



**University  
of Victoria**

Graduate Studies

Notice of the Final Oral Examination  
for the Degree of Doctor of Philosophy

of

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“High Resolution Dinoflagellate Cyst Sedimentary Records of Past Oceanographic  
and Climatic History from the Northeastern Pacific Over the Last Millennium”

School of Earth and Ocean Sciences

Thursday, June 25, 2015

1:00 P.M.

Bob Wright Building

Room A319

Supervisory Committee:

Dr. Vera Pospelova, School of Earth and Ocean Sciences, University of Victoria (Supervisor)

Dr. Laurence Coogan, School of Earth and Ocean Sciences, UVic (Member)

Dr. Robie Macdonald, School of Earth and Ocean Sciences, UVic (Member)

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Dr. Tigger Tail, Department of Bouncing, UVic

## Abstract

This thesis contributes to the development of dinoflagellate cysts as indicators of past environmental change in the Northeastern Pacific coastal ocean, and investigates past variations in sea-surface temperature, salinity and primary productivity encoded in dinoflagellate cyst sedimentary records from the Santa Barbara Basin (SBB, southern California) and Effingham Inlet (Vancouver Island, British Columbia) over the last millennium. The dinoflagellate cyst records extracted from the SBB and Effingham Inlet predominantly laminated sediments, analysed at sub-decadal resolutions, constitute some of the most detailed records of cyst-producing dinoflagellate populations in the world.

A two year-long sediment trap study from the SBB documents the seasonality in dinoflagellate cyst production for the first time on the Pacific coast of the United States. The study shows that dinoflagellate cyst data can be used as indicators of sea-surface temperature and primary productivity variations associated with seasonal upwelling in the SBB. In particular, several dinoflagellate cyst taxa such as *Brigantedinium* spp. And *Lingulodinium machaerophorum* are identified as indicators of “active upwelling” (typically occurring in spring and early summer) and “relaxed upwelling” conditions (fall and early winter) at the site, respectively.

Analysis of a dinoflagellate cyst record from the SBB spanning the last ~260 years at biannual resolution documents the response of cyst-producing dinoflagellates to instrumentally measured warming during the 20th century, and reveals decadal scale variations in primary productivity at the site that are coherent with phases of the Pacific Decadal Oscillation (PDO). The cyst assemblages are dominated by cysts produced by heterotrophic dinoflagellates (in particular *Brigantedinium* spp.), but the turn of the 20<sup>th</sup> century is marked by an abrupt increase in concentrations of *L. machaerophorum* and *Spiniferites ramosus*, two cyst taxa of autotrophic affinity. Their increasing abundances during the 20th century are interpreted to reflect warmer conditions and possibly stronger stratification during summer and fall. The dinoflagellate cyst data suggest a warming pulse in the early 1900s and provides further evidence that persistently warmer and/or more stratified conditions were established by the late 1920s.

The dinoflagellate cyst record from Effingham Inlet, spanning the last millennium, is characterized by the proportionally equal contribution of cysts produced by autotrophic and heterotrophic dinoflagellates in most samples. The cyst data indicate variations in seasurface temperature, salinity and primary productivity, which are associated with the local expressions of the Medieval Climate Anomaly (from the base of the record to ~1230), the Little Ice Age (from ~1230 to ~1900) and warming during the second half of the 20th century.

Both dinoflagellate cyst records reveal that since the beginning (in the SBB) and mid-20th century (in Effingham Inlet), autotrophic dinoflagellates contribute to a greater portion of the primary production in the region, whereas heterotrophic dinoflagellates, as indicators of diatom populations, decline. Variability in the dinoflagellate cyst data is coherent at both sites and suggest a reduced expression of decadal scale variability associated with the PDO during the 19th century.