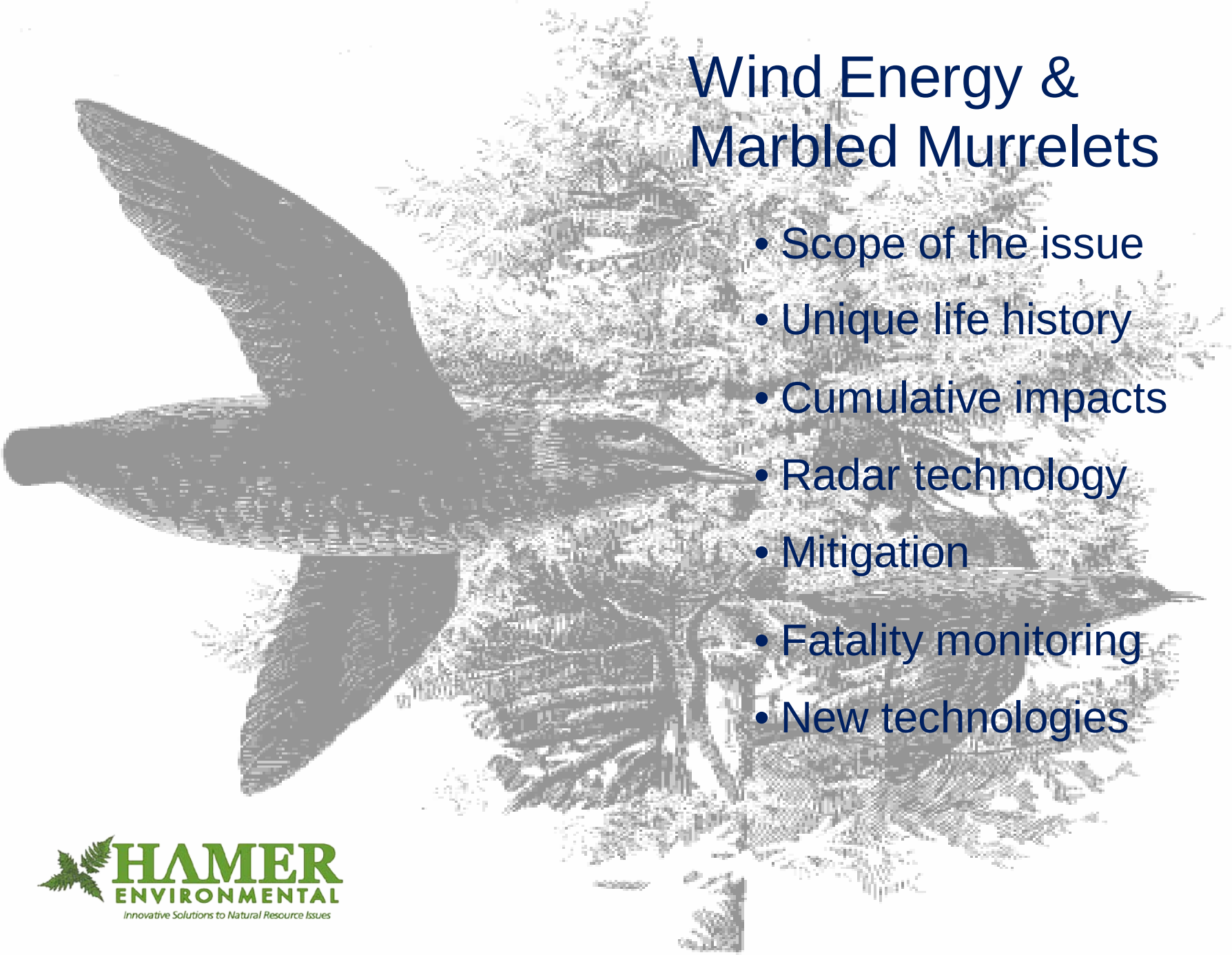

Wind Energy & Marbled Murrelets

- Scope of the issue
- Unique life history
- Cumulative impacts
- Radar technology
- Mitigation
- Fatality monitoring
- New technologies

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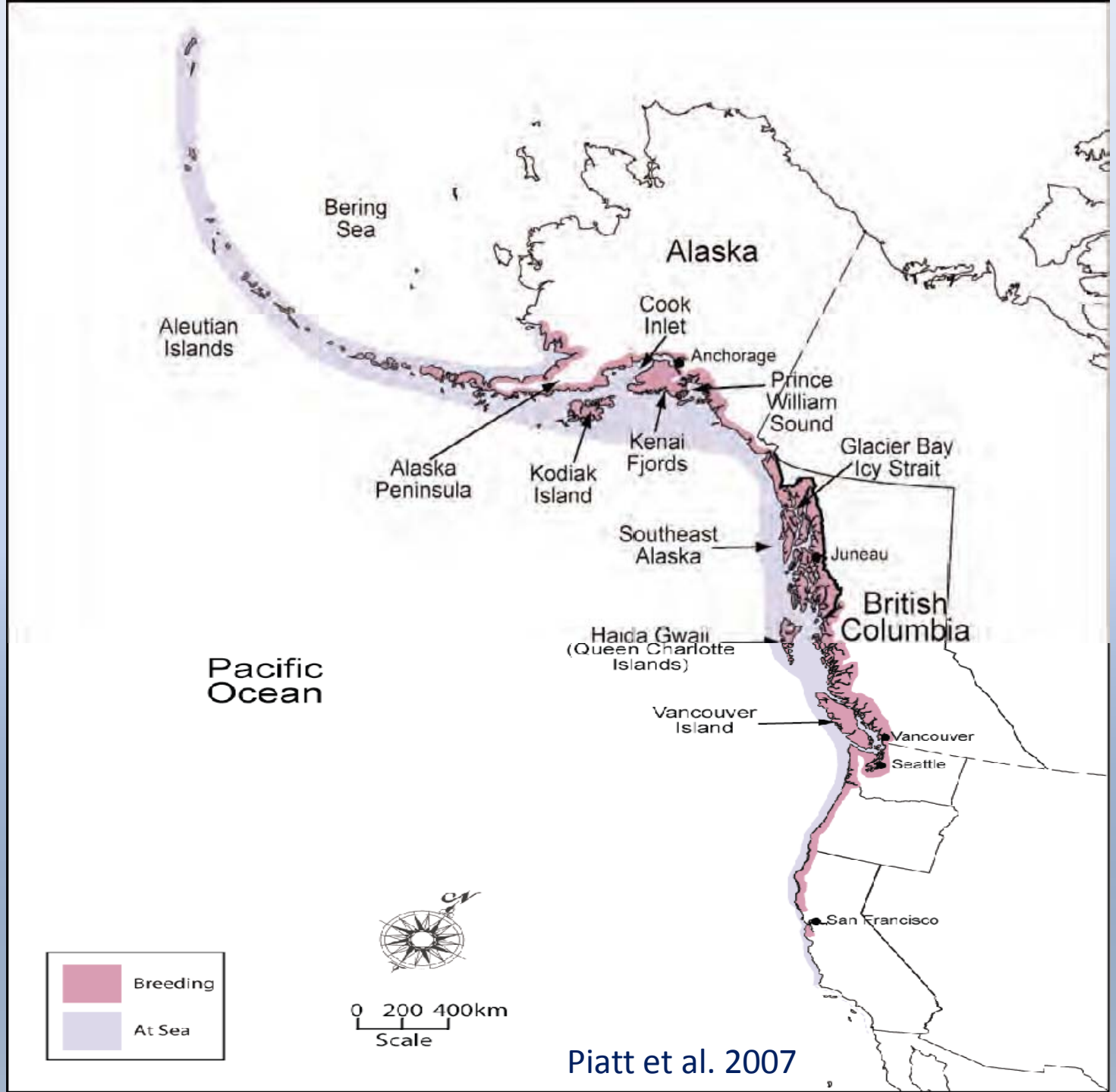
Innovative Solutions to Natural Resource Issues

