
9. Zooplankton Distribution in Poole Harbour

Paola Barbuto¹, Eunice Pinn¹ and Antony Jensen²

¹School of Conservation Sciences, Bournemouth University, Poole, Dorset BH12 5BB

²School of Earth and Ocean Sciences, Southampton Oceanography Centre,
University of Southampton, Hampshire SO14 3ZH

The distribution and abundance patterns of the zooplanktonic communities in the estuarine environment of Poole Harbour, and their link with physico-chemical parameters, are reported here for the first time. Over the summer of 1999, the harbour maintained a rich zooplankton standing stock, with peak production during August and September. Copepods and the larvae of gastropods, polychaetes, bivalves and decapods contributed a major share of the zooplankton community. Zooplankton spatial distributions were thought to be partly influenced by the hydrographic structure of the area and by the tidal currents, which contribute to a certain degree to species retention. Zooplankton abundance followed a similar pattern to chlorophyll 'a' concentration, but with a time lag of approximately one month. While spatial distribution patterns may be related to the hydrographic features of the harbour, temporal occurrence of the different zooplankton groups appeared to be related to the autochthonous production of the harbour.

Introduction

As with most coastal ecosystems, estuaries and lagoons are often productive environments supporting fisheries of commercial and recreational importance (e.g. Jouffre *et al.*, 1991; Wilson, 2002). Zooplankton abundance and biomass are both important determinants in assessing the rates of production, the nature of food webs and trophic transformations (Collins and Williams, 1982). Therefore, quantifying and understanding the processes controlling abundance and production of zooplankton within those ecosystems is of great conservation interest.

Planktonic communities in estuaries are typically rich and diverse, and can frequently be enriched by benthic algae resuspended from the seabed (Raymont, 1963). Although phytoplankton is usually abundant, the same does not always appear to be true for zooplankton, whose distribution and abundance can be irregular and are poorly understood (Barnes, 1974).

The inshore zooplankton community is typically characterized by a few holoplanktonic species (i.e. organisms that spend their entire life in the planktonic community) and a considerable variety of meroplanktonic animals (i.e. organisms that spend only part of their life cycle in the plankton, usually as eggs or larvae). The main results of research on

zooplankton in coastal waters were reviewed by Colombo *et al.* (1984), who emphasized the role of the biological communities in the coastal ecosystem organization. Ambrogi *et al.* (1987) suggested that the organization and seasonal occurrence of zooplankton in a lagoon depended on autochthonous production, while Collins and Williams (1981) suggested that the spatial distribution of the holoplanktonic community of an estuarine area is mainly dependent on the hydrology (e.g. salinity) of the system.

The ecology of Poole Harbour zooplankton is largely unknown. Therefore, the current study presents baseline information to evaluate production and community structure of zooplankton in the harbour.

Methods

In this study, only the mesoplankton community (animals ranging from 200 μm to 2 mm in size) was considered. This includes both species from the holo- and the meroplankton communities. Sampling was carried out at monthly intervals from May to September in 1999, over a designated horizontal transect of seven systematically distributed stations (Figure 1) at two different depths (1 m and 5 m). Fixed-depth sampling was performed at similar tidal states (high spring tide) to assess spatial distribution patterns of zooplankton within the harbour, whilst changes in population density and composition were monitored through horizontal and vertical tows. The relationship between the zooplankton groups and environmental parameters was assessed using data resulting from the direct measurement of the physico-chemical variables including temperature, salinity, chlorophyll 'a' and phaeo-pigments (Barbuto, 1999).

Results and discussion

The zooplankton community within Poole Harbour showed clear variations in spatial and temporal distribution patterns. Thirty-three groups of zooplankton were identified with clear numerical dominance of holoplanktonic species (Table 1), particularly calanoid copepods (*Acartia* spp.), which is typical of most neritic and estuarine environments (Raymont, 1963). These species were restricted to Wareham Channel, which suggests that there was a certain degree of retention of the population within this part of the harbour.

With regard to the meroplanktonic groups, cirripede nauplii and the larvae of gastropods, bivalves, polychaetes and decapods were the most abundant groups, particularly in the Upper Wych Channel (Table 1). Their spatial distribution appeared to be partly influenced by the location of the adult population (Burkill, 1983), and by the hydrographic features of the system. The Upper Wych Channel (sampling stations 3 and 4) (Figure 1) borders molluscan aquaculture beds (Manila Clam, Palourde, oyster, cockle and mussel) in this part of the harbour.

