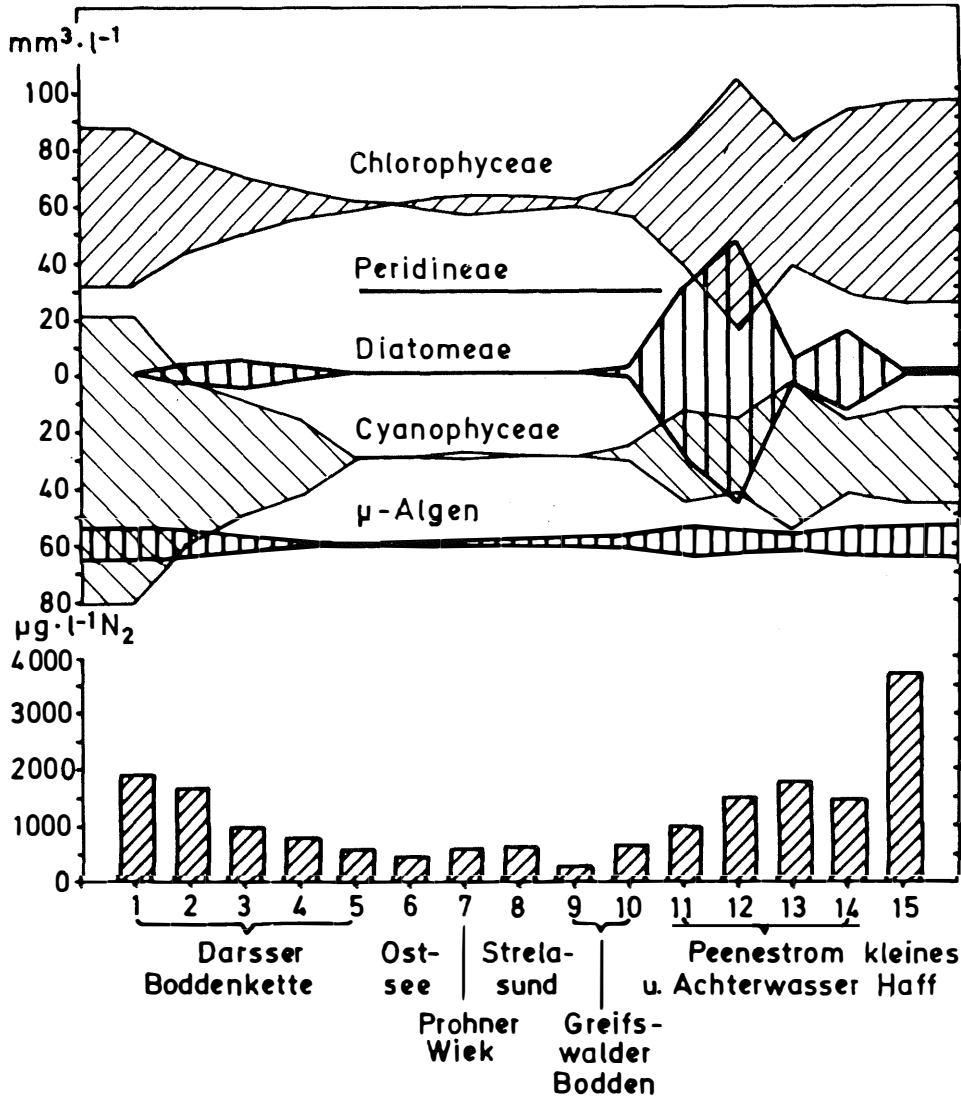


Figure 3

Link between total nitrogen concentration and planktic algal biomass at selected coastal stations (cf. Fig. 1) (modified after SCHNESE 1969)

Besides these predominantly descriptive analyses of the biotic structure of the Greifswalder Bodden, KEILBACH, SCHILDMACHER and later above all HEGEMANN took the first promising steps towards a functional autecological analysis. The effects of the master factor salinity on the free amino acid pools of teleosts and invertebrates and the calculation of simple energy balances for the most important commercial fish species were a modest counterpart to SCHLIEPER's ecophysiological research in Kiel (see HEGEMANN 1987). Intended partly to elucidate how brackish water ecosystems function



Figure 4

Fritz Gessner and Gerhart Hauptmann at the microscope in the Biologische Forschungsanstalt on Hiddensee (1931)

and partly to enlarge our practical ecophysiological knowledge of commercial fish species (SPANNHOF et al. 1985), this work, too, was later resumed at Rostock University.

