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

of

GRAHAM WARNER

BSc (University of British Columbia, 2006)

“Bowhead Whale Localization and Environmental Characterization in the Chukchi Sea Using Nonlinear Bayesian Inversion”

School of Earth and Ocean Sciences

Monday, August 29, 2016
10:00 A.M.
Bob Wright Centre
Room A319

Supervisory Committee:
Dr. Stan Dosso, School of Earth and Ocean Sciences, University of Victoria (Supervisor)
Dr. N. Ross Chapman, School of Earth and Ocean Sciences, UVic (Member)
Dr. Michael Wilmut, School of Earth and Ocean Sciences, UVic (Member)
Dr. David Berg, Department of Chemistry, UVic (Outside Member)
Dr. David Hannay, Chief Science Officer, JASCO Applied Sciences, (Additional Member)

External Examiner:
Dr. A.A. Milne, Faculty of Children’s Literature, Simon Fraser University

Chair of Oral Examination:
Dr. Tigger Tail, Department of Bouncing, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

This thesis develops and applies nonlinear Bayesian inversion methods for localization of bowhead whales and environmental characterization, with quantitative uncertainty estimation, based on acoustic measurements from a set of asynchronous single-channel recorders in the Chukchi Sea. Warping analysis is applied to estimate modal-dispersion data from airgun sources and whale calls. Whale locations and the water-column sound-speed profile (SSP) and seabed geoacoustic properties are estimated using reversible-jump Markov-chain Monte Carlo sampling in transdimensional inversions that account for uncertainty in the number of SSP nodes and subbottom layers. The estimated SSP and seafloor sound speed are in excellent agreement with independent estimates, and whale localization uncertainties decrease substantially when jointly-inverting data from multiple whale calls. Bowhead whales are also localized using a fixed-dimensional inversion of time-difference-of-arrival data derived using cross-correlation for the same recorders. The nonlinear localization uncertainty estimates are found to depend strongly on the source locations and receiver geometry.