The Western Section of The Wildlife Society and Wildlife Research Institute

Western Raptor Symposium
February 8-9, 2011
Riverside, California

Symposium Sponsors

February 8 – 02:05-02:25 pm Session: Overviews – Wind Farms

A Visual Method of Evaluating Migratory Golden Eagle Behaviour at a Pre-operational Wind Farm in the Canadian Rocky Mountains

Naira N. Johnston, Ecosystems Science and Management, University of Northern British Columbia, Prince George, BC, Canada; johnstn@unbc.ca; Bradley, James E.; Ecosystems science and management, University of Northern British Columbia, Prince George, BC, Canada; Otter, Ken A.; Ecosystems Science and Management, University of Northern British Columbia, Prince George, BC, Canada.

We documented migratory golden eagle (*Aquila chrysaetos*) flight tracks at a wind farm in the Hart Range of northeast British Columbia, Canada. In fall 2009 and spring 2010 we conducted visual surveys to define 3-D flight tracks of birds, which were integrated into GIS for analysis on factors that influenced the altitudes of eagles entering a proposed turbine string area on a ridge (risk-zone). Of the 412 eagles detected in the fall, 6% entered the risk zone –3% of which were at rotor swept height. Fall heights increased with increasing wind speed; were lower under head-winds compared to cross-winds; and, were lower over sloped compared to flat areas of the ridge. Spring counts were lower (N =104) than the fall and most birds entering the risk zone (26%) did so under weak wind conditions. Spring heights were positively correlated with wind speed, and were higher in the hours immediately after midday. Although post-construction avoidance rates are likely to be high, a cumulative impact assessment for the region is needed to account for the potential effects on eagle migration. Our data collection technique could be used to identify areas of raptor use and document the occurrence of avoidance behavior post-construction.

A visual method of evaluating migratory golden eagle behavior at a pre-operational wind farm in the Canadian Rockies

Naira N. Johnston*
James E. Bradley
Ken A. Otter

*Email: johnstn@unbc.ca

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

Centre for Wind Energy and the Environment

Background

- Birds of prey are at lower risk of collision mortality during migration – when not hunting for food (de Lucas et al. 2007; Drewitt & Langston 2008)
- Concern exists along major migration routes where birds are funnelled (Steinen et al. 2007)
- Few collision risk studies exist along golden eagle (GOEA) migration routes (exception: Whitfield 2009)
  - Findings indicate fewer turbine approaches than expected based on a `Band' Collision Risk Model (Whitfield 2009)

Background

- Much has yet to be learned regarding golden eagle avoidance behaviour to turbines or wind farms during migration
- Western NA has the greatest concentration of migratory GOEAs along the Rocky Mountains
- My study is the first for an area in BC heavily slated for wind farm development – which is also along a significant GOEA migration route (approx. 1000+ individuals fall; 300 individuals spring)