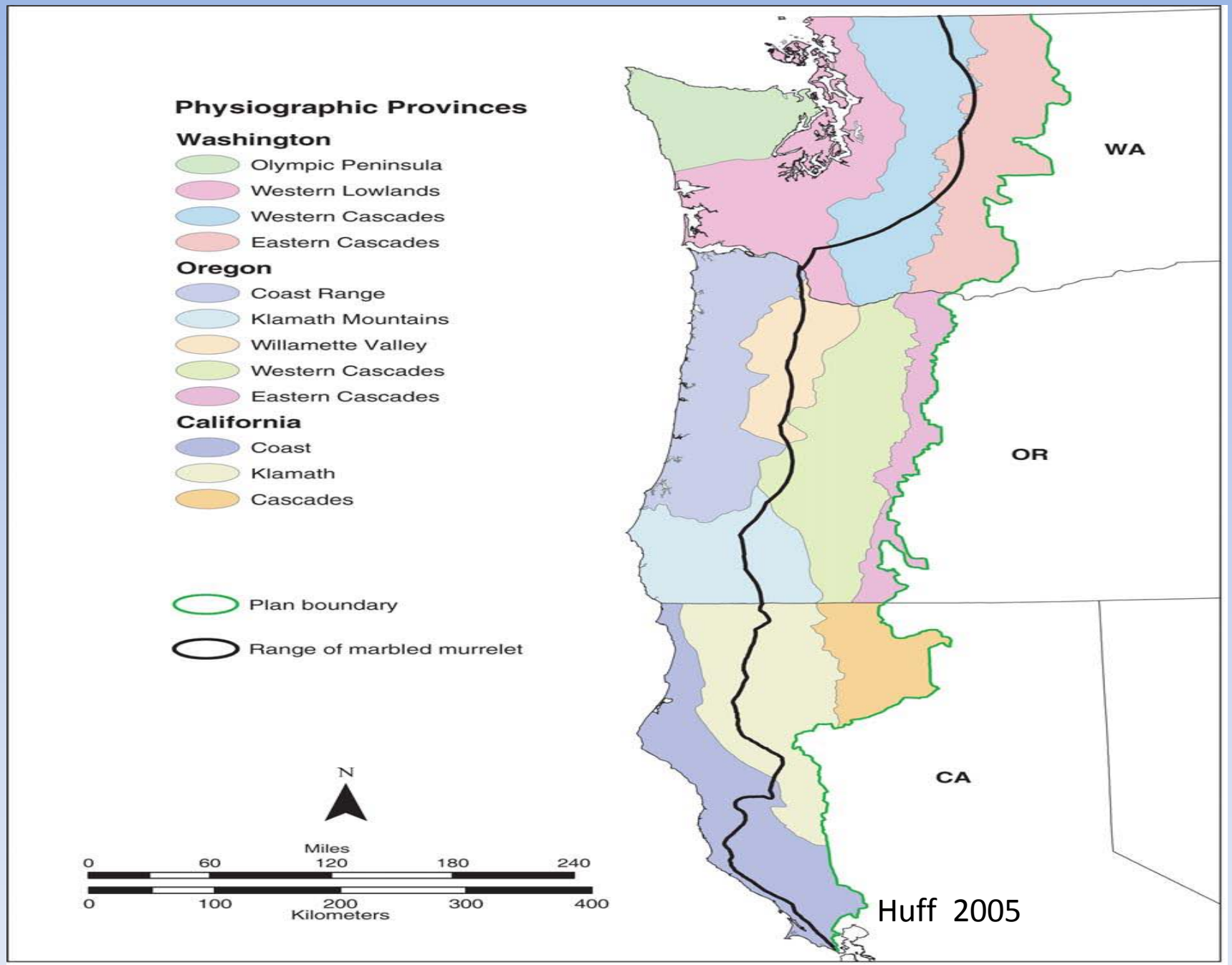
Aeroecology (Kunz 2010)

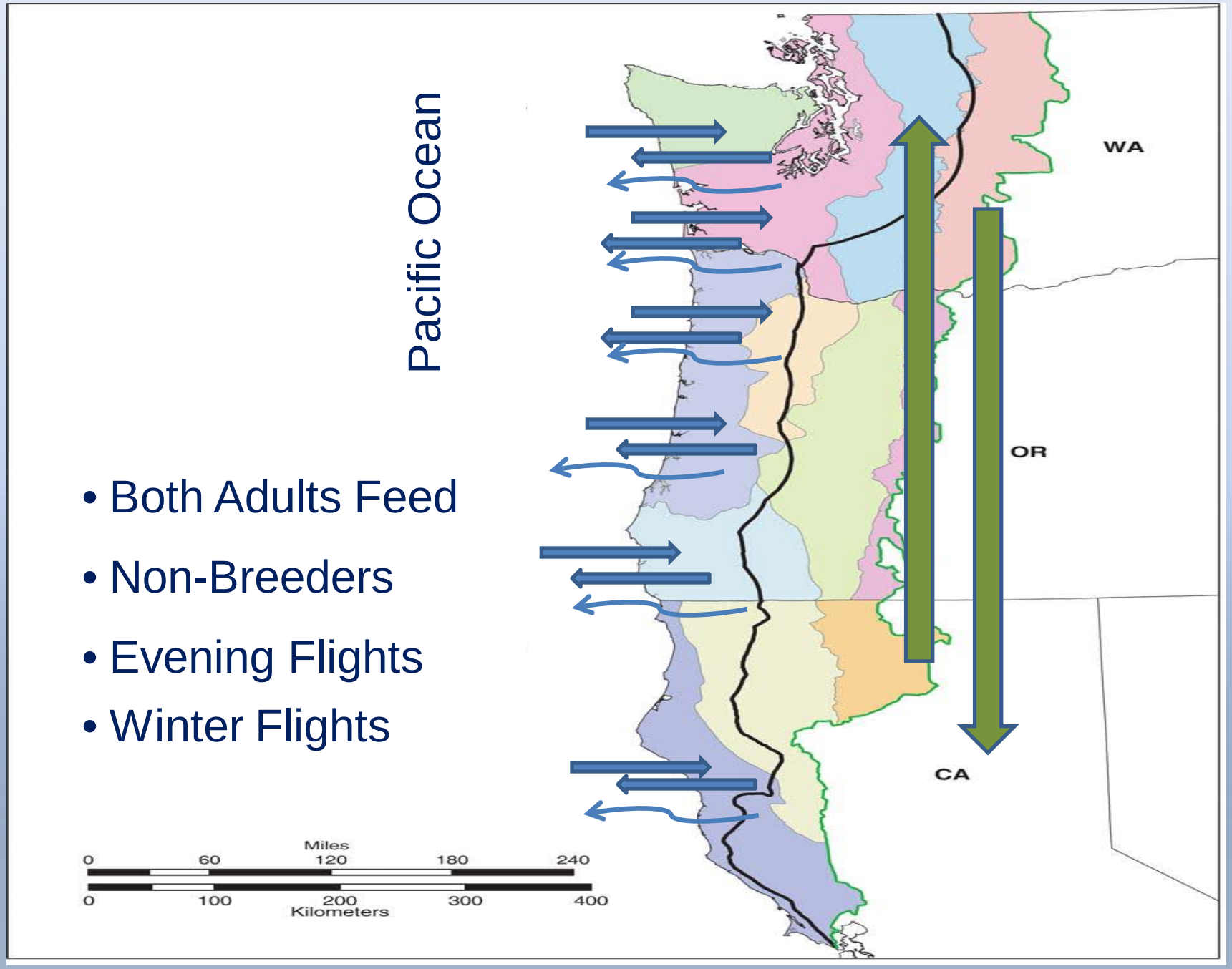
Flight behavior influenced by:

- Changing atmospheric conditions (winds, cloud cover, fog precipitation, air temp, ceiling height)
- Sunlight/Darkness, polarized light, moonlight
- Topography
- Habitat
- Distance from ocean and nest elevation



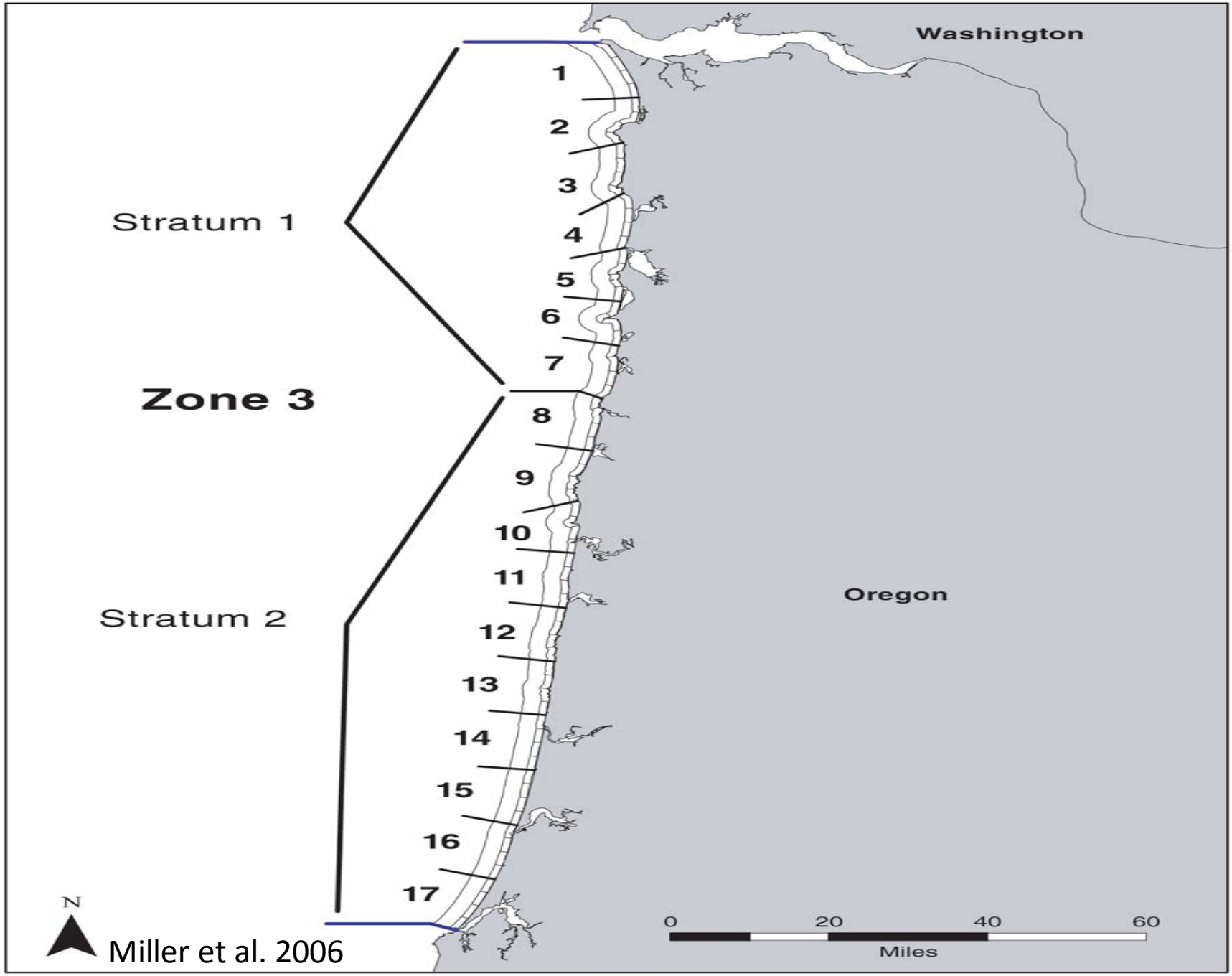
Piatt et al. 2007


Physiographic Provinces
Washington
Olympic Peninsula
Western Lowlands
Western Cascades
Eastern Cascades
Oregon
Coast Range
Klamath Mountains
Willamette Valley
Western Cascades
Eastern Cascades
California
Coast
Klamath
Cascades
Plan boundary
Range of marbled murrelet
N
Miles
0
60
120
180
240
0
100
200
300
400
Kilometers
WA
OR
CA
Huff 2005



