EVOLUTIONARY CONCEPTS

Atul Bhargava

Department of Botany
Mahatma Gandhi Central University
Motihari-845401, Bihar
INDIA

Programme: M.Sc.- Botany
Course: Systematics and Evolution (BOTY 4202)

- **Evolutionary ecology: field that examines how interactions take place between and within species.**

- **Delves into the evolutionary perspectives of mutualistic organisms, competitors, predators, prey and pathogens.**

- **Subfields**
  - **life history evolution,**
  - **sociobiology,**
  - **evolution of inter and intra specific relationships, and**
  - **evolution of biodiversity, life forms and communities.**

Evolutionary ecology primarily concentrates on the following:

[I] How interactions (both among species and between species and their physical environment) shape the development of species through selection and adaptation.

[II] Aftermaths of the resulting evolutionary change.

Evolutionary ecologists

[I] Charles Darwin (1809–1882)

- English naturalist, geologist and biologist.
- Published his theory of evolution in his 1859 book *On the Origin of Species*.
- Theory of natural selection and population dynamics discusses how population of a species change over time.
- Darwin speculated that evolution must be gradual, with no major breaks or discontinuities.
- Finally, he reasoned that the mechanism of evolution was natural selection.

[II] George Evelyn Hutchinson (1903–1991)

- British ecologist.
- Father of Modern Ecology.
- One of the first scientists to combine ecology and mathematics.
- According to Hutchinson, he constructed "mathematical models of populations, the changing proportions of individuals of various ages, birthrate, the ecological niche, and population interaction in this technical introduction to population ecology.

[III] Robert MacArthur (1930–1972)

- Highly influential, Canadian-born American ecologist.
- Played an important role in the development of ‘niche partitioning’ and ‘community stability’.
- Stated that ecosystem stability increased when the number of interactions (complexity) between the different species within the ecosystem increased.
- Along with E.O. Wilson co-authored *The Theory of Island Biogeography* (1967).
- Best known in the field of Evolutionary Ecology for his work *The Theory of Island Biogeography*.

[IV] Eric Pianka (1939–Present)

- American herpetologist & evolutionary ecologist.
- Research contributions:
  - foraging strategies
  - reproductive tactics
  - competition and niche theory
  - community structure and organization
  - species diversity
- Known for his interest in lizards to study ecological occurrences.
- Claimed they were “often abundant, making them relatively easy to locate, observe, and capture.
- Published- *Lizards: Windows to the Evolution of Diversity.*

[V] Michael Rosenzweig (1941–Present)

- Professor of Ecology and Evolutionary biology at the University of Arizona.
- Popularized the concept of *'Reconciliation ecology'*.
- This concept began with his theory that "designated nature preserves would not be enough land to conserve the biodiversity of Earth, as humans have used so much land that they have negatively impacted biogeochemical cycles and had other ecological impacts that have negatively affected species compositions".

Common Terms Associated with Evolutionary Ecology

[A] Physiological ecology

- Briefs on how organisms survive in environments.
- There is often an emphasis on harsh conditions, for example extremely cold or very hot environments, or aquatic environments having high salt concentrations.
- Examples:
  - How do some animals thrive in the dry environments, where temperatures are generally high and freestanding water is seldom available?
  - How do bacteria survive in hot springs, such as those in Yellowstone National Park (USA) or Manikaran (India) where conditions are detrimental to most species?

[B] Behavioral ecology

- Examines the ecological factors responsible for behavioral adaptations.
- Considers how individuals find their food and keep away from their enemies.
- Example, why do some life forms migrate from one place to another while others are do not?
- Why do some animals, such as lions, exhibit social behaviour. Live and hunt in groups, while others like tigers are largely solitary and hunt alone?

[C] Population ecology (PE) or autecology

- Examines single species.
- Examines why some species are rare while others are abundant.
- PE shares an indefinite boundary with *community ecology*.
- Species abundances vary both from year to year and across the species' geographic range.
- PE facilitates in finding out
  - What causes abundances to fluctuate?
  - Why do numbers of some species changes 3-4fold over decades, while of some groups like insects, vary 10-100fold from one year to other?
  - What limits abundance, for, without limits, species numbers would grow exponentially.

[D] Biogeography

- Study of the geographical distribution of organisms.
- Some life forms have tiny geographical ranges of a few square kilometers, while others have ranges covering a continent.
- Some species have more-or-less fixed geographical ranges, while others fluctuate.
- Biogeography also considers the range of many species, and raises fundamental questions on why species with small geographic ranges are often found in specific habitats housing many such species, rather being scattered randomly.

[E] Community Ecology (CE) or Synecology

- Considers the ecology of communities i.e. a set of species found in a particular place.
- Because the complete set of species for a particular place is usually not known, CE focuses on subsets of life forms like plant communities or insect communities.
- A fundamental question deals with the size of the ‘set of species’.
  - Why more species are present in vast tracts than smaller ones, more on continents than on islands, and more in the tropical zone than in the Arctic zone.
  - Why ecological factors cause the diversity of species to vary.
  - Why the presence of a predator may sometimes increase the number of species present in a community?

Thank you