Griffon Vulture Flight Behaviour

Photo: Mario modesto

- Low wing loading
- Rely on soaring flight

Photo: Jerry Ting

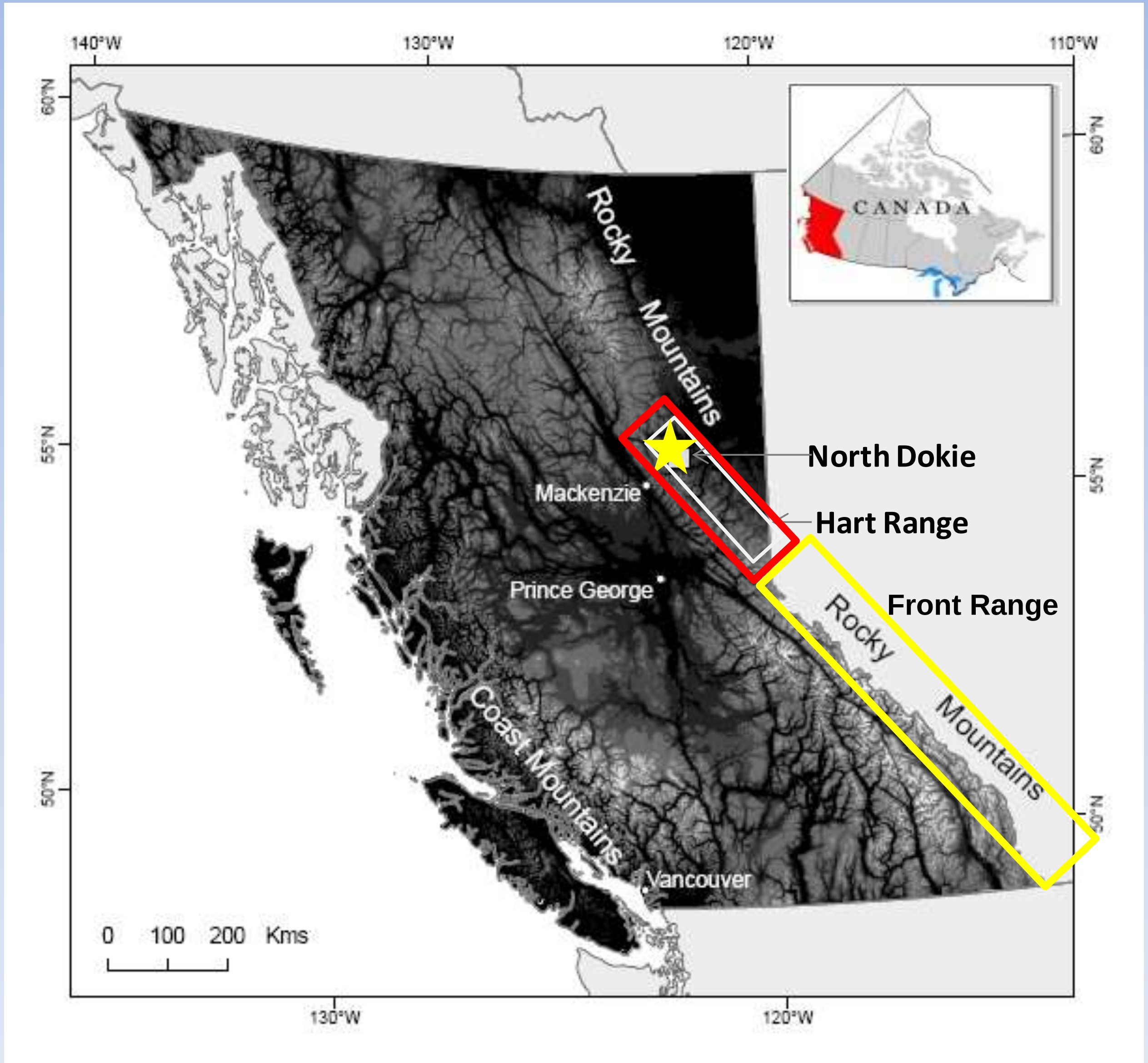
Griffon vulture Research - Spain

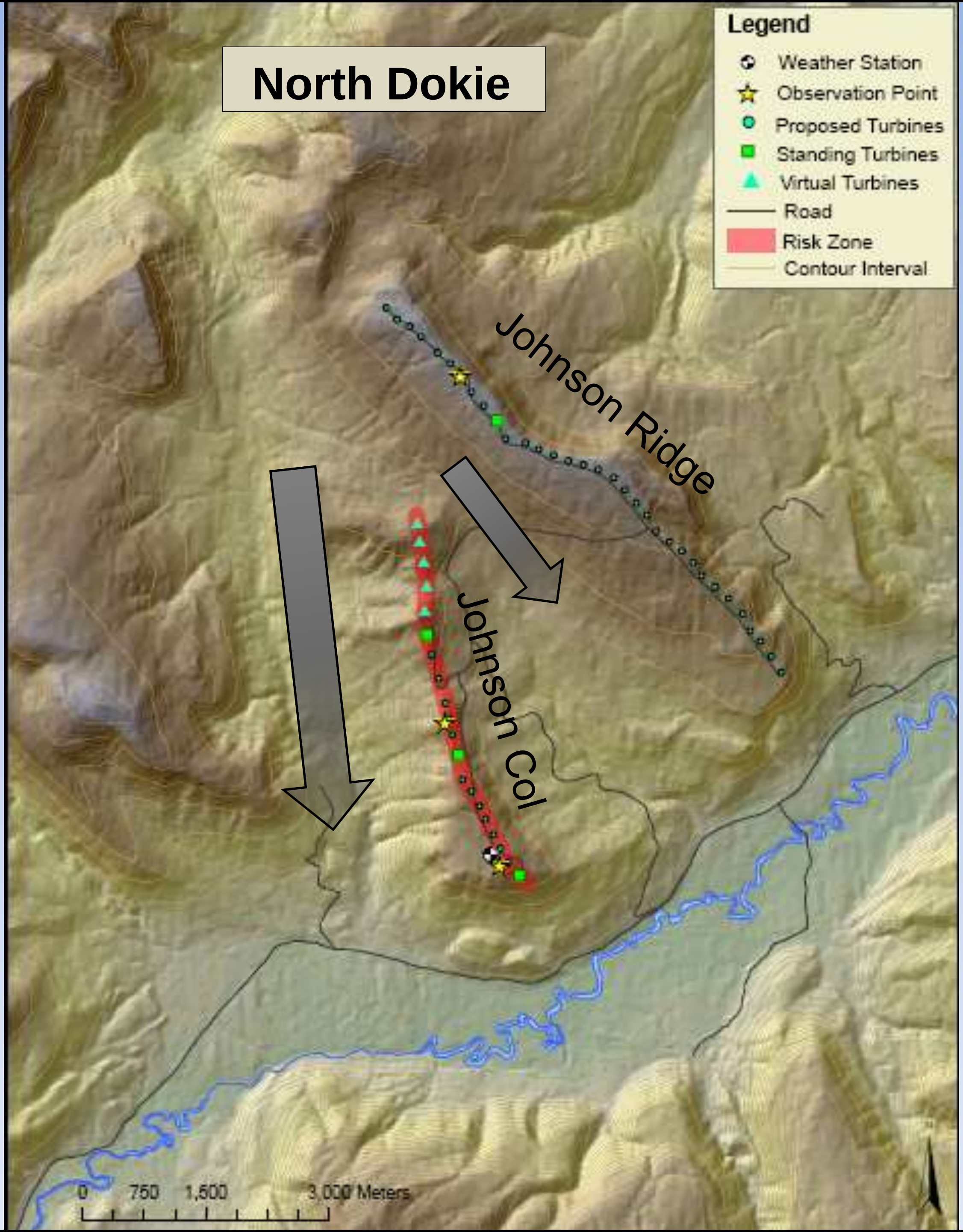
- In Spain, Barrios & Rodriguez (2004) found griffon vulture collision risk increased as **wind speed decreased**, particularly over **gentle slopes** (Barrios & Rodriguez 2004)
- Collision risk was higher for vultures that used **circle-soaring flight ("Thermalling")** near turbines
    - For proposed wind farm developments in mountainous areas, it will be important to identify the ridge-top areas used by GOEAs, in addition to the weather conditions that reduce flight altitudes

Research Question

- Fall migration: Are any weather variables, ridge-top topography features and/or flight behaviors associated with golden eagle flight altitudes over the ridge-top (also the proposed turbine string)?

