Long-term wildlife monitoring: ecological and statistical considerations

13-18 November, LaCONES-CCMB, Hyderabad

Workshop Goals: This workshop will address the essential components of an effective, long-term monitoring program, emphasizing design and analysis components, and with a focus on wildlife populations.

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Introduction: Ecological systems are defined by intricate spatial and temporal dynamics that drive multiple, complex, interactions. Such dynamics and interactions are not easily identified or explained in a "snapshot" of time (i.e., a short-term study). Effective management requires knowledge that encompasses the spatial and temporal scale at which interactions occur, which is often long-term. A long-term perspective allows an empirical examination of biological populations and of ecological processes that enables an evaluation ofstatus and the identification of pattern. Effective management also requires an understanding of the uncertainty associated with current knowledge, and periodic updates of objectives and management actions, as outcomes are identified and uncertainties are clarified.

Although long-term ecological monitoring programs are designed to inform policy and decision making processes and thus enable effective natural resource management, large numbers of long-term monitoring studies fail due to poorly defined objectives, inadequate designs, and inadequate data analyses. These failures result in massive losses of time, effort, and money. Therefore, establishing a cost-effective monitoring program, that can assess whether management objectives are being attained, is essential.

Workshop Topics:

Background: Long-term wildlife monitoring and the need for it:
Why monitor? Who is doing it? (examples from elsewhere)

General Principles of Monitoring Programs:
Monitoring programs must be efficiently administered, adequately funded, supported by the stakeholders of the monitoring program, have effective data management procedures and regular reporting schedules. Monitoring programs are best begun with well thought out questions about

the system so that the design of the program (location, methods and data collection) can be appropriate to achieving credible answers to those questions.

Essential analytical components for environmental monitoring programs:
Outlined below, and including statistical methods to assess status and trend in biological populations.

1) Specify objectives in terms of measurable attributes
2) Identify the monitoring state variables (e.g., indicators) and why they were selected
3) State the spatial and temporal domain of the population of interest (i.e., the sample frame)
4) State the type of change to detect
5) Specify the magnitude of change to detect (effect size; essential for sample design decisions)
6) Following (5), specify desired precision for the trend estimate (requires pilot data and a components of variance analysis)
7) Generate estimates of uncertainty
8) Specify 'trigger point' (thresholds) that will lead to a management response
9) Specify the management action that will occur
10) Determine (monitor) the effects of the management actions
11) Update design as needed (adaptive monitoring)

Statistical Issues:
All of the above steps are important but program components cannot compensate for inadequate attention to design and analytical issues. Therefore, our workshop will emphasize sampling design decisions such as sample size, spatial allocation of sampling units, sampling frequency, effect sizes, and statistical precision. These sampling design components are all ultimately related to the concept of "statistical power"—the probability of detecting significant ecological changes when they occur. Monitoring data are typically collected at multiple times and locations. Therefore, we will explore "state-of-the-art" statistical methods for assessing temporal and spatial trends in status of biological populations.

Specifics:
Workshop Format:
The workshop format will be a combination of interactive lectures (to develop the background and theory of the key concepts) and laboratory exercises focused on data analysis and statistical methods, and field methods. In lab computer applications will use the R programming language (R scripts will be written by the instructors).

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Participant's Background:
Individuals interested in the workshop should have advanced training in ecology, including a background in quantitative thinking and statistical methods.