C4b: Research Methods in Natural Sciences

Instructors: Abi Tamim Vanak, Priyadarsanan, Priyanka Jamwal, Shrinivas Badiger, Soubadra Devy, Siddappa Setty, T. Ganesh, N. A. Aravind

Credit hours – 1.5
Course structure: Lectures on theoretical concepts – 1 month
Field course: 10 days
Number of credits: 1.5
Semester 2: January to May 2014

Course description

This course is intended to familiarise students with the basic methods commonly employed by natural scientists. The course will begin with lectures on the theoretical concepts underpinning each type of monitoring, when to use what, sampling designs, etc. and will include a 10 day field component. We will expect students to choose 1 topic on which to write a term paper and present their findings with a clear hypothesis, rationale, sampling design, methodology, analysis, results and conclusion.

The following topics will be covered during the course.
1) Population/biodiversity inventory
2) Population monitoring (long-term)
3) Ecological/behavioural monitoring
4) Sample collection
5) Biomonitoring (aquatic systems)

Course outline

Introduction: Doing ecology in field: some issues and constraints

   a. Theoretical lectures on methodology and sampling design, types of sampling designs, when to use what? Rapid surveys vs. long-term studies etc.
   b. Framing ecological questions, hypothesis and objectives, ecological experiments

Population/Biodiversity Inventory sampling

Plant sampling - Siddappa
Field: Transect and quadrat sampling methods and Non-quadrat sampling methods

Vertebrate sampling: Abi, Aravind, Soubadra
Lecture: Species-area curves, rarity, sign decomposition, presence/absence vs. presence only.

Field: Live trapping, sign surveys, camera trapping

Invertebrate sampling - Priyan, Aravind
Lecture 1. Organisation and importance of insect diversity,
Lecture 2.coevolution of insects and angiosperms
Field: Pitfall, bait trap, Maltese trap, Yellow pan tray, Sweep net, etc

Population Monitoring sampling

Plant sampling – Siddappa, Soubadra
Field: Quadrats, Permanent plots, Tree growth

Vertebrate sampling – Abi, Aravind
Lecture 1: Occupancy, sightability, probability of detection, imperfect detection
Lecture 2: Assumptions of distance sampling, assumptions of capture/recapture, types of capture/recapture

Distance sampling, Capture/recapture, Occupancy

Invertebrate sampling Aravind, Priyan
Belt Transects Pitfall, bait trap, Maltese trap, Yellow pan tray
  A) Butterfly:
          a. Line transects- Principles and methods
  B) Molluscs (Land and freshwater):
          a. Quadrat sampling- Principles and methods
          b. Dredging
          c. Dragnet
          d. Scooping
          e. Soil sampling
  C) Other economically important invertebrates (other than insects):
          a. Stone wash
          b. Kick-net
          c. Soil sampling

Ecological/behavioural methods

Observational studies, behavioural methods, Animal capture and handling, radio-telemetry – Abi, Aravind

Interaction studies: Pollination, dispersal, herbivory: Soubadra, T. Ganesh, Priyan
Design of experiments, sampling/counting flowers, nectar, herbivory, fruits etc

Lecture: 1. Concepts of pollination ecology
Lecture 2. Theories of herbivory
lecture 3. frugivory and Dispersal ecology

Field components: Design of experiments,
Demo of pollination exps (self /cross), anthesis and floral structure (floral biology), measurements of rewards(pollen and nectar quantification) visitation (discerning pollinators from robbers), pollen load quantification of floral resources

Measuring phenology for pollination, dispersal and herbivory,

Dispersal: fruit / seed traits, quantification of dispersal assemblages, measuring dispersal rates, seed shadow quantification**.**

Herbivory: measuring leaf area, quantification of herbivory, types of herbivory, levels of herbivory, insect herbivores

Protocols for field collection and preservation. Abi, Ravikanth, Priyan, Aravind.
Collection, preservation and storage (Dry and wet storage). Ethics of animal collection. Herbarium, insects, scats, genetic materials

Biomonitoring protocols for aquatic systems (Aravind, Srini, Priyanka)
Hydrologic and Environmental sampling (Priyanka Jamwal and Shrinivas Badiger): The goal of this module is to gain field understanding of the linkages between physical, chemical and biological (PCB) aquatic processes covered in the environmental science (C1B) course. We will revisit the concepts of measurement and field methods to determine PCB characteristics of water, and compare them against permissible standards set for different water uses. These field methods include measurement of discharge (quantity) in natural streams using various methods (float, current meter), and water quality sampling to estimate the contaminant load in natural streams. Parameters related to soil such as soil carbon, bulk density, soil moisture and those related to water quality such as dissolved oxygen, organic carbon, nitrates, total nitrogen, pH, conductivity in water sample will be measured/estimated. Water quantity and quality sampling will be used as a surrogate indicator to identify the sources of contamination and the characteristics of the ecosystem. This data would then be correlated to the stream ecology covered in other module so fthis course for determining the stream biodiversity

   c. *Field projects*

Various methods in sampling following organisms
Mammals
Birds
Butterflies
Reptiles and amphibians
Molluscs

A properly designed ecology project will be made that asks questions in evolutionary, population, community and ecosystem ecology.
After a brief demo of the sampling protocols the students will come up with project ideas with the guidance of instructors keeping in view that similar projects may be done by students of subsequent batches.

Basic Reading
a. Ecological Methodology 2013 – available for download: Charles Krebs -
http://www.zoology.ubc.ca/~krebs/books.html
b. Ecological Census Technique: William Sutherland
c. Measuring ecological diversity. Anne Magguran

Attendance 10%
Field + ppt 50%
Assignment (1) 40%

Session-wise time-table (Tuesdays – 10:00 -10:50am)

DATE	Day	Sessions	Instructors
07-01-2014	Tuesday	Introduction: Doing field ecology	T Ganesh
14-01-2014	Tuesday	Protocols for field collection and preservation	Aravind/Ravikanth
21-01-2014	Tuesday	Vertebrate sampling	Abi
28-01-2014	Tuesday	Vertebrate sampling	Abi
04-02-2014	Tuesday	Plant sampling	Siddappa
11-02-2014	Tuesday	Invertebrate Sampling	Priyan
18-02-2014	Tuesday	Invertebrate Sampling	Priyan
24-02-2014		Field visit for NS methods course **(C4b)**	
25-02-2014			
26-02-2014			
27-02-2014			
28-02-2014			
04-03-2014	Tuesday	Vertebrate Monitoring	Abi
11-03-2014	Tuesday	Ecological and behavioral studies (Radio Telemetry)	T Ganesh/Abi
18-03-2014	Tuesday	Invertebrate Monitoring	Aravind
25-03-2014	Tuesday	Interaction (Pollination)	Soubadra/Priyan
01-04-2014	Tuesday	Interaction (Dispersal)	T Ganesh
08-04-2014	Tuesday	Bio-monitoring Aquatic systems	Aravind
15-04-2014	Tuesday	Bio-monitoring Aquatic systems	Srini
22-04-2014	Tuesday	Bio-monitoring Aquatic systems	Priyanka
29-04-2014	Tuesday	Final PPT	