- Both Adults Feed
- Non-Breeders
- Evening Flights
- Winter Flights

Pacific
Ocean
WA
OR
CA
Miles
0
60
120
180
240
0
100
200
300
400
Kilometers



Miller et al. 2006

Evaluation Report for the 5-Year Status Review of the Marbled Murrelet in Washington, Oregon, and California

March 2004

Prepared for
U.S. Fish and Wildlife Service, Region 1

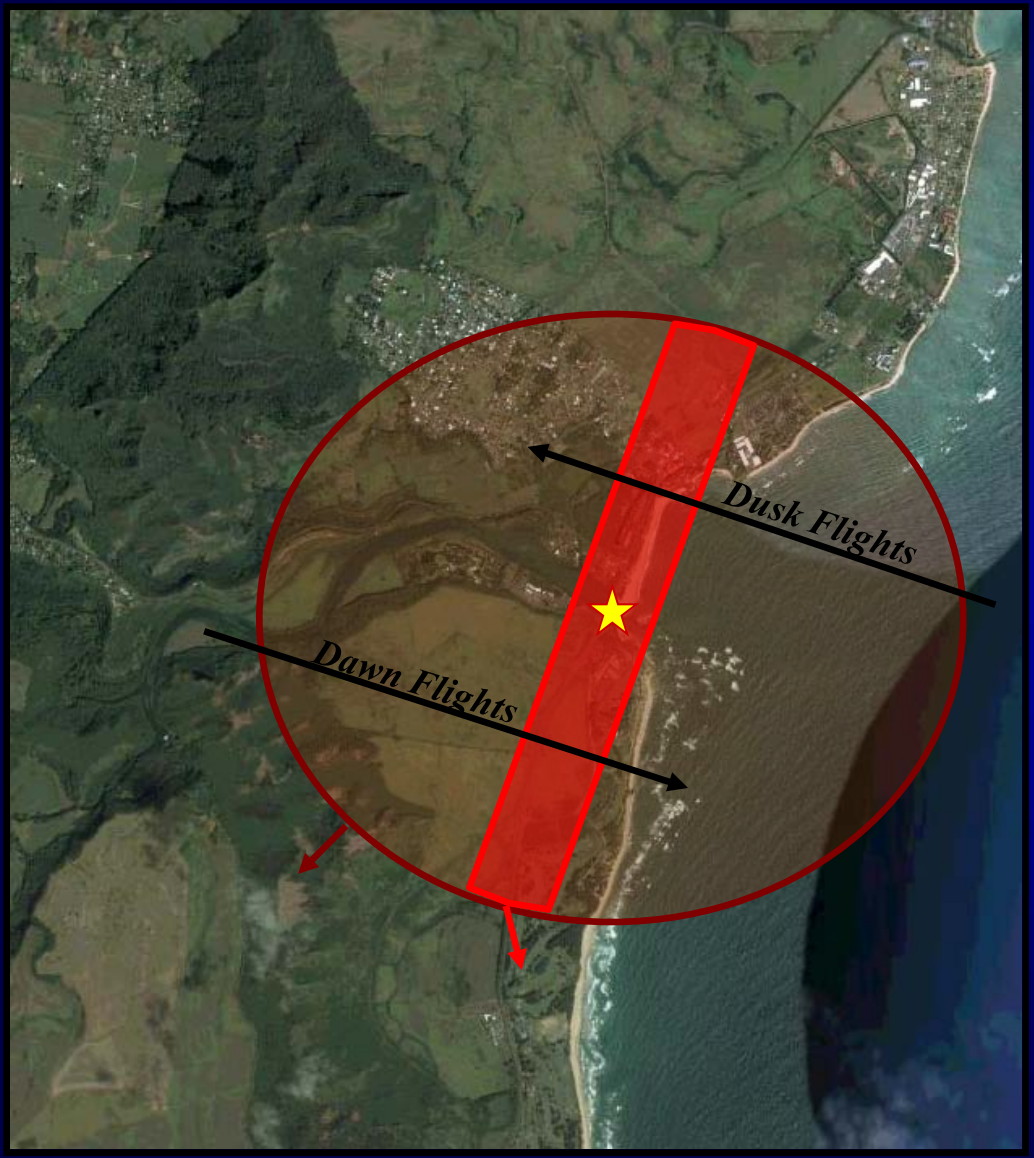
- The Zone Model is a female-only, multi-aged, discrete-time stochastic Leslie Matrix population model.

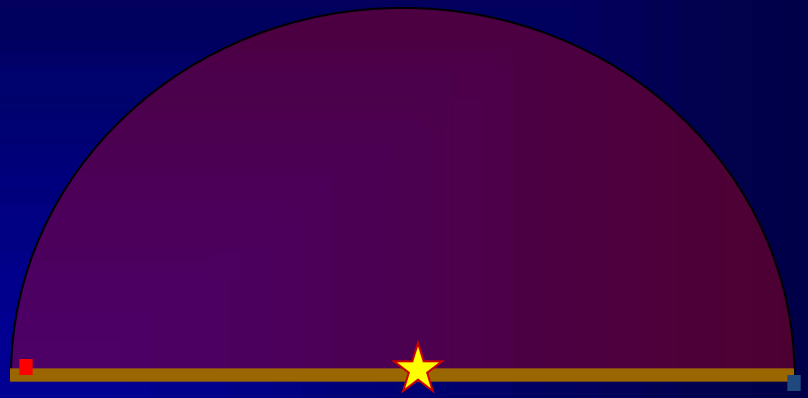
- Integrates available information on demography, stochastic variability, environmental variability, rare natural events, and human impacts into a coherent vision of expected future population trends and extinction probabilities.

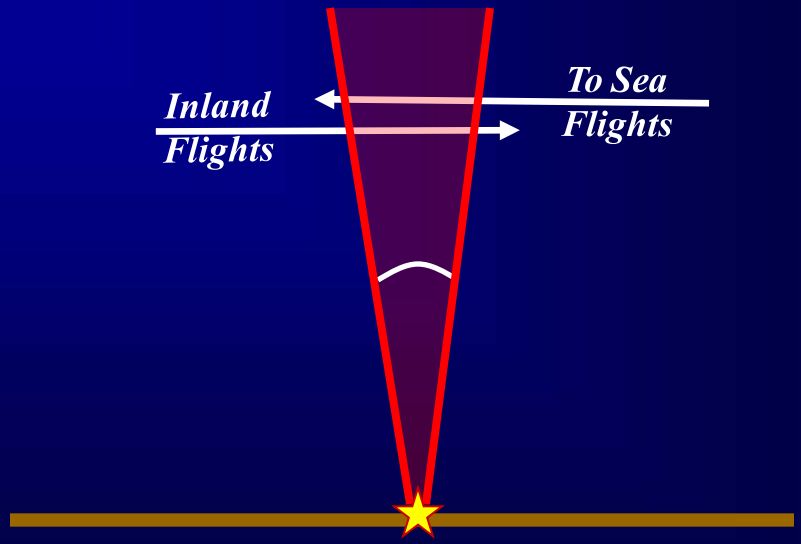
Step 1:
Estimate total marbled murrelet population after 25-35 years using 1,000 simulations w/ no mortality (no wind project) for any Conservation Zone or combinations of Zones.