Study Site


140°W
130°W
120°W
110°W
60°N
55°N
50°N
CANADA
Rocky Mountains
North Dokie
Hart Range
Front Range
Rocky Mountains
Mackenzie
Prince George
Coast Mountains
Vancouver
0 100 200 Kms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Legend
Weather Station
Observation Point
Proposed Turbines
Standing Turbines
Virtual Turbines
Road
Risk Zone
Contour Interval
Johnson Ridge
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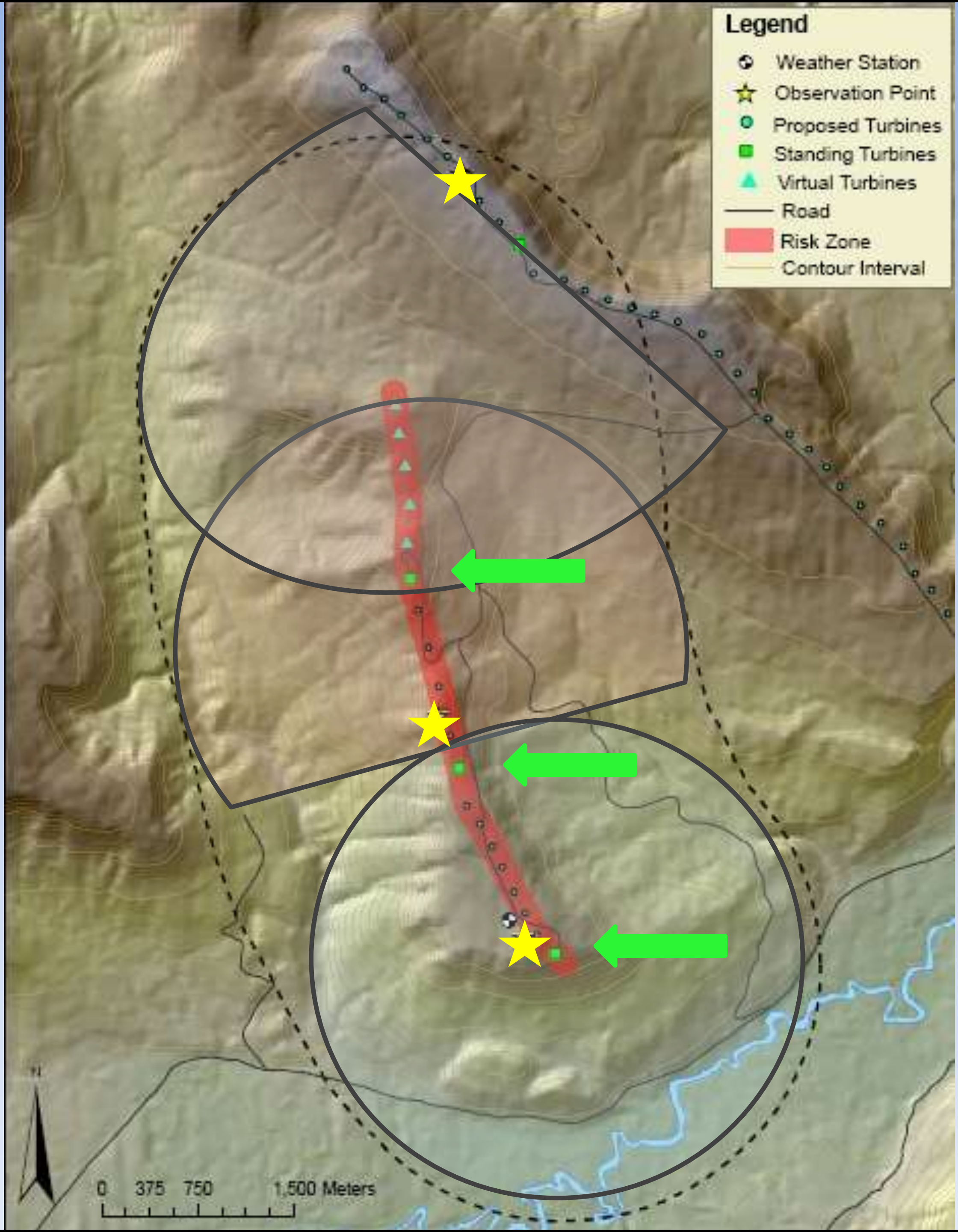
0 750 1,500 3,000 Meters

Methods - Field

- Surveyed between September 13 to October 24th, 2009
- Surveyed for 6 hours/day, between 900-1530 hrs
- 3 observation sites
  - Surveyed 2/day (3 hours each)
  - Rotated between sites to cover different time blocks (am/pm)

