


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
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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