The planktonic assemblages maintained substantially the same composition from May to September (Figure 2). The communities belonging to defined areas of the harbour appeared



Figure 1 Sampling sites. Station 1: Wareham Channel (Buoy 84); Station 2: Wareham Channel (Buoy 74); Stations 3 and 4: Upper Wych Channel (Shipstal Point and Ramhorn Lake); Station 5: South Deep (between Furzey and Green Island, No. 13); Station 6: South Deep (Buoy 42); Station 7: Diver Middle Channel (Diver 51).

to achieve a structure which showed a degree of self-organization and predictability. This had a certain degree of independence from the physical environmental variables.

No obvious relationship was observed between the abundance of the major zooplanktonic groups and temperature, salinity or phaeo-pigments. It is suggested that the higher concentration of larval stages in the western part of the harbour compared with the eastern part of the system might be caused by a residual circulation and the more sheltered conditions of the harbour. These could promote an increase in primary production and larval retention. Thus, temporal change in abundance of species recorded in the west part of Poole Harbour, toward the end of the summer, appeared to be linked with the increase of chlorophyll 'a' concentration observed during late summer (Figure 3).

The influence of tidal import (and export) of neritic forms to the system from the coastal environment of Poole Bay must also be considered when looking at zooplankton composition at the surface. However, organization and temporal succession of zooplankton in the harbour suggested that the temporal abundance and structure of Poole Harbour zooplanktonic communities were mainly dependent on autochthonous production, food availability and tidal and residual circulation.

Table 1 Abundance of zooplankton groups (abundance as numbers per m³)

Stn*	Calanoids	Copepod nauplii	Herpacticoids	Cirripede nauplii	Gastropod larvae	Bivalve larvae	Polychaete larvae	Decapod larvae
May	1808	17	0	626	122	35	52	0
1	1600	35	0	52	365	0	17	17
2	87	17	0	69	17	17	0	0
3	904	35	0	122	17	0	17	0
4	122	17	0	87	17	0	17	0
5	122	0	0	87	52	0	17	0
6	191	17	17	35	313	0	70	17
June								
1	113	487	9	157	183	165	17	0
2	557	591	17	930	122	70	87	70
3	365	461	9	235	35	17	104	9
4	209	1017	35	313	304	78	104	52
5	435	1409	78	365	200	96	183	96
6	391	991	96	304	113	52	69	113
7	383	713	148	226	183	44	78	113
July								
1	2487	1478	35	313	696	70	156	0
2	278	191	70	557	174	104	52	0
3	748	661	174	504	87	209	122	0
4	1078	957	104	278	209	244	469	0
5	244	296	191	122	244	226	17	0

6	487	400	330	296	244	17	35	0
7	296	139	191	174	52	35	70	0
August								
1	1861	2574	87	348	87	104	70	0
2	278	765	209	626	52	383	87	17
3	313	1270	70	209	52	365	35	17
4	748	1270	417	174	87	539	157	0
5	226	661	313	104	104	226	52	0
6	278	574	626	70	139	104	70	0
7	35	313	278	52	52	104	52	0
September								
1	23478	8348	1130	435	174	435	4435	0
2	1426	1148	244	122	122	122	17	0
3	1426	2470	226	122	591	417	330	0
4	504	1757	348	157	261	400	70	0
5	87	1148	469	0.0	104	122	70	0
6	90	1126	469	0.0	104	122	70	0
7	557	800	469	87	35	348	87	0

* See Figure 1 for station positions.