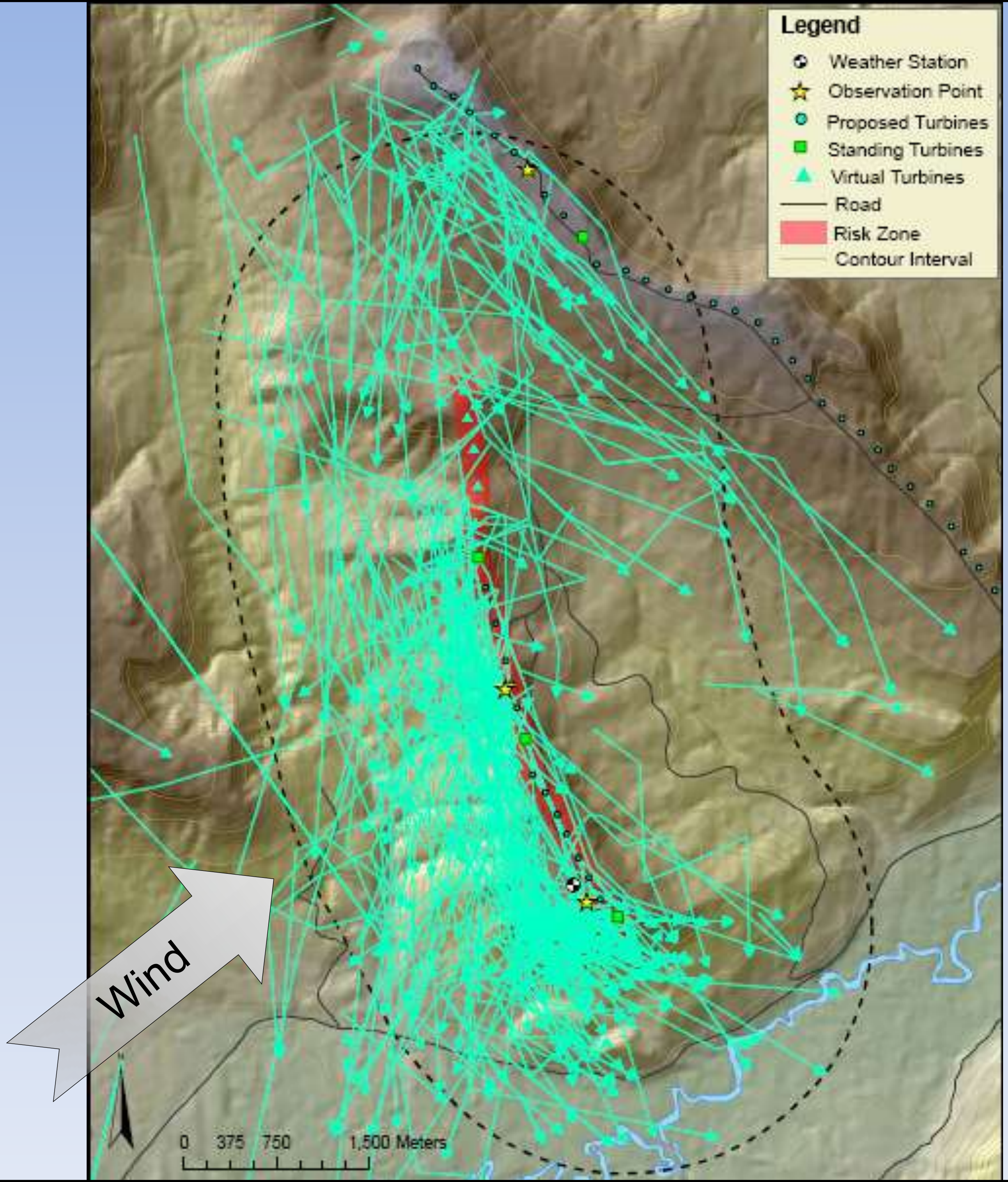
Methods - Field

- Collected 3D points of bird locations
  - Compass for direction
  - Clinometer for altitude relative to observer
  - Horizontal distance estimation
    - Horizontal distance using maps with known distance rings
- Used same experienced observers (Band et al. 2007)
- Focused the collection of points for eagles that approached the ridge-top


Legend
Weather Station
Observation Point
Proposed Turbines
Standing Turbines
Virtual Turbines
Road
Risk Zone
Contour Interval
0 375 750 1,500 Meters

Methods – Data Handling

- Simple trigonometry to create bird locations
- Imported 3D points into GIS
  - ET Geowizard to create tracks and obtain flight heights (above ground level) (Tchoukanski 2003)
- Obtained flight heights upon entry to a **risk-zone** (100m buffer of proposed turbine string)
- Statistical analysis using R
- Onset™ weather station collected weather variables at 2 m above ground (1215 m)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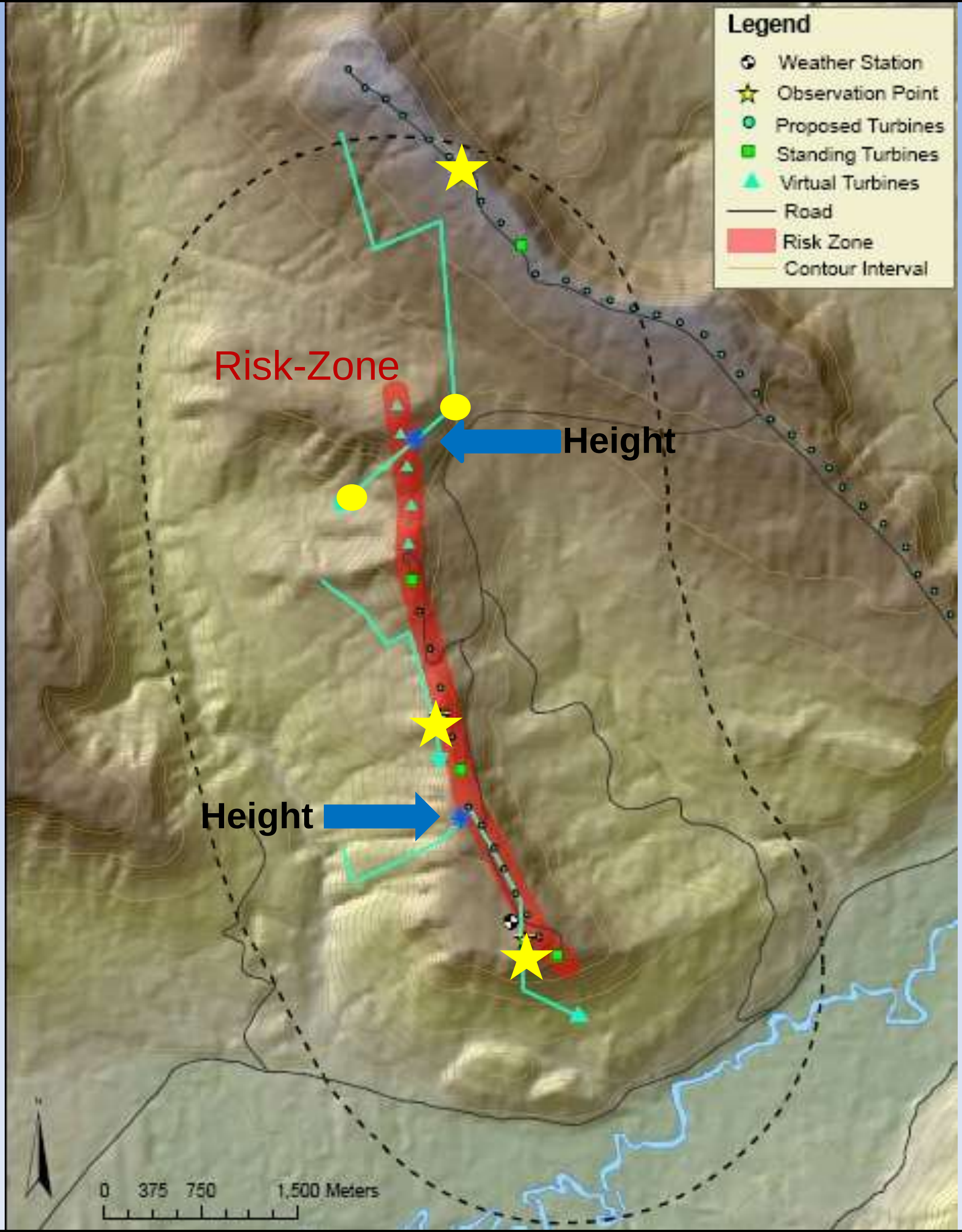

