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Studies on the types of Benthic-Invertebrates

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Abstract

Benthos is also known as benthic invertebrates and it is most important integral part of aquatic ecosystems. It occupies all the stratum of sediment, serves to maintain the ecosystem proper. It comprises of both flora and fauna which are interrelated in relation to their food web. There is diversity in types of benthic invertebrates found in both freshwater and saline too. The present chapter deals with the types of benthic invertebrates, based on the habit and habitat (distribution, size and feeding habits) of the organism in aquatic ecosystem.

Introduction

Benthos is the bottom layer organisms occupied in all types of ecosystems, both in saline as well as in freshwater. The term „benthos" is used as an expressive term for the entire bottom community and the "benthic boundary layer" relate to the immediate physical environment of the benthos (McCave, 1976). Benthos word is coined by a German zoologist Ernst Hackel in1891. In Greek, the meaning of benthos is „Depth of the Sea"; the organisms live in a benthic region concerning the sediment. On the basis of types of organism they are classified into Zoo-benthos and Phyto-benthos e.g. all the benthic animals are known as zoo-benthos while benthic plants known as phyto-benthos such as microalgae etc. In all the benthos community or even closely related species may receive their food differently (Covich *et al.*, 1999). There are numerous food web relationships in which one species interrelates positively or negatively with others or in which the addition or defeat of only species alter food web dynamic. Benthos converts „organic detritus", from "sedimentary storage" into "dissolved nutrients" that can be mixed into overlying waters, which is used by rooted plants, macrophytes and algae, phytoplankton to improve primary productivity. Some benthos is "omnivores" and feed on macrophytes, algae, and zooplankton. Many benthoses are consumed by fishes. Through their mixing of sediments and consumption of diverse resources, benthos can, directly and indirectly, influence microbial production and release of greenhouse gases, toxic gases, and nitrogen (Covich *et al.*, 1999).

Types of Benthos:

On the basis of distribution of these organisms in water are classified into three types, Endo-benthos, Epi-benthos (Pearson and Rosenberg, 1978) and Hyper-benthos (Mees and Jones, 1997).

Endo-benthos:

These organisms are living inside the sediment, they ingest sediment"s fine particulate matter e.g. Oligochaetes. Endo-benthic organisms are sedentary. They consist of diverse species that show different tolerances to pressure. They are representative of different zoological groups including annelids, bivalves, and crustaceans that contribute greatly to aquatic ecosystems. Among annelids, oligochaetes are mainly presented in freshwater, whereas polychaetes are mainly marine organisms. Among Insects Chironomus larvae used in eco-toxicological freshwater studies. (Amiard-Triquet and Berthet, 2015).

Epi-benthos:

These organisms are lying over the surface of sediment, e.g. Hydroids, molluscs, sponges, crustaceans etc. According to Rees, (2007), epi-benthos that comprises the flora and fauna inhabit the seabed surface like seaweeds, sponges, colonial hydroids, crabs, shrimps, and fish etc. the size of epi-benthos is considerably greater than their endo-benthic organisms.

Hyper-benthos:

These organisms are living above the sediment floor, they have capability to swim near the bottom instead of attached to substratum, e.g. Rock cods. Many larval and early post-larval fish and crustaceans have a hyper-benthic life style (Mees and Jones, 1997). Mysids, a major component of the hyper-benthos, are used increasingly in aquaculture, and in eco-toxicology and pollution studies (Laughlin and Linden, 1983; Brandt *et al.*, 1993). There are two arguments in favor of using the term hyper-benthos in preference to the commonly used term supra-benthos (Mees and Jones, 1997). The similar assemblage of organisms is referred to as demersal zooplankton in the tropics, and as hyper-benthos or supra-benthos at higher latitudes, deep-sea workers prefer the term bentho-pelagic plankton and refer to the zone as the benthic boundary layer.

On the basis of size of organisms they are classified into Macro-benthos, Meio-benthos and Micro-benthos.

Macro-benthos:

These organisms are living at the bottom of water column and they are easily seen with the naked eyes e.g. it is mostly Polycheates, Chironomids, Bivalves, Echinoderms, etc. generally their dynamics are elevated in low productive ponds. They are larger than 1 mm. Macro-benthic organisms are extremely responsive to ecological discomfort; they are greatly influenced by various factors in water. The density of macro-benthic invertebrates are controlled by a variety of ecological factors such as habitat characteristics (Hynes, 1970; Peeters and Gardeniers, 1998), sediment feature (Chapman and Lewis, 1976), size of sediment grain (Tolkamp, 1980), and by biological factors such as competition and predation (Kohler, 1992; MacKay, 1992; Macneil *et al.*, 1999). Stream flow, nature of substratum and organic pollution, generally regulates the species composition (Negi and Singh, 1990). According to Koperski (2011) many of factors which potentially controls the biodiversity of macro-benthos, however, clear-cut examples of strong influence on biodiversity of the total macro-benthos are rare and the diversity of macrobenthos dwelling in fresh waters is determined by geographic, climatic, and historical factors. The macro-benthos is acting as important tools of bio-monitoring due their long life cycle, limited mobility and differential sensitivity to different kind of pollution. Diversity of the total macro-benthos appears to be related only to composite environmental factors, viz. productivity or habitat heterogeneity (Voelzl and McArthur, 2000), while different groups of benthic invertebrates may be strongly affected by simple, abiotic environmental factors (Koperski, 2011).

Meio-benthos:

These organisms are smaller than 1 mm but larger than 0.1 mm e.g. Foraminifera, Ciliophora, Amphipoda, Cladocera, Crustacean, Ostracoda etc. They are roughly defined as metazoans that can pass through a 500-µm sieve, but are retained on a 40-µm sieve (Higgins and Thiel, 1988). Nematodes, rotifers, and harpacticoid copepods often dominate permanent meiofaunal (or meio-benthos) communities, although curious animals such as tardigrades (water bears), ostracods, cladocerans, gastrotrichs and micro-turbellarians can be found in some habitats. Temporary meio-fauna are typically dominated by the youngest instars of aquatic insects (chironomids), but also comprise oligochaetes and water mites (Traunspurger and Majdi, 2017). Meiofauna can be found worldwide, from glacier fed rivers to thermal springs, from oligotrophic to eutrophicated waters and they massively inhabit groundwater biotopes (Ward and Palmer, 1994; Rundle *et al.,* 2000; Traunspurger, 2000). Meio-fauna are diverse, numerically dominant, and act as trophic intermediaries between micro- and macroscopic organisms in stream ecosystems (Schmid *et al.*, 2000; Schmid-Araya *et al.*, 2002a). Some meio-fauna (especially oligochaetes, bdelloid rotifers, and some nematodes) are quite healthy and can thrive in organically polluted environments. (Traunspurger and Majdi, 2017).

Micro-benthos:

These organisms are very small in size, less than 0.1mm e.g. diatom, amoeba, bacteria etc. The micro-benthos includes various groups commonly presented in interstitial environments, with a noticeable abundance and diversity. These groups are important for coastal ecosystem functioning, participating both as producers and consumers (Dietrich and Arndt, 2000; Patterson *et al.*, 1989). In shallow water, the bottom substratum is soft; some important bio-chemical processes occurs in the sediment, where dense micro-benthic communities drive central ecosystem functions like primary production, decomposition and nutrient cycling (Larson and Sundback, 2008). The microbial organisms are eukaryotic e.g. diatoms, dinoflagellates, phytoflagellates, etc., but also some prokaryotic photosynthetic organisms i.e. cyanobacteria, contribute to the benthic community (MacIntyre *et al.,* 1996). Micro-benthos especially in shallow waters is often enriched by planktonic species. Micro-phyto-benthos comprise only autochthonous source of primary production on sediment in the absence of macroscopic vegetation (Larson and Sundback, 2008). Benthic micro-algae regulate sediment-water nutrients fluxes, might reduce the population of nitrifying bacteria capable of having an active metabolism (Risgaard-Petersen, 2003).

Feeding habits of the benthos retrieve the existence of diversity of life at the bottom of water bodies. The feeding habits can be classified on the basis of capturing as well as ingestion of the food particle five types of feeding habits are recognized as Suspension feeders, Deposit feeders, Herbivores, Carnivores and Scavengers.

Suspension feeders:

These are the immobile organisms and remain attached to the substratum, generally hard substratum and construct a tube or hard case into which they retreat when they sense danger. These organisms have appendages covered by mucus to which suspended particles from the water column becomes attached. They are then carried by means of the cilia and antennae to the mouth (Lavaleye *et al.*, 2007). These organisms may capture and ingest the particulate food particles present in the suspended in water. This comprises of mainly bacteria, detritus, phytoplankton and zooplankton. The size, shapes, chemical composition and concentration of suspended particle also influences rates and efficiencies of particle capture, the activities of diverse suspension feeding organisms influence a wide range of ecological processes (Hentschel and Shineta,

2008) e.g. sponges, polycheates, snail, clams, oysters, lancelets etc. many active suspension feeders are known as filter feeders (Hentschel and Shimeta, 2019; Cumming and Graf, 2010).

