Management procedure for determining appropriate limits to the bycatch of small cetaceans in the European Atlantic & North Sea

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Management Procedure

- Conservation context of SCANS-II project: bycatch
- Developed management procedures for determining appropriate limits to bycatch
- Explicitly stated and prioritised objectives
- Input data on population, output bycatch limit
- Based on realistic data requirements
- Include a feedback mechanism
- Incorporate uncertainty explicitly
- Rigorous testing to ensure robustness to uncertainty
Candidate Management Procedures

• Previous cetacean management procedures:
  1) Rule of thumb (e.g., 1% of population size)
  2) Potential Biological Removal (United States)
  3) Catch Limit Algorithm (International Whaling Commission)
Potential Biological Removal (PBR)

- Developed and used by U.S. government for managing marine mammal populations
  

- Input current minimum estimate of population size \((N_{\text{min}})\)

- Removal limit = \(N_{\text{min}} \times 0.5 \times R_{\text{max}} \times F\)

- \(R_{\text{max}}\) is assumed maximum population growth rate

- \(F\) used to tune the procedure to achieve objectives
Catch Limit Algorithm (CLA)

- Developed by International Whaling Commission for setting catch limits (Revised Management Procedure) 
  

- Input time-series of estimates of population size and catch

- Simple population model fit to these data to estimate current population size \( (N_T) \), current status \( (D_T) \) and maximum population growth rate \( (R_{\text{max}}) \)

- Removal limit = \( \alpha \times R_{\text{max}}(D_T - \beta) \times N_T \)

- \( \alpha \) and \( \beta \) can be used to tune the procedure to achieve objectives
Simulation Testing

• How to test performance of management procedures?
• Developed computer simulation model for testing
• Conducted simulation trials to judge performance under a wide range of uncertainties
• For example:
  1) population status
  2) life history
  3) stock structure
  4) historical bycatch
  5) environmental variability
Simulation Model

- Bycatch limit
- Implementation (error & bias)
- Realized bycatch
- Simulated population
- Survey (error & bias)
- Estimate of pop. size
- Management procedure

Adapted from Cooke 1999 ICES J. Mar. Sci. 56:797-810
PBR, initial population status = 20% carrying capacity (K)
Multiple Simulation Trials

Solid lines = median, dashed lines = 90% interval

Population size/K

0 0.2 0.4 0.6 0.8 1

Year

0 40 80 120 160 200

Bycatch limit/K

0 0.01 0.02 0.03 0.04 0.05
• CLA specifies protection period that speeds short-term recovery
• CLA specifies increase, then decrease in bycatch limits
PBR vs CLA - Survey Precision

- PBR: less precise surveys → lower bycatch limits (conservative)
• CLA also conservative with respect to survey precision
Performance Criteria

• Conservation criteria
  1) Final population size
  2) Minimum population size
  3) Recovery delay
  4) Protection level

• Other management criteria
  1) Total bycatch
  2) Variability in bycatch limits
Performance Criteria

• Criterion 1: long-term population status (200 years)
Performance Criteria

- Criterion 2: delay in recovery (years)
Tuning Management Procedures

• Choose specific objective for each criterion
  1) maintain / recover populations to ≥80% carrying capacity
  2) delay in recovery to 80% no longer than $x$ years or $y\%$
     …with 95% probability

• Choose worst-case scenario(s) for simulation
  1) maximum population growth rate - 4%
  2) survey bias - 50% overestimate
  3) bias in estimates of bycatch - 50% underestimate

• Run simulations adjusting values of tuning parameter(s) until objectives achieved
• 95% probability of:
  - long-term population size $\geq 80\%$ carrying capacity
  - recovery delay $< 100$ years
• 95% probability of:
  - population size ≥80% carrying capacity at 200 years
  - recovery delay < 75 years
Tuned Management Procedures (CLA 2)

- 95% probability of:
  - population size $\geq 80\%$ of carrying capacity during 200 years
  - recovery delay $< 50$ years
Implementation: Harbour porpoise

• Data for input to management procedures

1) Population size (SCANS I & II; 1994 & 2005)

2) Bycatch – observer programmes and fishing effort (e.g., UK, Denmark, Sweden)
   *e.g., Vinther and Larsen (2004) J. Cet. Res. Manage. 6:19-24*

3) Indices of population size
   *European Seabirds at Sea surveys (1980 – present)*
Implementation: Harbour porpoise

• Species-specific simulation trials

1) Mortality and birth rates – bycaught and stranded specimens (several countries)

2) Multiple stock structure and movement rates – genetics, tracking, etc.
Summary

- Developed management procedures to determine appropriate limits to bycatch of small cetaceans
- Developed flexible & comprehensive simulation model to test procedures
- Tuned procedures based on specific objectives and generic set of simulation trials
- Species-specific simulation trials (based on data) desirable before implementation
Acknowledgements

- Kelly MacLeod, Simon Northridge and SCANS-II investigators
- Mark Bravington, Russell Leaper, André Punt, and Paul Wade
- Researchers who contributed data on stranded and bycaught harbour porpoise including Graham Pierce and Jennifer Learmonth (University of Aberdeen, Scotland), Paul Jepson and Rob Deaville (Institute of Zoology, UK), Alfredo López and Rebeca Lago (Coordinadora para el Estudio dos Mamíferos Mariños, Galicia), Finn Larsen (Danish Institute for Fisheries Research) and Carl Kinze (Zoological Museum, University of Copenhagen, Denmark)
- Financial support provided by EU LIFE Nature project LIFE04 NAT/GB/000245.