Legend
Weather Station
Observation Point
Proposed Turbines
Standing Turbines
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Road
Risk Zone
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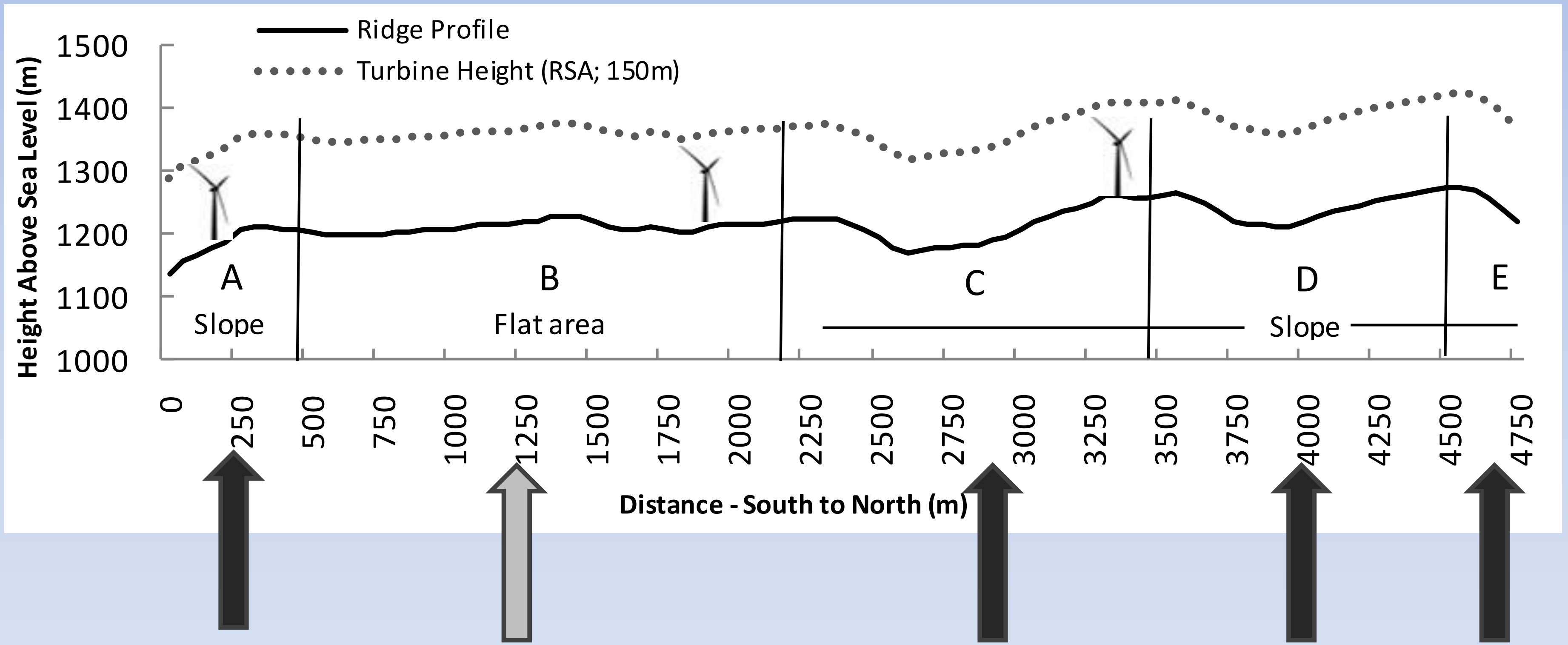
Risk-Zone
Height
Height
0 375 750 1,500 Meters

