B – BIOLOGICAL OCEANOLOGY

Benthic studies – BB

BB.01.

QUANTITATIVE INVESTIGATIONS OF UNDERWATER MEADOWS IN PUCK BAY

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Oceanologia 1980, no. 12, pp. 125–139.

Abstract

The investigations covered 120 km^2 of Puck Bay proper and part of the outer Bay down to the 17-metre isobath. The extent of the underwater meadows was established by free diving. The flora and plant fauna collected simultaneously in late August and early September 1969 were analysed quantitatively.

On the basis of previous phytosociological investigations and the ecological series outlined, the area was divided into 4 parts corresponding to the following communities: Part I – *Zostera marinae*, Part II – *Chara* and *Ulva*, Part III – *Fuceto – Furcellarietum*, Part IV – No indigenous vegetation.

The underwater meadows occur down to a depth of 6 m, in most cases in the form of patches or strips. Cover was most uniform (almost 100%) in the *Chara* and *Ulva* communities, although they are floristically the least differentiated. As regards biomass, the meadows of Puck Bay proper are twice as abundant (about 200 g m^{-2}) as those of the outer Bay. The plant fauna is most numerously represented by Lamellibranchiata, Gastropoda and insect larvae. The *Zostereteа marinea* L. community is the richest as regards abundance and biomass. In general, the plant fauna is not as abundant as in the immediate post-war period. The differences in the fauna inhabiting particular plant communities are quantitative rather than qualitative. During the summer, the meadows are inhabited mainly by juvenile forms, including typical benthic species.

With respect to the physico-chemical and biological conditions, this is the most similar to the Baltic of all the Polish coastal bays. From the floristic and faunistic point of view, its underwater meadows are similar to those of the Danish lagoons and estuaries, as well as the areas between the rocky islets off the Finnish coast.

Puck Bay therefore constitutes an intermediate link between the biocenoses of a more temperate climate with the same or higher salinity, and those situated in a more severe climate but with less saline waters.

BB.02.

OUTLINE OF THE NUMBER AND BIOMASS OF BOTTOM FAUNA IN THE VISTULA LAGOON

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Oceanologia 1983, no. 14, pp. 187–200.

Abstract

Investigations of the zoobenthos of the Vistula Lagoon were carried out at the nine stations shown in Fig. 1. Three samples were collected at each station by means of an Ekman-Birge bottom sampler with a collecting surface area of 225 cm^2. The samples were collected at *ca* one-month intervals from May to November 1997 and April to October 1978.

The bottom fauna of the Vistula Lagoon is qualitatively meagre (Tab. 1), consisting essentially of two groups of animals: Oligochaeta and Chironomidae. The former predominate as regards numbers (Figs. 2 and 3), whereas the latter, primarily *Chironomus* f.l. *semireductus* and *Procladius* sp., determine the biomass (Figs. 6 and 7). The total numbers and biomass of the remaining taxa are insignificant.

An increase in the number of Oligochaeta individuals was observed towards the north-east (Figs. 2 and 3), which coincides with the abundance of organic matter. The highest numbers were recorded at the inshore stations. The numbers of *C.* f.l. *semireductus* were relatively uniform except for a slight increase observed in the south-western part of the lagoon in 1977. In this case too, the highest numbers were recorded at the inshore stations. The numbers of the third group, *Procladius* sp., were somewhat higher in the centre of the lagoon. Despite some differences, the average number of zoobenthos was similar in both years. The small number of species and the pronounced predominance of only a few taxa are indicative of the advanced eutrophication of the basin.

The main component of the biomass was *C.* f.l. *semireductus* (Figs. 6 and 7). No regularities were observed in its biomass distribution. That of Oligochaeta, similar to its numbers, increased along the middle part of the lagoon.

Seasonal variations of zoobenthos of the Vistula Lagoon are due mainly to fish feeding and the evolutional cycle of Chironomidae.

BB.03.

MORPHOLOGICAL AND ANATOMICAL INVESTIGATIONS OF *FURCELLARIA FASTIGIATA* (HUDS.) LAM. FROM PUCK BAY

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Oceanologia 1983, no. 16, pp. 133–147.

Abstract

This work is based on material collected from various depths of Puck Bay in autumn 1968 and spring 1969. Thalli of *Furcellaria fastigiata* (Huds.) Lam. were sampled off Osłonino and Rzucewo (Fig. 1). The study material consisted of the growth apices of the thalli, 2–5 cm in length (Fig. 2). Cytochemical techniques were applied to fix and stain the slides.

Morphological and anatomical examination using microscope photography enabled the following to be established: structural type, shape of thallus, size of cell and cell nucleus, the chemical nature of the cell walls and the location of the basic storage substance.

BB.04.

ANALYSIS OF THE COMPOSITION AND VERTICAL DISTRIBUTION OF THE MACROALGAE IN THE WESTERN PART OF THE GULF OF GDAŃSK IN 1979 AND 1980

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Oceanologia 1984, no. 19, pp. 101–115.

Keywords: Macroalgae, Vertical distribution, Gulf of Gdańsk

Abstract

The aim of this work was to collect recent data on the composition and distribution of macroalgae in the Gulf of Gdańsk with attention given to seasonal variations. Materials were collected along 5 sampling profiles situated in the western part of the Gulf of Gdańsk, and at one sampling

point on the beach at Jurata (Fig. 1). Samples were collected at monthly intervals during two growing seasons (1979 and 1980). At sampling points down to 1 m depth the materials were collected manually; a dredge was used in deeper water. On the beach, samples for quantitative analysis were collected from randomly selected 1 × 1 m or 0.5 × 0.5 m squares, whereas materials for qualitative analysis were taken from large, undefined areas. At deeper sites where the dredge was used, subsamples of 1 dm^3 were taken for quantitative analysis, the extent of dredge filling with the material being estimated each time.

BB.05.

AN ATTEMPT TO DETERMINE THE TROPHIC STRUCTURE OF THE BOTTOM FAUNA IN COASTAL WATERS OF THE GULF OF GDAŃSK

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Oceanologia 1985, no. 21, pp. 109–121.

Keywords: Trophic structure, Bottom fauna, Coastal waters, Gulf of Gdańsk

Abstract

The paper is an attempt to characterise the trophic structure of the bottom fauna in coastal waters of the Gulf of Gdańsk on the basis of results of studies on the composition and distribution of the zoobenthos carried out in 1977–1981. Five trophic groups were distinguished: herbivores, which are of no importance in the Gulf of Gdańsk, suspension-feeders, deposit-feeders, predators and facultative suspension-deposit-feeders. The last-named group was distinguished in view of considerable disagreement as to the character of *Macoma balthica* feeding behaviour.

The trophic structure appeared to be broadly diversified with respect to region and depth. Suspension-feeders predominated in the shallow zone (down to 20 m depth) in the western part of the gulf. The deep eastern areas of the whole gulf were inhabited mostly by facultative suspension-deposit-feeders, *M. balthica* being dominant in the total bottom fauna biomass.

BB.06.

ENERGY VALUES OF THE BODY OF *MACOMA BALTHICA* L. FROM THE GULF OF GDAŃSK

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Oceanologia 1986, no. 24, pp. 55–62.

Keywords: Energetic values, *Macoma balthica*, Gulf of Gdańsk

Abstract

Energy values of *Macoma balthica* from 6 stations situated in the Gulf of Gdańsk were measured directly by combustion in a microbomb calorimeter and indirectly by calculation based on the biochemical composition. There were no statistically significant differences between the values obtained by the two methods. The average total energy values from the microbomb and those calculated from the biochemical composition for the same material were equal to 22.6 ± 1.75 and 22.58 ± 1.75 kJ g^{-1} d.w. respectively. A correlation between the energy value and the lipid content was found.

BB.07.

VARIATIONS IN ENERGY AND LIPID CONTENT OF *MYTILUS EDULIS* FROM THE GULF OF GDAŃSK

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Oceanologia 1988, no. 25, pp. 99–107.

Keywords: *Mytilus edulis*, Lipid content, Energy variations, Gulf of Gdańsk

Abstract

Variations in the energy values and lipid content in the body of *Mytilus edulis* from the Gulf of Gdańsk in relation to age and wet weight of individuals in an annual cycle (February 1983 – January 1984) are presented. The mean energy value was equivalent to 20.58 J mg^{-1} dry weight and 23.26 J mg^{-1} dry weight of organic matter. Mussels attain the highest energy values during the period of reproduction (April–May) and in August. After the phytoplankton bloom in autumn (October–November) individuals again exhibit high energy values. The lowest values were recorded in December. The mean lipid content was equal to 17.3%; maximum values were noted

during the reproductive period (October and November), minimum values in September.

BB.08.

SPECIFICITY OF THE BALTIC MACROPHYTOBENTHOS (Communications)

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Oceanologia 1990, no. 28, pp. 115–117, (no abstract).

BB.09.

THE PRODUCTION CHARACTERISTIC OF THE PHYTOBENTHOS OF THE GULF OF GDAŃSK (Communications)

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Oceanologia 1990, no. 28, pp. 119–122, (no abstract).

BB.10.

LONG-TERM CHANGES IN THE BIOCOENOSIS OF THE GULF OF GDAŃSK

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Oceanologia 1992, no. 32, pp. 69–79.

Keywords: Changes in the biocoenosis, Gulf of Gdańsk, Eutrophication

Abstract

Eutrophication and generally increasing pollution have given rise to far-reaching changes in the biocoenosis. These mainly concern the structure of communities and the intensity of growth of particular species, and to a lesser extent, their species composition, through the reduction in

abundance or disappearance of some species, in particular in the Inner Puck Bay, where once-lush underwater meadows have all but disappeared.

BB.11.

A TAXONOMIC ANALYSIS OF THE *ECTOCARPACEAE* (*PHAEOPHYTA*) FROM THE GULF OF GDAŃSK

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Oceanologia 1992, no. 32, pp. 81–97.

Keywords: *Ectocarpaceae*, Numerical taxonomy

Abstract

Three species of *Ectocarpaceae* are cited in the literature as being present in the Gulf of Gdańsk: *Pilayella littoralis*, *Ectocarpus siliculosus* and *Ectocarpus confervoides.*

The morphological characters were analysed using the numerical taxonomy method; the life cycle was also studied. Material was collected with a dredge from 4 regions of the Gulf of Gdańsk at monthly intervals from April to October.

Cluster analysis showed that there are no satisfactory morphological characters distinguishing *Ectocarpaceae* spp. from the Gulf of Gdańsk. In addition, observations of their life cycle indicated that *E. siliculosus* and *P. littoralis* are two generations of the same species.

BB.12.

CHANGES IN THE COMPOSITION AND DISTRIBUTION OF BENTHIC ALGAE ON THE POLISH COAST OF THE BALTIC SEA (1986–1991)

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Oceanologia 1992, no. 33, pp. 183–190.

Keywords: Phytobenthos, Southern Baltic, Changes in composition

Abstract

The composition and frequency of phytobenthic organisms along the Polish Baltic coast was analysed. During 5 years of observations, Chlorophyta were found to be dominant, and the brown alga *Pilayella litoralis* expanded rapidly in highly eutrophic areas. Absent at the start of observations, *Fucus vesiculosus* appeared in some areas in 1990.

BB.13.

SEASONAL CHANGES IN ENERGY VALUE AND LIPID CONTENT IN A POPULATION OF *COROPHIUM VOLUTATOR* (PALLAS, 1766) FROM THE GULF OF GDAŃSK

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Oceanologia 1993, no. 35, pp. 61–71.

Keywords: *Corophium volutator*, Bioenergetic values, Lipids,
Gulf of Gdańsk

Abstract

Materials for the study were collected in the near-shore zone of the Gulf of Gdańsk, at Swarzewo, between October 1991 and September 1992. The population of *Corophium volutator* (*Amphipoda*) from the Gulf of Gdańsk is characterised by a low energy value – $12.69 \pm$ (SD) 3.49 J mg^{-1} DW ($18.22 \pm$ (SD) 2.49 J mg^{-1} AFDW). The mean lipid level in their bodies – $5.8 \pm$ (SD) 4.14% d.w. – was also found be low, which explains their relatively low energy value.

It has been shown that in addition to factors such as food quality and availability, seasonal variability in population composition has a significant influence on the nature of changes in the energy value and lipid level in *C. volutator*.

