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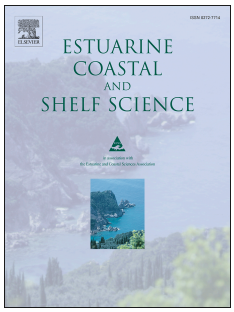

Detailed temperature mapping–Warming characterizes archipelago zones

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Detailed temperature mapping - warming characterizes archipelago zones

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Abstract

Rapidly warming shallow archipelago areas have the best energetic options for high ecological production. We analyzed and visualized the spring and summer temperature development in the coastal areas of the Northern Baltic Sea. Typical for the Baltic is a high annual periodicity and variability in water temperatures. The maximum difference between a single day average temperatures across the study area was 28.3 °C. During wintertime the littoral water temperature can decrease below zero in outer archipelago or open water areas when the protective ice cover is not present and the lowest observed value was -0.5 °C. The depth and exposition are the most important variables explaining the coastal temperature gradients from the innermost to the outermost areas in springtime when water is heated by increasing solar radiation. Temperature differs more within coastal area than between the basins. Water temperature sum was highest in innermost areas, lowest in open water areas and the variation in daily averages was highest in the middle region. At the end of the warming period, the difference in surface water temperatures between the innermost and outermost areas had diminished at the time when the cooling began in August-September. These clear temperature gradients enabled us use the cumulative water temperature to classify the coastal zones in a biologically sensible manner into five regions. Our study shows a novel approach to study detailed spatial variations in water temperatures. The results can further be used, for example, to model and predict the spatial distribution of aquatic biota and to determine appropriate spatio-temporal designs for aquatic biota surveys. The new spatial knowledge of temperature regions will also help the evaluation of possible causes of larger scale climatological changes in a biological context including productivity.

Keywords: temperature, Baltic Sea, data logger, gradient, coastal zone, production prerequisites

1. Introduction

Water temperature in coastal areas is of critical ecological importance for many species. It reflects atmospheric and climatological forcing and it is also a driver of regional weather and climate (Oesch et al. 2005; Neumann 2010). The cycle of the water temperature affects limnological and biological processes, including actions from ice cover break-up (Anderson et al. 1996) to species distribution (Magnuson et al. 1979) and the growth, timing and success of reproduction and survival of several aquatic organisms (Jackson, Peres-Neto & Olden 2001; Casselman 2002; Staehr & Sand-Jensen 2006; Chezik et al. 2014). Water temperature has been recognized as one of key factors, for example, in spatial mapping of species distribution in the coastal areas (Sundblad et al. 2009; Veneranta et al. 2011; Kallasvuo et al. 2016 in press).