Ridge-Top Topography

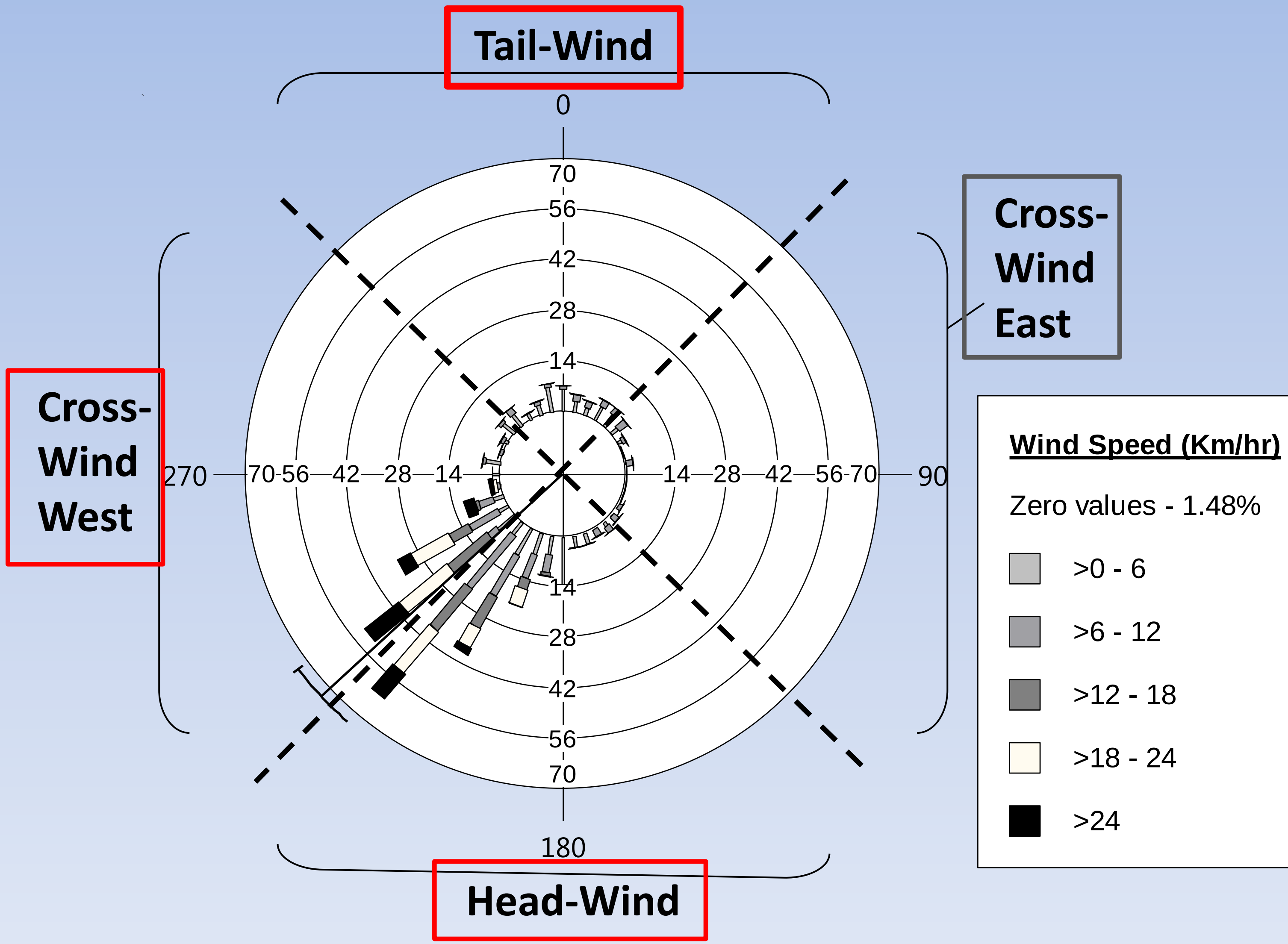
sloped versus flat sections



<u>Sloped</u>: grade 18-24; <u>Flat</u>: grade 1-2

Wind Direction Categories

Wind Speed by Direction – Fall 2009



Statistical Analysis

- Mixed-effects model to determine what variables, if any, were associated with heights of eagles as they entered the risk-zone.
  - <u>Variables</u>: **Weather** (wind speed and direction, temperature, relative humidity, cloud cover, and cloud ceiling height); **topography** (sloped or flat areas); **flight behavior** (circle-soaring, soaring or powered-flight); **date**; **time** (am/pm); and **age** (adult-looking, juvenile-looking, unknown).
  - Observation site = random effect

Results - Overview

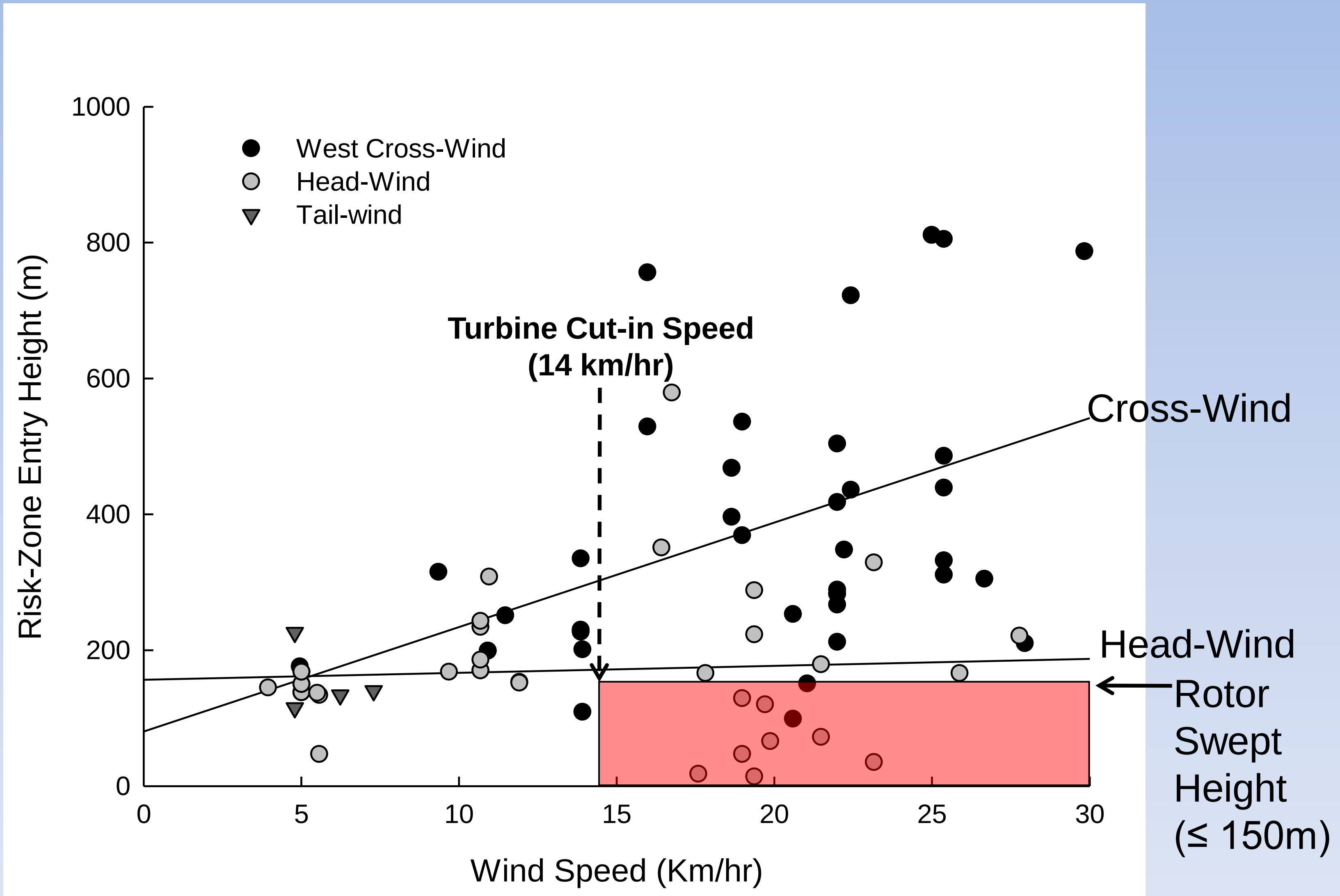
- Of the **417** golden eagles detected within 2km of the study ridge, approximately **20% (*n* = 81)** entered the risk-zone (100 metres from the turbine string)
- Of the 81 birds, **12% (*n* = 10)** entered the risk-zone at ***rotor swept height (≤ 150 m)*** and at winds ***above turbine cut-in speed (14 km/hr)***
  - This represents **2.5%** of birds detected within 2km

