Using GIS As A Management Tool for Coastal Ecosystems

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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: ENGULGING

PRIMARY PREY: SWARMING MYSIDS

METHODS

- Behavioral Studies
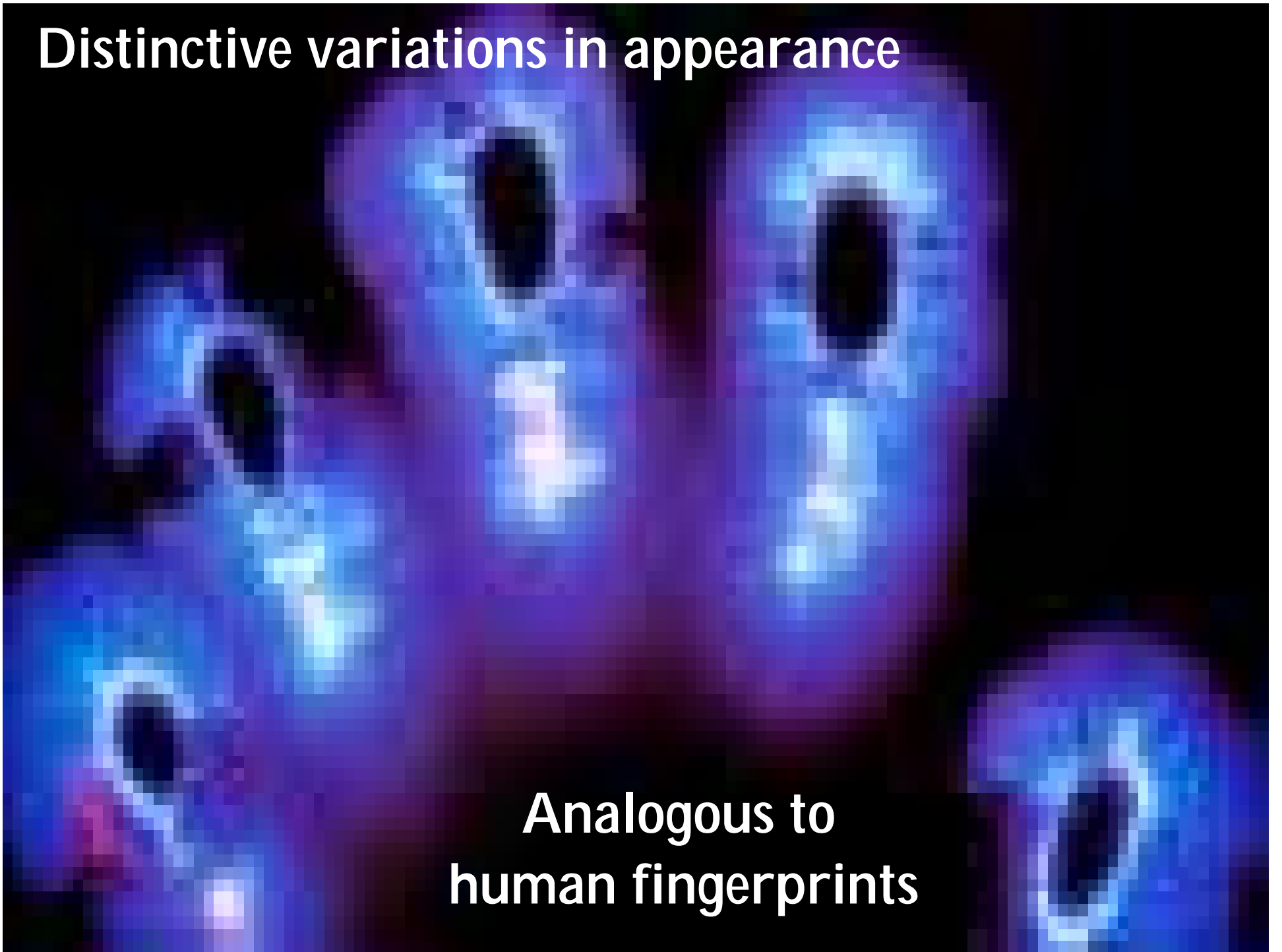- Underwater Sampling
- Computer Mapping (GIS)

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
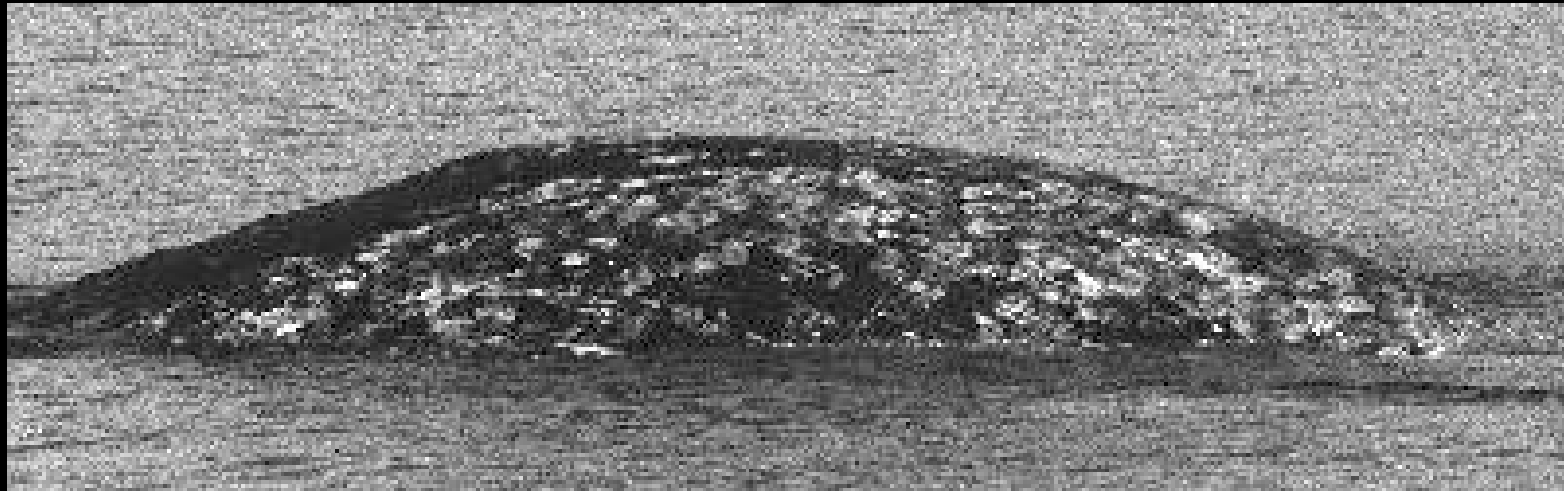Home Ranges
Migratory Movements
Site Fidelity

