Structured Decision Making Examples: Large Scale

Harvest Management for Mid-Continent Mallards

U.S. Fish and Wildlife Service

Problem Statement

- Each year, federal hunting regulations are established for waterfowl in 4 administrative flyways in North America
- Want to provide sustainable harvesting opportunities for waterfowl hunters

What's at Stake?

- >50 million birds in spring
- 2 million hunters
- 13 million birds harvested/year
- $1.6 billion/yr economic output

Brief History of N.A. Duck Harvest Management

- Migratory Bird Treaty Act (1918): hunting permitted if compatible with population maintenance
- 1930-1960:
  - Commonsense management (restrictive regulations when populations were low)
  - Development of comprehensive monitoring programs

Brief History of N.A. Duck Harvest Management

- 1960-75:
  - Final development of monitoring programs
  - Mallard population model developed and used to guide hunting regulations
  - Controversy and politics
- 1975-85:
  - Development of alternative models
  - Uncertain harvest effects
  - Controversy remained

Adaptive Harvest Management (AHM) Working Group

- 1985-90:
  - FWS and CWS adopted a general policy of conservative regulatory response to uncertainty
  - Many stakeholders did not agree with this conservative approach
- 1992:
  - Fred Johnson convened an *ad hoc* group of federal and state biologists and managers to explore AHM concepts and develop an approach

Adoption of AHM, 1995

- 1994-95 waterfowl hunting season:
  - Political intervention bypassed Flyway Council system
  - Led to frustration with regulatory system and desire for a more objective approach
- 1995:
  - FWS group developed approach
  - Approach implemented for mid-continent mallards
  - Selective pressures:
    - uncertainty about effects of hunting
    - stakeholder dissatisfaction with political intervention
    - stakeholder desire for objectivity

Objective Function

- Maximize harvest over long term, giving equal value to harvested birds now and in future years
- Devalue harvest when predicted spring population size is below goal set by the North American Waterfowl Management Plan

Management Actions

- Actions are sets of hunting regulations defined by season length and daily bag limit:
  - Restrictive (short season, small daily bag)
  - Moderate (moderate season and daily bag)
  - Liberal (long season, large daily bag)

Mid-continent Mallard Regulations

		ATL	MIS	CEN	PAC
Hours		½ hour before sunrise – sunset			
Dates			Oct. 1 – Jan. 20		
Days	R	30	30	39	59
	M	40	40	51	79
	L	50	50	60	93
Basic bag	R	3	3	3	4
	M	4	4	4	5
	L	5	5	5	6

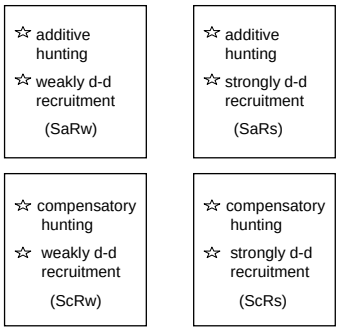
Management Actions

- Decision timing:
  - Annually, in summer, preceding the fall hunting season
  - Based on breeding ground surveys of ducks and ponds the previous spring

4 Population Models

- Life-cycle models with:
  - Reproductive rate determined by number of ponds, duck density
    - (1) Strongly density dependent (lower reproductive rate with more ducks)
    - (2) Weakly density dependent
  - Annual survival determined by harvest rate
    - (1) Compensatory mortality (minimal effect of harvest)
    - (2) Additive mortality (near maximal effect of harvest)

4 Population Models



Monitoring Programs

- North American waterfowl monitoring is the most comprehensive program for terrestrial wildlife populations in the world!
  - May breeding ground survey (abundance)
  - Banding program (survival and harvest rates)
  - Harvest survey (harvest and age ratio)
  - Ancillary surveys (winter survey, July breeding ground surveys)

Decision Step

- Decide (using optimization) which package of hunting regulations to implement, based on:
  - Objective function
  - Models
  - Current system state (estimated number of ponds and ducks the previous spring)

Adaptive Management: Outline of Iterative Process

- Iterative process
  - Observe state of system (pond and duck numbers)
  - Assess model performance
  - Derive and implement optimal management action based on:
    - Objective function
    - Available management actions
    - Model set
    - Past performance of the different models
    - Current state of system
  - Implement optimal management action

Learning

- Decision is made each summer, and each model makes a prediction about what the duck population will be the next spring
- May aerial survey provides an estimate of spring duck numbers
- Compare predictions with the estimate:
  - increase faith in models that predict well
  - decrease faith in models that predict poorly

Learning

- Since 1995, the 2 models with weakly density-dependent reproductive rates have been the better predictors
- Hence, these models are more important in the determination of annual hunting regulations

Double-Loop Learning

- In addition to the iterative regulations cycle (annual), it is possible to revisit start-up phase decisions periodically
- Waterfowl managers (federal, state, private) are now revisiting objectives and management actions
- For example, there is a desire to incorporate habitat management into management actions, treating hunting regulations and habitat within the same adaptive framework

AHM: Mid-Continent Mallards, 1995-2007

- Decisions have been transparent and optimal
- Approach has been well received and has survived politically and institutionally
- Structural/ecological uncertainty has been reduced
- Debate among stakeholders has appropriately moved from ecological uncertainty to discussion of appropriate objectives and actions
- Efforts to extend to other species and populations