Why Habitat?

- Survey data provide pattern of distribution (eventually)
- Pattern ≠ process
- Habitat gets at process, which might then enhance prediction

Habitat as a Component of Each Break-out

- Habitat as a correlate of distribution, a predictor of distribution, a tool for survey design
- Habitat for predicting risk associated with bycatch
- Habitat to understand risk and effects of oil spills

Difficulty, complexity, time investment

- Proximate Objectives
  - determine distribution of birds at sea
  - determine habitat associated with this distribution
  - assess population trends
- Ultimate Goal
  - elucidate the mechanisms underlying distribution, abundance, and population trends
    - understanding biology, ecology, physiology, human activity
- Habitat needs to be understood in the context of individual-based ecological choices

Examining Habitat Use

- Habitat Used = Resource Selection
  - Entire field of study focused on resource selection functions (e.g. Manly et al. 2002)
- Assumption
  - not random
  - improve individual fitness
- Habitat selection →habitat management
  - Primarily terrestrial, closed aquatic systems

Resource Use

- Habitat analysis = resource use versus
  - available, not used
- Sampling Unit
  - Individual or population level
- Presence / absence, Abundance, Time spent

- Temporal boundaries for use (e.g. season)

- Is use detected with equal probability among categories?
- How are rare habitats handled?
- Is flying over a patch of ocean = use?

What is Available?

- How will availability be defined and measured
  - What is ‘available’ to a breeding pelican? A wintering frigatebird?
- All of these determine the assumptions within the analyses and THE SCOPE OF INFERENCE

Study Designs for Habitat Selection

- Classified based on two criteria
  - Scale of selection: individual or population
  - Definition and measure of use, nonuse, and availability

Four Designs for Habitat Selection

1. Animals studied at population level (no marked individuals), availability measured at population level (e.g. study area)

   Survey data

   Does not allow assessment of individual variation

   Efficient

   BIG PICTURE

Four Designs for Habitat Selection

2. Animals studied at individual level (marked individuals), availability measured at population level (study area)
3. Animals studied at individual level, availability measured at individual level (e.g. home range)
4. Animals studied at individual level, use and non-use measured for each individual

Location data

Allows assessment of individual variation

Time and resource intensive

DETAILS

Marine Habitat Use

- Does this work at sea?
  - 3D, highly variable in space and time, animals using spatial scales unheard of on land
- Can we measure the attributes being used or selected by seabirds?
- Can we manage these attributes, which is the typical approach in terrestrial systems?
- Are there external forces acting on these attributes that might be managed (surrogates)?

Seabird Habitat At Sea = Prey

- Bottom-up regulation
- Seabirds respond to prey, so prey dictates habitat selection
  - Unlike land animals where other behaviors can play a major role
- Prey concentrate over a variety of spatial and temporal scales
  - ephemeral
- What concentrates prey?

What Comprises Seabird Habitat

- Fixed
  - Physical seascape and landscape features
- Variable
  - Physical, biological, chemical oceanographic features
  - Climate (short-, meso-, and longterm cycles & shifts)
  - Predictability varies but can be high (scale issue) especially for certain physical features

Habitat Factors: Fixed in Space/Time

- Interactions with land features that concentrate prey, create benign environment
  - bays, capes, straits
- Interactions with marine features that concentrate prey
  - benthic features
- Interactions with anthropogenic features that concentrate prey
  - oil platforms, docks, artificial reefs

Habitat Factors: Variable in Space/Time

- Climate and weather
  - wind, air temperature, SST, El Nino
- Physical oceanographic features
  - horizontal: fronts, eddies, convergence zones
  - vertical : pycnocline, clarity, upwelling
  - 3D: surface feeding, plunge diving, pursuit divers
- Biological oceanographic features
  - *Sargassum* reefs

Ephemeral

- Prey
  - schooling prey
  - individual prey
- Human activity
  - attraction to fishing vessels
  - competition for prey
  - enhanced prey base
  - ‘predation’

The Role of Colony Location

- Seabirds are central place foragers
- Wide range in incubation shift lengths, but tend to be long
- Wide range in at-colony brood rearing, but tend to be long

- Colony location is a key determinant of accessible habitat during the breeding season

Southeastern Plan
Open Water Species: Habitat

- Shore to 20 km, supports breeding, nonbreeding, and transient species
- Oil & gas, fisheries, plastics, pollutants, water quality, wind turbines, competition for prey
- Recommended Actions
  - Water quality protection
  - Rapid response planning
  - Energy development planning
  - Gillnets and bycatch
  - Die offs

Southeastern Plan
Pelagic Species: Habitat

- > 20 km offshore, supports nonbreeding and transient species
- Oil spill, fisheries, plastics, pollutants, *Sargassum* harvest, competition for prey, lighted structures
- Recommended Actions
  - Bycatch & fisheries competition
  - *Sargassum* protection
  - Energy development planning
  - Rapid response plans
  - Die offs

Southeastern Plan
Open Water Species

- Immediate Management, Regional
  - Red-throated Loon
- Management Attention, Regional/Contin
  - Horned Grebe, Mag Frigatebird, Wh Pelican
- Management Action, Regional
  - Common Loon, Common Tern, Black Tern
- Planning & responsibility
  - DCCO, Bonaparte's Gull, Forster's Tern
- Grebes and coots also mentioned

Southeastern Plan
Pelagic Species

- Critical Recovery, Continental
  - Bermuda Petrel
- Immediate Action, Regional/Contin
  - Audubon's Shearwater
- Management Attention, Regional/Contin
  - Black-capped Petrel, Masked Booby, Brown Booby, Razorbill
  - Sooty Shearwater, Northern Gannet
- Management Action, Regional
- Planning & responsibility, Continental
  - Greater & Cory's Shearwater, Band-rumped Storm-petrel, Bridled Tern, Manx Shearwater, Sooty Tern, Brown Noddy
- Grebes and coots also mentioned