JOHN O'BRIEN
BSc (Marine Biology), Dalhousie University, 2011

DEPARTMENT OF BIOLOGY

TITLE OF THESIS:	PROCESSES REINFORCING REGIME SHIFT TO TURF-FORMING ALGAE IN A KELP BED ECOSYSTEM
TIME/DATE:	10:00 am, Monday, January 8, 2018
PLACE:	Room 3107, The Mona Campbell Building, 1459 LeMarchant Street

EXAMINING COMMITTEE:

Dr. Isabelle Côté, Department of Biological Sciences, Simon Fraser University (External Examiner)

Dr. Heike Lotze, Department of Biology, Dalhousie University (Reader)

Dr. Melisa Wong, Department of Biology, Dalhousie University (Reader)

Dr. Sandra Walde, Department of Biology, Dalhousie University (Reader)

Dr. Robert Scheibling, Department of Biology, Dalhousie University (Supervisor)

DEPARTMENTAL REPRESENTATIVE:	Dr. Paul Bentzen, Department of Biology, Dalhousie University
CHAIR:	Dr. Peter Duinker, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

Canopy-forming brown algae (kelps and fucoids) that provide habitat structure on temperate rocky reefs increasingly are replaced by assemblages of low-lying and pervasive turf algae, driving concerns that these shifts represent a stable degraded reef state. In this thesis, I elucidate the reinforcing processes and feedbacks that inhibit recovery of subtidal kelp beds following large-scale losses, and stabilize regime shifts to turf algae in Nova Scotia. Field observations and a kelp-thinning experiment showed that density and grazing intensity of the snail *Lacuna vincta* on the dominant kelp species *Saccharina latissima* increased non-linearly with decreasing kelp biomass. This enhances direct and indirect kelp tissue loss creating a positive feedback between disturbances that defoliate kelp (hurricanes, outbreaks of the invasive epiphytic bryozoan *Membranipora membranacea*) and grazing. An active feeding preference of *L. vincta* for sporogenous over vegetative tissue, correlated with the distribution of anti-grazing phlorotannins, resulted in intense grazing on sori of *S. latissima* during seasonal spore production that reduced kelp fecundity. Estimates of potential reproductive output (spores m^{-2}) at 5 sites suggested low density of reproductive adults in degraded kelp populations imposes propagule supply constraints that are exacerbated by grazing losses. Limited kelp recruitment occurred over 5 years of observations at 2 sites that were characterized by pervasive turf algae following canopy defoliation. High tissue loss and mortality of juvenile sporophytes were related to effects of grazing by *L. vincta*, encrustation by *M. membranacea*, and high temperatures. Kelp cover and density remained low after 5 years at both sites and turf-forming, opportunistic and invasive algae dominated reefs. A global meta-analysis of interactions between turf algae and other foundation species indicated that canopies of macroalgae or established corals generally suppress the abundance of turf algae on reefs, but that turf algae inhibit establishment of canopy algae recruits and expansion of coral colonies. Competition from turf algae likely maintains regimes on temperate and tropical reefs by inhibiting recovery of foundation species following disturbances that enable turf algae to establish. Stabilizing feedbacks that maintain shifts to turf algal assemblages bear consequences for communities dependent on the foundation species they replace.