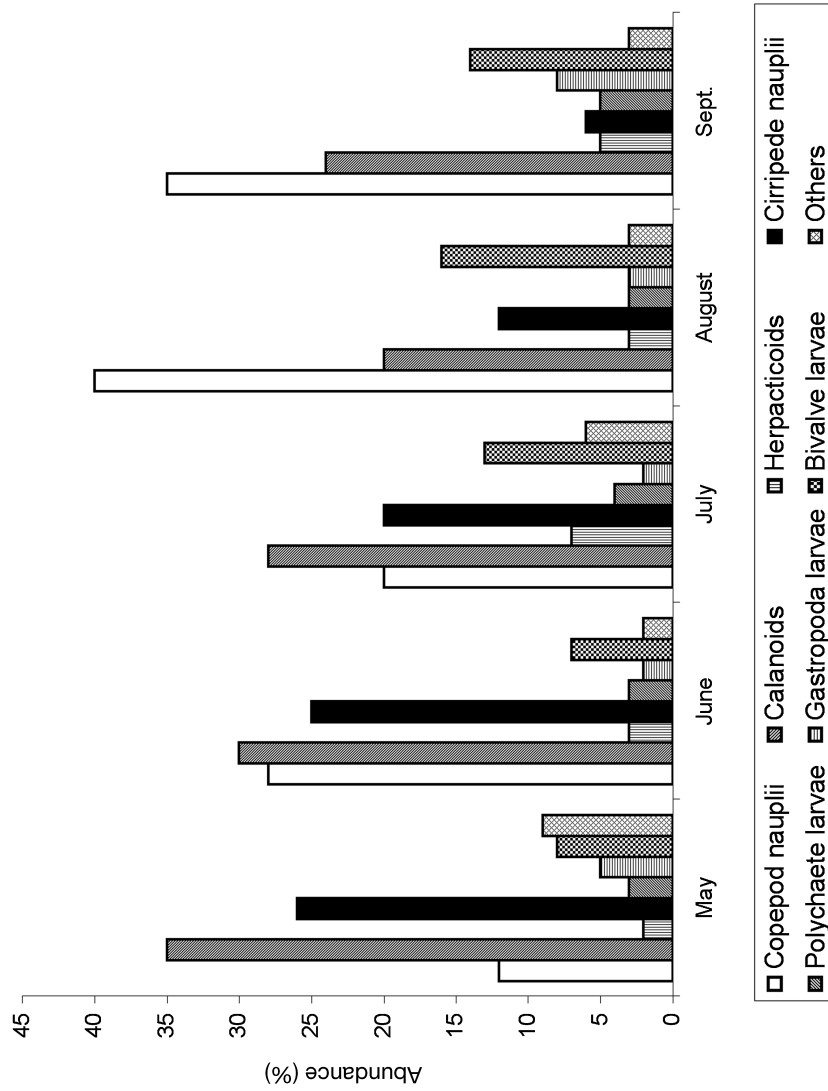


Figure 2 Composition of the zooplankton community of Poole Harbour.

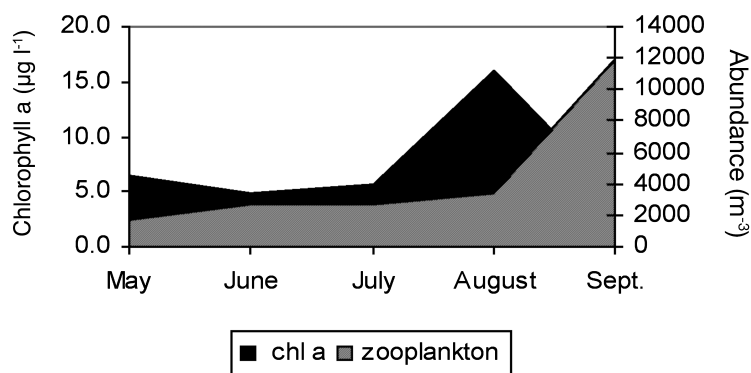


Figure 3 Chlorophyll 'a' concentration and zooplankton abundance.

References

- Ambrogi, R., Ferrari, I., Geraci, S. and Ros, J. (1987) Biotic exchange between river, lagoon and sea: The case of zooplankton in the Po Delta. pp. 601–608. In: *European Marine Biology Symposium, Barcelona*.
- Barbuto, P. C. (1999) A Preliminary and Ecological Survey of the Summer Macro and Mesozooplankton in Poole Harbour, An Open Coastal System, Dorset, South England. Dissertation submitted in partial fulfilment of the requirements for the degree of M.Sc. (Oceanography), University of Southampton.
- Barnes, R. S. K. (1974) *Coastal Lagoons*. Cambridge: Cambridge University Press.
- Burkill, P. H. (1983) Sampling and analysis of zooplankton populations. pp. 139–183. In: *Practical Procedures for Estuarine Studies*. Morris, A. W (ed.). London: NERC.
- Collins, N. R. and Williams, R. (1981) Zooplankton of the British Channel and Severn Estuary. The distribution of four copepods in relation to salinity. *Marine Biology*, **64**: 273–283.
- Collins, N. R. and Williams, R. (1982) Zooplankton communities in the Bristol Channel and Severn Estuary. *Marine Ecology Prog. Series* **9**: 1–11.
- Colombo, G., Cecchierelli, V. and Ferari, I. (1984) Lo zooplankton delle lagune. *Nuova Thalassa*, **2**: 185–200.
- Jouffre, D., Lam-Hoai, T., Millet, B. and Amanieu, M. (1991) Structuration spatiale des peuplements zooplanctoniques et fonctionnement hydrodynamique en milieu lagunaire. *Ocean. Acta*, **14**: 5.
- Raymont, J. E. E. (1963) *Plankton and Productivity in the Oceans*. Oxford: Oxford University Press.
- Wilson, J. G. (2002) Productivity, fisheries and aquaculture in temperate estuaries. *Estuary, Coastal Shelf Science*, **55**: 953–967.