BB.14.

VARIATIONS IN ENERGY VALUES AND LIPID CONTENT IN *ENTEROMORPHA* SPP. FROM THE GULF OF GDAŃSK

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Oceanologia 1995, no. 37 (2), pp. 171–180.

Keywords: Energy values, Lipid content, *Enteromorpha* spp., Gulf of Gdańsk

Abstract

The variations in energy values and lipid content in *Enteromorpha* spp. collected from Jurata at monthly intervals during the period from November 1992 to October 1993 and from 7 stations situated on the coast of the Gulf of Gdańsk during September 1993 in relation to season and place are presented.

As far as the samples from Jurata are concerned, seasonal variations in energy values and lipid content are observed when the highest total energy values and lipid content were recorded at the beginning of the growing season during April and May – between 14.0 and 10.8 J mg^{-1} DW – for total energy and between 6.0 and 5.0% of DW for lipid content. After this time, these values started to decrease and fluctuated between 8.2 and 10.5 J mg^{-1} DW for total energy and between 2.5 and 3.7% of DW for lipid content. The ash values fluctuated within a wide range between 12.2 and 27.5% of DW; here, the highest values were recorded at the end of the growing season and the lowest ones at the beginning.

Moreover, different values were recorded for energy, organic matter, ash and lipid content in samples collected from different stations on the coast of the Gulf of Gdańsk during September, where the highest total energy values and lipid content were recorded in the samples from Chałupy, followed by those from Jurata – 9.9 and 9.5 J mg^{-1} DW for total energy and 3.4 and 3.5% of DW for lipid content respectively.

BB.15.

THE BIOCHEMICAL COMPOSITION OF *SADURIA (MESIDOTEA) ENTOMON* (ISOPODA) FROM THE GULF OF GDAŃSK (SOUTHERN BALTIC)

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Oceanologia 1996, no. 38 (1), pp. 113–126.

Keywords: Crustacea, Biochemical composition, *Saduria entomon*

Abstract

The biochemical composition of *Saduria entomon* specimens from the Gulf of Gdańsk (southern Baltic) has been investigated. The average values found, expressed as a percentage of dry weight, are as follows: 28.8% proteins, 6.7% lipids, 8.0% carbohydrates and 28.0% ash. Seasonal variation in the biochemical composition of *S. entomon* was observed during the study period. The differences in protein, lipid, carbohydrate and ash content between males and females were not statistically significant ($p > 0.05$). The relatively small average contents of individual components compared to those in other crustaceans from the Gulf of Gdańsk may have resulted from the broad food preferences of *S. entomon*, ensuring its access to nutrients throughout the year.

BB.16.

THE INFLUENCE OF HYDROGEN SULPHIDE ON MACROFAUNAL BIODIVERSITY IN THE GULF OF GDAŃSK

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Oceanologia 1996, no. 38 (1), pp. 127–142.

Keywords: Hydrogen sulphide, Sediment, Zoobenthos

Abstract

Investigations into the occurrence and concentrations of hydrogen sulphide in sediments of the Gulf of Gdańsk were carried out in September 1994. It was found that the concentration of H_2S increased with basin and sediment depths. The highest concentration (1244 μmol dm^{-3}) was recorded in the 4–8 cm sediment layer at the deepest of the stations investigated (station 14; 82 m depth). The studies demonstrated that numerous species belonging to the macrozoobenthos are exposed to H_2S concentrations from several to several hundred μmol dm^{-3}. These are both deep-water species –

Macoma balthica, *Harmothoe sarsi*, *Saduria entomon*, *Pontoporeia femorata* – and shallow-water species – *Corophium volutator*, *Mya arenaria*. High concentrations of hydrogen sulphide, *i.e.* > 1000 μmol dm^{-3}, caused the number of different macrozoobenthos species to decrease, even though abundance and biomass levels remain high. The studies indicated that the presence of hydrogen sulphide is best tolerated by two species – *M. balthica* and *H. sarsi*.

BB.17.

CHLOROPHYLLS *c* IN BOTTOM SEDIMENTS AS MARKERS OF DIATOM BIOMASS IN THE SOUTHERN BALTIC SEA

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Oceanologia 1996, no. 38 (2), pp. 227–249.

Keywords: Chlorophyll *c*, HPLC, Baltic Sea, Spitsbergen fjords, Diatoms, Marine environment

Abstract

Sediments from different regions of the Baltic Sea, collected in the years 1992–1994, were analysed for chlorophyll *c* content by reversed-phase HPLC. For comparison, a series of samples from Spitsbergen fjords were also analysed. Diatom distribution was determined in selected samples. The total chlorophylls *c* in sediments is a very sensitive indicator of the occurrence of chlorophyll *c*-containing algae in the overlying water column. The shape and relative proportions of the chlorophyll *c* peaks in the HPLC chromatogram reflect the presence of fresh and senescent algal cells, as well as the oxygen conditions in the environment. Both benthic and planktonic diatoms are the main source of chlorophylls *c* for the Baltic sediments. Furthermore, the ratio of chlorophylls *c* and *b* to chlorophyll *a* depends on the proportions of diatoms, green algae and blue-green algae in the total Baltic phytoplankton biomass.

BB.18.

A COMPARISON OF THE MACROFAUNAL COMMUNITY STRUCTURE AND DIVERSITY IN TWO ARCTIC GLACIAL BAYS – A 'COLD' ONE OFF FRANZ JOSEF LAND AND A 'WARM' ONE OFF SPITSBERGEN

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Oceanologia 1996, no. 38 (2), pp. 251–283.

Keywords: Arctic ecosystems, Glacial bays, Macrofauna communities, Biodiversity

Abstract

The species composing the bottom fauna of Skoddebukta, a tidal glacier bay off West Spitsbergen (77°N), and Tikhaia Bay off Franz Josef Land (Hooker Island 80°N) were studied. Skoddebukta contained transformed Atlantic waters at a temperature of $> +4$°C in summer, while the Arctic waters of Tikhaia Bay were at their summer maximum temperature of < -0.5°C. The glaciers were of different types: 'warm' at Skoddebukta and 'cold' at Tikhaia Bay. Over 210 benthic taxa were identified at both sites, 30% of species being common to both. The zoogeographical status of the fauna was similar in both bays. Cluster analysis of the samples revealed the existence of 7 associations. The associations mostly influenced by glacier or river outflow were significantly dominated by deposit feeders and displayed low diversity. The Tikhaia Bay community was more diverse than that in Skoddebukta, which is due to its better trophic conditions and lower level of inorganic sedimentation-induced disturbance.

BB.19.

THE SANDY LITTORAL ZOOBENTHOS OF THE POLISH BALTIC COAST

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Oceanologia 1996, no. 38 (3), pp. 361–378.

Keywords: Baltic littoral, Benthos

Abstract

Macrobenthos and meiobenthos were quantitatively sampled in the sandy littoral along the Polish Baltic Sea coast in August 1994. Macrofaunal abundance (0–987 indiv. m^{-2}), biomass (0–3.19 g m^{-2} wet wt.) and the number of species (3) were very low. Eight meiofaunal animal groups were found. Meiofaunal abundance (38–760 indiv. 10^{-1} cm^{-2}) was dominated by Nematoda and Turbellaria, the biomass (0.86–34.9 mg 10^{-1} cm^{-2} wet wt.) by Oligochaeta. In terms of biomass, the macrobenthos:meiobenthos ratio ranged from 0.02 to 5.17. Macrofaunal abundance and biomass were more variable than those of the meiofauna.

BB.20.

HYDROGEN SULPHIDE AND OTHER FACTORS INFLUENCING THE MACROBENTHIC COMMUNITY STRUCTURE IN THE GULF OF GDAŃSK

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Oceanologia 1996, no. 38 (3), pp. 379–394.

Keywords: Gulf of Gdańsk, Macrofaunal communities, Hydrogen sulphide, Biodiversity

Abstract

Three stations in the Gulf of Gdańsk were sampled monthly for one year with regard to macrozoobenthos composition, oxygen content and temperature of near-bottom waters, granulometry, organic matter content and H_2S concentration in sediments. The differences in H_2S concentrations at the stations were most conspicious. The presence and concentrations of H_2S appeared to be the decisive factor for the grouping of samples in the Bray-Curtis Similarity Index-based ordination. Even seasonality was of secondary importance. The number of species and the Shannon Indices decreased, and the dominance of the predominant species – *Macoma balthica* – increased in accordance with the H_2S gradient between the stations. The community was dominated by detritus-feeders.

Experimental biology – BE

BE.01.

THE EFFECT OF THE CHEMICAL STRUCTURE OF POLYENE MACROLIDES ON THE PERMEABILITY OF THE *CHLORELLA VULGARIS* PLASMA MEMBRANE

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Oceanologia 1976, no. 6, pp. 19–36.

Abstract

A new model for investigating the mechanism of action between polyene macrolides and *Chlorella vulgaris* has been developed. This model was subjected to a systematic study in order to discover the relationship between the chemical structure of these substances and their physico-chemical properties on the one hand, and the nature of the changes they elicit in the plasma membrane of this alga on the other.

The degree of damage to the plasma membrane in *C. vulgaris* was found to depend on the chemical structure of the antibiotic, in particular on the size of the macrolide ring and the degree of saturation of the chromophore, but not on the molecular mass of the antibiotic, its ionic nature, the structure of the nitrogen-containing fragment or the degree of dispersion in water.

Additionally, it was found that all polyene macrolides begin their attack on *C. vulgaris* cells by inducing specific changes in the plasma membrane structure of this alga, thereby enabling potassium ions to diffuse freely. The activity of some antibiotics is restricted to this first stage and have been referred to as 'specifically active'. The other antibiotics cause further changes in the plasma membrane of *C. vulgaris* permitting the free diffusion of a larger quantity of metabolites. This particular damage to the plasma membrane in *C. vulgaris* can be reversed, provided that oxygen and potassium are present, the latter in an isotonic concentration.

The migration of K^+, Ca^{++}, sorbose, glucose, amino acid, carbonate and acetate ions was investigated in damaged cells. It was found that the loss of K^+ ions as a result of polyene activity is not an enzymatic process but takes place by free diffusion. Polyene antibiotics do not directly affect the enzymatic system of active K^+ ion transport. Polyene macrolides have no

effect on the uptake of metabolites by *C. vulgaris* cells through facilitated diffusion, but they do inhibit the active uptake of organic metabolites.

BE.02.

THE INFLUENCE OF GIBBERELLIC ACID ON IRON UPTAKE BY BALTIC PHYTOPLANKTON

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Oceanologia 1979, no. 11, pp. 99–111.

Abstract

The effect of gibberellic acid (GA_3) on iron uptake and the magnitude of primary production in Baltic phytoplankton as well as in standard phytoplankton cultures incubated in a natural seawater environment and on synthetic substrates was examined.

Iron uptake was measured using the isotope ^{59}Fe, primary production by the ^{14}C technique, and the biomass by assessing the chlorophyll *a* content.

GA_3 was found to have a distinctly stimulatory effect on iron uptake by phytoplankton, which took place within a strictly limited pH range of 6–6.5. It is very probable that this occurred through the formation of an assimilable GA_3–Fe complex and that the stimulatory effect of GA_3 on phytoplankton growth was due to increased iron uptake by phytoplankton cells.

The effect of GA_3 on iron uptake by phytoplankton incubated in natural seawater varied, depending on season and sampling site. The paper discusses which environmental factors significantly affect the action of GA_3 on phytoplantkon under natural conditions.

BE.03.

SCELETONEMA COSTATUM (GREV.) CLEVE CULTURE IN ARTIFICIAL SEAWATER

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Oceanologia 1983, no. 16, pp. 149–166.

Abstract

Sceletonema costatum (Grev.) Cleve is a centric diatom characteristic of coastal waters [3, 5, 16, 27]*. This species was isolated from the sediment of old Baltic seawater. A few cm^3 of detritus was transferred to artificial seawater ASPM (Tab.) [10], as a result of which a multispecific culture was obtained. Single colonies of *S. costatum* were isolated in order to obtain monospecific strains.

