

Evolutionary ecology of sharks and rays: brain development and reproductive investment

PhD project available at Simon Fraser University, Vancouver, starting 2009

The thousand or so species of sharks and rays display an extraordinary diversity of life histories, with the widest array of reproductive modes and levels of maternal investment of any group of vertebrates. Their reproductive modes range from egg-laying to live bearing with a range of different mechanisms through which additional investment is provided to the offspring¹. In mammals the evolution of high levels of maternal investment is thought to underlie the evolution of large brains² and there is some evidence to support this in sharks and rays³. We seek to test the link between maternal investment in offspring and the evolution of brain size and structure through phylogenetic comparative analysis.

This funded PhD project will provide the student with broad training in phylogenetic comparative analysis, field capture of elasmobranchs and the laboratory analysis of brain structure. The student will be expected to collaborate with and work alongside other students and will gain a wider training in the links among life histories, population dynamics and conservation biology of fishes. The student will be based at the vibrant and expanding Earth to Ocean research group at the Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, BC Canada.

To apply for this project please send a CV and a 1-page research proposal (including context, hypotheses, approach & timeline). It is strongly encouraged that the candidate read the references provided below prior to building the conceptual framework of their own proposal. Send this along with a cover letter with details of three referees to the contact supervisor (Nick Dulvy: nkd3@sfu.ca with the subject heading "PhD competition A") before January 31st 2009. An understanding of life history evolution, parent-offspring conflict, brain size evolution, phylogenetic reconstruction, comparative analysis and laboratory experience is desirable, but not required. Ideal candidates should have good organizational skills and be comfortable working autonomously as needed. Financial support will be \$20,000 per year. International students considering graduate studies at Simon Fraser University should obtain current immigration requirements from a Canadian Embassy or consulate.

1. NK Dulvy, JD Reynolds (1997). Evolutionary transitions among egg-laying, live-bearing and maternal inputs in sharks and rays. *Proceedings of the Royal Society of London, B* **264**, 1309.
2. MG Elliot, B Crespi (2008). Placental invasiveness and brain-body allometry in eutherian mammals. *Journal of Evolutionary Biology* **21**, 1763
3. KE Yopak, TJ Lisney, SP Collin, JC Montgomery (2007). Variation in brain organization and cerebellar foliation in chondrichthyans: Sharks and holocephalans. *Brain Behavior and Evolution* **69**, 280.

Life histories, demography and extinction risk in sharks and rays

PhD project available at Simon Fraser University, Vancouver; starting 2009

Sharks and rays are among the most threatened vertebrates because they have slow life histories^{1,2} and they are subject to high mortality due to unregulated bycatch in trawl and longline fisheries^{3,4}. The aim of this project is to use the available existing knowledge to develop predictive models of extinction risk grounded in life histories and demography.

This funded PhD project will provide the student with broad training in phylogenetic comparative analysis and statistical modeling of large complex datasets. The student will be expected to collaborate with and work alongside other students and will gain a wider training in the links among life histories, population dynamics and conservation biology of fishes. The student will be based at the vibrant and expanding Earth to Ocean research group at the Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, BC Canada.

To apply for this project please send a CV, a 1-page research proposal (including context, hypotheses and approach) and a cover letter with details of three referees to the contact supervisor (Nick Dulvy: nkd3@sfu.ca with the subject heading "PhD competition B") before January 31st 2009. It is strongly encouraged that the candidate read the references provided below prior to building the conceptual framework of their own proposal. An understanding of life histories, population dynamics and willingness to learn programming and statistical modeling is desirable, but not required. Ideal candidates should have good organizational skills and be comfortable working autonomously as needed. Financial support will be \$20,000 per year. International students considering graduate studies at Simon Fraser University should obtain current immigration requirements from a Canadian Embassy or consulate.

1. MG Frisk, TJ Miller, MJ Fogarty (2001). Estimation of biological parameters in elasmobranch fishes: a comparative life history study. *Canadian Journal of Fisheries and Aquatic Sciences* **58**, 969.
2. MK McAllister, EK Pikitch, EA Babcock (2001). Using demographic methods to construct Bayesian priors for the intrinsic rate of increase in the Schaefer model and implications for stock rebuilding. *Canadian Journal of Fisheries and Aquatic Sciences* **58**, 1871.
3. JK Baum, RA Myers, DG Kehler, B Worm, SJ Harley, PA Doherty (2003). Collapse and conservation of shark populations in the northwest Atlantic. *Science* **299**, 389.
4. SC Clarke, MK McAllister, EJ Milner-Gulland, GP Kirkwood, CGJ Michielsens, DJ Agnew, EK Pikitch, H Nakano, MS Shivji (2006). Global estimates of shark catches using trade records from commercial markets. *Ecology Letters* **9**, 1115.