Oceanologia (2015) 57, 78—85

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/oceano

ORIGINAL RESEARCH ARTICLE

Seasonal variability in the population dynamics of the main mesozooplankton species in the Gulf of Gdańsk (southern Baltic Sea): Production and mortality rates☆,☆☆

Lidia Dzierzbicka-Głowacka [a,*], Marcin Kalarus [b], Maja Musialik-Koszarowska [b], Anna Lemieszek [c], Maria Iwona Żmijewska [b]

[a] *Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland*
[b] *Institute of Oceanography, University of Gdańsk, Gdynia, Poland*
[c] *Maritime Institute, Gdańsk, Poland*

Received 2 June 2014; accepted 9 June 2014
Available online 23 October 2014

KEYWORDS
Copepoda;
Biomass;
Secondary production;
Mortality rates;
Baltic Sea;
Gulf of Gdańsk

Summary This manuscript is a continuation of the results presented in the earlier work by Dzierzbicka-Głowacka et al. (2013). Major purpose of this study is to characterize population dynamics of three major Baltic calanoid copepod species (*Acartia* spp., *Temora longicornis* and *Pseudocalanus* sp.) in the Gulf of Gdańsk during the years 2006—2007. This paper focuses mostly on biomass estimation, production and mortality rates. All three species had the highest observed biomass in summer 2007 and it was 12.62, 9.16 and 0.80 mg C m^{-3} for *Acartia* spp., *T. longicornis* and *Pseudocalanus* sp., respectively, while highest daily production rates for those species were 28.22, 18.47, 1.34 mg C m^{-2}, all recorded in summer 2007. Mortality rates were calculated for all copepodite stages of selected species, and in most cases highest values were observed during summer seasons.

☆ This research was carried out with the support of a grant from the Polish State Committee for Scientific Research (No. NN306 353239).
☆☆ This manuscript is a continuation of the previous work by Dzierzbicka-Głowacka et al. (2013).
* Corresponding author at: Powstańców Warszawy 55, 81-712 Sopot, Poland. Tel.: +48 58 7311912.
E-mail address: dzierzb@iopan.gda.pl (L. Dzierzbicka-Głowacka).
Peer review under the responsibility of Institute of Oceanology of the Polish Academy of Sciences.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.oceano.2014.06.001

1. Introduction

Estimates of zooplankton production rates and mortality are a useful tool to obtain knowledge of marine productivity and quantifying transfers between food web components. Mortality is also an important process influencing behaviour, together with food availability and transport processes accounting for distribution and migration patterns (Aksnes and Ohman, 1996; Ohman and Wood, 1996). For example, mortality risk is one of the major explanatory variables used in habitat and behaviour modelling (Aksnes and Giske, 1993); therefore, there is an increasing need for empirical estimates for future application in modelling of Baltic Sea zooplankton.

The Baltic Sea is one of the largest brackish water bodies in the world; its water type and its location in the boreal climate zone determine the nature of the communities of organisms living in this sea. Consequently, zooplankton consists of brackish, marine euryhaline and freshwater species (Hernroth and Ackefors, 1979; Szulz et al., 2012; Wiktor, 1990). According to Wiktor (1990), Gulf of Gdańsk zooplankton typically consisted of euryhaline and eurythermic taxa, where for copepods these are mainly *Temora longicornis*, *Acartia* spp., and *Pseudocalanus* sp.

Recent studies indicate that a *Pseudocalanus* species from the central Baltic, hitherto named *Pseudocalanus elongatus*, might actually be *Pseudocalanus acuspes* (Bucklin et al., 2003; Holmborn et al., 2011). Although *P. elongatus* may also be present in the southern Baltic, the designation *Pseudocalanus* sp. (after Möllmann et al., 2005) seems to be more appropriate.