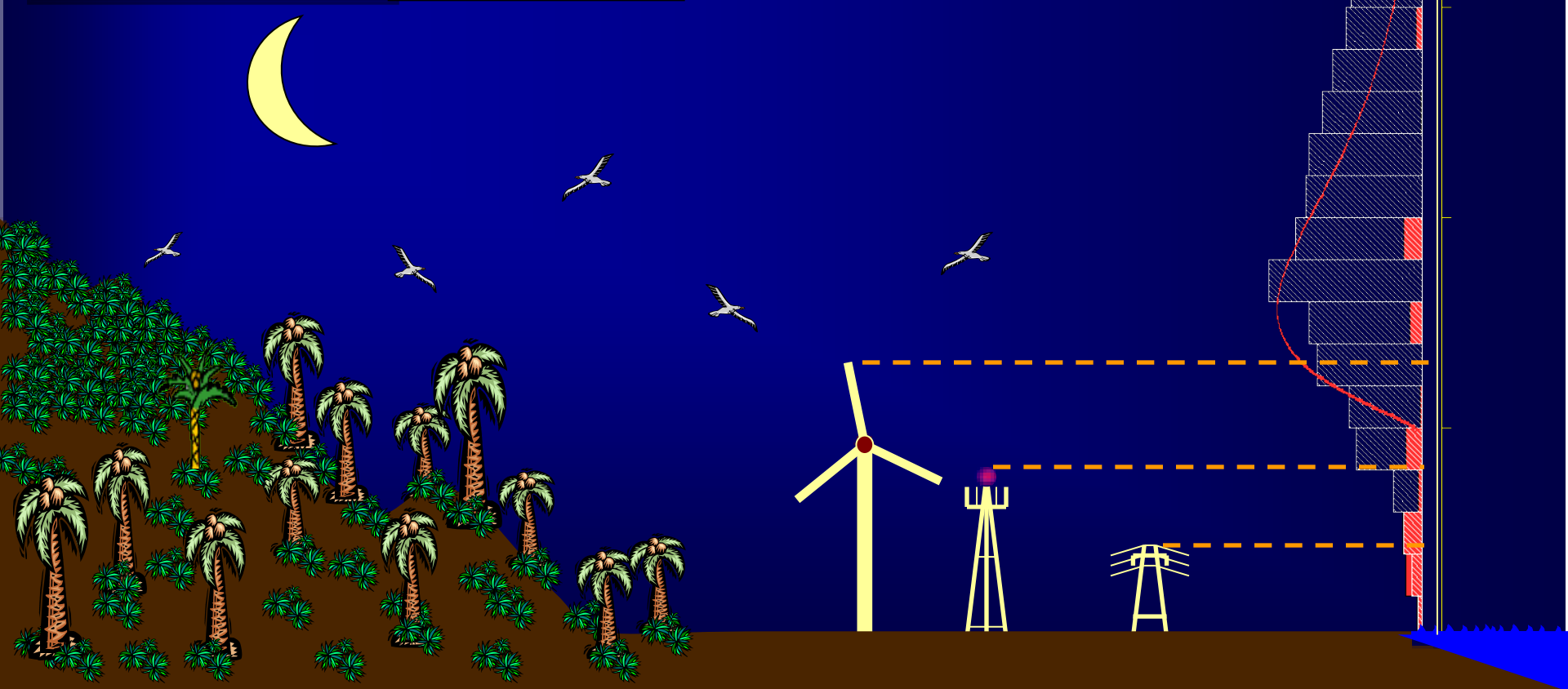
Step 2:
Conduct population simulations with wind project for worst case, best case and medium case turbine mortality estimates using ROC models.

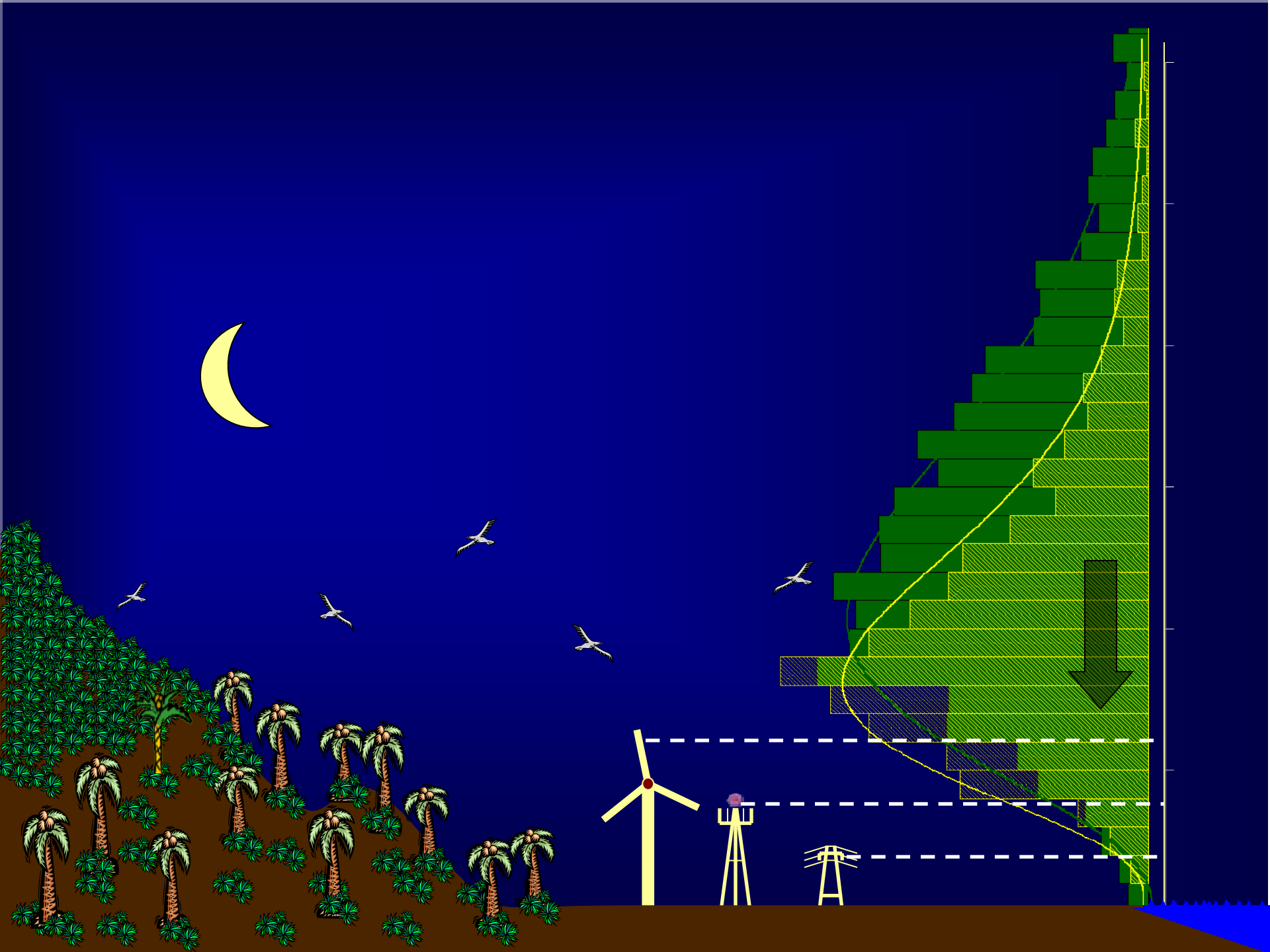
Step 3:
Statistically compare no mortality case to w/ mortality case to determine significance of effects.