At this point it seems appropriate to say a few words concerning the Biologische Forschungsanstalt (BFA) on Hiddensee, which also belongs to Greifswald University.

The primarily botanical investigations into the ecology of the brackish waters around Rügen did not start until relatively late. If we ignore occasional floristic reports (for instance HOLTZ 1891), F. SCHÜTT was the first scientist to propose quantitative plankton studies in the Greifswalder Bodden. Due to his early activities in Kiel, joint work with HENSEN, APSTEIN and BRANDT, and his participation in the plankton expedition funded by the Humboldtstiftung, he was well acquainted with production biological problems. The very thorough phytoplankton studies written by his pupils FRAUDE (1906) and ABSHAGEN (1908) are particularly interesting, and their accounts of the regular blooms of blue-green algae, which were observed even in those days, are fascinating.

The establishment of the Biologische Forschungsanstalt on Hiddensee in 1930 marked the beginning of intensive research into the coastal and bodden waters of Rügen. F. GESSNER was the initiator of the main activities, and his extensive studies (1931–33) led him to describe the hydrographic and production biological situation in the bodden waters of North Rügen and south of the Darss-Zingst Peninsula (see for example GESSNER 1937). Although later no longer on Hiddensee himself, his publications (GESSNER 1940 a, 1957) and personal contacts contributed greatly to progress in this direction. Tribute is paid to FRITZ GESSNER's services to science in HÜBEL (1982).

Despite his intensive scientific work, GESSNER found the time to maintain contact with many of the islands famous guests, and the visitors' book of the Biologische Forschungsanstalt contains such names as ALBERT EINSTEIN, SIEGMUND FREUD, ERNST TOLLER and AUGUST THIENEMANN. His relationship with GERHART HAUPTMANN was particularly close, the two often coming together during the summer months to work at the microscope or to discuss philosophy, politics and science far into the night (Fig. 4).

His studies were later continued by TRAHMS (1937, 1939 a), who also enlarged their scope to include phytobenthos (TRAHMS 1939 b). Nutrient levels (TRAHMS and STOLL 1938) and zooplankton production (RENTZ 1940) were also studied during this period. Further studies relating to the nutrient balance of these waters led TRAHMS (1941) to recognize the importance of phosphate recycling from the sediment for the productivity of the inland bodden waters.

The beginning of World War II put a temporary end to all research on Hiddensee, and systematic aquatic research ceased until R. BAUCH was appointed director of the Biologische Forschungsanstalt in 1947. Production biological studies were then carried on by J. OVERBECK. Although they now seem paradoxical, OVERBECK's marine fertilization experiments (OVERBECK 1956) are worth to mention: multiple applications of phosphate fertilizer during the growth season each led to only a brief increase in phytoplankton production before being balanced out by the ecosystem. His results are of great importance in connection with current questions concerning the nutrient load that the bodden waters can sustain (SCHIEWER et al. 1986). Moreover, OVERBECK (1962) recognized the significance of nanoplankton for Rügen's inland bodden waters and carried out the first sediment studies relating to phosphate recycling from the topmost layer.

The site-specific forms of *Fucus vesiculosus*, which are particularly diversified in our coastal and bodden waters, were studied by BAUCH (1954, 1955/56) BAUCH, SUCKOW and SCHWARTZ (1968) or KALÄHNE, WARTENBERG and BAUCH (1955/56) which encouraged other authors to undertake similar studies (MÜLLER-STOLL and KÜNZENBACH 1956, OVERBECK 1956).

The use of ^{14}C to study phytoplankton production dates back to 1959. Numerous publications (for instance HÜBEL 1966 a, b, 1968, 1973, SCHNESE and HÜBEL 1976) appeared, dealing with the productivity of the coastal and bodden waters, their annual and interannual dynamics and the influence of environmental factors. The data since collected in the course of 28 years of research demonstrate the anthropogenic influence on phytoplankton production in these waters.

The importance of inorganic nitrogen, as the factor limiting primary production in our coastal waters, was early recognized (HÜBEL 1960). Extensive studies using the acetylene reduction technique revealed the importance of nitrogen fixation for the cycling of matter in coastal waters (HÜBEL and HÜBEL 1974 a, b, 1976, 1980).