The size of the inoculum (Fig. 1), the nutrient content (N, P, Si, microelements) (Figs. 2, 3 and 4) and salinity (Figs. 5 and 6) were investigated. It was found that the size of the inoculum could affect the duration of the logarithmic growth phase (Fig. 1). The optimum inoculum should not exceed 10^3–10^4 cells cm^{-3} of new culture medium. The most important nutrients in the ASPM medium are orthophosphate, nitrate and metasilicate (Tab.). It was demonstrated that the optimum concentrations of these nutrients should be 50 mg $NaNO_3$ dm^{-3}, 5 mg K_2HPO_4 dm^{-3} and 35 mg $Na_2SiO_3 \times 5H_2O$ dm^{-3} ASPM (Fig. 3b), as well as 1 cm^3 microelement solution per 1 dm^3 ASPM (Tab., Fig. 3). Higher concentrations of these nutrients did not produce any significant rise in cell numbers (Figs. 3c, d and 4d). *S. costatum* reproduces at the same rate at salinities 10, 20 and 30 PSU (Figs. 5 and 6).

This species reproduces rapidly, more than twice in 24 h at 10°C and at a constant illumination of *ca* 3000 lux. During the log phase this diatom forms chains from *ca* 10 to 30 cells in length, but during stationary phases and ageing, these colonies break up into short sections 1 or 2 cells in length.

S. costatum probably forms dormant cells. This could explain the ability of this species to survive for half a year in the sediment of old seawater standing in shade without aeration. Following its transfer to the culture medium, a multispecific diatom culture began to grow after a few days.

The preparation of the ASPM culture medium based on the method of Guillard [10] and other authors [21, 25] is decribed.

BE.04.

THE EFFECT OF HUMIC COMPOUNDS ON ALGAE

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Oceanologia 1983, no. 17, pp. 9–18.

*The original references to the literature have been retained in all the abstracts.

Abstract

The paper presents the results of ecological and physiological experiments that gradually revealed the mechanism of action of humic compounds on algae. A distinction was drawn between the indirect influence due to multivalent cation bonding, and the direct influence on the protoplasm, largely the plasmalemma, and consequently, on the metabolism. The considerable diversity of humic compounds is pointed out, particularly with regard to the occurrence of functional groups, the size of colloidal particles and molecules, and the associated differences in physiological effectiveness, especially in waters of variable acidity. The variable reactions of particular algal species to the presence of humic acids is discussed.

BE.05.

EXTRACELLULAR EXCRETA OF ALGAE AS A FACTOR REGULATING THE GROWTH OF ALGAE CULTURES

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Oceanologia 1983, no. 17, pp. 19–20.

Abstract

An attempt was made to determine the effect of extracellular algal excreta on the growth of *Chlorella pyrenoidosa*, *Scenedesmus quadricauda*, *Dictyosphaerium pulchellum*, *Selenastrum capricornutum* and *Anabaena variabilis* monocultures, and to investigate the mutual interaction of algae grown in polycultures. Algae were cultivated in the laboratory at a temperature of 24°C continuously illuminated at 1500 lx. Growth was measured by counting the algal cells in a Bürker cell and using the drop method for *A. variabilis*.

The filtrate of *D. pulchellum* had a heteropromoting effect on these algae. Filtrates of *S. acutus* and *C. pyrenoidosa* demonstrated an inhibitory action, while those obtained from *S. quadricauda*, *Hormidium flaccidum* and *A. variabilis* either stimulated or inhibited algal growth. Autoinhibition of growth was observed: this was much more distinct in *A. variabilis* than in *C. pyrenoidosa*. In the initial phase, the growth of *C. pyrenoidosa* and *A. variabilis* showed no great differences; in *S. quadricauda, S. capricornutum* and *D. pulchellum*, growth rates became differentiated from the second day of cultivation onwards.

Many authors maintain that algae grown in polycultures mutually modify their growth. In most cases mutual growth inhibition takes place. This was also observed during the present investigations. The growth curves

of the separate components cultivated in polycultures differed depending on the species involved, although their growth was usually worse than in monocultures of these organisms. Only *S. acutus*, growing together with *C. pyrenoidosa* and *H. flaccidum*, and *C. pyrenoidosa* growing with *H. flaccidum*, demonstrated a growth similar to that in monocultures. The observed relationships are in agreement with the earlier remarks concerning the action of filtrates on monocultures. However, the growth curves for the individual algae differed in the two experiments, as there was a high concentration of extracellular excreta in the filtrates, which acted on the monocultures immediately, whereas in the polyculture, these substances accumulated only gradually. The resultant reaction of the algae in polycultures also depended to a large extent on the interaction between the different species, which is closely related to the physical properties of the organisms.

BE.06.

THE EFFECT OF SOME ORGANIC SOLVENTS ON THE GROWTH OF *CHLORELLA* ALGAE, STRAIN 366

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ELŻBIETA LECHOTYCKA
Institute of Mother and Child, Warsaw

Oceanologia 1983, no. 17, pp. 21–28.

Abstract

Chlorella algae, strain 366, were found to be capable of utilising ethanol by means of mixo- and heterotrophic growth. The quantitatively assessed growth stimulation due to the ethanol was accompanied by a reduction in the initial concentration of ethanol and its eventual exhaustion in the culture, even before the algae had attained the stationary growth phase. The hydrocarbons investigated – hexane, cyclohexane and benzene – present in the cultures in concentrations incomparably smaller than that of ethanol, displayed increasing toxicity manifested by an inhibition of growth that was transient (hexane and cyclohexane) or total (benzene). Unlike hexane, cyclohexane actually stimulated algal growth; this was more intensive in comparison with the control cultures and occurred after the growth inhibition phase.

BE.07.

THE INFLUENCE OF THE REDOX POTENTIAL OF THE MEDIUM ON THE GROWTH OF SOME CHLOROPHYCEAE

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Oceanologia 1983, no. 17, pp. 29–33.

Abstract

Scenedesmus quadricauda, *Chlorella pyrenoidosa* and *Ankristodemus acicularis* were grown aseptically in a photothermostat on Uspenski's medium with 5 essential microelements added. Oxidising or reducing agents were added to the medium to raise or lower its redox potential. Moreover, for comparison, nitrogen was administered as nitrate or ammonia. In some experiments the culture was solidified by the addition of agar.

In the liquid cultures the dry mass of algae rose during a fortnight or so; the increase in protein did not take so long. The P:Fe ratio in the algae increased with time, the chlorophyll content decreased. Under constant illumination the redox potential of the culture medium rose along with the rise in dry mass. Where light and darkness alternated during a 24 h period the rH value of the medium and the dry mass of algae were found to have increased by the end of the daylight period; after the period of darkness, the situation was reversed.

The various oxidising and reducing compounds affected the algae individually and no general rule governing the effect of the magnitude of the redox potential could be found. The increase in algal biomass was greater on the nitrate than on the ammonia medium, even when these were buffered. The algae grew into a solid medium only in the presence of light. All three green algae species reacted in a similar manner to changes in the various parameters.

BE.08.

CULTIVATION OF *ACETABULARIA CALYCULUS* ON A COMPLETELY ARTIFICIAL MEDIUM

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Oceanologia 1983, no. 17, pp. 35–41.

Abstract

It was demonstrated that *Acetabularia calyculus* can be grown under entirely artificial conditions without soil extract or natural seawater on the following culture medium:

A. NaCl – 33.12 g; $MgCl_2 \times 6H_2O$ – 6.5 g; $MgSO_4 \times 7H_2O$ – 5.7 g; KCl – 0.887 g; $NaHCO_3$ – 0.241 g; distilled water 1000 ml.

B. $CaCl_2$ – 7.15 g; distilled water – 1000 ml.

C. $FeSO_4(NH_4)_2SO_4 \times 6H_2O$ – 1.4 g; $ZnSO_4 \times 7H_2O$ – 0.44 g; $MnSO_4 \times H_2O$ – 0.155 g; $CuSO_4 \times 7H_2O$ – 0.031 g; $CoSO_4 \times 7H_2O$ – 0.048 g; $(NH_4)_6 \times Mo_7O_{24} \times 4H_2O$ – 0.064 g; EDTA-Na – 3.7 g; distilled water – 1000 ml.

D. Na_2HPO_4 – 4 g; $NaNO_3$ – 20 g; distilled water 1000 ml; vitamin B_1 and B_{12}.

The algae were grown in 500 and 1000 cm^3 Erlenmayer flasks at 22–24°C under light of intensity 1300 lux. These conditions permit the normal growth of these algae, whose life cycle lasts 9–10 months.

The development of the principal morphotic structures is as follows: rhyzoid formation – 1 month; stem growth – up to 3 months; whorl formation – between 4 and 7 months; the cap forms in the 7th or 8th month, and takes one or two months to mature.

BE.09.

STUDY OF TRITIUM RETENTION IN *CHLORELLA PYRENOIDOSA* AND *SCENEDESMUS ACUTUS* CELLS

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Oceanologia 1983, no. 17, pp. 43–50.

Abstract

Tritium incorporation in cells grown in the presence of HTO and the retention of this nuclide following its removal from the culture medium was studied comparatively in the algae *Chlorella pyrenoidosa* and *Scenedesmus acuta*. By the end of the retention time (180 h), the specific radioactivity of the cells fell to 70–75% of its initial value. A far greater proportion of tritium was detected in the dry mass than had been present in the cell water, and considerable quantitative differences with respect to the two species were demonstrated.

The ratio of radioactivity in the organic fraction to that in the cell water in *C. pyrenoidosa* is *ca* 9 and independent of time, whereas in *S. acutus* it rises from 16.8 to 25.3 during a 180-h retention.

BE.10.

THE EFFECT OF 3,4-BENZOPYRENE ON THE GROWTH OF *CHLORELLA*, STRAIN 366

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Institute of Chemistry and Physics, Silesian Medical Academy, Sosnowiec

Oceanologia 1983, no. 17, pp. 51–57.

Abstract

The growth stimulation due to 3,4-benzopyrene (BP) in *Chlorella* algae (strain 366), grown in liquid culture media saturated with BP, was assessed quantitatively. By comparison with the experiments described in another of our papers [14], in which cultures with hexane, cyclohexane and benzene are described, our observations of the cultures with BP indicate that this hydrocarbon has no toxic effects on the algae whatsoever. The accelerated reproduction and the increase in size of algal cells [8] resulting from treatment with certain polycyclic aromatic hydrocarbons is discussed in the light of the carcinogenic properties of many such hydrocarbons.

BE.11.

CAROTENOIDS LOCALISED IN THE CELL WALL OF *CHLORELLA* AND *SCENEDESMUS* (CHLOROPHYCEAE)

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Oceanologia 1983, no. 17, pp. 59–60.

Abstract

It has been found that *Chlorella fusca*, strain 211–8p and *Scenedesmus obliqus*, strain 633, capable of synthesising ketocarotenoids, produce rosyfraise pigmented mother cell walls (CWM). The cell walls isolated from a homogenate (CWH) of green cells from these strains demonstrate a very similar pigmentation. These pigments have been identified as carotenoids. Their total concentration in *Chlorella* was CWM 167 ± 20; CWH 68 ± 3 μg g^{-1} and in *Scenedesmus* CWM 166 ± 16; CWH 128 ± 5 μg g^{-1} CW dry weight. The carotenoid composition of both types of cell wall CWH and CWM is very similar, both containing cantaxanthin, astaxanthin,

a chemically unidentified ketocarotenoid, and lutein. Ketocarotenoids are prevalent in the cell walls, making up some 80% of the total cell wall carotenoid content. The ketocarotenoids are but a small component in the carotenoid moiety of the whole cell. Echinenone was present in the cell walls of *Scenedesmus*, but not in *Chlorella*.

It is possible that the quantitative differences in the CWH and CWM carotenoid composition of these algae are due to CWM released into the nutrient solution exposed to air and light.

The presence of carotenoids in the CWM, which have no internal cellulose or plasmolemma layer, confirms the supposition that they occur mainly in the outer, trilaminar layer of the complete CW, and that they are integral components of the cell walls of these algae.

The method of isolating CWH and CWM, as also the methods of identifying the carotenoids, are described in this paper. In addition, the literature dealing with algal cell wall pigments is reviewed.

BE.12.

A LABORATORY ASSESSMENT OF THE PURIFICATION OF AGRICULTURAL WASTE MATTER CONTAINING A HIGH ORGANIC LOAD USING ALGAE

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Oceanologia 1983, no. 17, pp. 61–71.