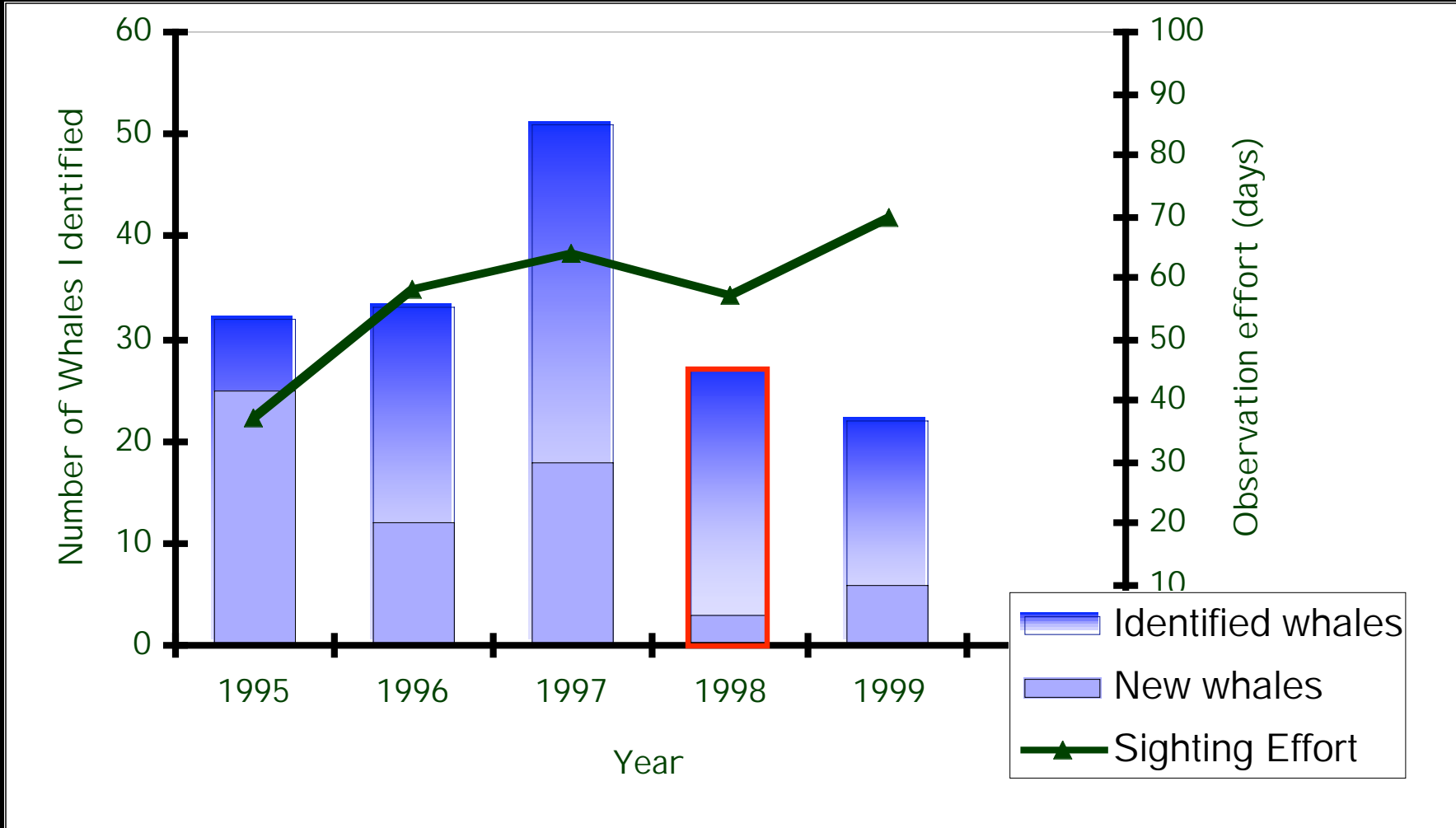# UNDERWATER SAMPLING
- •Mysid Assemblages
- •Mysid Densities

DATA ANAYLSIS:
PHOTO IDENTIFICATION CATALOG
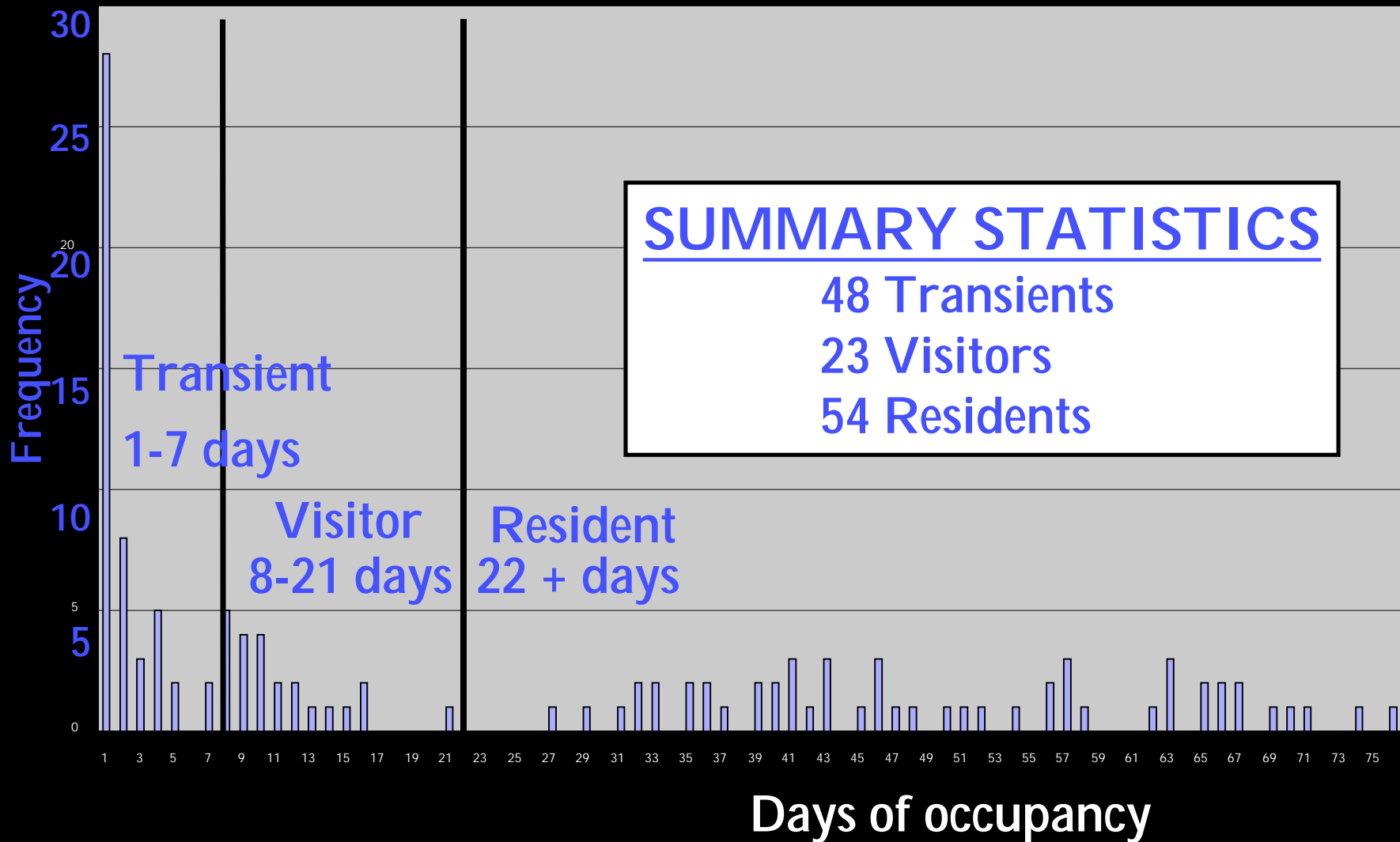## GEOREFERNCED LATITUDE/LONGITUDE DATA
GIS – ANIMAL MOVEMENT

