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5. Du Preez, C.; Davies, S.C.; Clarke, E.; Fruh, E.L.; Curtis, J.; "Cobb Seamount species inventory." *Canadian Technical Report of Fisheries and Aquatic Sciences* (**in review**).
6. Edinger, E.; Du Preez, C.; Leys, S.; Chu, J.W.F.; Lacharité, M.; "Cold-water corals and sponges and their habitats in Canadian waters." *In* Recent research studies on seabed structure and benthic biodiversity relationships in Canadian Marine habitats. Edited by P. Lawton and E. Edinger. *Canadian Technical Report of Fisheries and Aquatic Sciences* (**in review**).
7. Neves, B.; Du Preez, C.; Edinger, E.; "Mapping coral and sponge habitats on a shelf-depth environment using multibeam sonar and ROV video observations: Learmonth Bank, Northern British Columbia, Canada." *Deep Sea Research II* **2014**, 99, 169 -183.
8. Tunnicliffe, V.; Du Preez, C.; "Notable offshore environments: hydrothermal vents and seamounts. *In* Recent research studies on seabed structure and benthic biodiversity relationships in Canadian Marine habitats." Edited by P. Lawton and E. Edinger. *Canadian Technical Report of Fisheries and Aquatic Sciences* (**in review**).



University
of Victoria

Graduate Studies

PROGRAMME

The Final Oral Examination
for the Degree of

DOCTOR OF PHILOSOPHY
Department of Biology

Cherisse Du Preez

2008

University of Victoria

BSc

"Resolving Relationships Between Deep-sea Benthic Diversity and Multi-scale Topographic Heterogeneity"

Thursday, November, 20, 2014
9:30am

Bob Wright Centre, room A319

Supervisory Committee:

Dr. Verena Tunnicliffe, Department of Biology, University of
Victoria (Supervisor)

Dr. S. Kim Juniper, Department of Biology, UVic (Member)

Dr. Henry Reiswig, Department of Biology, UVic (Member)

Dr. Rosaline Canessa, Department of Geography, UVic
(Outside Member)

External Examiner:

Dr. Frédéric Guichard, Department of Biology, McGill
University

Chair of Oral Examination:

Dr. Fraser Hof, Department of Chemistry, UVic

Abstract

Resolving diversity patterns and their underlying drivers has application for both ecological theory and ocean management. Because seafloor characteristics are often used to assess bottom habitat, I examined the relationship between deep-sea benthic (bottom-living) diversity and multi-scale topographic heterogeneity. Most work occurred on the Canadian Pacific continental shelf at Learmonth Bank with additional sites in Strait of Georgia (BC) and Gulf of Maine (Atlantic shelf). High-resolution species distribution and seafloor data were annotated from remotely operated vehicle benthic imagery surveys while large-scale seafloor data were derived from multibeam sonar.

New method development to address problems of current methods and to facilitate comparison among ecosystems is a major outcome. My new MiLS method (microtopographic laser scanning) can profile the deep seafloor at a resolution of ~1-2 cm with high accuracy and precision. I also developed a new ACR (arc-chord ratio) rugosity index as a measure of 3-D topographic heterogeneity that is simple, accurate and highly versatile.

Model systems and scales vary among my studies but results consistently yield a positive relationship between diversity and topographic heterogeneity and identify bottom hydrodynamics as an important underlying driver. Rockfish *Sebastes* spp. associate with higher seafloor rugosity non-randomly and select for deep-sea corals and sponges over inert substrata alone. Data indicate that degradation of biogenic structures is a long-term detriment to rockfish species. Gorgonian coral- and sponge-dominant biotopes strongly associate with a single substratum type. These relationships were used to map coral and sponge distributions. This work, which collectively adds new information on the ecological relevance and distribution of corals and sponges, is pertinent to the conservation and management of fish stocks and vulnerable marine ecosystems. Epibenthic community variables abundance, richness, and Shannon diversity positively correlated with both the local microtopographic heterogeneity on a scale of 10 m² and with the surrounding regional large-scale topographic heterogeneity on scales of 25 to 250,000 m². Relationships were strongest between epibenthic community variables and the largest scale rugosity and were used to generate and test predictive diversity models. Where management strategies rely on surrogate

measures in data-poor areas, mapping benthic diversity using ACR rugosity will provide good representation.

Although bottom hydrodynamics is consistently identified as an underlying driver of epibenthic patterns related to topographic heterogeneity, data suggest the nature of the relationship varies across spatial scales. At small scales, high topographic heterogeneity likely increases diversity by increasing the number of available niches (including hydrodynamic gradients; e.g., the abrupt vertical rugosity created by tall corals and sponges provides rockfish refuge from currents) while at large scales, high topographic heterogeneity increases local diversity less directly through distant hydraulic events that alter bottom flow hydrodynamics.

Awards, Scholarships, Fellowships

2011-2014, Natural Sciences and Engineering Research Council (NSERC) Postgraduate Scholarship

2011-2014, President's Research Scholarship, *University of Victoria*

2011-2013, Canadian healthy oceans network (CHONe) and NSERC Strategic Network Enhancement Initiative (awarded 4 times)

2010-2012, The W. Gordon Field Memorial Fellowship (awarded 3 times), *University of Victoria*

2008-2010, Fellowship, *University of Victoria*

2010..., The Dr. Michael Bigg Memorial Bursary; Robert Le Grys Memorial Bursary; Dr. Ernst Von Rudloff Bursary; CHONe travel award; ArcticNet training award...

Publications

1. Du Preez, C.; "A new arc-chord ratio (ACR) rugosity index for quantifying three-dimensional landscape structural complexity." *Landscape Ecology* (**in press**).
2. Du Preez, C.; Tunncliffe, V; "Shortspine thornyhead and rockfish (Scorpaenidae) distribution in response to substratum, biological structures, and trawling." *Marine Ecology Progress Series* **2011**, 425, 217 -231.