Abstract

The myxotrophic growth of the alga *Chlorella pyrenoidosa* on pig manure extracts was investigated. These are rich in all nutrient elements and ensure an algal growth that is more than twice as good in comparison with the mineral control.

During algal growth considerable quantities of elements are removed from the extracts, *e.g.* up to 87% N, 44% P, 52% Mg and 51% S. The turbidity of the extracts is reduced. The organic matter content of the extracts also drops substantially, *e.g.* at the end of the culture the permanganate test result has fallen by 69% and the BOD_5 by 95%, an indication that *C. pyrenoidosa* is suitable for purifying this kind of sewage.

The following optimum parameters were established for the growth of this alga on such extracts: concentration of extracts 1:30, light intensity 50 klx, continuous aeration with 5% added CO_2, a large inoculum and a growth period of 24 h. Under these conditions other algae – *Scenedesmus*

acutus, Spirulina platensis and *Chlorella* sp. *var. halofila* – were grown too. Their biomass increases significantly on pig manure extracts, and the degree of decontamination of the substrate accompanying this growth is considerable.

BE.13.

THE EFFECT OF NITRATE CONCENTRATION ON THE PHOTOSYNTHETIC ACTIVITY OF UNICELLUAR ALGAL CULTURES

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Oceanologia 1983, no. 17, pp. 85–92.

Abstract

Respiratory quotients (RQ) of *Chlorella* 366 cells grown on culture media containing variable quantities of nitrates were compared using micromanometric methods of measuring O_2 and CO_2 in the dark and under illumination. RQs increased during photosynthesis, an indication that metabolic processes had accelerated. Cells grown in media with elevated or zero nitrate concentrations require a longer adaptation time in comparison with cells growing in the standard L_{5m} medium.

BE.14.

CONTENTS OF CYTOKININ-TYPE SUBSTANCES IN SEAWATER AND THE INFLUENCE OF THESE SUBSTANCES ON THE GROWTH PROCESSES OF SOME BALTIC ALGAE

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Oceanologia 1983, no. 17, pp. 107–108.

Abstract

The presence of cytokinin-type substances was demonstrated in seawater. This activity was usually higher in the near-bottom waters than in the surface layer.

It was assumed that the higher cytokinin activity in near-bottom waters could be attributed to the presence of substantial associations of *Fucus* plants in this zone. This supposition was confirmed in some additional experiments. It was found that the cytokinin activity examined in the same volume of medium increases with the increasing biomass of the *Fucus*

thallus. This finding suggested the possibility of these substances exuding into the environment. In consequence, the secondary influence of these compounds on plant growth cannot be excluded.

To prove this question, the effect of different authentic cytokinins on Baltic phytoplankton was investigated. The cytokinins used were kinetin (6-furfurylaminopurine), 6-benzylaminopurine (BAP), 6-(3-methyl -2-butenyl-amino)purine (2iP) and trans-6-(4-hydroxy-3-methylbut -2-enylamino)purine (zeatin).

The data obtained showed that these substances significantly influence the content of chlorophylls as well as the dry weight of phytoplankton. 2iP was especially active among these cytokinins. The responses of phytoplankton to this compound were demonstrated by a significant stimulation of both chlorophyll *a* and carotenoid contents. The stimulation of chlorophyll *b* due to 2iP action was notable. The reactions of phytoplankton to the other cytokinins used were markedly lower.

It was concluded that the active cytokinin-type substances present in seawater can modify the growth processes of some algae and thus play an important role as an ecological factor in the aquatic medium.

BE.15.

DETERMINATION OF ATP IN BIOLOGICAL MATERIAL BY A BIOLUMINESCENCE METHOD USING A SCINTILLATION COUNTER

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Institute of Biology, Gdańsk University, Gdańsk

Oceanologia 1984, no. 18, pp. 127–133.

Abstract

A simple, rapid and inexpensive method of ATP determination in biological material is described. The method is based on the measurement of flashes emitted by the firefly luciferin-luciferase system in a liquid scintillation counter. The method permits the routine analyses of both fresh and frozen samples. The high sensitivity (10^{-12} M ATP) makes it suitable for ATP analyses in small samples.

BE.16.

SEASONAL CHANGES IN OXYGEN CONSUMPTION BY *CRANGON CRANGON* L. (CRUSTACEA, NATANTIA) IN THE GULF OF GDAŃSK

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Oceanologia 1984, no. 19, pp. 117–126.

Keywords: *Crangon crangon* L., Oxygen consumption, Gulf of Gdańsk

Abstract

During 1978 oxygen consumption by *Crangon crangon* males and females was measured manometrically at temperatures of 4°, 9°, 12°C (spring), 15°, 18°C (summer), 10° and 9°C (autumn) and 4°C (winter). The oxygen consumption usually increased with ambient temperature, but none was noted in the 10°–15°C range. The highest oxygen consumption was observed in summer when the temperature was 18°C. During spring the consumption was lower than at the same temperature in autumn. In individuals of different sexes but with the same body mass, the oxygen consumption was higher in females. At all the temperatures, the oxygen consumption rose with increasing wet mass of the individuals, but the rate of metabolism in *C. crangon* fell.

BE.17.

DAILY LOCOMOTORY ACTIVITY OF *MESIDOTEA (SADURIA) ENTOMON* (L.) (ISOPODA, CRUSTACEA) FROM THE GULF OF GDAŃSK

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Oceanologia 1990, no. 28, pp. 51–59.

Keywords: Crustacea, Locomotory activity, Behaviour

Abstract

The research aimed to examine the twenty-four hour rhythm of locomotory activity in *Mesidotea (Saduria) entomon* (L.) from the Gulf of Gdańsk under conditions close to natural, taking into account the effect of temperature, substrate and illumination. The locomotory activity was recorded using a thermistor sensor. The duration of the activity under these conditions depends on the length of night. As much as 86% of the total activity takes place at night, while during the day *M. entomon* digs itself into the sand. An increase in ambient temperature from 4° to 12°C within the limits of the ambient temperature results in a decrease of activity. Replacing the sandy bottom with a glass bottom in the measuring chamber results in increased daily activity (66% of the total) compared to night activity. Continuous illumination causes the animals to bury themselves

in the sand and to reduce their activity to occasional movements of the antennae.

BE.18.

EFFECTS OF SALINITY, TEMPERATURE AND LIGHT ON THE GROWTH AND MORPHOLOGY OF GREEN PLANKTONIC ALGAE

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Oceanologia 1991, no. 31, pp. 119–138.

Keywords: Growth of algae, Morphology of algae, Salinity, Temperature, Light, Green algae, *Chlorella vulgaris*, *Scenedesmus armatus*, *S. acuminatus*, *S. acutus*, *Monoraphidium contortum*, *M. griffithii*, *Oocystis submarina*, *O. parva*, *Stichococcus bacillaris*

Abstract

The influence of the main environmental factors such as salinity, temperature and light intensity on the growth and cell volume of 9 planktonic green algae isolated from the Gulf of Gdańsk was studied. The species were cultivated in the salinity range of 0–35 PSU, temp. 5–38°C and light intensity (PAR) 20–380 μE $m^{-2}\,s^{-1}$. The species examined differed widely in their optimum growth conditions – 4 were brackish-water species and 5 freshwater species. With respect to temperature requirements, groups of three species each belonged to high-temperature, mesothermophilous and low-temperature strains. Most species required relatively high light intensities, as in 6 of them growth was saturated at 120 μE $m^{-2}\,s^{-1}$.

BE.19.

ENERGY BUDGETS IN THE POPULATIONS OF *CRANGON CRANGON* L. (CRUSTACEA) AND *CARDIUM GLAUCUM* (POIRET) (MOLLUSCA) IN THE GULF OF GDAŃSK

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Oceanologia 1992, no. 32, pp. 99–108.

Keywords: Energy budget, Crustacea, Mollusca

Abstract

The energy budgets for *Crangon crangon* and *Cardium glaucum* populations in the Gulf of Gdańsk were calculated. The population of *C. crangon* consumes 56 666 J m^{-2} $year^{-1}$; the energy consumed by the *C. glaucum*

population is much less – 10 474 J m^{-2} $year^{-1}$. The total productivity of *C. crangon* (12 066 J m^{-2} $year^{-1}$ is much higher than that of *C. glaucum* (904 J m^{-2} $year^{-1}$). The annual respiration of *C. crangon* is much higher than that of *C. glaucum*. *C. crangon* females assimilate about 40% of the energy consumed (males only 19%). In *C. glaucum* 28% of the energy consumed is assimilated.

BE.20.

THE EFFECT OF SALINITY ON OSMOREGULATION IN *COROPHIUM VOLUTATOR* (PALLAS) AND *SADURIA ENTOMON* (LINNAEUS) FROM THE GULF OF GDAŃSK

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Oceanologia 1995, no. 37 (1), pp. 111–122.

Keywords: Osmoregulation, Salinity, *Corophium volutator*, *Saduria entomon*, Gulf of Gdańsk

Abstract

Material for the study was collected in the summer of 1994 in the Gulf of Gdańsk where specimens of *Corophium volutator* and *Saduria entomon* – organisms living in a zone of critical salinity (5–8 PSU) – commonly occur.

The high osmolarity of their body fluids is indicative of their adaptation effort to the salinity in their habitat. A species of marine origin, *C. volutator* maintains its osmotic concentration of haemolymph at a high level, as other species in brackish waters do; however, this is not the case with *C. volutator* specimens living in saline seas. *S. entomon* – a relict of glacial origin, originally from the Arctic Sea – also maintains a high osmotic concentration of haemolymph in comparison with specimens of this species living in the Beaufort Sea.

BE.21.

A NEW APPLICATION OF OXYREACTIVE THERMAL ANALYSIS IN MARINE ALGOLOGICAL STUDIES

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Oceanologia 1996, no. 38 (1), pp. 99–112.

Keywords: Algae, Methodology, Oxyreactive thermal analysis, Taxonomical differentiation

Abstract

This is a preliminary study of the application of oxyreactive thermal analysis in algological investigations. Several species of Chlorophyta, Phaeophyta, Rhodophyta and *Zostera marina* taken from different stations off the southern Baltic coast have been studied. It is pointed out that oxyreactive thermal analysis can be used for taxonomical investigations in order to establish the systematic membership of certain species of algae based on fragments of thallus. This method can also be applied in order to establish environmental specificity by differentiating the chemical composition of certain species. It is also suitable for assessing biochemical differentiation among the various parts of the thallus.

BE.22.

COMPARATIVE ESTIMATIONS OF THE ENERGY CONTENT OF *ENTEROMORPHA* SPP. USING DIFFERENT METHODS

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Oceanologia 1996, no. 38 (3), pp. 351–360.

Keywords: *Enteromorpha* spp., Comparative determination, Energy content, Jurata

Abstract

The energy content of *Enteromorpha* spp. from Jurata (situated in the western part of the Gulf of Gdańsk) was determined. The values were measured directly by combustion in a microbomb calorimeter and indirectly by calculation based on the biochemical composition, and on carbon and nitrogen contents.

On the basis of the results obtained, very little difference – on average $2.98 \pm 5.69\%$ (0.54 ± 0.67 J mg^{-1} of DW) – was found between the energy values calculated from the carbon content and those calculated from carbon and nitrogen contents. Moreover, the values calculated from both these sources were higher those that calculated from the biochemical composition

by about $14.95 \pm 12.24\%$ (2.09 ± 1.72 J mg^{-1} of DW) and $17.28 \pm 14.41\%$ (2.63 ± 2.07 J mg^{-1} of DW) for the two methods respectively. At the same time, large differences were found between the values calculated using microbomb calorimetry and other methods (biochemical composition, carbon content, and carbon and nitrogen contents): they were $20.40 \pm 15.09\%$, $33.76 \pm 5.86\%$ and $35.74 \pm 6.71\%$ for the three methods respectively.

BE.23.

EFFECTS OF SIDEROPHORES AND AMINO ACIDS ON THE GROWTH AND PHOTOSYNTHESIS OF POPULATIONS OF *CHLORELLA VULGARIS* BEIJERINCK AND *ANABAENA VARIABILIS* KÜTZING

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Oceanologia 1996, no. 38 (4), pp. 543–552.