RESULTS
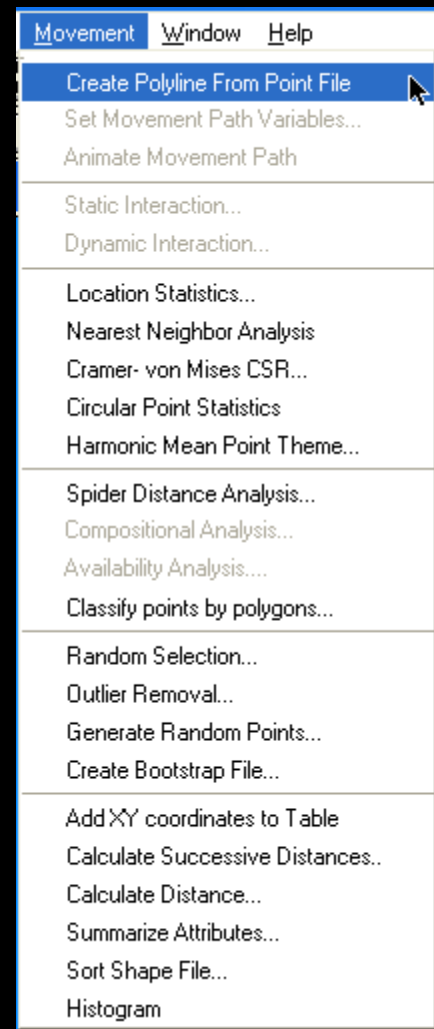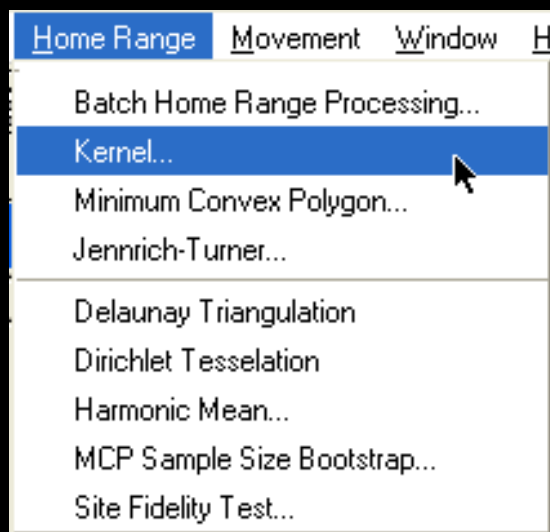
Gray Whale Counts & Sighting Effort

Residency Patterns 1996-1999

Frequency (y-axis): 30, 25, 20, 15, 10, 5, 0

Transient
1-7 days

Visitor
8-21 days

Resident
22 + days

SUMMARY STATISTICS
48 Transients
23 Visitors
54 Residents

Days of occupancy (x-axis): 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75
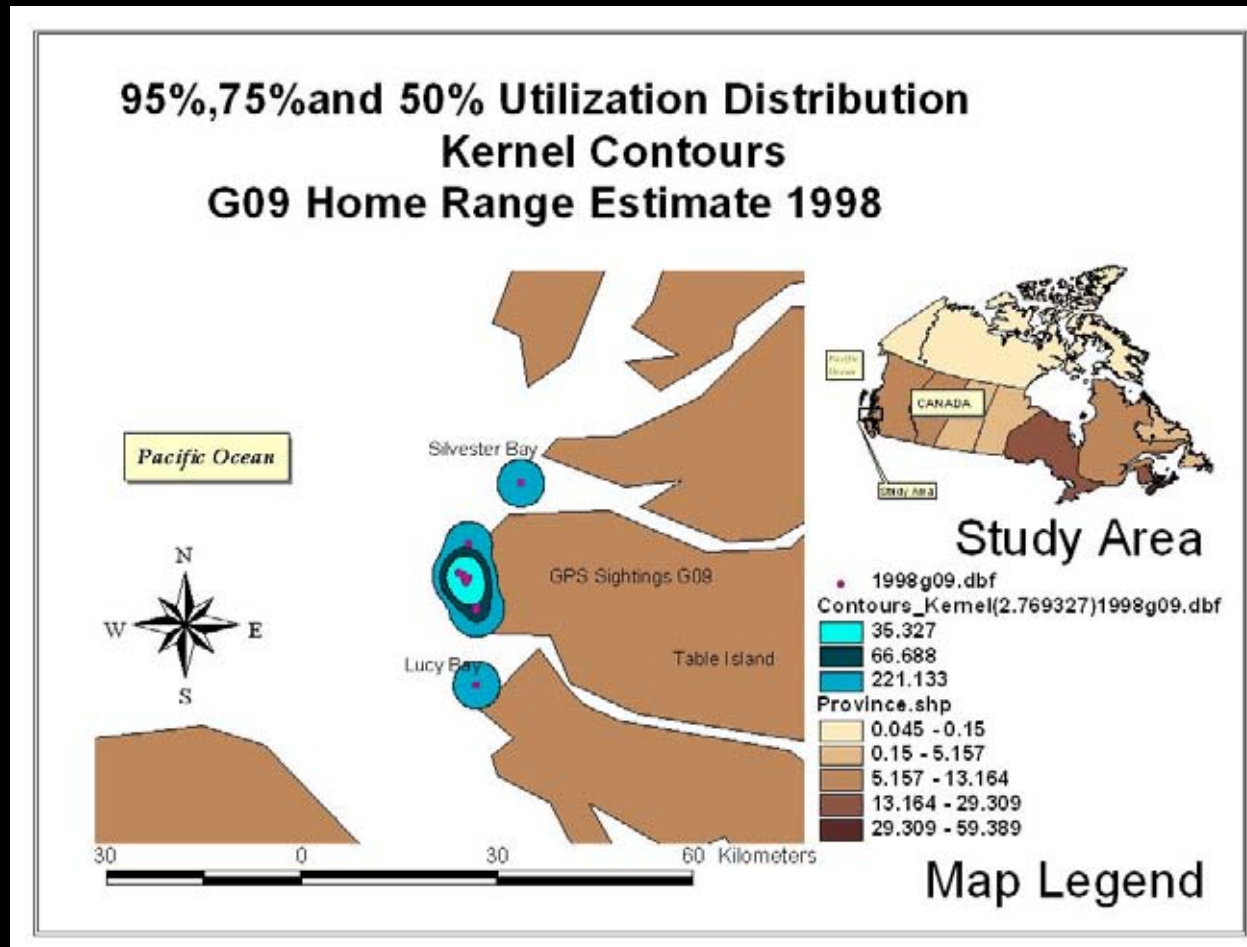
Animal Movement Extension
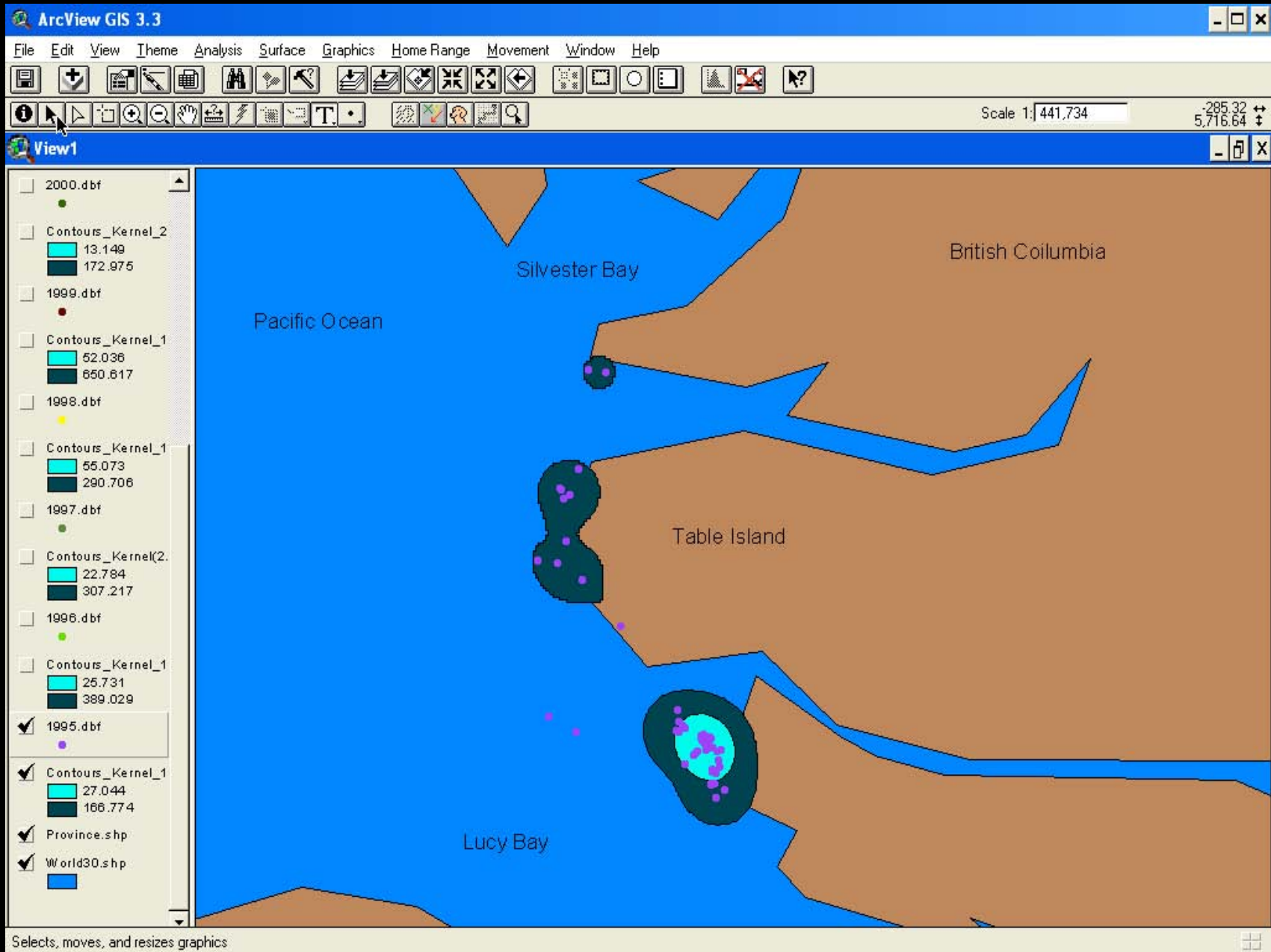# ArcView 3.x
Spatial Analyst

