Using GIS As A Management Tool for Coastal Ecosystems

Michelle Kinzel, William Megill, Deborah Randall
and Lei Lani Stelle
Coastal Ecosystems Research Foundation  www.cerf.bc.ca
INTRODUCTION
PURPOSE OF THE STUDY

• Determine habitat usage and occupancy patterns
• Estimate home range size
• Identify hot spots of habitat usage

• Long term monitoring of recovering endangered species and dynamic ecosystem community
• Correlate home range analysis with prey distribution and densities
• Establish recommendations for coastal development planning
Gray Whale Migration Route

- Northern Latitude
  - Feeding Grounds
  - Summer Occupancy
- Study Area
  - Vancouver Island
- Southern Latitude
  - Breeding Grounds
  - Winter Occupancy
GRAY WHALES SKIM MUD ON PRIMARY FEEDING GROUNDS
TOP CONSUMERS AND BIOTURBATORS
Alternate feeding grounds – Alternate feeding methods

- Artifact of recovery?
- Increased foraging pressures
- Alternate methods, alternate prey
- Unusual whale die off 1999
TERTIARY FEEDING GROUNDS: ROCKY BOTTOM
PRIMARY FEEDING MODE: ENGULFING
PRIMARY PREY: SWARMING MYSIDS
METHODS

• Behavioral Studies
• Underwater Sampling
• Computer Mapping (GIS)
 IMAGES AS SCIENTIFIC TOOLS

Tool for studying cetacean populations as a part of a sustainable marine ecosystem
Distinctive variations in appearance

Analogous to human fingerprints
Tools: Vessel, camera, film, data log, patience and skill
LONG TERM BEHAVIORAL MONITORING STUDIES
G 014 - BOOMERANG

1995

1996

1997

1998

1999

2000

2001
CETACEAN RESEARCH

Mark-Recapture
Population Size
Social Organization
Behavioral Studies

Demographics
Calving Rates
Survival Rates

ArcView Extensions: Animal Movement
Home Ranges
Migratory Movements
Site Fidelity
UNDERWATER SAMPLING

• Mysid Assemblages
• Mysid Densities
DATA ANALYSIS:
PHOTO IDENTIFICATION CATALOG
GEOREFERENCED LATITUDE/LONGITUDE DATA
GIS - ANIMAL MOVEMENT
RESULTS
Gray Whale Counts & Sighting Effort

Year

Number of Whales Identified


Observation effort (days)

Gray Whale Counts & Sighting Effort

 Identified whales

New whales

Sighting Effort

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

Identified whales

New whales

Sighting Effort
Residency Patterns 1996-1999

SUMMARY STATISTICS
48 Transients
23 Visitors
54 Residents

Days of occupancy
Animal Movement Extension
ArcView 3.x
Spatial Analyst

ArcView’s Animal Movement Extension: Home Range Analysis

95%, 75%, and 50% Utilization Distribution
Kernel Contours
G09 Home Range Estimate 1998

Study Area

Map Legend
Home Range Analysis - 1995, All Whale Sightings
Home Range Analysis - 1997, All Whale Sightings

The image shows a map with various whale sighting locations marked. The map includes locations such as Silvester Bay, Table Island, and Lucy Bay. The 1997 whale sightings are highlighted in the map view.

The software interface is ArcView GIS 3.3, indicating the tool used for this analysis. The scale of the map is 1:441,734.
Home Range Analysis - 1998, All Whale Sightings
Home Range Analysis - 1999, All Whale Sightings
Home Range Analysis - 2000, All Whale Sightings
Home Range Analysis - 2001, All Whale Sightings
Areas of Home Range Probability Contours

Core Area/Home Range %

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Core Area (50%)</th>
<th>Home Range (95%)</th>
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</thead>
<tbody>
<tr>
<td>1995</td>
<td>27</td>
<td>167</td>
</tr>
<tr>
<td>1996</td>
<td>26</td>
<td>389</td>
</tr>
<tr>
<td>1997</td>
<td>23</td>
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<td>2000</td>
<td>13</td>
<td>173</td>
</tr>
<tr>
<td>2001</td>
<td>20</td>
<td>113</td>
</tr>
</tbody>
</table>

Core Area/Home Range %

- 1995: 16.2%
- 1996: 6.6%
- 1997: 7.4%
- 1998: 18.9%
- 1999: 8.0%
- 2000: 7.6%
- 2001: 17.7%
ArcView’s Animal Movement Extension: Site Fidelity Analysis

All combined whale sightings for years 1995 - 2001 showed site fidelity with a $p > 99.0099$ that movement was more constrained than random movement patterns.
STATISTICAL SUMMARY

RESIDENCY/HABITAT USAGE
- Residents, transients and visitors variable by year
- Number of residents 9 – 27 per year

BEHAVIORAL STUDIES
- 77 - 86 % activity budget in feeding mode

COMPUTER MAPPING (GIS)
- Home Ranges: 113 – 650 km$^2$
- Core Areas: 13 – 55 km$^2$
- Critical Habitat: 7 – 19 % of home range
- Resident animals exhibit site fidelity

UNDERWATER SAMPLING
- 9 Key Species of Mysids
- Seasonal Variability in Abundance and Distribution
CONCLUSIONS

• Established community of returning resident gray whales
• Behavior changes with ecosystem dynamics; prey abundance and distribution
• Coastal regions important feeding grounds
• Whales exhibit site fidelity for every year from 1995-2001; indicating choice in habitat selection and usage
• Selective conservation efforts are recommended
Future Studies:

• Further use of GIS Tools such as Animal Movement and Spatial Analysis to answer scientific questions about selective habitat use by gray whales.
• Coastal Management based on assessments using these tools.
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www.cerf.bc.ca

The Society for Conservation GIS
www.scgis.org
Domestic Scholarship Award
2002, 2003 & 2005
ESRI Conference Fees & Training

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www.conservationgis.org

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