Keywords: *Chlorella vulgaris*, *Anabaena variabilis*, Siderophores, Amino acids, Chlorophyll *a*, Photosynthesis

Abstract

The object of this paper was to determine whether the presence of the amino acids and siderophores tested is important to the growth and photosynthesis of phytoplanktonic cells cultivated under iron deficiency conditions, and can thus shed light on the function of two groups of natural chelating agents in the aquatic environment. The results obtained indicate that the siderophoric substances and amino acids can modify physiological processes in populations of cells of cyanobacteria and green algae.

Ecological modelling – BM

BM.01.

THE EFFECT OF THE DYNAMIC PROPERTIES OF A VERTICALLY STRATIFIED SEA AND NUTRIENTS ON CONCENTRATION OF PHYTOPLANKTON

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Oceanologia 1988, no. 26, pp. 63–79.

Keywords: Mathematical model, Stratified sea, Turbulent diffusion, Passive suspension

Abstract

The paper presents considerations on the methodology and results of theoretical investigations into the effect of the dynamics of a stratified sea and nutrients on chlorophyll concentration. The investigations were carried out using Crank-Nicholson's indirect numerical method based on a one-dimensional mathematical model of turbulent diffusion of a passive suspension, as well as Platt's model describing the efficiency of a source. The algorithm of the numerical model is discussed and the results of investigations obtained using this algorithm are presented in the figures.

BM.02.

DESCRIPTION OF SEASONAL CHANGES IN HYDROBIOLOGICAL PARAMETERS IN THE GULF OF GDAŃSK USING A TRIGONOMETRIC POLYNOMIAL

HENRYK RENK
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Oceanologia 1989, no. 27, pp. 79–92.

Keywords: Baltic Sea, Hydrobiological parameters, Seasonal changes

Abstract

A trigonometric polynomial of the type $X = X_0 + X_1 \cos(\omega t - \Phi_1) + X_2 \cos(2\omega t - \Phi_2)$ where $\omega = 2\Pi/T$, $T = 365.25$ days, was used to describe changes in the following hydrobiological parameters: surface water temperature in the Gdańsk Deep, oxygen concentration in surface water, pH of surface water, mean daily energy of solar radiation per 1 m^2 area at

Gdynia, Secchi depth in the Gdańsk Deep, ratio of primary production per 1 m^2 area chlorophyll concentration, and mesozooplankton biomass.

BM.03.

STATISTICAL RELATIONS BETWEEN PHOTOSYNTHESIS AND ABIOTIC CONDITIONS IN THE MARINE ENVIRONMENT; AN INITIAL PROGNOSIS OF THE WORLD OCEAN PRODUCTIVITY ENSUING FROM THE EARTH'S WARMING UP

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Institute of Oceanology, Polish Academy of Sciences, Sopot

Oceanologia 1990, no. 29, pp. 147–174.

Keywords: Biological productivity, Photosynthesis, Nitrogen concentration, Temperature, Prognostic model

Abstract

The article discusses the relations between photosynthesis and the main abiotic factors of the marine environment. Based on experimental data collected in various regions of the World Ocean, statistical correlations between the parameters of photosynthesis and temperature and the content of various forms of nitrogen have been determined. These correlations formed the background to the models forecasting the primary production of the World Ocean ensuing from the Earth's warming up. The models were used to determine the possible alterations of the photosynthesis parameters in the World Ocean and also in the regions of the Polish deep-sea fishery fleet's operations.

BM.04.

NUMERICAL ANALYSIS OF THE INFLUENCE OF GRAZING ON THE TWO-DIMENSIONAL DISTRIBUTION FUNCTION OF THE PHYTOPLANKTON CONCENTRATION IN A STRATIFIED SEA

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Oceanologia 1994, no. 36 (2), pp. 155–173.

Keywords: Mathematical model, Stratified sea, Phytoplankton, Grazing

Abstract

This paper presents the results of simulated phytoplankton grazing by zooplankton and the influence of this process on the distribution function of chlorophyll *a* concentration in a stratified sea. The salinity, temperature and

density functions of the sea are known. The process of grazing is described by a two-dimensional function in a day-night system. The investigation was carried out at various times of hydrodynamic instability. The results suggest that, to a certain extent, grazing camouflages the stratification of the water basin. It was observed that grazing was responsible for the shape of the vertical fluorescence profiles of chlorophyll *a* under natural conditions to the same extent as dynamic processes and the input of solar energy. Numerical analysis of grazing and the hydrodynamic instabilities shows that in the distribution of chlorophyll *a* concentration the phenomenon of 'patchiness' occurs as a result of the processes described above.

BM.05.

MODEL OF THE ANNUAL PHYTOPLANKTON CYCLE IN THE MARINE ECOSYSTEM – ASSIMILATION OF MONTHLY SATELLITE CHLOROPHYLL DATA FOR THE NORTH ATLANTIC AND BALTIC

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Oceanologia 1995, no. 37 (1), pp. 3–31.

Keywords: Marine ecosystem, Phytoplankton, Dynamics modelling, Primary production, Remote sensing

Abstract

An annual-cycle model for the phytoplankton-zooplankton-nutrients ecosystem is presented for the North Atlantic and Baltic Sea. Satellite-derived surface chlorophyll data assimilation in the ecosystem model are discussed, and a number of methods of fitting model dynamics to the data are proposed. Statistical analysis of simulation results yields the main types of annual chlorophyll and primary production variability.

BM.06.

MATHEMATICAL MODELLING OF THE CHLOROPHYLL *a* CONCENTRATION IN A STRATIFIED MEDIUM

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Oceanologia 1996, no. 38 (2), pp. 153–193.

Keywords: Mathematical model, Stratified sea, Phytoplankton

Abstract

Numerical studies and computer simulations of time-space variability in the phytoplankton concentration field in the near-surface layer of a stratified sea were the aim of this research work; the task was focused on finding the main mechanisms governing this variability. In the two-dimensional model applied the following hydrophysical processes were taken into consideration: the fine-scale dynamic processes such as interlayers, Kelvin-Helmholtz hydrodynamic instability, biological and chemical processes such as primary production, phytoplankton mortality, phytoplankton grazing by zooplankton, concentration of nutrients and their uptake and regeneration.

Marine microbiology – BMb

BMb.01.

NITRITES AS A SOURCE OF NITROGEN FOR *STICHOCOCCUS BACILLARIS* Näg.

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Institute of Microbiology, Warsaw University, Warsaw

Oceanologia 1983, no. 17, pp. 73–83.

Abstract

The growth of *Stichococcus bacillaris* Näg. on substrates containing 5–2000 mg N–NO_2 dm^{-3} at pH 8.0 was investigated. Growth was poor on substrates with a low nitrite concentration: the biomass of these cultures contained little nitrogen or chlorophyll, the cells were much smaller, and there were fewer dividing cells.

Nitrogen concentrations from 200 to 800 mg dm^{-3} were found to promote satisfactory growth in this strain. The effect of pH on its growth was studied by varying the pH from 3.0 to 11.0 in substrates containing a constant 200 mg N–NO_2 dm^{-3}; growth occurred only on neutral and alkaline subatrates. Growth on substrates containing nitrites at pH 3.0–6.0 was most probably inhibited by the formation of HNO_2.

In general, the results of these experiments indicate that within a given pH range, nitrites are as good a source of nitrogen for algal growth as urea, nitrates or ammonia.

BMb.02.

DIURNAL DYNAMICS OF BACTERIOPLANKTON IN THE GULF OF GDAŃSK IN SPRING 1987 (Communications)

SPODRA APINE

Oceanologia 1989, no. 27, pp. 93–96, (no abstract).

BMb.03.

BACTERIOLOGICAL INVESTIGATION OF THE SURFACE MICROLAYER OF THE GULF OF GDAŃSK

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KRZYSZTOF KORZENIEWSKI, LUCYNA FALKOWSKA
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Oceanologia 1991, no. 30, pp. 93–103.

Keywords: Surface microlayer, Number of bacteria, Physiological activity, Southern Baltic

Abstract

The number of heterotrophic bacteria in the surface microlayer and the subsurface layer of the southern Baltic was determined using the ZoBell medium. The ability of the bacteria isolated from the two water layers to perform certain physiological processes was also determined with the use of test substrates.

It was established that the number of bacterioneouston was 1.5–2 times greater than the number of bacterioplankton. Ammonifying, lipolytic, proteolytic and amylolytic bacteria were the most numerous among the physiological groups, whereas pectinolytic and cellulolytic bacteria were scarce.

BMb.04.

THE PROTEOLYTIC ACTIVITY OF BENTHIC BACTERIA IN THREE ESTUARINE LAKES

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Oceanologia 1992, no. 32, pp. 109–118.

Keywords: Estuaries, Benthic bacteria, Proteolytic activity

Abstract

Investigations to determine the number and proteolytic activity of bacteria inhabiting the bottom sediments of three estuarine lakes are reported. Proteolytic bacteria occurred in large numbers in all the lakes. Proteolytic activity differed depending on the time of sampling and whether the bacteria were halophilic or nonhalophilic. Bacteria isolated from the hypertrophic Lake Jamno demonstrated a greater proteolytic activity than those from the eutrophic Lakes Łebsko and Gardno.

Pelagic studies – BP

BP.01.

PRELIMINARY REPORT OF WORK OF POLISH HYDROBIOLOGISTS DURING THE ANTARCTIC EXPEDITIONS 1968–1970 (Communications)

STANISŁAW RAKUSA-SUSZCZEWSKI
Department of Bioenergetics and Bioproductivity, Nencki Institute of Experimental Biology, Polish Academy of Sciences, Warsaw

Oceanologia 1973, no. 2, pp. 231–234, (no abstract).

BP.02.

THE ESTIMATION AND CHARACTERISATION OF PHYTOPLANKTON POPULATIONS IN THE COASTAL WATERS OF THE GULF OF GDAŃSK

BARBARA MALEWICZ, RYSZARD BOJANOWSKI, CZESŁAW POPŁAWSKI
Department of Oceanology, Institute of Geophysics, Polish Academy of Sciences, Sopot

Oceanologia 1975, no. 3, pp. 91–104, (no abstract).

BP.03.

THE SECOND EXPLORATION OF ANTARCTICA BY POLISH BIOLOGISTS 1971–1972 (Communications)

STANISŁAW RAKUSA-SUSZCZEWSKI
Department of Bioenergetics and Bioproductivity, Nencki Institute of Experimental Biology, Polish Academy of Sciences, Warsaw

Oceanologia 1975, no. 3, pp. 105–110, (no abstract).

BP.04.

SWORDFISH (*Xiphias gladius*) ATTACKS SUBMARINE *ALVIN*

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Woods Hole Oceanographic Institution, Woods Hole, Massachusetts (USA)

Oceanologia 1975, no. 3, pp. 111–116.

Abstract

On 6 July 1967 the submarine *Alvin* from the Woods Hole Oceanographic Institution reached the bottom of Blake Plateau at a depth of 610 m. With all the craft's outer lights turned on, visibility was 11–13 m; the water temperature was 7.9°C. On the bottom there lay a swordfish, which proceeded to attack the *Alvin* and thrust its entire 'sword' in between the upper and lower parts of the window. The fish thrashed about in an attempt to extricate its tail, but it only succeeded in injuring its skin and muscles. The submarine's crew decided to surface after having secured the fish's tail. The swordfish was 2.45 m long – the 'sword' alone was *ca* 76 cm long – and weighed 89 kg. Such unprovoked attacks on inanimate objects in the sea are rare. Observations of the swordfish are continuing and are providing further valuable insights into the biology of this species.

BP.05.

INVESTIGATIONS INTO THE POSSIBILITY OF APPLYING AN ADDITIONAL FEATURE IN THE IDENTIFICATION OF *SAGITTA ENFLATA* (GRASSI)

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Department of Biology, Gdańsk University, Gdynia

Oceanologia 1980, no. 12, pp. 99–108.

Abstract

The present paper attempts to answer the question whether the ratio of total length to distance of the ganglion ventralis from the septum, which in *Sagitta enflata* (Grassi) is *ca* 1.85, is sufficiently constant to be accepted as a characteristic of the species. The variability of this feature in the population represented by about 3300 individuals collected along the N. W. African shelf, is given further consideration.

BP.06.