http://www.absc.usgs.gov/glba/gistools/animal_mvmt.htm
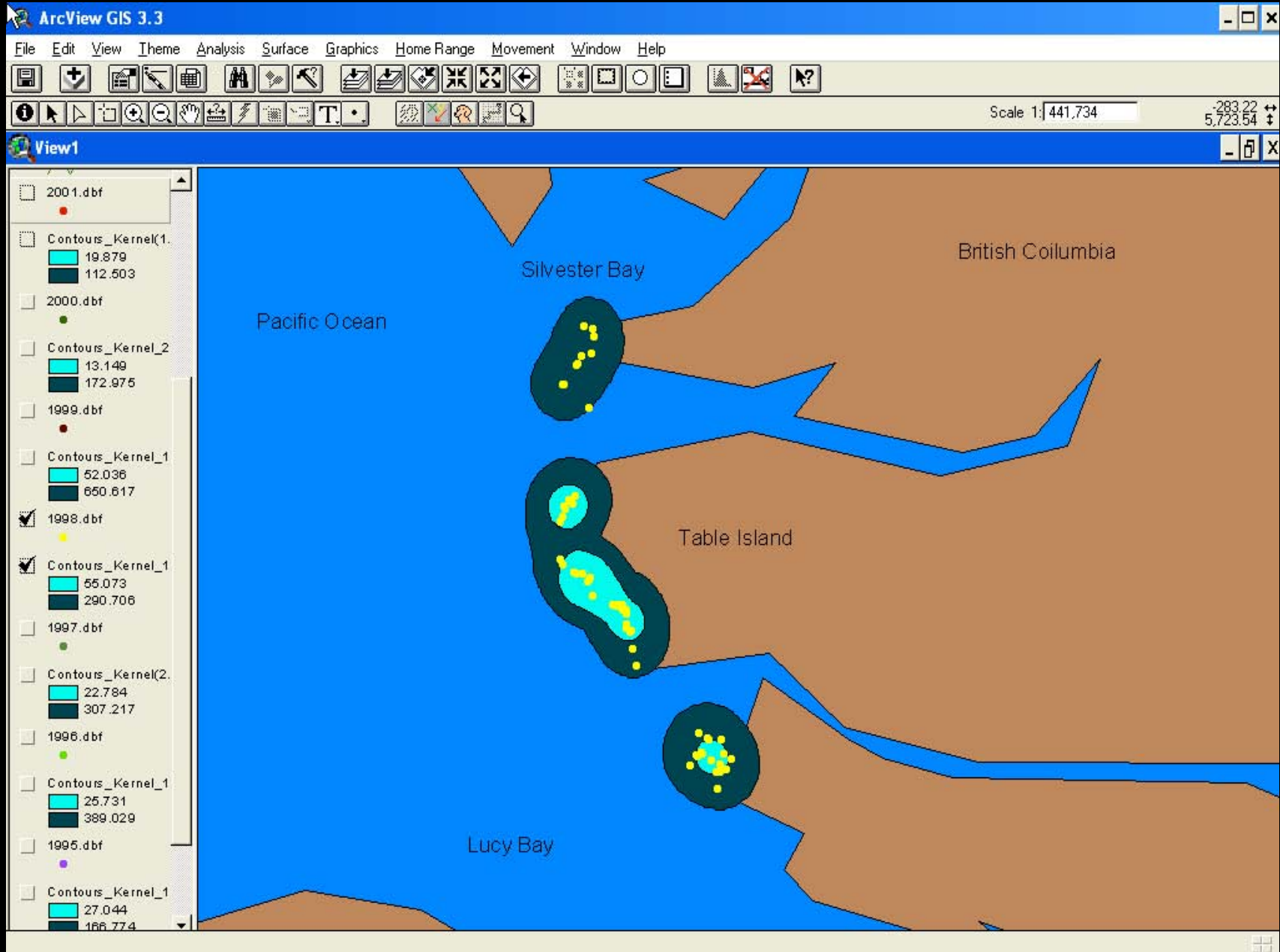
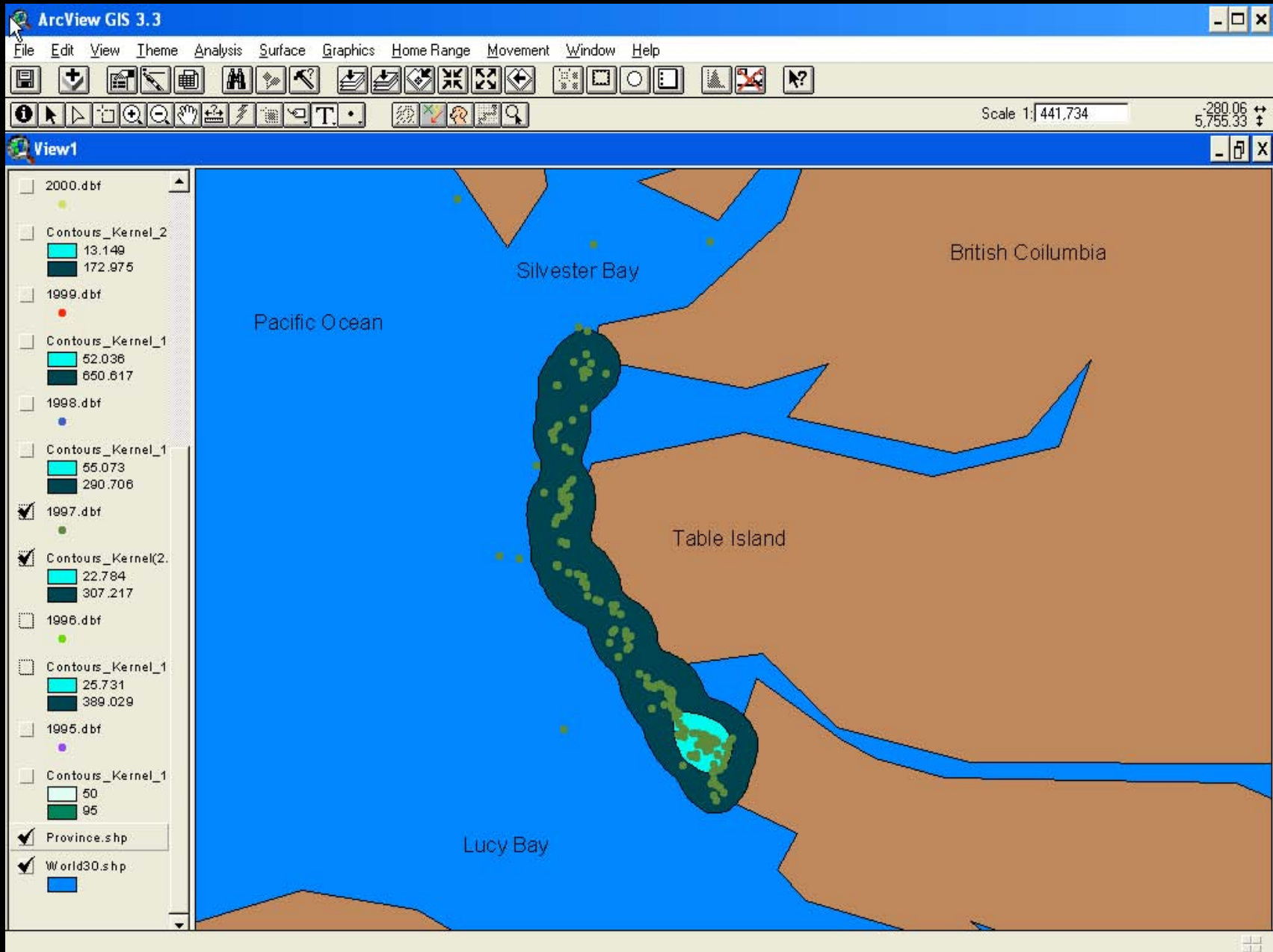# ArcView's Animal Movement Extension: Home Range Analysis