Deposit feeders:

The organisms which ingest particulate and deposited food, ingestion of sediment (microorganisms, decomposing organic matter) the animals which feed on surface layer of sediment is known as tentaculate surface deposit feeders (use tentacle to feed on surface) e.g. polycheates, sea cucumber etc. the organism which create sediment cone e.g. lugworm, Arenicola marina, it creates U shaped burrows, funneling sediment into mouth.

Herbivores:

The organism which feed on algae or algal cells in detritus is known as Herbivore benthos. They are generally found in shallow region, these organisms have unique mouth parts known as radule, which helps to cut and chew herbs matter (Lavaleye *et al.,* 2007) they are also know as shredders and grazers. Kajak and Warda, (1968) postulate that chironomus species has selective feeding habit and prefer algae; he also stated that the chironomus larvae could live purely on bacteria ingested with the detritus. Diatoms are the most important group of chironomid diet (Johanson and Beaver, 1983). Cocconeis diatom are more frequently as an important component in the diet of Hydropsyche occidentalis (caddis fly), while the filamentous green algae, Cladopora glomerata consumed in large amount by Sigara (corixidae) (Koslucher and Minshell, 1973).

Carnivores and Predators:

These are the organisms which feed on other live organisms of varying in size; they acquire a modified sensory organ which helps to find out the prey. They are very fluent to acquire their food prey as food. They have well modified mouth parts, teeth, jaws and extendible pharynx to capture and consume their prey. Some of the benthos is referred to as a scavenger which is subcategory of carnivores. The body of scavengers is same as that of carnivore but they feed on dead bodies or remnants of either benthic or pelagic organism (Lavaleye *et al.*, 2007). Carnivores consume additional animals which consist of asteroid starfish, may crabs, many fish, and anemones. Scavengers nourish on carcasses as well as residue of other animals and plants. Many deposit feeders also scavenge. Good examples of such species are the fiddler crabs, which are normally deposit feeders but can also scratch apart departed fish. According to Cummins (1975), the benthic macro-invertebrates may be divide into the functional trophic groups i.e. Scappers, shredders, collectors, and predators. The scappers or grazers are mainly herbivores feeding on attached algae. The shredder feed on coarse particulate organic matter and egests it in a fine particulate matter from which is in turn filtered and accumulated by the collectors and lastly the predators which are carnivorous and feed on small macro-invertebrates.

References

1. Amiard-Triquet, C. and Berthet, B. (2015): Endobenthic Invertebrates as Reference Species. Aquatic Ecotoxicology, 229-252
2. Chapman, M. A. and Lewis, M. H. (1976): An introduction to the freshwater Crustacea of New Zealand. Auckland, Collins.
3. Covich, A. P., Palmer, M. A. and T. A. Crowl (1999): The Role of Benthic Invertebrate Species in Freshwater Ecosystems. BioScience, 49 (2): 119-127.
4. Cummings, K. S. and Graf, D. L. (2010): Mollusca: Bivalvia. Ecology and Classification of North American Freshwater Invertebrates, 309-384.
5. Cummins, K. W. (1975): Macroinvertebrates. In: B.A. Whitton (ed.) Rivere cology. University of California Press, Berkeley, California, 170-198.
6. Dietrich, D. and Arndt, H. (2000): Biomass partitioning of benthic microbes in a Baltic inlet: Relationships between bacteria, algae, heterotrophic flagellates and ciliates. Marine Biology, 136: 309-322.