PRIMARY PRODUCTION IN EZCURRA INLET DURING THE ANTARCTIC SUMMER OF 1977/78

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Oceanologia 1984, no. 15, pp. 175–184.

Abstract

The aim of this study was to assess the primary productivity and chlorophyll *a* concentration in the waters of Ezcurra Inlet and to characterise the optical conditions under which photosynthesis proceeds in this basin. The experimental work was carried out during the 2nd Polish Antarctic Expedition from r/v 'Antoni Garnuszewski', anchored centrally in the Inlet. Primary productivity was measured in situ using the ^{14}C method, while chlorophyll *a* levels were measured spectrophotometrically using the Strickland-Parsons formula.

The primary productivity of Ezcurra Inlet was found to exceed that of the open oceanic waters in the South Shetlands region. It is, however, comparable with the productivity of Baltic Sea water during summer.

The considerable temporal differences in photosynthetic intensity during the study period can be put down to fluctuations in a number of abiotic and biotic factors affecting primary production in the sea. Directly affecting the absolute magnitude of primary production, the most significant of these are the phytoplankton concentrations in the sea at a given instant and the irradiance within the water. In this particular case, both these factors were highly time-variable.

BP.07.

BIOLUMINESCENCE OF ZOOPLANKTON IN THE ANTARCTIC FJORD – EZCURRA INLET

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Oceanologia 1984, no. 15, pp. 185–207.

Abstract

The bioluminescence of marine zooplankton from Ezcurra Inlet (in the vicinity of the PAS's Antarctic Research Station) was studied experimentally with the aid of sensitive photometric apparatus installed on the deck of the vessel 'Antoni Garnuszewski'. A large number of species were found to be bioluminescent: at intervals they emitted light pulses several seconds in duration of an intensity corresponding to an illumination of 10^{-9}–10^{-5} μW cm^{-2} nm at a distance of *ca* 20 cm in the 480 nm wavelength range.

Three characteristic phases of bioluminescent activity were found to occur: 1) a shock period following the removal of the animals from the sea lasting 20–30 minutes, during which the intensity of bioluminescence gradually subsided, 2) a fairly stable period lasting several hours, and 3) a period during which bioluminescence disappeared rapidly.

Bioluminescent activity was greatest in *Metridia* sp., which emitted characteristic light pulses identified on the recording apparatus in the form of sharp peaks with a pulse rise time of the order of 0.1 s and a relaxation time of 3–10 s. After the shock period in a sample containing the natural zooplankton association, fewer than 3 light pulses per hour were emitted on average by a single *Metridia* sp. specimen. The spontaneous bioluminescence of the genus *Euphausia* (mainly *E. superba*) is weaker and quite different in character. The light, appearing seldom, is weak but lasts for many seconds with variable intensity. Observations and experiments show that bioluminescence fulfils certain life functions in these organisms. In particular, these light signals replace acoustic signals as a means of expressing emotional states; furthermore, they help these animals to remain together in their natural concentrations in the water.

BP.08.

PHYTOPLANKTON OF THE SHELF ZONE OF THE NORTH-EAST PACIFIC OCEAN

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Oceanologia 1983, no. 16, pp. 41–52.

Abstract

From July to September 1977, the r/v 'Profesor Siedlecki' of the Sea Fisheries Institute participated in an expedition to the north-eastern Pacific in order to conduct hydrological and biological investigations in the shelf zone, the results of which indicated that this area is one of great biological fertility. This is manifested in the profusion of phytoplankton species – 116 in all – 114 of which belong to the order of Diatoms. Each of the three regions studied - the shelf of the Gulf of Alaska, that off the West Coast of the USA and that of Vancouver Island – displayed a biocenotic structure characterised by a number of specific features (a biocenosis containing characteristic, typical and cosmopolitan species).

BP.09.

THE MORPHOLOGICAL VARIABILITY AND INDIVIDUAL DEVELOPMENT CYCLE OF *SAGITTA ENFLATA* (GRASSI) 1881 WITH RESPECT TO THE SHELF WATER DYNAMICS OFF NORTH-WEST AFRICA

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Sea Fisheries Institute, Gdynia

Oceanologia 1983, no. 16, pp. 53–73.

Abstract

In the shelf waters off north-west Africa, the most numerous representative of the Chaetognatha is *Sagitta enflata* (Grassi). Statistical analysis of the differences between certain features in individual specimens has revealed the existence of two populations – a 'northern' and a 'southern' one. The animals of the 'southern' population, associated as this is with the stable, warm waters mainly to the south of Cape Verde, are characterised by a shorter overall length, a shorter caudal segment, a shorter distance between the *septum* and the *ganglion ventralis*, a relatively shorter ovary and fewer eggs in the ovary of a mature specimen, in comparison with the those of the 'northern' population. The latter lives in cooler waters where upwelling occurs. It is highly probable that the rate of growth and maturation in *S. enflata* is faster in the 'southern' than in the 'northern' population.

BP.10.

CLUSTER ANALYSIS OF ZOOPLANKTON NUMBERS IN THE VISTULA LAGOON

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Oceanologia 1983, no. 16, pp. 75–98.

Abstract

The paper is based on zooplankton material collected over three years in the Vistula Lagoon (March–November 1975, May–November 1977 and February–November 1978). These samples were collected with a Ruttner grab every month at the same ten stations, five of which (1, 2, 4, 6, 8) lay on an E–W transect along the lagoon, and four others (3, 5, 7, 9) were located on transects across the lagoon (Fig. 1). A total of 512 samples were collected and examined under the microscope in a cell 1 cm^3 in volume (Tab. 1).

The aim of this work was to analyse zooplankton concentrations from their numbers based on definitions of similarity and distance [7, 8, 9]. The degree of similarity was expressed by the Marczewski and Steinhaus formula:

$$S = \frac{w}{a + b - w}.$$

The structure of dendrites and the means of their linear alignment was based on similarity analysis, assuming retention of the shortest distances (Figs. 2, 3, 4, 5). All possible clusters of stations and taxa during the three-year study are presented in diagrammatic form in Tabs. 2, 3, 4 and 5.

BP.11.

DYNAMICS OF ZOOPLANKTON NUMBERS IN THE VISTULA LAGOON

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Oceanologia 1983, no. 16, pp. 99–132.

Abstract

Zooplankton samples were collected every month from May to November 1977 and from February to November 1978 at the same 9 stations in the Vistula Lagoon, selected so as to take account of the hydrological characteristics of the basin (Fig. 1). The plankton was sampled with a 5-litre Ruttner grab at depths of 0, 1, 2, 3 and 4 m. A total of 368 samples were collected and analysed microscopically in a cell containing 1 cm^3 of water (Tab. 1).

Statistical analysis determined the spatial variability of the species composition and numbers of zooplankton (Tabs. 2–11, Fig. 2). The results of this study show that the mean numbers of individuals increase north-eastwards along a mid-lagoon axis, as do the salinity, organic matter content and phytoplankton numbers (Fig. 3). The average numbers during this period ranged from 448 000 to 579 000 individuals per m^3 in the least saline waters at the south-western end of the lagoon and from 921 000 to 932 000 individuals per m^3 near the state frontier.

The spatial distribution of zooplankton in the Vistula Lagoon depends on several factors, among which the salinity and food resources are of especial importance. Its vertical distribution is chiefly dependent on the intensity of water mixing and the water transparency.

BP.12.

ANALYSIS OF AGGLOMERATION TENDENCIES OF ZOOPLANKTON IN THE VISTULA LAGOON AS A FUNCTION OF TIME

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Oceanologia 1984, no. 18, pp. 149–177.

Abstract

The analysis of the agglomeration tendencies in zooplankton in the Vistula Lagoon indicates that the formation of the zooplankton in particular seasons of the year depends on climatic and environmental conditions.

BP.13.

STRUCTURAL CHANGES AND DISTRIBUTION OF THE MESOZOOPLANKTON IN THE GULF OF GDAŃSK IN AN ANNUAL CYCLE

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Oceanologia 1984, no. 19, pp. 79–99.

Keywords: Mesozooplankton, Structural changes, Gulf of Gdańsk

Abstract

The present work is based on material collected every day at the end of March and beginning of April, in June, July, November and December 1980, from one station in the Gulf of Gdańsk. Species composition, abundance and vertical distribution of the mesozooplankton in particular months are presented in relation to thermal conditions and water salinity. An attempt has been made to follow up seasonal changes in the domination structure and percentages of the three basic trophic groups of the mesozooplankton: filterers, euryphagous organisms and zoophagous organisms.

BP.14.

ENERGY VALUE AND LIPID CONTENT OF THE BALTIC ZOOPLANKTON

HENRYK RENK, JERZY FILARSKI, STANISŁAW OCHOCKI,
BARBARA PIECHOWSKA
Sea Fisheries Institute, Gdynia

Oceanologia 1985, no. 21, pp. 99–108.

Keywords: Lipid content, Zooplankton, Baltic Sea

Abstract

The results of measurements of energy value and lipid content in the zooplankton of the southern Baltic in 1974 are presented. Diel and seasonal changes in these parameters are illustrated. The energy value of organic matter ranged from 25.5 to 33.2 $J\,mg^{-1}$, while the lipid content of dry plankton matter fluctuated between 4.3 and 22.9%.

BP.15.

LONG-TERM TRENDS IN MESOZOOPLANKTON BIOMASS GROWTH IN THE SOUTHERN BALTIC

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Oceanologia 1985, no. 22, pp. 63–70.

Keywords: Biomass of mesozooplankton, Dynamics of mesozooplankton

Abstract

The dynamics of the southern Baltic mesozooplankton biomass in the years 1951–1974 are discussed with respect to the whole 24-year period and, to three separate, shorter periods of 6–8 years each. The biomass trend was clearly a rising one. On the basis of the results of investigations carried out in 1981–1983, this trend may be expected to continue in the coming years.

BP.16.

THE DYNAMICS OF SEASONAL CHANGE OF THE PHYTOPLANKTON BIOMASS IN THE GULF OF GDAŃSK

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Oceanologia 1986, no. 23, pp. 77–83.

Keywords: Phytoplankton biomass, Blue-green algae, Diatoms, Dinoflagellates, Green algae, Gulf of Gdańsk

Abstract

Mean phytoplankton biomass measurements from depths of 0 and 5 m are described on the basis of samples collected in the western part of the Gulf of Gdańsk between May and November 1977 and between March and December 1978. The biomass ranged from 0.03 to more than 2.00 mg dm^{-3}. The biomass in spring and autumn were found to be higher than in summer, and this was caused by the rapid growth of diatoms.

BP.17.

INTERDEPENDENCE BETWEEN DIMENSIONS OF TWO *DINOFLAGELLATA* SPECIES *(DINOPHYSIS NORVEGICA* CLAPAREDE ET LACHMANN, *CERATIUM TRIPOS* O. F. MÜLLER/NITZSCH) AND SELECTED PARAMETERS OF THE ENVIRONMENT

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Oceanologia 1986, no. 24, pp. 47–53.

Keywords: Dimension variations, *Dinoflagellates*, Salinity and temperature, Multiple regression

Abstract

Differences in size (length, breadth) in *Dinophysis norvegica* and *Ceratium tripos* cells occurring with respect to salinity and temperature in the Baltic and Atlantic have been recorded. These differences are accounted for by the species' autecology, indicative of the oceanic nature of *D. norvegica* and the intermediate nature (maximum size at 30 PSU salinity) of *C. tripos*. The multiple regression method for an ecological interpretation of this phenomenon was used.

BP.18.

AGGREGATION ANALYSIS OF PLANKTONIC ROTIFERS IN BRACKISH WATERS OF THE SOUTHERN BALTIC

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REINHARD HEERKLOSS, WERNER SCHNESE
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Oceanologia 1986, no. 24, pp. 63–73.

Keywords: *Rotatoria*, Dendrites, Brackish waters, Southern Baltic

Abstract

The work was based on three-year studies of zooplankton carried out at the same time in the Vistula Lagoon (Poland) and the Darss-Zingst Boddenkette (GDR). The aggregation analyses of *Rotatoria* taxa were performed on the basis of qualitative composition, abundance and similarity indices in a spatial and time system using dendrites.

BP.19.