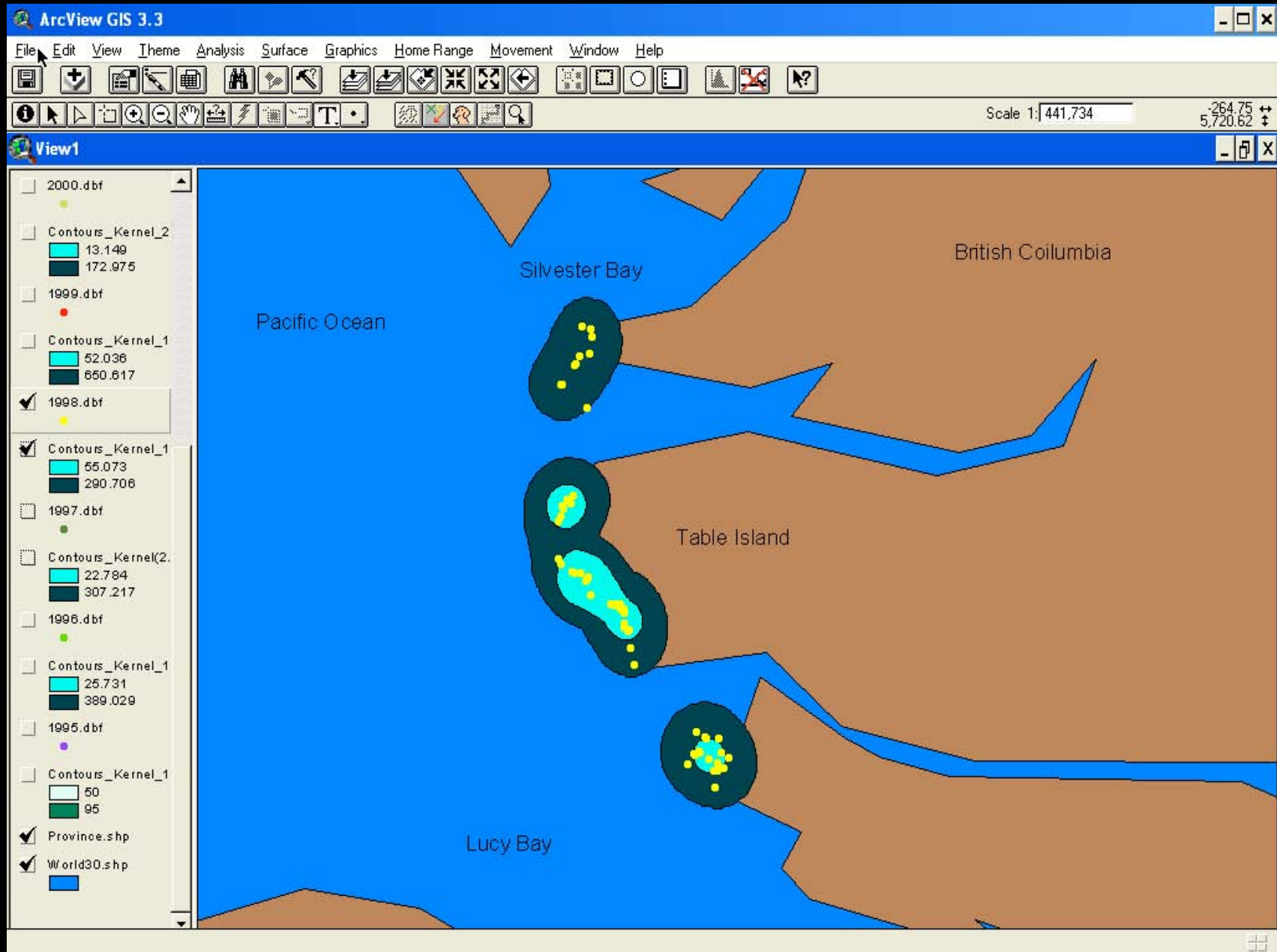# Home Range Analysis - 1995, All Whale Sightings
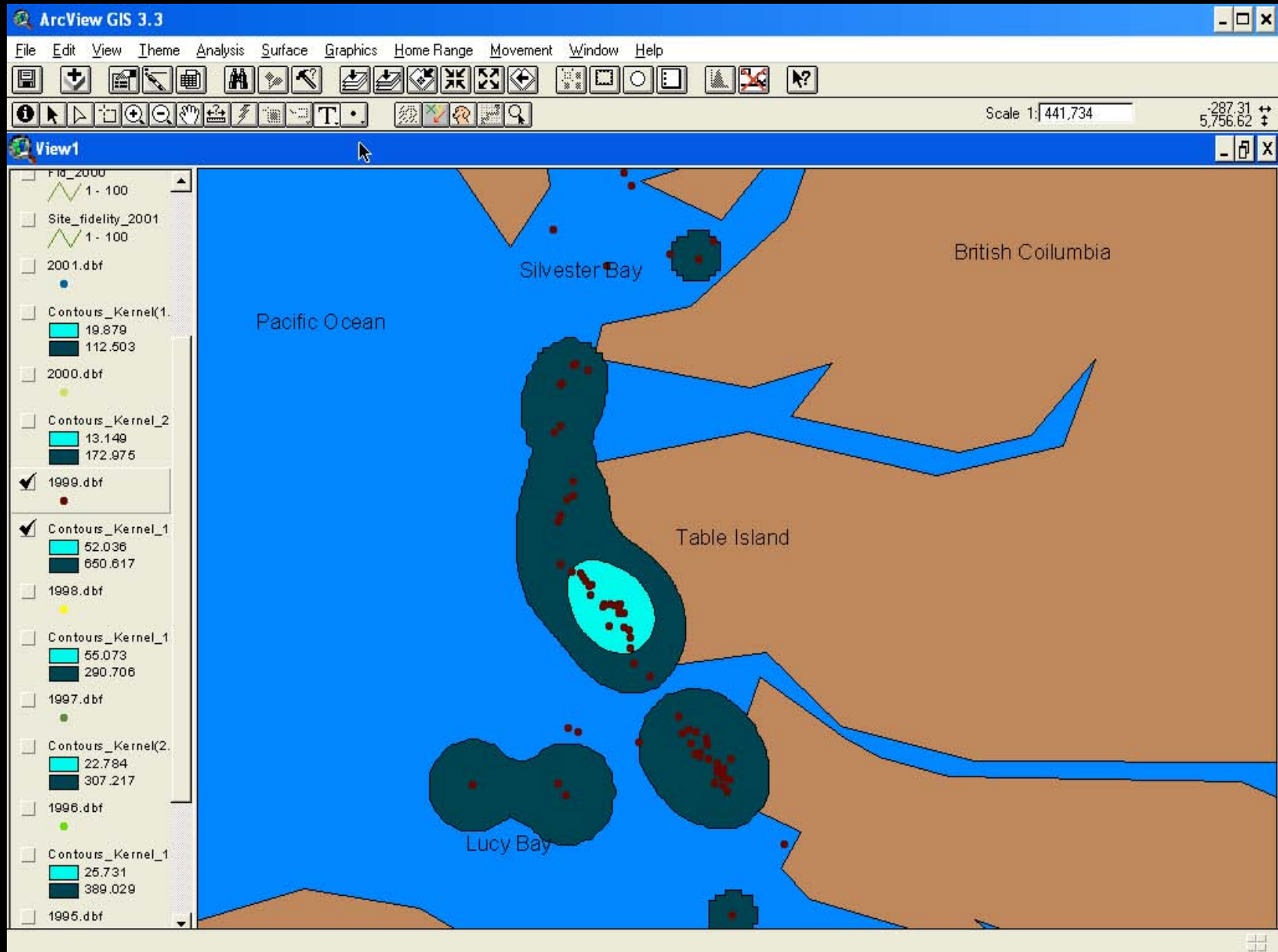
Home Range Analysis - 1996, All Whale Sightings