Results – Statistical Model

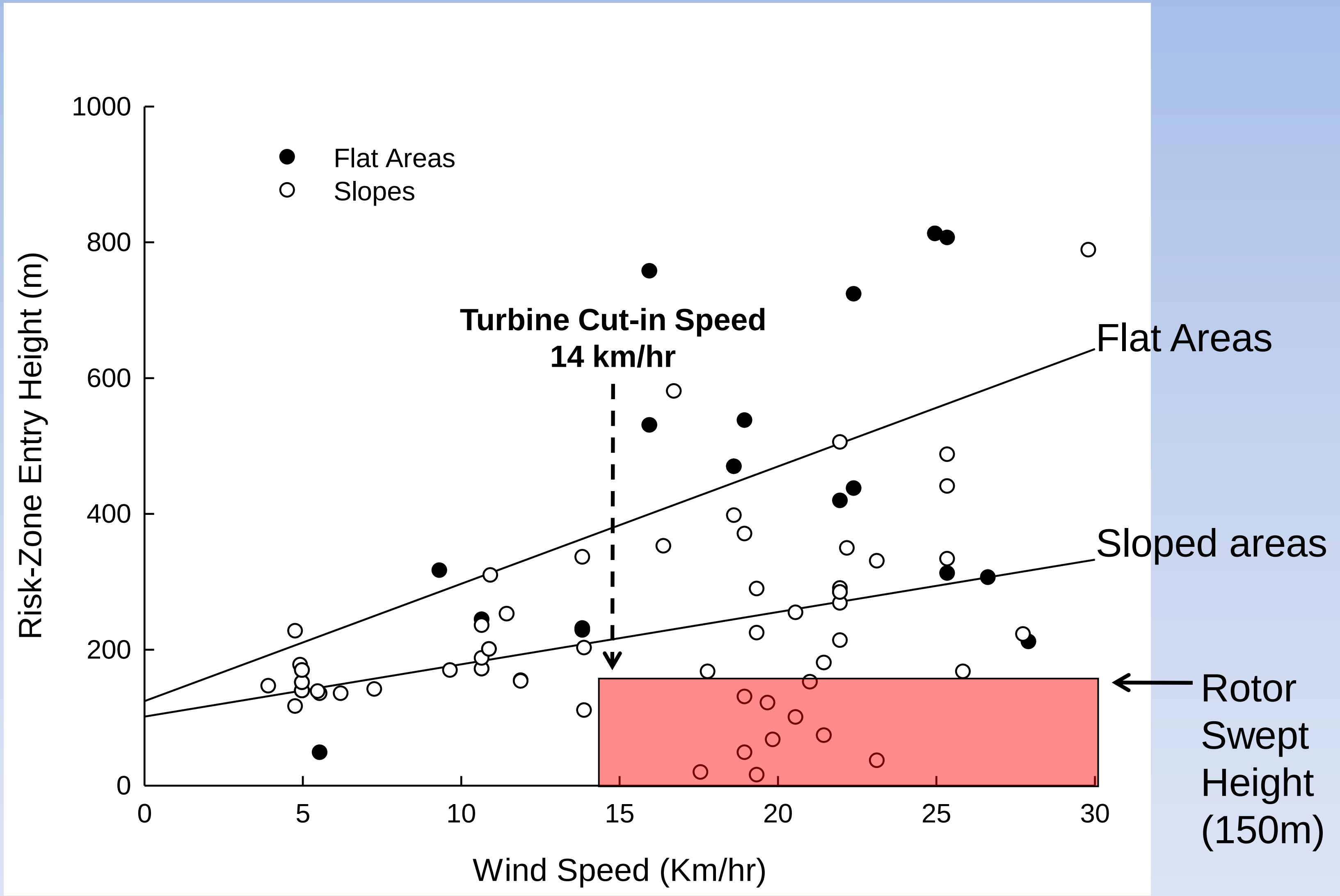
Heights for eagles that entered the risk-zone:

- Positively correlated with **wind speed** ($F_{1,74}$ = 4.446, P = 0.038)
- Lower under **head-winds** compared to cross- and tail-winds ($F_{2,74}$ = 8.402, $P \leq 0.001$; Tukey ($|t|$ = 4.065, $P \leq 0.001$))
- Lower over **sloped topography** features compared to flat areas ($F_{1,74}$ = 8.627, P = 0.004)