THE GENUS *EUCHLANIS* (ROTATORIA) IN BRACKISH WATERS OF THE VISTULA LAGOON (SOUTHERN BALTIC)

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Department of Sanitary Hydrobiology, Agricultural and Technical Academy, Olsztyn

Oceanologia 1988, no. 26, pp. 97–103.

Keywords: *Euchlanis*, Rotifers, Brackish water

Abstract

The results presented in this paper represent a part of long-term studies into the occurrence of *Euchlanis dilatata* Ehrenberg, and *Euchlanis dilatata f. lucksiana* (Hauer), the latter being found for the first time in the shallow, brackish, eutrophic waters of the Vistula Lagoon (southern Baltic).

BP.20.

LIGHT CURVES OF MARINE PLANKTON PHOTOSYNTHESIS IN THE BALTIC

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Oceanologia 1989, no. 27, pp. 61–78.

Keywords: Daily irradiation, Primary production, Rate of photosynthesis, Efficiency of photosynthesis, Baltic Sea

Abstract

Empirical correlations between the intensity of photosynthesis of the marine phytoplankton and daily irradiation in the southern Baltic were analysed. The statistical 'light curves' of photosynthesis *in situ* and their seasonal changes in the Baltic were examined. Additionally, with the help of long-term statistical data of the irradiation field distribution in the southern Baltic, the characteristic depths of photosynthesis as well as their seasonal changes were determined.

BP.21.

SHORT-TERM CHANGES IN THE PELAGIC BIOCENOSIS IN THE NEAR-SURFACE LAYER AT STATION G-2 (GDAŃSK DEEP, SOUTHERN BALTIC) DURING THE SPRING BLOOM

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Oceanologia 1990, no. 28, pp. 5–23.

Keywords: Plankton, Spring bloom, Ecosystem

Abstract

The aim of the study was to find out what factors have played a major role in bringing about short-term quantitative changes in various components of the biocenosis. The depth of 5 m was chosen for the study as representing the near-surface layer. The composition of the biocenosis and the biomass of its major components were studied; the most important trophic relations between them were indicated. Observations of quantitative changes in some of the components were carried out in the sea, with

measurements being taken at the same site at regular time intervals over a period of three days. This permitted the scope of changes to be determined and to ascertain whether they occur in a diurnal cycle. In order to eliminate distortions caused by the advection of water masses and migrations of the organisms themselves, observations of quantitative changes were carried out on organisms with the shortest life cycle (bacteria and algae) in enclosed systems, exposed *in situ*. In this way, the rate of growth of certain taxa was determined. In addition, the rate of growth of individual zooplankton groups, possible under the given feeding conditions, as well as mortality of algae and zooplankton caused by grazing, were estimated.

BP.22.

EVALUATION OF PRIMARY PRODUCTION OF PHYTOPLANKTON BASED ON CHLOROPHYLL-DELAYED FLUORESCENCE IN SEAWATER

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Oceanologia 1990, no. 28, pp. 39–49.

Keywords: Primary production, Delayed fluorescence, Chlorophyll, DCMU influence

Abstract

The intensity of chlorophyll-delayed fluorescence in the presence and absence of *diuron* (a photosynthesis inhibitor), as well as of phytoplankton primary production and chlorophyll concentration were measured simultaneously in the Gulf of Gdańsk during the International Ecological Experiment 'Sopot–87' (1st–8th May 1987). The correlation coefficient between delayed fluorescence and chlorophyll concentration was equal to $r = 0.7$, while that between delayed fluorescence in the presence of *diuron* and chlorophyll concentration was $r = 0.9$. The correlation coefficient between the primary production and delayed fluorescence (calculated using a previously proposed formula taking into account the intensity of the incident light at the depth studied) was equal to $r = 0.95$. The results imply that the method of delayed fluorescence in seawater is promising for the

determination of both chlorophyll concentration and primary production of phytoplankton.

BP.23.

PRIMARY PRODUCTION OF THE SOUTHERN BALTIC IN 1979–1983

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Oceanologia 1990, no. 29, pp. 51–75.

Keywords: Primary production, Southern Baltic, Baltic monitoring

Abstract

The paper presents the results of the determination of primary production in 1979–1983, carried out within the framework of the first stage of the Baltic Monitoring Programme. The annual primary production of the open waters of the southern Baltic was equal to *ca* 100 g C m^{-2}. It has been established that primary production in the gulf regions is higher than in the open waters of the southern Baltic. It follows from the calculations that in the last dozen or so years the annual production of the Baltic has increased annually by *ca* 2.5% on average compared with the long-term mean.

BP.24.

QUANTITATIVE CHANGES IN THE BALTIC MESOZOOPLANKTON ON THE BASIS OF MONITORING WITHIN THE 1979–1983 PERIOD

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Oceanologia 1990, no. 29, pp. 77–90.

Keywords: Quantitative changes, Mesozooplankton, Southern Baltic, Seasonal variability

Abstract

The paper summarises a 5-year monitoring programme of the southern Baltic with respect to mesozooplankton. The investigations revealed the occurrence of a significant quantitative variability in the occurrence of zooplankton in particular years, its range being much greater in spring and summer. Zooplankton was more abundant in 1981 and 1983. The smallest amount of zooplankton occurred in 1979. Moreover, it has been observed that mesozooplankton occurs in larger numbers in spring in the eastern part, but in summer in the western part of the southern Baltic.

BP.25.

COMPOSITION AND RESOURCES OF PHOTOSYNTHETIC PIGMENTS OF MARINE PHYTOPLANKTON

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Oceanologia 1990, no. 29, pp. 91–115.

Keywords: World Ocean, Phytoplankton, Photosynthetic pigments

Abstract

The paper reviews the authors' own and literature data on the time-space changes in marine phytoplankton resources in different areas of the World Ocean. Sets of phytosynthetic pigments that occur for various groups of marine phytoplankton are quantitatively characterised. A statistical analysis of the pigment composition of natural phytoplankton populations is presented. These analyses were done for both various biological types of seas and ocean and various depths in the sea.

BP.26.

CHLOROPHYLL *a* CONCENTRATION AND DISTRIBUTION IN THE SOUTHERN BALTIC IN THE PERIOD 1979–1983

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Oceanologia 1991, no. 30, pp. 77–91.

Keywords: Baltic Sea, Chlorophyll *a*, Eutrophication

Abstract

The article presents the results of chlorophyll *a* distribution measurements carried out in the southern Baltic in 1979–1983. The open seawater of the southern Baltic contained on average 1–3 $\mathrm{mg\,m^{-3}}$ of chlorophyll *a* after the spring phytoplankton bloom, which usually takes place in April or May. The chlorophyll *a* concentrations in the Gulf of Gdańsk and in the Pomeranian Bay were considerably higher and increased towards the Vistula and Oder estuaries. As regards the long term analysis of the chlorophyll *a* concentration in the Gdańsk Deep, a noticeable increasing trend has been observed.

BP.27.

KRILL DISTRIBUTIONS AND THEIR DIURNAL CHANGES (ELEPHANT ISLAND, SOUTH ORKNEY ISLANDS, DECEMBER 1988, JANUARY 1989)

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Oceanologia 1991, no. 31, pp. 139–152.

Keywords: Krill, Migration, Distribution

Abstract

Krill swarms were recorded acoustically along 2340 NM of the ice edge between Elephant Island and South Orkney Islands. Depth distributions and migration patterns were different in these three regions. It has been suggested that physical factors are the most important for both horizontal and vertical krill distributions.

BP.28.

ESTIMATION OF CARBON RELEASE FROM PHYTOPLANKTON CELLS DURING PHOTOSYNTHESIS IN THE GULF OF GDAŃSK

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Oceanologia 1993, no. 34, pp. 49–56.

Keywords: Carbon released from phytoplankton, Primary production, Baltic Sea, Gulf of Gdańsk

Abstract

The results of daily primary production determined by the ^{14}C method in the Gulf of Gdańsk are presented. The amount of carbon released from phytoplankton cells during photosynthesis was calculated from the difference between the daily primary production of separate morning and afternoon incubations and that of all-day incubation. The largest quantity of matter, *ca* 25% of the primary production, was released from phytoplankton cells in May, whereas during the other spring and summer months (April to September) carbon release varied between 6 and 10% of primary production.

BP.29.

THE OCCURRENCE OF MEDUSAE IN THE SOUTHERN BALTIC AND THEIR IMPORTANCE IN THE ECOSYSTEM, WITH SPECIAL EMPHASIS ON *AURELIA AURITA*

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Oceanologia 1993, no. 34, pp. 69–84.

Keywords: *Aurelia aurita*, Jellyfish, Medusae, Biomass, Baltic Sea

Abstract

The material for the study was collected in 1983–1991 in the Polish fisheries zone by means of a bongo net. Long-term studies reveal that during the year, the first *Aurelia aurita* medusae appear in the southern Baltic in July and may occur until January of the following year. The period of their mass occurrence was limited to four months (August–November). The mean biomass for that period was 800 cm^3 1000 m^{-3}. Medusae of another species, *Cyanea capilata*, occurred irregularly throughout the year but in much smaller numbers. Calculations made for the southern Baltic show that during their mass occurrence, the *A. aurita* medusae consume on average 4.3% of the mesozooplankton production. This means that in general they have relatively little influence on mesozooplankton as predators and on fish as competitors for food. It should be noted, however, that there are periods and places, in which their abundance is several times higher than average. In such situations the pressure of medusae on the mesozooplankton is much greater.

BP.30.

SEASONAL AND SPATIAL VARIATIONS IN THE POPULATION STRUCTURE AND LIFE HISTORIES OF THE ANTARCTIC COPEPOD SPECIES *CALANOIDES ACUTUS*, *CALANUS PROPINQUUS*, *RHINCALANUS GIGAS*, *METRIDIA GERLACHEI* AND *EUCHAETA ANTARCTICA* (CALANOIDA) IN CROKER PASSAGE (ANTARCTIC PENINSULA)

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Oceanologia 1993, no. 35, pp. 73–100.

Keywords: Antarctica, Calanidae, Migrations, Age structure

Abstract

Seasonal and spatial variations in the population structure and life cycles of 5 Antarctic copepod species – *Calanoides acutus*, *Calanus propinquus*, *Rhincalanus gigas*, *Metridia gerlachei* and *Euchaeta antarctica* – have been reconstructed from analyses of sets of vertically-stratified zooplankton samples taken with a 200 μ-mesh net by day and by night during 3 austral seasons (summer, 1985–1986, autumn 1988 and winter 1989) from the 1200 m deep Croker Passage off the Antarctic Peninsula. Developmental stages from C1 to adults were enumerated. Sex ratios were determined in *M. gerlachei* from C5 to adults, in *E. antarctica* from C4 to adults, and in other species in adults only.

Seasonal changes in the relative depth distribution and abundance of the various stages were used to compare the population dynamics of these 5 copepods. The life span of *C. acutus* is less than one year while *C. propinquus* can live for even more than a year. The population of *R. gigas* shows the occurrence of 2 generations per year. Multiple generations are noted for *M. gerlachei*, while *E. antarctica* shows a single reproductive peak in the winter followed by the growth of a single generation. The seasonal portioning of vertical space in the water column is very important for copepods with different food requirements. The spatial separation eliminates competition not only between species but among their growth stages as well. These population characteristics are related to other aspects of the ecology of polar zooplankton.

BP.31.

SEASONAL AND DIEL CHANGES IN THE ABUNDANCE AND VERTICAL DISTRIBUTION OF THE ANTARCTIC COPEPOD SPECIES *CALANOIDES ACUTUS*, *CALANUS PROPINQUUS*, *METRIDIA GERLACHEI* AND *EUCHAETA ANTARCTICA* (CALANOIDA) IN CROKER PASSAGE (ANTARCTIC PENINSULA)

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Oceanologia 1993, no. 35, pp. 101–127.