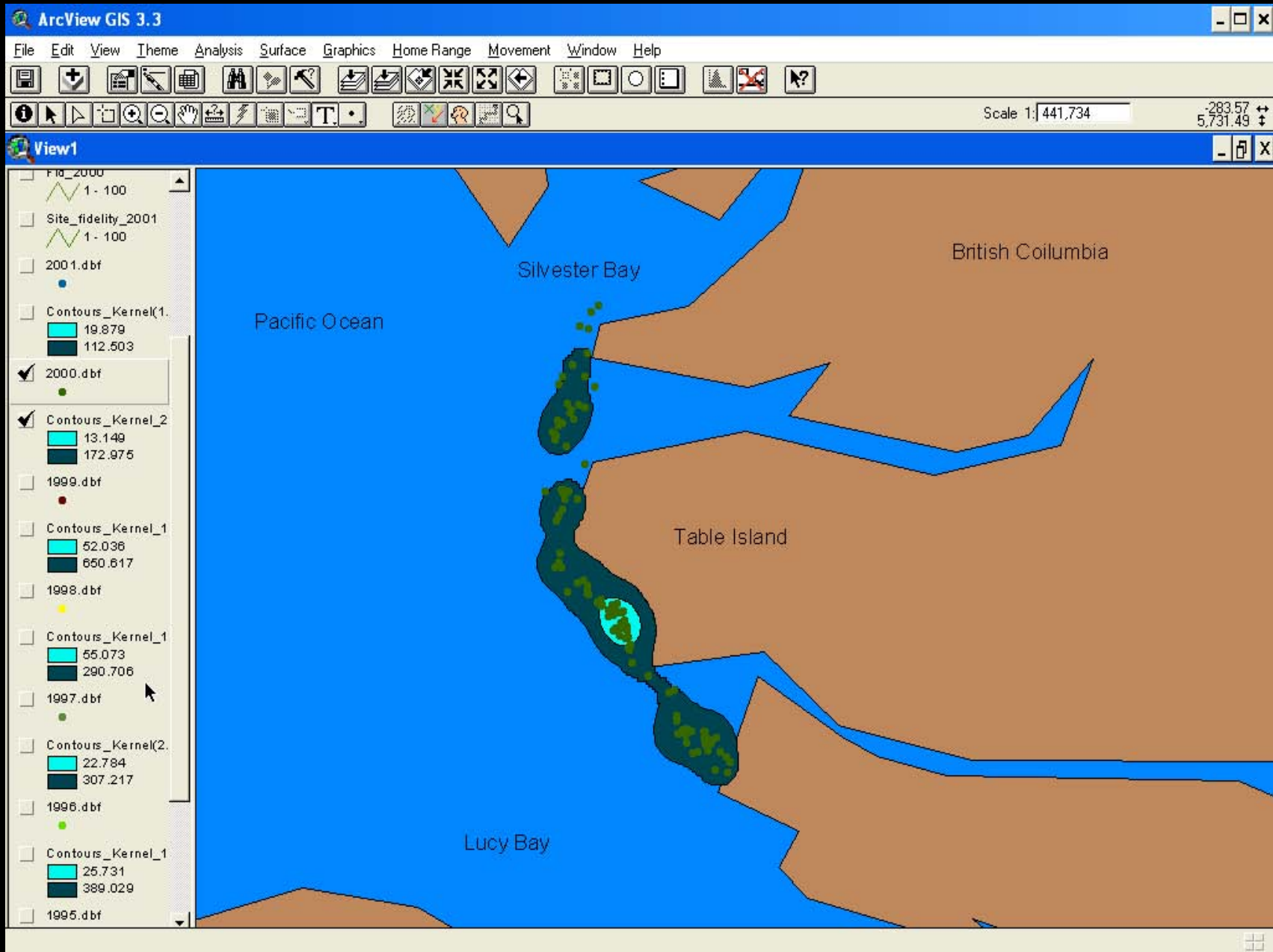# Home Range Analysis - 1997, All Whale Sightings