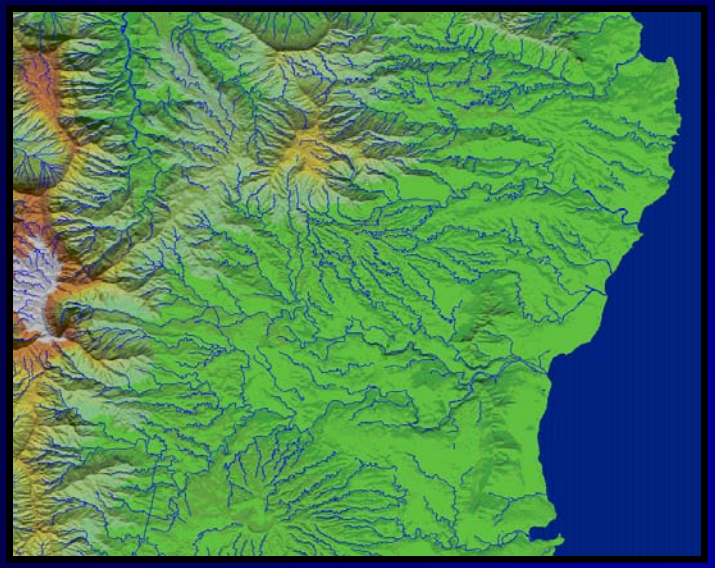

Dusk Flights
Dawn Flights




Inland
Flights
To Sea
Flights







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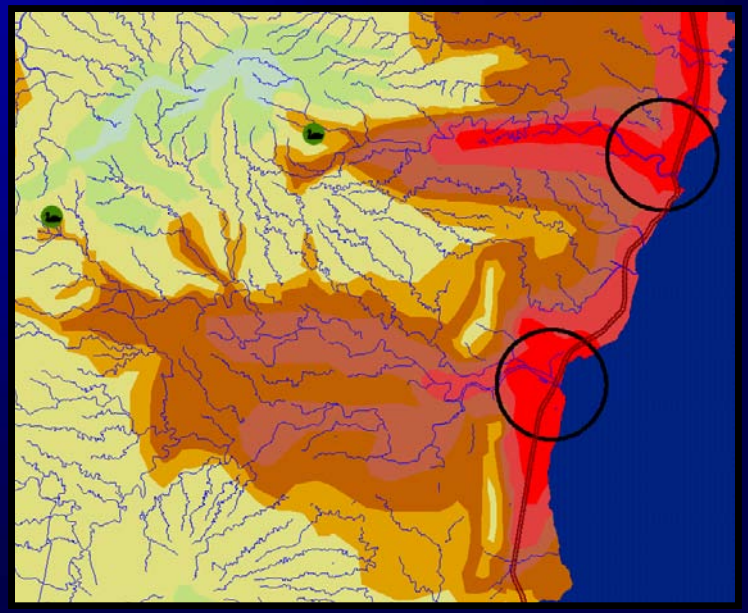
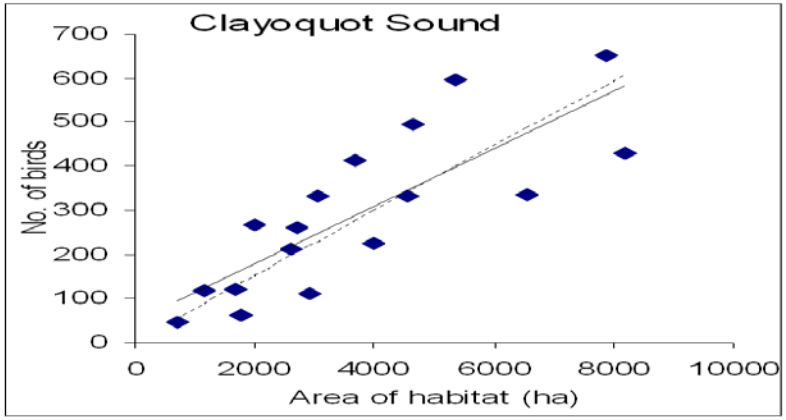
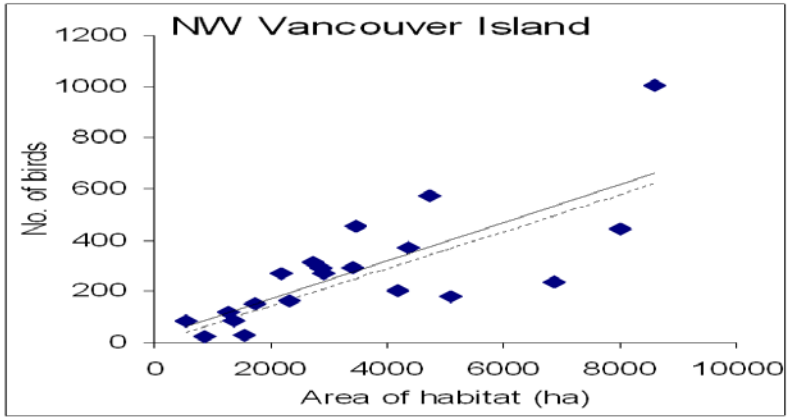
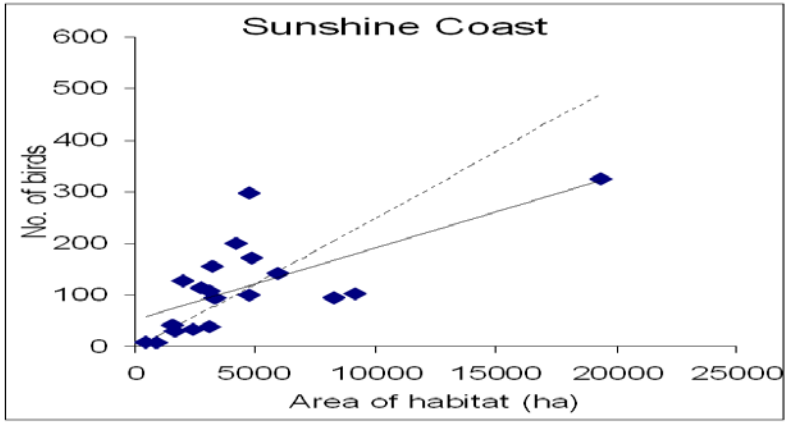
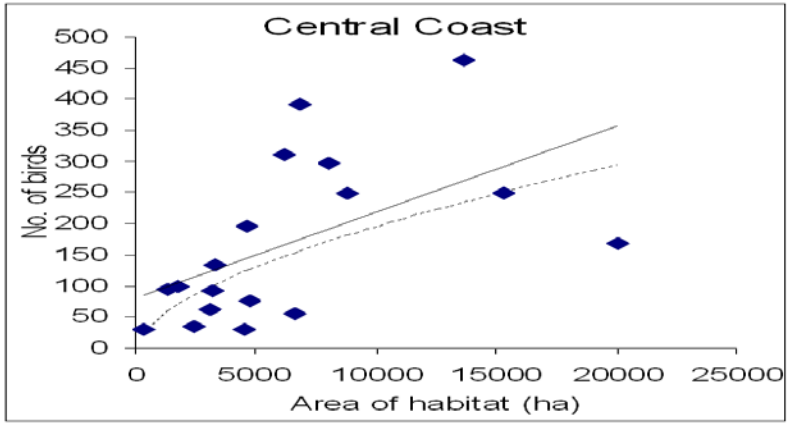
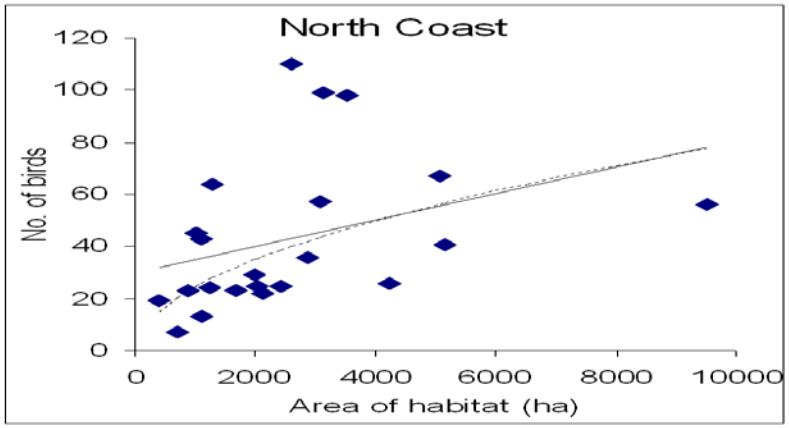












Burger et al. 2004. Marine Ornithology 32:1-11

Mitigating Incidental Take

1) Purchase & protect suitable habitat.

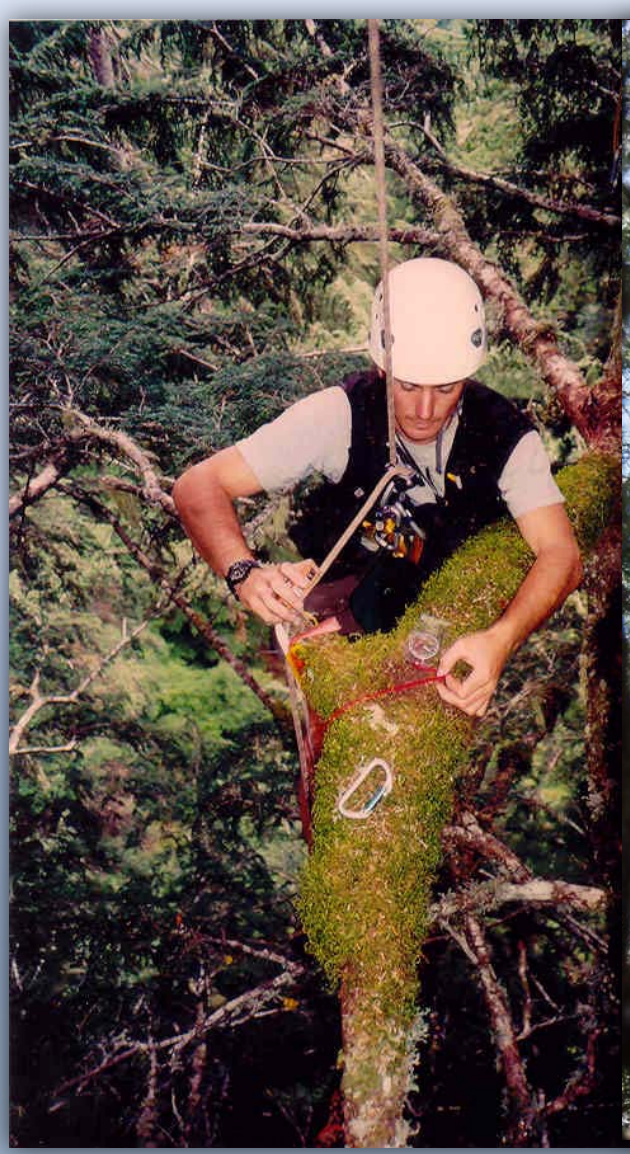
2) The USFWS recovery plan: “long-term recovery actions should include increasing the amount, quality and distribution of suitable nesting habitat.”

3) Protect currently unsuitable habitat to allow it to become suitable, reduce fragmentation, provide replacement habitat.

4) Use silvicultural techniques to speed habitat development and the structural qualities of the habitat.

5) Western Hemlock stands and mistletoe!

