ABSTRACT

It is important to reconstruct high-resolution proxy records from past environmental settings, in order to perform improved predictions of future climate variability on Earth. The method used in this thesis is stable isotope analyses of oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$), applied on two intertidal *Littorinidae* gastropod species (*Littorina littorea* and *Littoraria undulata*). The emphasis has been on developing comparative methods, in which intra-annual environmental and climatic interpretation could be obtained by using recent and subfossil shells from coastal areas in NW Europe and SW India. Intrashell $\delta^{18}O$ and $\delta^{13}C$ profiles of the common intertidal gastropod *L. littorea*, of recent and mid-Holocene origin, were analysed from the Limfjord region (Denmark). From intra-annual measurements of sea-surface temperature (SST), sea-surface salinity (SSS), surface-water $\delta^{18}O$ values, and gastropod isotopic data, a species-specific *Littorina* equilibrium equation was determined. The relationship display that a –0.22‰ change in shell $\delta^{18}O$ correspond to a one-degree (C) increase in temperature. The maximum (winter) isotopic values revealed a growth stop temperature of 3.7±1 °C. This temperature was then used as a boundary condition to constrain the temperature and salinity during the mid-Holocene. The subfossil shells indicated a summer surface-water temperature close to 22±1 °C, and salinity of 31±1 PSU, for the Stone Age (Mesolithic) site. The results suggest a more pronounced water exchange between the central Limfjord and the North Sea during the late Atlantic time, and temperatures of 2-4 °C warmer than present. To further test the validity of the *Littorina* equation and extend the geographical range for which it is valid, recent *Littorina* shells were investigated along a latitudinal transect from 58°N to 70°N along the coast of Norway. Calculated summer and winter temperatures from the gastropod oxygen isotope curves matched hydrographic data within ±1 °C, which suggests a strong dominance of solar insolation on the $\delta^{18}O$ shell signals. Coastal SST and SSS, including seasonality in NW Europe during the early phase of the Eemian interglacial ca. 125 kyr ago were reconstructed, based on isotopic analyses of recent and subfossil *Littorina* shells from Kattegat (Sweden) and the English Channel (United Kingdom). The recent gastropods accurately registered seasonal variations in ambient water conditions (±0.6 °C). The results for the Eemian shells indicate annual palaeo-SST ranges between 8-18 °C in the English Channel, and 8-26 °C in Kattegat. Both Eemian sites experienced summer temperatures 1-3 °C above recent conditions. Minimum winter SST in the English Cannel was similar to today (ca. 8 °C), but in the Kattegat region SST was 8 °C warmer during winter, and similar to present conditions in the English Channel. The early Eemian isotopic results indicated that the English Channel was in full contact with the Atlantic Ocean (SSS >35 PSU), and a strong North Sea affinity of the Kattegat surface water (SSS ca. 29 PSU). This is explained by high sea-level stand, and an increased oceanic connectivity through the epicontinental seas of NW Europe. This supports previous contentions that intrashell isotopic patterns in the common intertidal *Littorina littorea* gastropod represents a powerful tool for high-resolution palaeoclimatic reconstructions. Temperature and productivity shifts were reconstructed from intrashell $\delta^{18}O$ and $\delta^{13}C$ analyses in the gastropod *Littoraria undulata*, from the coastal Arabian Sea. The shells from Karnataka (13°N) showed profound post monsoonal ^{12}C depletion, due to increased surface water productivity. The seasonality shift in $\delta^{13}C$ was of ca. 3‰ magnitude, which could be linked to upwelling of ^{12}C rich waters induced by the SW monsoon. Mean annual SST calculated from shell $\delta^{18}O$ values displayed a consistent accuracy within ±0.5 °C of observed values. In terms of *Littorinidae* shell growth rates, interpretations from growth experiments and isotopic results in conjunction with environmental data, indicated an shell aggregation of ca. 0.10-0.15 mm per day for young specimens of the species *Littorina littorea* and *Littoraria undulata*.

Keywords: gastropod, *Littorinidae*, oxygen and carbon isotopes, mid-Holocene, Eemian interglacial, climate, seasonality, temperature, monsoon, upwelling, shell growth