Ecological Connectivity

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What is connectivity?

- Sheaves (2009) calls for connectivity as an object of study
- “...physical or ecological events that allow materials or organisms to move between or influence habitats, populations or assemblages that are intermittently isolated in space or time.” (Sheaves 2009)
  - Multiple mechanisms
  - Multiple manifestations of connectivity
  - Various spatial scales
  - Various temporal scale
  - Effects range from individual to population scale
- Invokes elements of Theory of Island Biogeography and Meta-population dynamics, but also short-term movements (“within patch”) and food web dynamics
- Is this a useful definition?
Movement & Migration

- Small-scale-daily or seasonal movements among adjacent habitats
- Life-history connectivity: animals require multiple, ecologically distinct, connected habitats to complete life-cycle.
- Population analogue: nursery role hypothesis (Beck et al. 2001)
- Population level: species-level dynamics are influenced by migration and dispersal among multiple, connected habitats (coastal fish species; Secor’s work)
Fig. 1. *Lutjanus argentimaculatus*. Life-history migration of the mangrove jack, illustrating the hierarchy of migrations at a variety of scales that connect a variety of habitats in complex ways to produce a ‘connectivity-fractal’
Must these scales of connectivity match scales of habitat size, disturbance?
Connectivity & Trophic Function

- Nutrient and material transport (recall Ward and Stanford)
  - Nutrient export and exchange
  - Nutrient sinks (retention)
  - Can be related to physical mechanisms (river inputs, aeolian delivery) or biological mechanisms (movement)
- Can subsidize adjacent habitats, ecosystems
- Ecosystem stability?
Multi-habitat support of a fish larvae, illustrated by rock bass, Ambloplites rupestris. Allocations from the various habitats are the mean percent contribution to fish species somatic growth from various habitats based on OM source origin (Hoffman et al. in review).
Predatory-Prey Dynamics

- Typical predator-prey model are generally not spatially-explicit, yet neither predator nor prey are distributed evenly in space.
- Can re-conceive in space (i.e., foraging-arena theory), i.e., “predator-pit” hypothesis.
- Just another mortality term?
Connectivity in Conservation

- Clear links between connectivity and ecosystem health...but how conserve?
- What are we trying to conserve? A space? A process? A species? A community?
- Goal: integrate connectivity processes that maintain biodiversity, ecological productivity, habitats for more efficient and effective conservation actions
- THE goal for the next century?
Classification

Fig. 1. Classification of processes connecting environmental realms, (a) narrow interfaces where two realms have short, (b) broad interfaces where the boundary between two realms have wider spatial separation, (c) constrained connections where the path between two endpoints is defined by relatively narrow connecting features, and (d) diffuse connections where the path between two endpoints is unknown.
Planning

Fig. 2. Planning on narrow interfaces, (a) the interface is included incidentally when planning occurs across the entire planning region; (b) the interface is represented as a distinctive linear feature; (c) a buffer on either side of the interface is composed of specifically configured planning units (also compare Rouget et al., 2003); (d) data are stratified in higher resolution planning units around the interface. Thick dashed lines represent the location of the interface, the full line (b) represent the linear feature of the interface.