

## Seasonal productions of dinoflagellate cysts in relation to environmental characteristics in Jinhae-Masan Bay, Korea: One year sediment trap observation

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To investigate dinoflagellate cyst production and seasonality in relation to major environmental factors, such as water temperature, salinity, chlorophyll-*a* (chl-*a*) and dissolved nutrients, and to propose dinoflagellate cysts as possible biological indicators for the reconstruction of past environmental conditions, a sediment trap study was conducted for one year, from March 2011 to February 2012, in Jinhae-Masan Bay, Korea. Marked increases in dinoflagellate cyst production were documented in Jinhae-Masan Bay during two distinct seasons (summer and late autumn) characterized by different environmental conditions. Summer (July and August) was characterized by relatively high water temperature, dissolved inorganic nitrogen (DIN), and chl-*a* concentrations and low salinity, whereas late autumn (November and December) exhibited high dissolved inorganic phosphorus, low water temperature and high salinity, compared to those of the summer. Fourteen dinoflagellate cyst taxa were identified. These assemblages were dominated by *Brigantedinium* species (round brown cyst), cysts of *Scrippsiella* species, *Spiniferites* species and cysts of *Alexandrium* species (ellipsoidal cyst). The total flux of dinoflagellate cysts ranged from 781 cysts m<sup>-2</sup> day<sup>-1</sup> to 5,602 cysts m<sup>-2</sup> day<sup>-1</sup>, and the production of autotrophic dinoflagellate cysts was mainly restricted to the warmest months (July-September) and autumn. Multivariable analysis revealed that the production of major dinoflagellate cysts, excluding those of *Brigantedinium* species, can be enhanced by environmental conditions during summer in Jinhae-Masan Bay. In particular, the increased production of cysts of *Scrippsiella* species was related to increased water temperature, and the increased production of *Spiniferites* species was associated with lower salinity. Two peaks in cyst production of *Alexandrium* species in August and November corresponded with significant increases in DIN and DIP; however, no significant relationship was found between the production of *Brigantedinium* species and environmental factors in Jinhae-Masan Bay. These results suggest that the cysts of *Scrippsiella* species, *Spiniferites* species and cysts of *Alexandrium* species present in sediment samples from Jinhae-Masan Bay can be used as biological indicators to reconstruct past environmental conditions involving relatively high water temperature, low salinity and enhanced nutrient level.

Keywords: *Scrippsiella*, *Spiniferites*, *Alexandrium*, phytoplankton, summer, Late autumn