Create Potential Nest Platforms



Climbed >1,500 trees

28% of Nests on Mistletoe Limbs

Nest Site on Mistletoe Limb

Assessing Mitigation Value

Predictive Models of Habitat Suitability

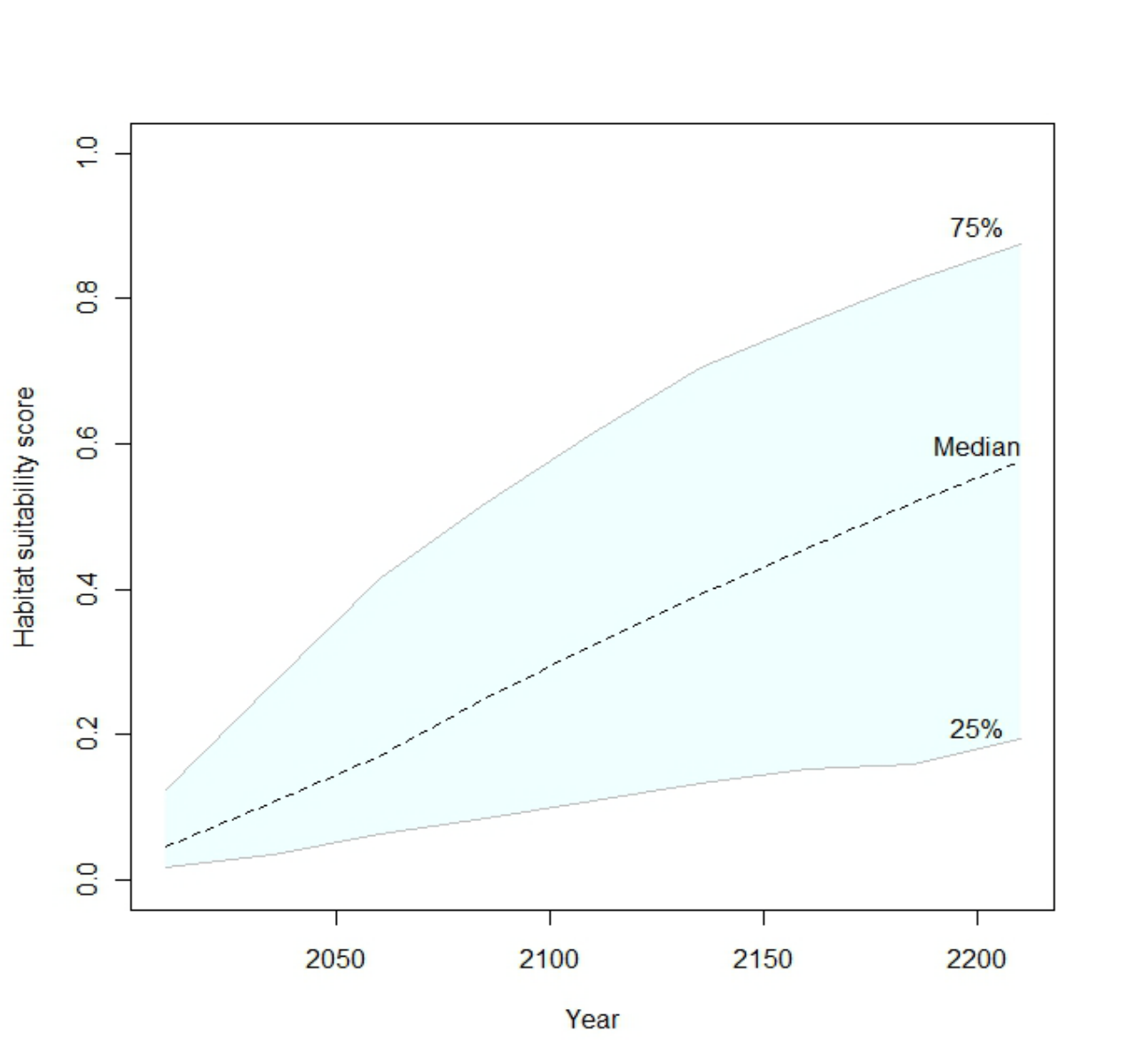
Use measures of forest characteristics to predict the presence of Marbled Murrelets & assess mitigation value of a stand. Model results give you a range from 0-100% probability of occupancy of stand.

Our habitat model tested on an independent sample of 50 stands with >75% accuracy to predict occupancy and non-occupancy of stands
*Journal of Wildlife Management 72(4):983–993; 2008.

Forest Growth Models

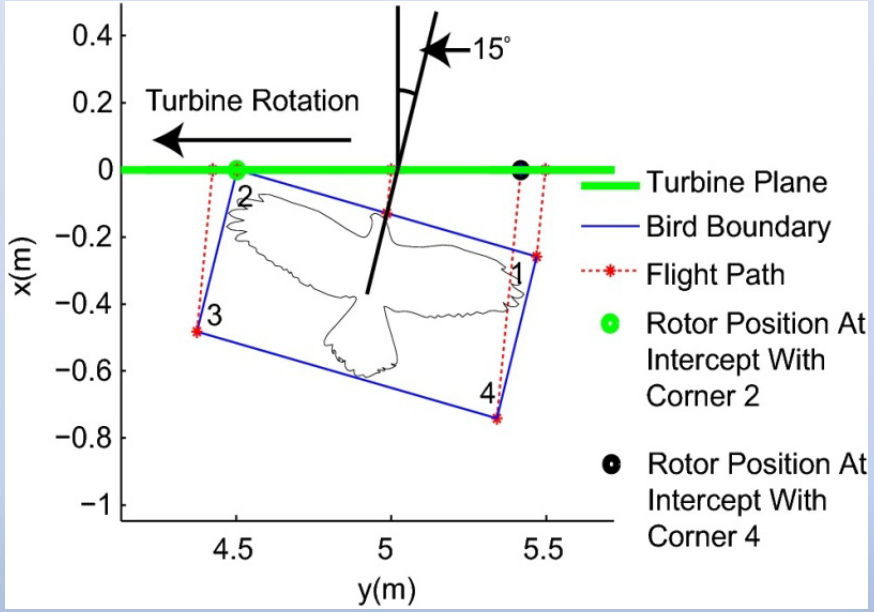
Use forest growth models like the Forest Projection and Planning System (FPS) software to extrapolate future forest conditions.

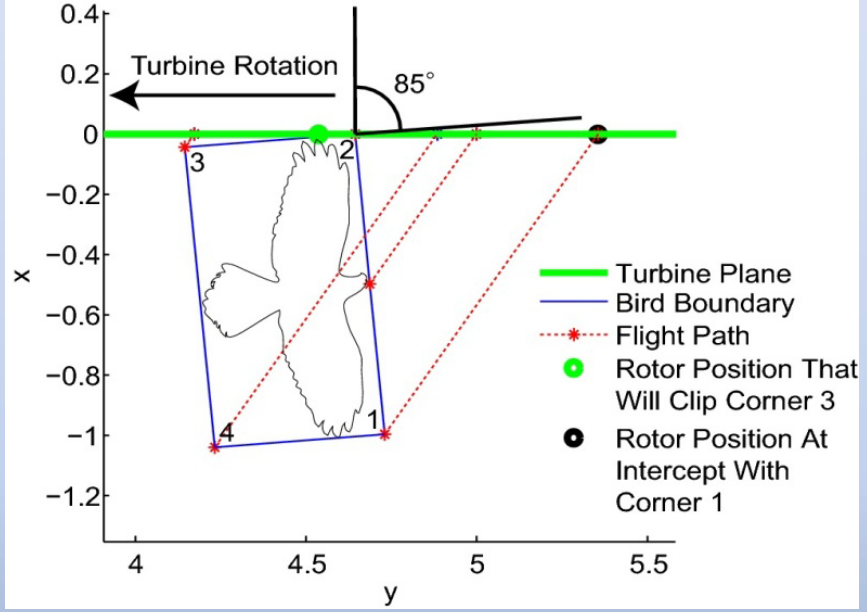
The values for these future forest characteristics can then be entered into the predictive model of habitat suitability to predict how stand suitability & mitigation value will change over time.



Median, first (25%), and third quartile (75%) Marbled Murrelet probability of occupancy scores 200 years into the future based on timber cruise data, forest growth projections, and habitat suitability models.