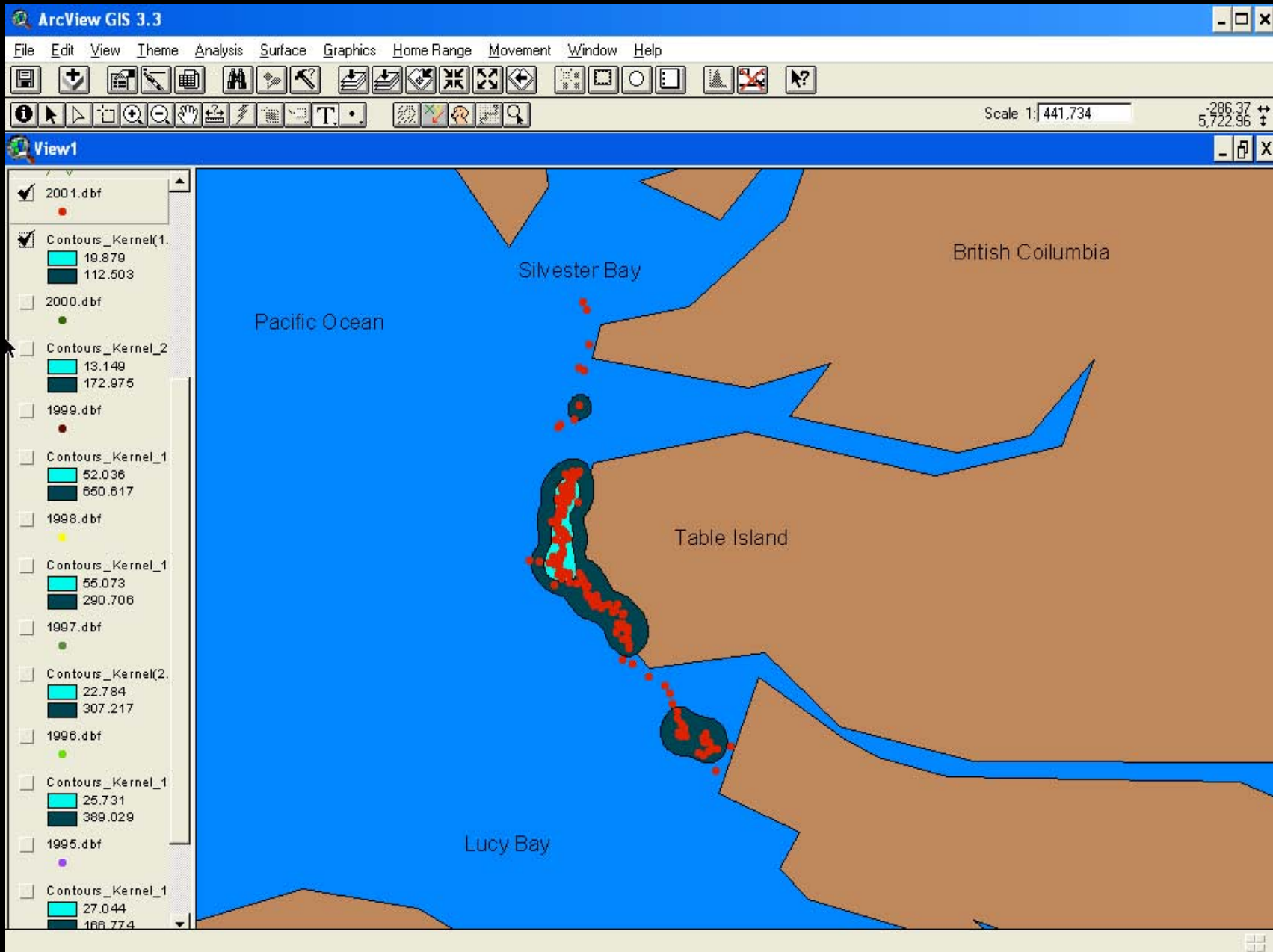# Home Range Analysis -1998, All Whale Sightings

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

Chart showing AREA (Km²) on the y-axis (0 to 700) versus YEAR on the x-axis, with two series: Core Area (50%) in red and Home Range (95%) in blue.

Year	Core Area (50%)	Home Range (95%)	Core Area/Home Range %
1995	27	167	16.2%
1996	26	389	6.6%
1997	23	307	7.4%
1998	55	291	18.9%
1999	52	651	8.0%
2000	13	173	7.6%
2001	20	113	17.7%
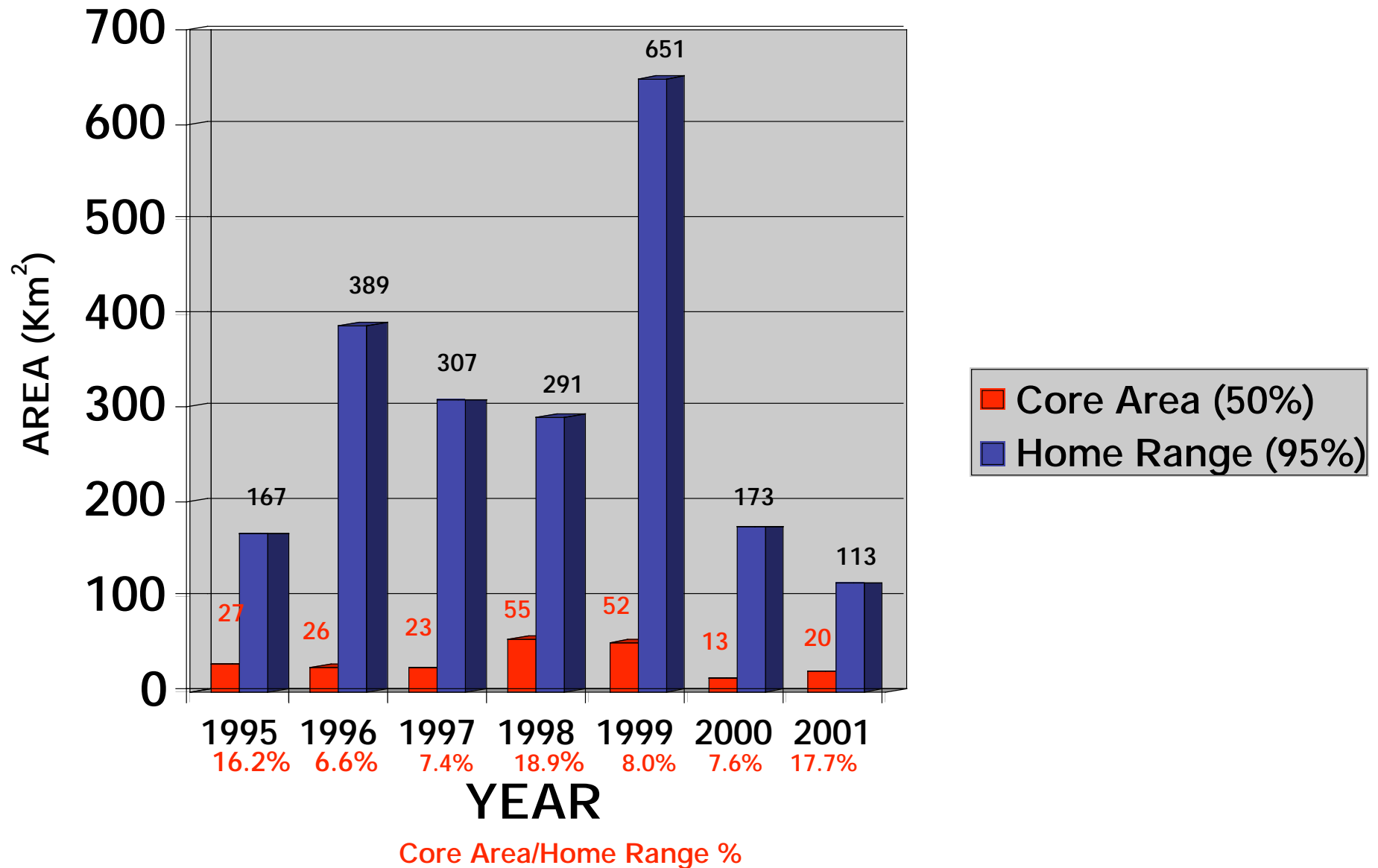
ArcView's Animal Movement Extension: Site Fidelity Analysis
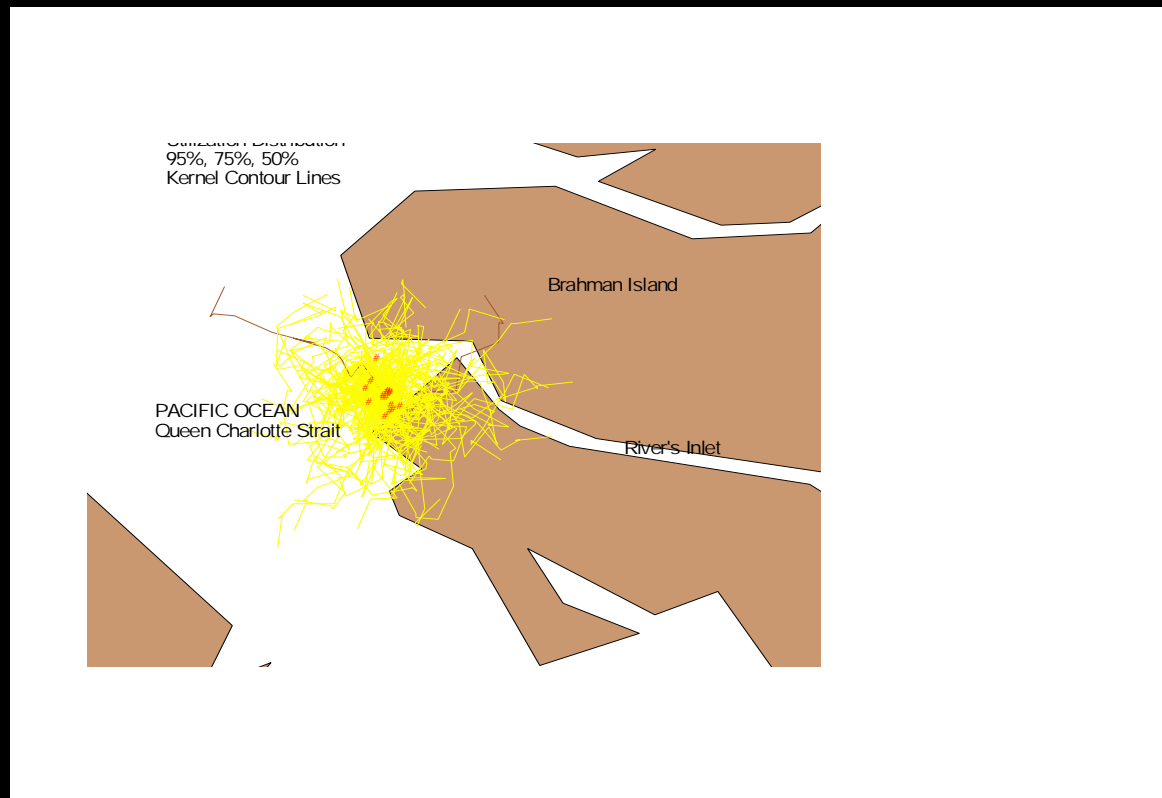
All combined whale sightings for years 1995 -2001 showed site fidelity with a p>99.0099 that movement was more constrained than random movement patterns