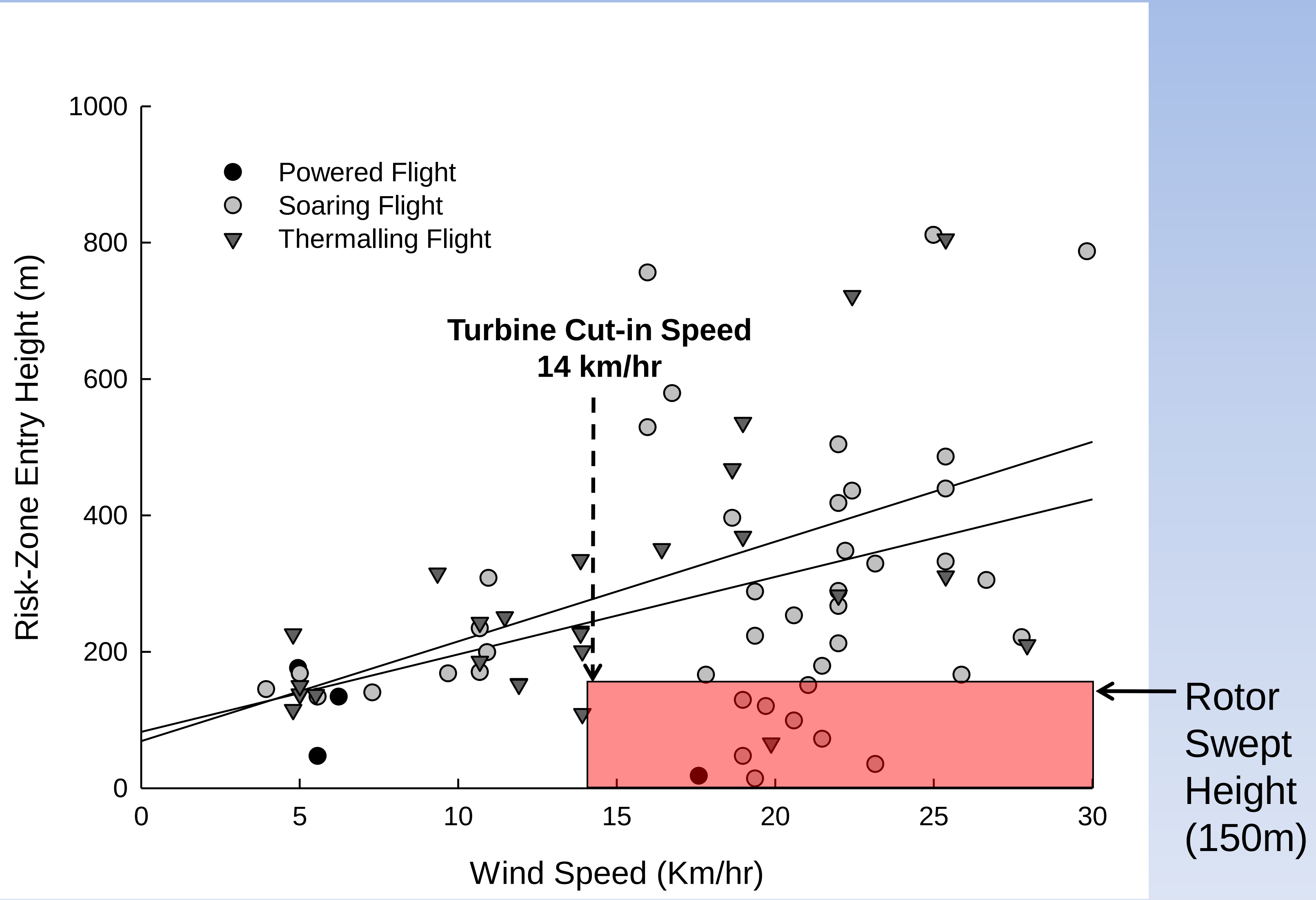
Results - Wind Direction



Results - Topography Type



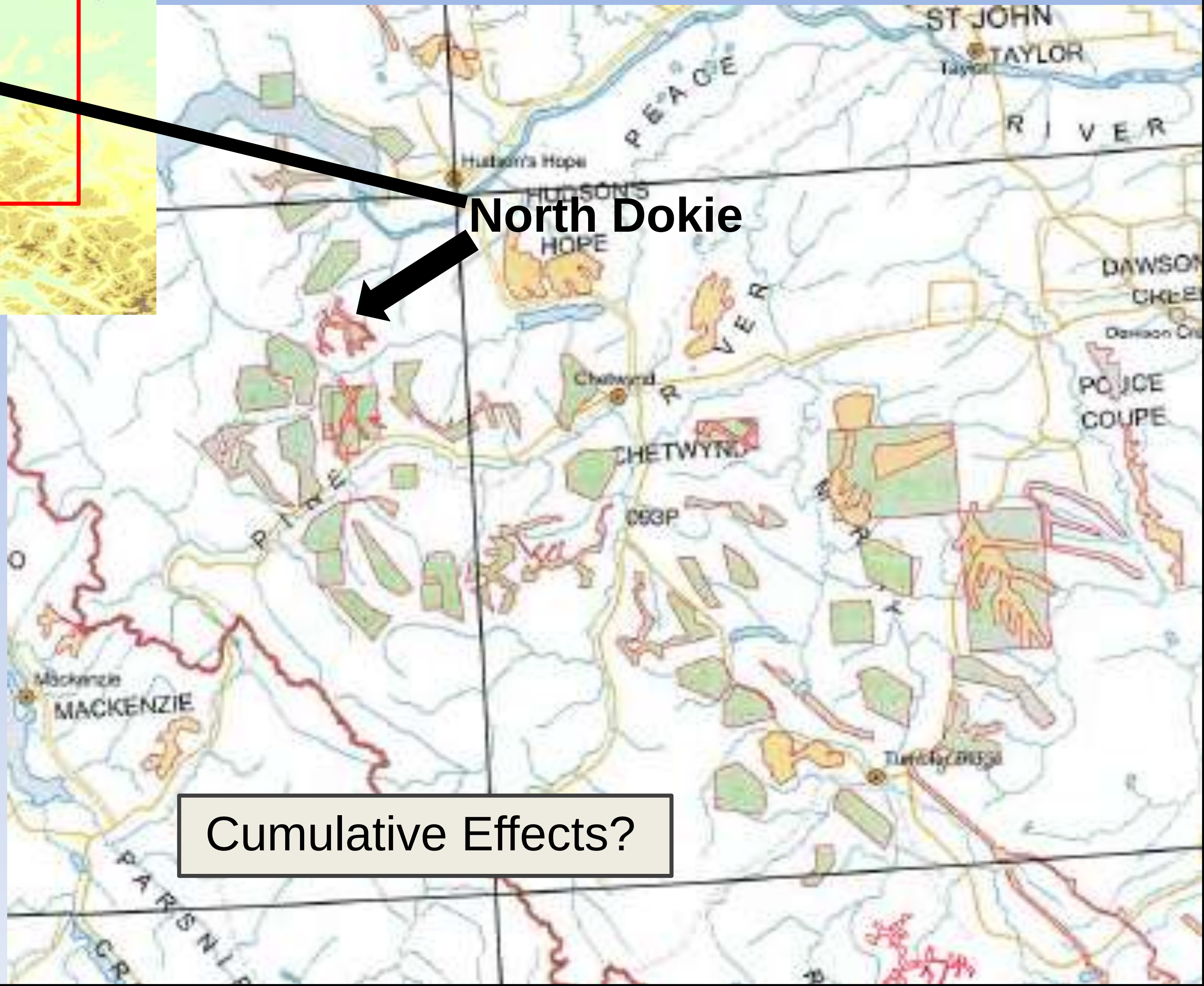
Results – Flight Behavior



Conclusions

- GOEA flight heights as they entered the risk-zone were **lower under head-winds regardless of wind speed**
- Heights were **lower over sloped topography**
- Circle-soaring flight not observed within RSH at winds above turbine cut-in speed
- Post-operation observations needed to quantify avoidance behaviours

Wind Power Land Tenures in the Peace Region 2006



North Dokie

Cumulative Effects?

Acknowledgements

Logistic Support

- *Nancy Alexander, UNBC*
- *Andrea Pomeroy, Stantec Inc.*
- *Plutonic Power – Dokie Wind Partnership*

Funding

- *NSERC Industrial Postgraduate Scholarship*
- *Environment Canada*
- *NSERC Strategic Projects Grant*
- *Stantec Inc.*