Keywords: Antarctica, Calanidae, Seasonal abundance, Diel and ontogenetic migration

Abstract

Seasonal and diel changes in the abundance and vertical distribution of 5 species of Antarctic copepods – *Calanoides acutus*, *Calanus propinquus*, *Rhincalanus gigas*, *Euchaeta antarctica* and *Metridia gerlachei* – have been reconstructed from analyses of sets of vertically-stratified zooplankton samples (500 μm and 200 μm-mesh adjacent nets) taken by day and night during 3 austral seasons (summer 1985–1986, autumn 1988 and winter 1989) from the 1200 m – deep Croker Passage, off the Antarctic Peninsula. In the laboratory, copepod counts were done of a known fraction of the total sample (1/2–1/8) from a 500 μm-mesh net, using a Motoda box splitter (Motoda, 1959). During all investigation seasons in Croker Passage the most abundant species is *M. gerlachei*. Seasonal ontogenetic migrations are undertaken by *C. acutus*, *C. propinquus* and *R. gigas*. In summer, in a 1000 m water column herbivorous species live above the *M. gerlachei* population, but in winter – below it. Both *M. gerlachei* and *E. antarctica* undertake diel migrations, clearly marked in the former species, less so in the latter. *M. gerlachei* inhabits the middle part of the water column during the day, but rises nearer the surface at night. *E. antarctica* inhabits the deepest layer; at night adults, mainly females, ascend towards the surface.

BP.32.

PHYTOPLANKTON OF THE GULF OF GDAŃSK IN 1992 AND 1993

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Oceanologia 1995, no. 37 (1), pp. 123–135.

Keywords: Phytoplankton, Seasonal changes, Distribution, Gulf of Gdańsk

Abstract

The article presents the results of a quantitative analysis of phytoplankton in the Gulf of Gdańsk from samples taken in 1992 and 1993. The quantity of phytoplankton was higher in 1993 than in 1992. The greatest difference in cell numbers between the two years was found among the diatoms. A high number of dinoflagellates was observed during spring in both years.

BP.33.

THE HYDROCHEMICAL AND BIOLOGICAL IMPACT OF THE RIVER VISTULA ON THE PELAGIC SYSTEM OF THE GULF OF GDAŃSK IN 1994. PART 2. PRIMARY PRODUCTION AND CHLOROPHYLL *a*

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Oceanologia 1995, no. 37 (2), pp. 207–226.

Keywords: Baltic Sea, Primary production, Seasonal spatial variability

Abstract

The time and space variability in potential and *in situ* primary production values, and in chlorophyll *a* concentrations in the Gulf of Gdańsk in 1994 are presented and discussed.

The spatial variability in the distribution of these parameters is closely related to both the powerful dynamics of the water masses in this region and the river Vistula discharges. The eutrophicating impact of the Vistula is particularly evident in the narrow inshore zone, to the east and west of the river mouth. Seasonal variability in primary production and chlorophyll *a* concentrations was recorded; their particularly high values in April 1994 were due to the plankton bloom. The assimilation numbers, characterising the intensity of phytoplankton photosynthesis, varied within the 1.6–5.5 mgC mgchl^{-1} h^{-1} range.

BP.34.

THE SEASONAL SUCCESSION OF HYALINE *HELICOSTOMELLA SUBULATA* AND AGGLUTINATED *TINTINNOPSIS LOBIANCOI* – DOMINANTS OF THE BALTIC TINTINNINA (CILIOPHORA) (Communications)

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Oceanologia 1996, no. 38 (3), pp. 405–418.

Keywords: Baltic Sea, *Helicostomella subulata*, Tintinnids, *Tintinnopsis lobiancoi*

Abstract

Tintinnid species composition and abundance were determined in surface water samples taken from four sites in the Gulf of Gdańsk, and along four cruise tracks from the Gulf of Gdańsk to Helsinki.
The seasonal succession of two dominants – the hyaline *Helicostomella subulata* and the agglutinated *Tintinnopsis lobiancoi* – was evident. The former coincided with the beginning of summer and was replaced early in the season by the latter. Other Tintinnina species were found only occasionally and did not significantly affect the total tintinnid abundance.

Ecotoxicology – BT

BT.01.

FISH AS AN INDICATOR OF HEAVY METAL POLLUTION IN THE BALTIC SEA

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Oceanologia 1981, no. 13, pp. 71–75.

Abstract

Elevated concentrations of heavy metals have been recorded in aquatic animals inhabiting estuarine and coastal waters. The ability of such animals to accumulate these metals renders them suitable as indicators of water pollution. The present study of the copper (Cu) and zinc (Zn) content in herrings and sprats from different parts of the Baltic Sea indicated that these fish species are indeed suitable water pollution indicators. It was also found that the Cu and Zn content in these fish depends on where they were caught. No correlation was found, however, between the weight of the fish and the Cu and Zn content in their tissues. The results were analysed statistically.

BT.02.

THE INFLUENCE OF CARBAMATE INSECTICIDES ON SOME PHYSIOLOGICAL PROCESSES IN *SCENEDESMUS QUADRICAUDA* (Turp./Breb.)

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Oceanologia 1983, no. 17, pp. 93–105.

Abstract

The reaction of the alga *Scenedesmus quadricauda* to the carbamate insecticides karbaryl and propoksur in the form of pure substances and commercial products was studied, as was the effect of the principal metabolites of both pesticides, α-naphthol and 2-isopropoxyphenol. The findings of this study indicate that over a given range of concentrations both karbaryl and propoksur cause periodic inhibition of cell growth, as

a result of which, biomass production is reduced. These compounds also retard photosynthesis in that they lower the level of chlorophyll *a* and/or its photosynthetic efficiency. The inhibitory action of these insecticides was usually strongest 3–5 days after application, and was dependent on the type, form and concentration of the product. Within the range of concentrations studied here, the metabolites of karbaryl and propoksur were biologically inactive.

BT.03.

THE EFFECT OF SELECTED DISPERSANTS ON GROWTH OF *CHLORELLA VULGARIS* BEIJERNICK AND *SCENEDESMUS QUADRICAUDA* (TURPIN) BRÉBISSON

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Oceanologia 1985, no. 22, pp. 35–40.

Keywords: Dispersants, *Chlorella vulgaris*, *Scenedesmus quadricauda*, Cultivation

Abstract

Studies were carried out on the effect of five dispersants: Corexit 7664, Corexit 9525, Corexit 9600, OSD/LT and BP 1100 WD on the growth of two species of planktonic green algae: *Chlorella vulgaris* and *Scenedesmus quadricauda*, isolated from water in the Gulf of Gdańsk. All dispersants had a more or less similar effect on the growth of both algal species. The lowest limitation of growth was observed for Corexit 7664, while the strongest reaction took place in the case of OSD/LT, and especially of BP 1100 WD.

BT.04.

GROWTH RESPONSES OF *SCENEDESMUS QUADRICAUDA* TO OIL POLLUTION AT DIFFERENT TEMPERATURES AND LIGHT INTENSITIES

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Oceanologia 1985, no. 22, pp. 41–49.

Keywords: Biological effects, Oil pollution, *Scenedesmus quadricauda*

Abstract

The influence of crude oil extracts on the growth of *Scenedesmus quadricauda*, cultivated at a temperature of 12°C and 22°C and a light intensity of 1500 lux or 3000 lux was investigated. The basal oil extract prepared from 50 cm^3 of oil in 1 dm^3 of the cultivation medium and its 50% and 10% dilutions were examined.

Generally, the growth of investigated algae was lower at a temperature of 12°C and higher at 22°C. The higher light intensity (3000 lux) applied at 12°C increased significantly the growth inhibiting effect of oil pollution. However, algae cultivated at 22°C showed a lower degree of inhibition, under the influence of oil extracts, at the higher than at the lower light intensity.

The biological consequences of oil-based pollutants in natural water basins are to a large extent determined by existing environmental conditions, a significant part being played by light intensity and temperature.

BT.05.

TOXIC EFFECT AND ACCUMULATION OF CADMIUM BY THE COMMON SHRIMP *(CRANGON CRANGON*, DECAPODA, NATANTIA)

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Oceanologia 1985, no. 22, pp. 51–62.

Keywords: Common shrimp, Toxic effect, Accumulation

Abstract

Experiments on the accumulation and elimination of cadmium in *Crangon crangon* were carried out in summer 1982. Mortality was high at Cd concentrations of 50 and 100 $\mu g\,dm^{-3}$, at which the animals died after moulting. The cadmium content was lower in the animal bodies than in the exuvia. The level of accumulation depended on the Cd concentration in water. During the elimination period (7 days), a slight decrease in Cd content in the animal body was observed after exposure to Cd concentrations of 5 and 10 $\mu g\,dm^{-3}$, while in the case of the 2 $\mu g\,dm^{-3}$ concentrations, the Cd content in the shrimp body remained at the same level. Higher percentages of moulting animals compared to the control sample were observed at the 2, 5 and 10 $\mu g\,dm^{-3}$ concentrations of Cd. The higher the concentration, the higher lower the mortality of moulting shrimps. Specimens kept in more saline water, and at higher cadmium

concentrations, accumulated lower levels of the metal than in less saline water.

BT.06.

THE TOXICITY OF THREE DISPERSED DIESEL FUEL OILS AND DISPERSANT TOWARDS SOME *SCENEDESMUS (CHLOROCOCCALES)* SPECIES

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Oceanologia 1994, no. 36 (2), pp. 175–186.

Keywords: Fuel oils, Dispersant, Toxicity, *Scenedesmus*

Abstract

The growth of *Scenedesmus* species exposed to three diesel fuel oils was examined in batch cultures. Oils were added to BBM medium in the form of aqueous fuel oil extracts (AFOE) and oil-in-water dispersions (OWD). Cell density, chlorophyll *a* and dry matter were used as growth parameters.

The growth of an *S. armatus* population was affected by AFOE and OWD of no. II oil in a similar way, even though the respective total hydrocarbon concentrations of AFOE and OWD were 49.8 and 15.1 ppm. This result indicates the dominant role of oil dispersion in the reduction of algal growth.

The toxicities of dispersant DP–105, mechanical dispersion (md) and chemical dispersion (cd) (using DP–105 plus I LS or I DS fuel oils) were compared. $EC_{50/48}$ values for I DS fuel oil were similar – 301.9 ppm (md) and 308 ppm (cd), whereas they were quite different for I LS fuel oil – 586.7 ppm (md) and 171.5 ppm (cd). $EC_{50/48}$ for dispersant DP–105 was 74.6 ppm. The toxicity of DP–105 and both oils increased after 96 h, especially in relation to I DS oil.

The results indicate significant differences in sensitivity of six *Scenedesmus* species to AFOE of no. II oil. The species can be ordered from the most sensitive to the most tolerant as follows: *S. microspina* $\gg$ *S. obliquus* $>$ *S. armatus* $>$ *S. opoliensis* $>$ *S. acutus* $\gg$ *S. quadricauda* strain G–15.

Analysis of variance (factorial experiment) resulted in a significant F–value for the combined effects of AFOE, light and temperature, suggesting an interaction between them.

BT.07.

CHANGES IN HEAVY METAL ACCUMULATION IN *ENTEROMORPHA* SPP. FROM THE GULF OF GDAŃSK

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Oceanologia 1995, no. 37 (1), pp. 99–110.

Keywords: *Enteromorpha* spp., Heavy metals, Gulf of Gdańsk

Abstract

The contents of Cu, Zn, Cd, and Pb were determined in samples of *Enteromorpha* spp. collected at Jurata at monthly intervals from November 1992 to October 1993, and at different stations on the coast of the Gulf of Gdańsk during one month. Of all the metals analysed, Zn occurs in the highest concentrations, followed by Cu, Pb and Cd. In the samples from Jurata all the four metals displayed considerable seasonal variations in their concentrations, the ranges for each element being Zn – 29.80–90.05 μg g^{-1} dry wt., Cu – 12.82–28.41 μg g^{-1} dry wt., Pb – 1.81–7.08 μg g^{-1} dry wt. and Cd – 0.08–0.51 μg g^{-1} dry wt. The highest concentrations of all elements except Pb were recorded in November 1992.

Different concentrations of these metals were recorded in *Enteromorpha* spp. collected at different stations on the same day; the highest concentrations of Zn, Cu, and Pb were found in samples from Jastarnia (Zn – 72.11 μg g^{-1} dry wt., Cu – 48.19 μg g^{-1} dry wt. and Pb – 9.41 μg g^{-1} dry wt.), and from Gdynia (Zn – 65.29 μg g^{-1} dry wt., Cu – 29.13 μg g^{-1} dry wt. and Pb – 5.72 μg g^{-1} dry wt.). This implies a high level of pollution at these stations in comparison with the others. The highest concentration of Cd was recorded in samples from Puck (0.43 μg g^{-1} dry wt.).