Several publications (WESTPHAL and GUBSCH 1973, 1975, WESTPHAL et al. 1980, BABENZIEN et al. 1982) have dealt with the microbiological parameters of the coastal waters, and many faunistic, ecological and floristic studies have been made (see KEILBACH 1982). SCHWARTZ (1959, 1963) analyzed the dynamics of the zooplankton of the coastal and bodden waters, and KOSLER (1962, 1968) continued the studies of the bottom fauna which SEIFERT initiated in 1939.

The abundance and biomass of the fauna colonizing the *Fucus* stands around Hiddensee were estimated by von OERTZEN (1965, 1968), whose ecophysiological studies of tolerance and performance (von OERTZEN 1973) permitted conclusions to be drawn regarding the causes of ecological phenomena.

Experiments to elucidate the feeding biology of zooplankton were carried out by SPITTLER (1969, 1973), and reports dealing with the algal vegetation of both the coastal and bodden waters were published by KÜNZENBACH (1955/56), RATHSACK-KÜNZENBACH (1961, 1969), OVERBECK (1965) and HÜBEL (1970).

The almost six decades of research into the ecology of brackish waters at the Biologische Forschungsanstalt on Hiddensee, which has focussed predominantly on the bodden waters of North Rügen, those south of the Darss-Zingst Peninsula and the western region of the Arkona Sea, provide us today with reliable information regarding eutrophication phenomena, long term faunistic and floristic changes and possible trends in these waters, which increasingly show the signs of anthropogenic influences.

Although Rostock University is more than seven centuries old, it has no genuine tradition of marine biology. E.A. ARNDT was therefore sort of a pioneer when he, although being a newcomer to the field, established a marine biological unit virtually out of nothing at the then Zoological Institute in 1960. Fueled by the enthusiasm for which he is well-known, and supported by only a few co-workers, he set forth to tackle a wide range of ecological problems in the Western Baltic. Two books (ARNDT 1964, ARNDT et al. 1969) and numerous other publications dealing mainly with the secondary fauna of hard bottoms and plankton distribution provide ample evidence of these activities. Under his leadership BRENNING initially studied the Biology of *Arenicola marina* (e.g. BRENNING 1967). Later he turned to the free living marine nematodes e.g. and is now a recognized copepod specialist (e.g. BRENNING 1973, 1985). GOSELCK, originally engaged on the ecophysiology of *Cordylophora caspia* (e.g. GOSELCK 1969), is now fully immersed in macrobenthos studies (e.g. GOSELCK 1985). Von OERTZEN started investigating the ecophysiology of mainly macro-benthic organisms of the Baltic, a subject which he still finds absorbing (e.g. von OERTZEN 1984). Among the botanists, PANKOW and KELL were the main proponents and their "Algenflora der Ostsee" (1971, 1976) is well-known.

All of these activities, which have been presented here only as examples, were undertaken in close cooperation with the Institute of Marine Research and the Institute of Ocean Fisheries and Fish Processing in Rostock and culminated in the establishment of the Baltic Marine Biologists 1968, when the first BMB-symposium was held at Rostock/Warnemünde.

It was partly because of this "germinating cell" at Rostock that during the redefinition of research and training programmes in the third reform of higher education in the GDR, marine biological capacity was concentrated at Rostock University. Supplemented by SCHNESE (plankton), ARLT (meiofauna) and SPITTLER (feeding biology) from Greifswald, the unit rapidly evolved into an efficient interdisciplinary research team, which also established thematic links with the team gathered around HÜBEL.

It would be unfair to mention only a few of the more than 200 scientific publications that have appeared, and we shall therefore mention just a few names representing research in new directions. ERDMANN and SCHIEWER (1984) for instance, took up the problem of salinity adaptation in blue-green algae and SCHIEWER has now taken charge of the above mentioned mesocosm studies (SCHIEWER 1986). E. M. SCHARF and W. SCHNESE (1984) studied the role of the microfauna in coastal waters, and HEERKLOSS et al. (1984) investigated trophometabolic interactions between phyto- and zooplankton.

Of those responsible for the extensive studies dealing with the chemistry of sediments, we shall mention only SCHLUNGBAUM and NAUSCH (1984). The unit headed by BIESTER (1979) is concerned with the ecology of the Rügen spring herring and the biology of the freshwater fishes found in brackish waters. The group represented by VIETINGHOFF (1984) integrates and models the results of all those activities initiated by SCHNESE to analyze ecosystem structures and functions.

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