7. Friedrich, H. (1969): Marine biology: an introduction to its problems and results. London: Sidgewick and Jackson.
8. Hentschel, B. T. and Shimeta, J. (2008): Suspension Feeders. General Ecology, 3437-3442.
9. Hentschel, B. T. and Shimeta, J. (2019): Suspension Feeders. Encyclopedia of Ecology, 2nd edition, (3): 624-628.
10. Higgins, H. P. and Thiel, H. (1988): Introduction to the Study of Meiofauna. Smithsonian Press, Washington, DC.
11. Hynes, H. B. N. (1970): The ecology of running waters. University of Toronto Press, Toronto, Ontario.
12. Johannsson, O. E. and Beaver, L. (1983): Role of algae in the diet of *Chironomus plumosus* f. semireductus from the Bay of Quinte, Lake Ontario. Hydrobiologia ,107(3): 237–247.
13. Kajak, Z. and J. Warda (1968): Feeding of benthic non predatory Chironomidae in lakes. Annales Zoologici Fennici, 5: 57-64.
14. Kohler, S. L. (1992): Competition and the structure of a benthic stream community. Ecological Monographs, 62:165-188.
15. Koperski, Paweł (2011): Diversity of freshwater macrobenthos and its use in biological assessment: A critical review of current applications. Environmental Reviews, 16-31.
16. Koslucher, Dale G. and Minshall, G. Wayne (1973): Food Habits of Some Benthic Invertebrates in a Northern Cool-Desert Stream (Deep Creek, Curlew Valley, Idaho-Utah). Transactions of the American Microscopical Society, 92 (3): 441-452.
17. Larson, F. and Sundback, K. (2008): Role of microphytobenthos in recovery of functions in a shallow-water sediment system after hypoxic events. Mar. Ecol. Prog. Ser., 357:1-16.
18. Laughlin, R. B. and O. Linden (1983): Oil pollution and Baltic mysids: acute and chronic effects of the water soluble fractions of light fuel oil on the mysid shrimp Neomysis integer. Marine Ecology Progress Series, 12: 29-41.
19. Lavaleye, M., Craeymeersch, J. A. and Duineveld, G. C. A. (2007): Functional diversity. ICES Cooperative Research Report No. 288, 109-115.
20. Mackay, R. J. (1992): Colonization by Lotic Macroinvertebrates: A Review of Processes and Patterns. Canadian Journal of Fisheries and Aquatic Sciences, 49(3): 617–628.
21. MacNeil, C., Dick, J. T. A. and Elwood, R. W. (1999): The dynamics of predation on Gammarus spp. (Crustacea: Amphipoda): Biological Reviews of the Cambridge Philosophical Society, 74: 375-395.
22. McCave, I. N. (ed.), (1976): The benthic boundary layer. New York: Plenum.
23. McIntyre, C. D., S. V. Gregory, A. D. Steinman and Lamberti, G. A. (1996): Modeling benthic algal communities: an example from stream ecology. 669–704, in R. J. Stevenson, M. L. Bothwell, and R. L. Lowe (editors): Algal ecology: freshwater benthic ecosystems. Academic Press, New York.
24. Mees, J. and Jones, M. B. (1997): The Hyperbenthos. Oceanography and Marine Biology: an Annual Review, 35, 221-255.
25. Negi, M. and Singh, H.R. (1990): Substratum as determining factor for bottom fauna in River Alaknanda. Proc. Indian Nat. Sci. Acad., 56:417-423.
26. Patterson, D., Larsen, J. and Corliss, J. (1989): The ecology of het-erotrophic flagellates and ciliates living in marine sediments. Prog. Protistol., 3: 185–277.
27. Pearson, T. H. and Rosenberg, R. (1978): Macrobenthic Succession in Relation to Organic Enrichment and Pollution of the Marine Environment. Oceanography and Marine Biology-An Annual Review, 16: 229-311.
28. Peeters, E. T. H. M. and J. J. P. Gardeniers, (1998): Logistic regression as a tool for defining habitat requirements of two common gammarids. Freshwater Biology, 39: 605–615.
29. Rees, H. L., Eggleton, J. D., Rachor, E., and Vanden Berghe, E. (Eds): (2007): Structure and dynamics of the North Sea benthos.

ICES Cooperative Research Report No. 288. 258.
30. Risgaard-Petersen, N. (2003): Coupled nitrification-denitrification in autotrophic and heterotrophic estuarine sediments: on the influence of benthic microalgae. Limnol Oceanogr., 48: 93–105.
31. Rundle, S. D., Bilton, D. T. and Shiozawa, D. K. (2000): Global and regional patterns in lotic meiofauna. Freshwater Biology, 44: 123-134.
32. Schmid, P. E., Tokeshi, M. and Schmid-Araya, J. M. (2000): Relation between population density and body size in stream communities. Science 289, 1557-1560.
33. Schmid-Araya, J. M., Hildrew, A. G., Robertson, A., Schmid, P. E. and Winterbottom, J. (2002a.) The importance of meiofauna in food webs: evidence from an acid stream. Ecology, 83: 1271-1285.
34. Tolkamp, H. H. (1980): Organism-substrate relationships in lowland streams. Agric. Res. Rep., 907: 211p.
35. Traunspurger, W. (2000): The biology and ecology of lotic nematodes. Freshwater Biology, 44: 29-45.
36. Traunspurger, W. and Majdi, N. (2017): Meiofauna. Methods in Stream Ecology, 3: 273-295.
37. Voelz, N. J. and McArthur, J. V. (2000): An exploration of factors influencing lotic insect species richness. Biodivers. Conserv., 9(11): 1543–1570.
38. Ward, J. V. and Palmer, M. A. (1994): Distribution patterns of interstitial freshwater meiofauna over a range of spatial scales, with emphasis on alluvial river aquifer systems. Hydrobiologia, 287: 147-156.

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