Avian Risk of Collision Modeling & Marbled Murrelets

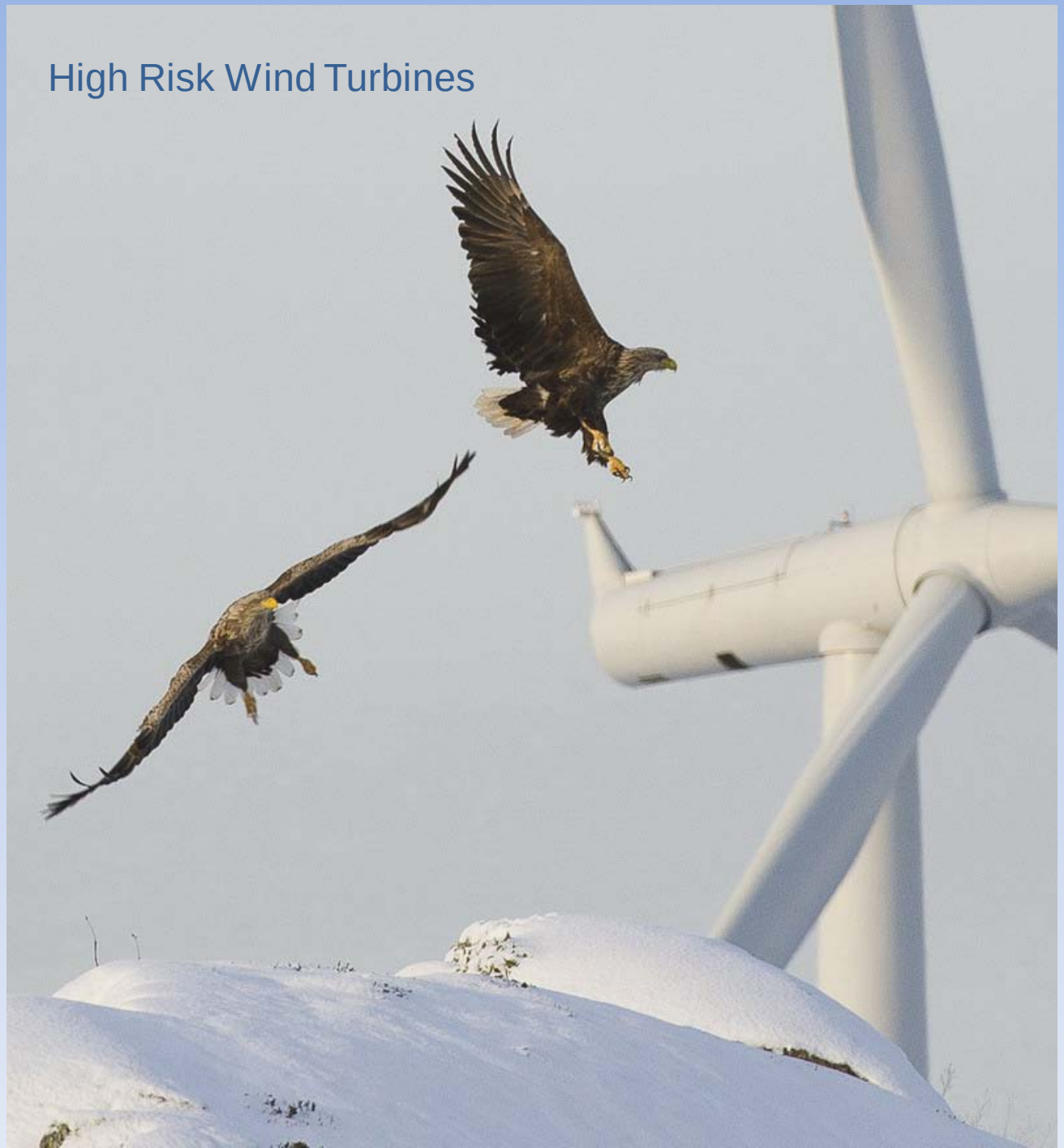


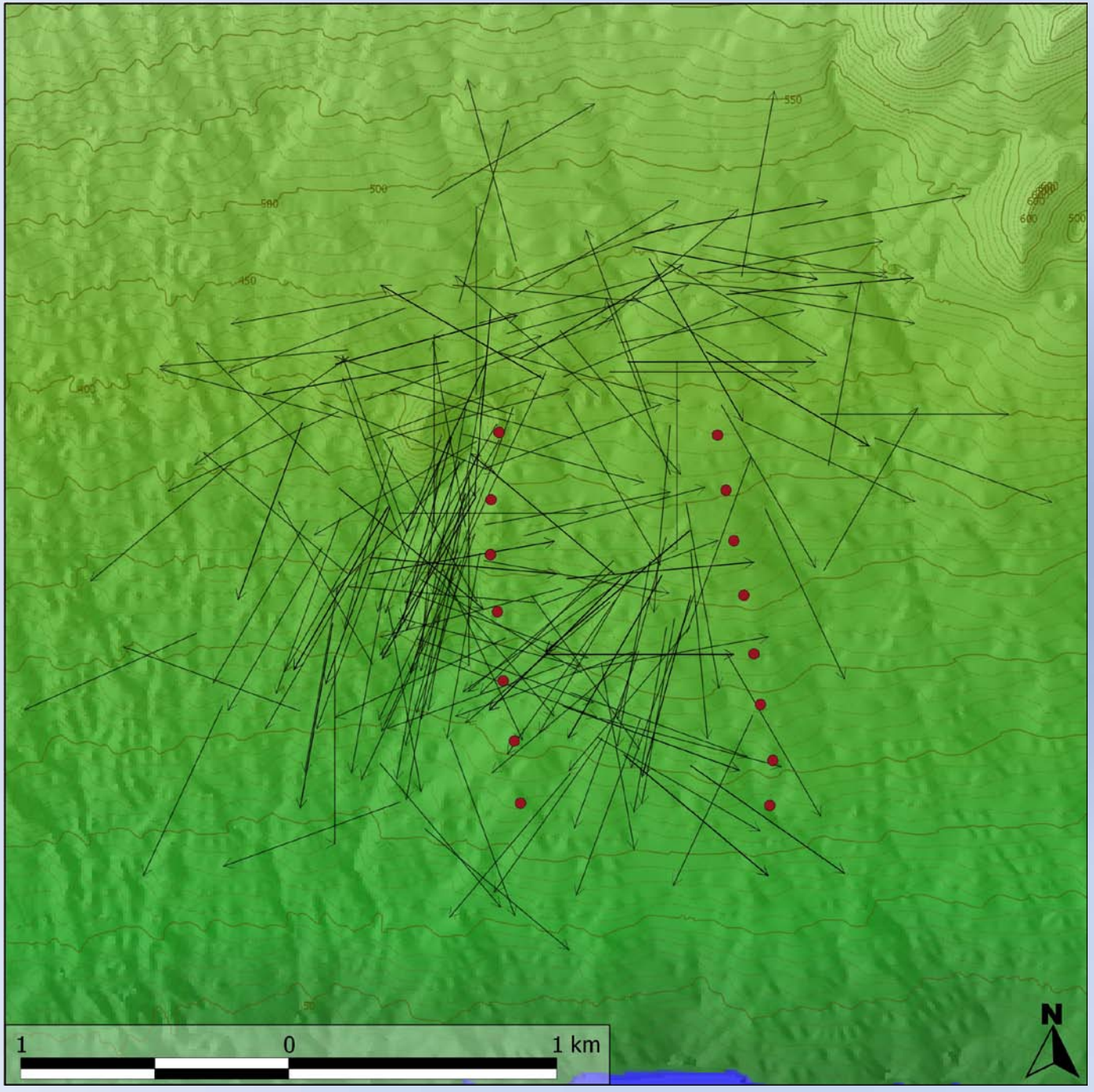


- Accounting for avian flight angle of approach has a significant effect on the estimated collision probability in ROC models.

- "Assessing Avian-Wind Turbine Collision Risk: An Approach Angle Dependent Model"
  (Journal of Wind Engineering 2011; Vol. 35. No.3)

High Risk Wind Turbines

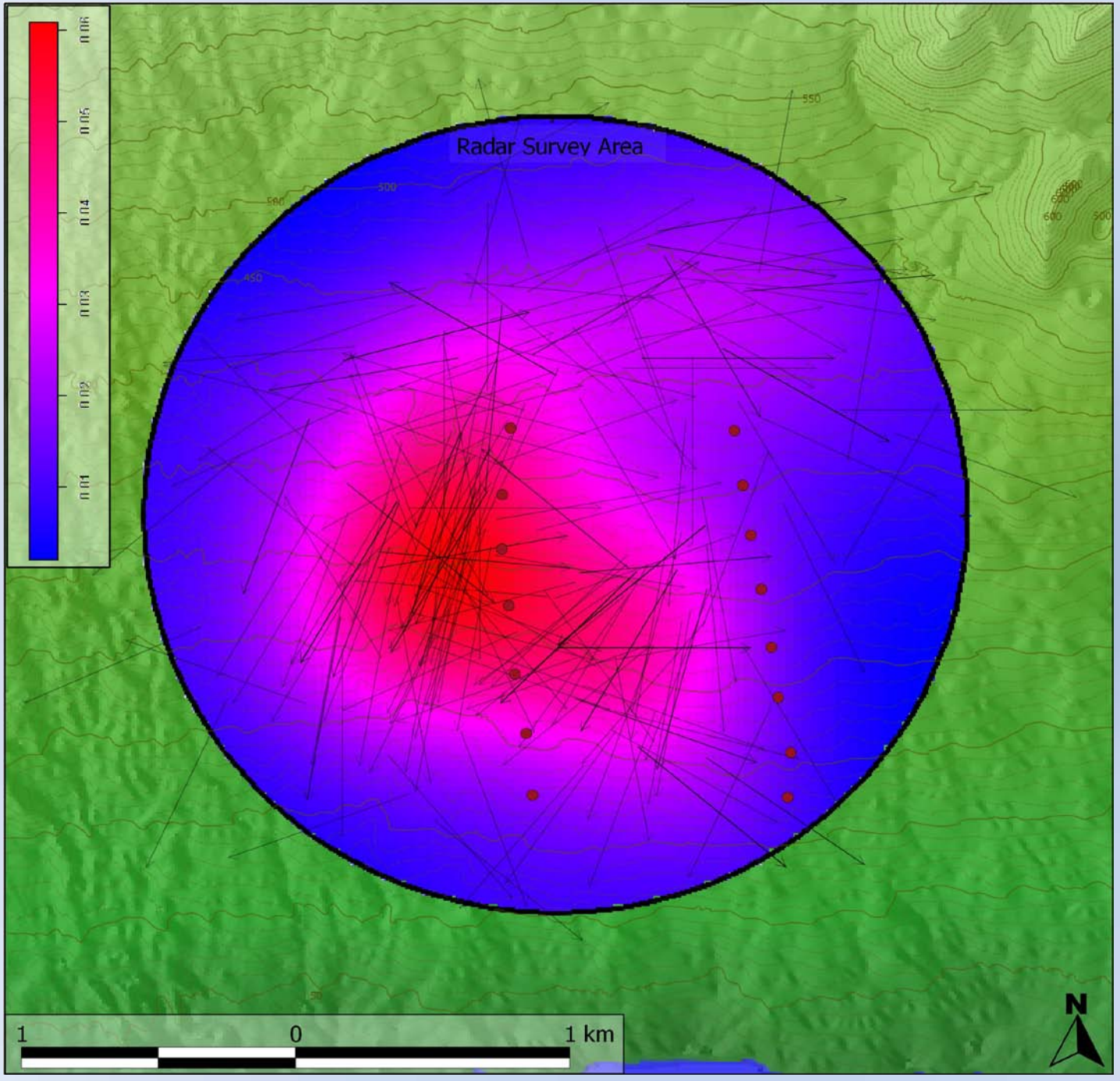




Step 1:

Add Avian Flight Paths

Current ROC Models Assume Uniform Flight Densities

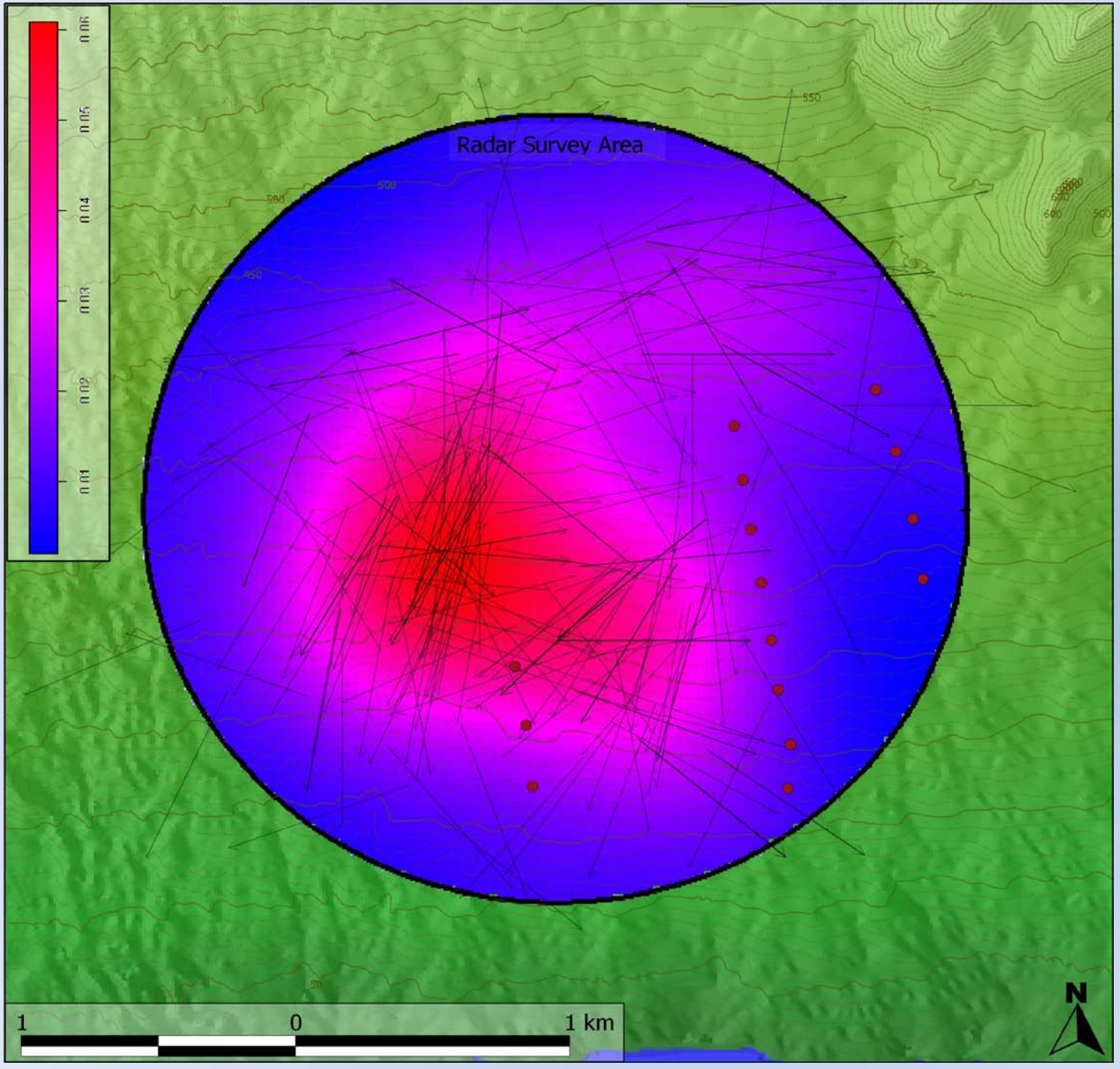


Step 2:

Compute a kernel smoothed intensity function from flight paths

Step 3:

Calculate Fatality Rate w ROC



Step 4:

Move High Risk Turbines

Step 5:

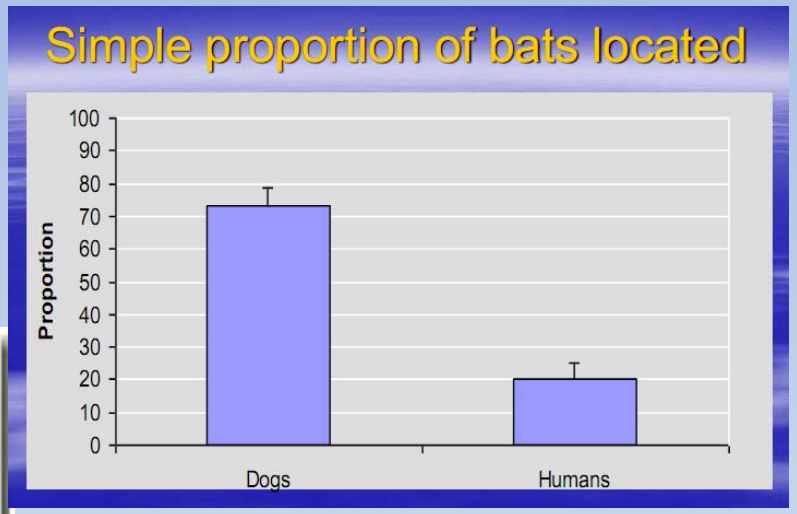
Recalculate Fatality Rate

Post-construction Fatality Monitoring

Issues: *Detecting rare events

*High brush densities

*Rough topography



Fiona Mathews 2011

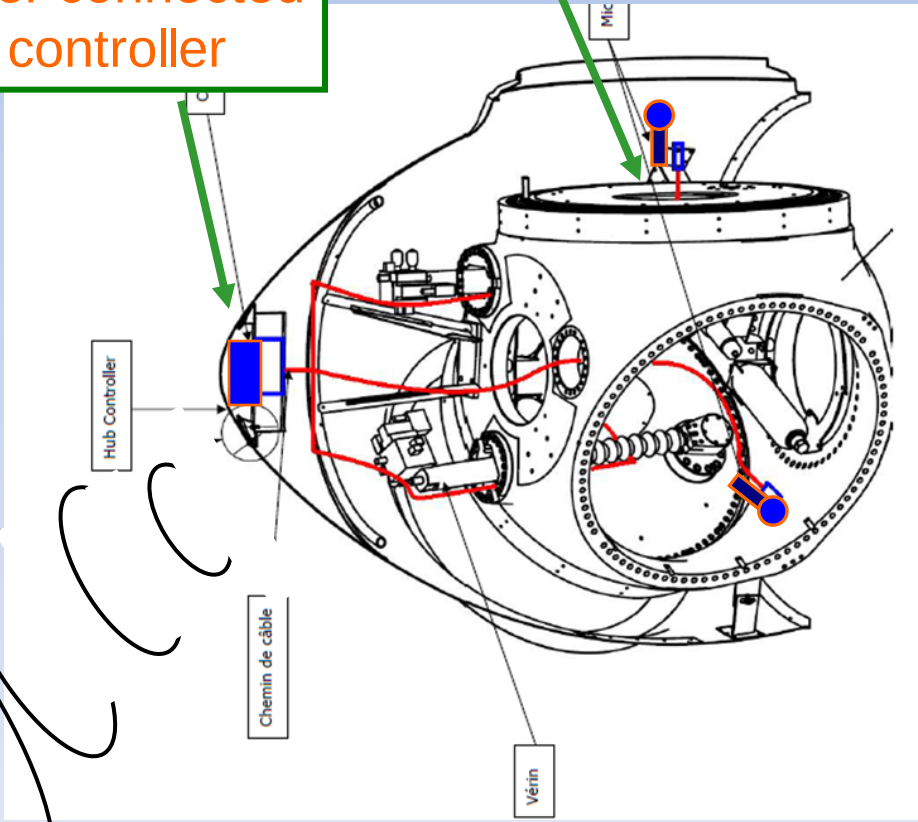
- Need for Dogs

- New Technologies

Non-Invasive Vibro-Acoustic Collision Sensor

Three microphones

Data logger connected in hub controller



GSM technology

for data collection ...

Advantages of Collision Sensor Technology

- Searchers know immediately which day to perform searches, under which turbines to focus this effort, and the exact time and environmental conditions under which they occurred.

- Biases due to infrequent searches, low searcher efficiency, and scavenger issues may be eliminated or minimized.

- Faster search responses will result in higher rates of successfully locating animals under the turbines, an increase in the number of species identified, and reduced survey costs.

- Collision sensors will be invaluable for assessing collision risks with offshore wind turbines where finding and collecting animals under turbines is currently impossible.

- Research on the efficacy of certain operational modifications to reduce collisions is currently limited and need to be tested.

- Research lacking on factors that could help reduce collision rates, such as turbine color, lighting, marking of blades, turbine lay-outs, and ultrasonic or laser deterrents.

Thank You

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Innovative Solutions to Natural Resource Issues