Data covering the seasonal and spatial variability of the investigated species have been already presented in the earlier work by Dzierzbicka-Głowacka et al. (2013). The main objective of the study is description of production and mortality rate of three major calanoid copepod species (*Acartia* spp., *T. longicornis* and *Pseudocalanus* sp.) in the southern Baltic Sea. The obtained data will be used in future numerical evaluations and for upgrading the copepod population model developed for the southern Baltic (Dzierzbicka-Głowacka, 2005; Dzierzbicka-Głowacka et al., 2006, 2010, 2011, 2013).

2. Material and methods

2.1. Sampling

The data are based on the analysis of samples collected monthly during a 2-year period (2006 and 2007). Samples were collected at six stations located in the western part of the Gulf of Gdańsk, southern Baltic Sea (Fig. 1). Five of the stations (So1 — 5 m, So2 — 10 m, So3 — 20 m, So4 — 30 m, J23 — 40 m) were located on a depth gradient transect and one station (M2 — 10 m depth) was located in Puck Bay. The zooplankton material was collected using a closing-type Copenhagen net of 0.50 m inlet diameter and 100 μm mesh size, equipped with a flowmeter. Qualitative and quantitative laboratory analyses were performed in accordance with the HELCOM guidelines included in the Combine manual Annex C-7 (www.helcom.fi), except for the nauplii, which were identified to species level. Adults of the genus *Acartia* were identified only to genus level, owing to the similarity between the three *Acartia* species, these are referred to as *Acartia* spp.

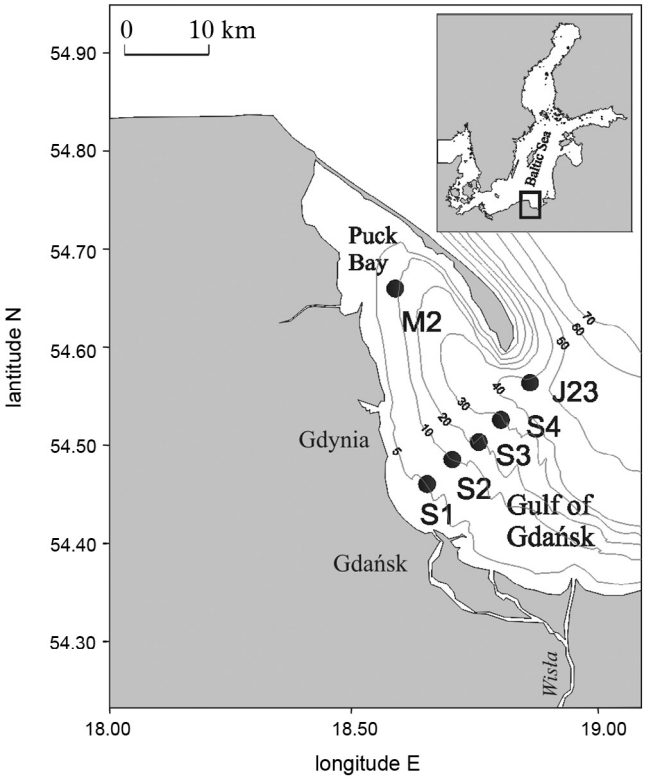

Figure 1 Location of the sampling stations in the Gulf of Gdańsk (southern Baltic Sea).

2.2. Biomass

Biomass was calculated from abundance with weight standards after Hernroth (1985); afterwards, obtained values were integrated over the whole depth layer. Finally, seasonal (winter: December—March, spring: April—June, summer: July—September, autumn: October—December) biomass values were derived by averaging corresponding months (Table 1). Carbon was calculated as 5% of wet weight after Mullin (1969); this conversion rate is usually used for Baltic copepods although as showed by Tanskanen (1994) it may lead to underestimation of zooplankton biomass.

2.3. Copepod production

With assumption of non-limiting food conditions, the production of the investigated species' copepodite stages was

Table 1 Number of samples in corresponding seasons (winter: December—March, spring: April—June, summer: July—September, autumn: October—December).

Year	Winter	Spring	Summer	Autumn
2006	54	18	54	18
2007	24	36	54	30