Kelp Bed Sampling
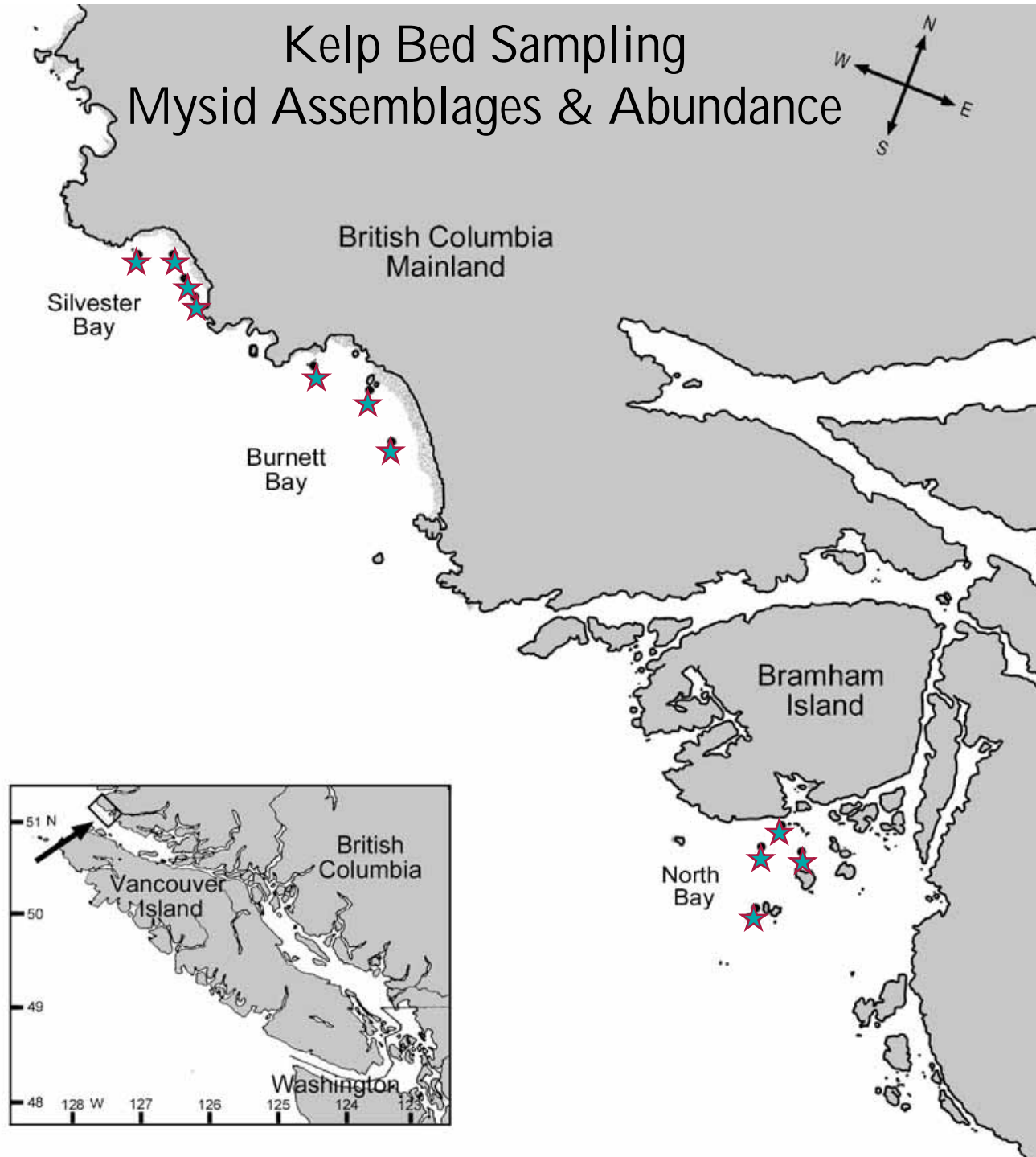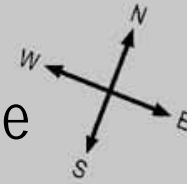Mysid Assemblages & Abundance

STATISTICAL SUMMARY

RESIDENCY/HABITAT USAGE
- Residents, transients and visitors variable by year
- Number of residents 9 – 2 7 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

Acknowledgements

Data collection and field logistics have been supported by many CERF crew members and guest

www.cerf.bc.ca

The Society for Conservation GIS

www.scgis.org
Domestic Scholarship Award
2002, 2003 & 2005
ESRI Conference Fees & Training

Software support for CERF's GIS Program made
possible by ESRI's Conservation Program
www.conservationgis.org

Philip Hooge
Glacier Bay Field Station/ USGS
Animal Movement Extension

http://www.absc.usgs.gov/glba/gistools/animal_mvmt.htm

Special thanks to....