Environment Canada Environnement Canada

Canada

# Cassin's Auklet at-sea distribution and exposure to stressors such as ship-source oil pollution and microplastics

**PICES, Yeosu, 23 October 2014**

**Patrick O'Hara**

**Canadian Wildlife Service - Environmental Stewardship Branch**

# Co-authors:

- Ken Morgan – Canadian Wildlife Service (EC)
- Jamie McDevitt-Irwin – Biology, University of Victoria, BC
- Jean-Pierre Desforges – Fisheries and Oceans Canada
- Peter S. Ross – Ocean Pollution Research, Vancouver Aquarium
- Sean Boyd – Science and Technology (EC)

## Thanks also to:

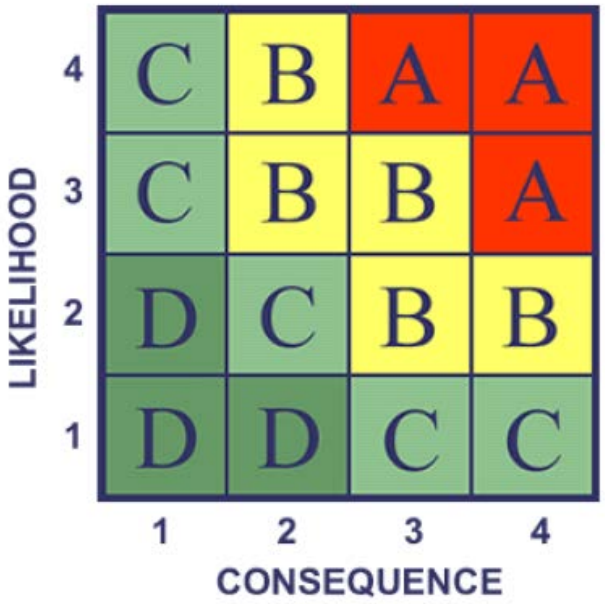
- Norma Serra-Sogas – Geography, University of Victoria
- Allan Roberts - Bamfield Marine Sciences Centre

# Spatial Risk Analysis Model

## Risk = Likelihood x Consequence

**Likelihood**
of stressor

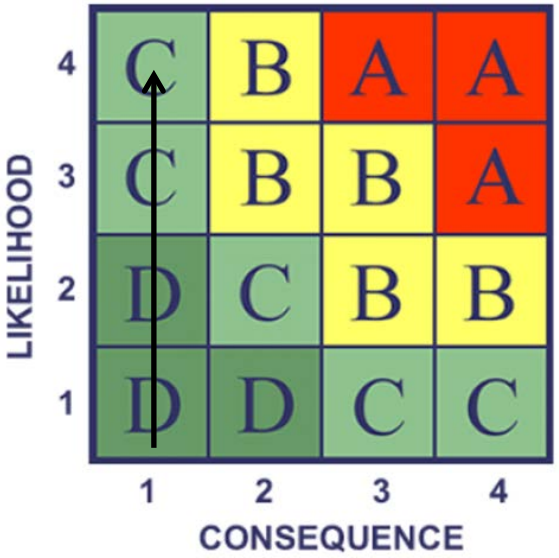
**Consequence**
of stressor should it occur



# Cassin's Auklet (CAAU)




- Long-lived/low reproductive rates
- ~55% global population breeds on Triangle Island
- Breeding: vulnerable to higher frequency smaller scale stressors



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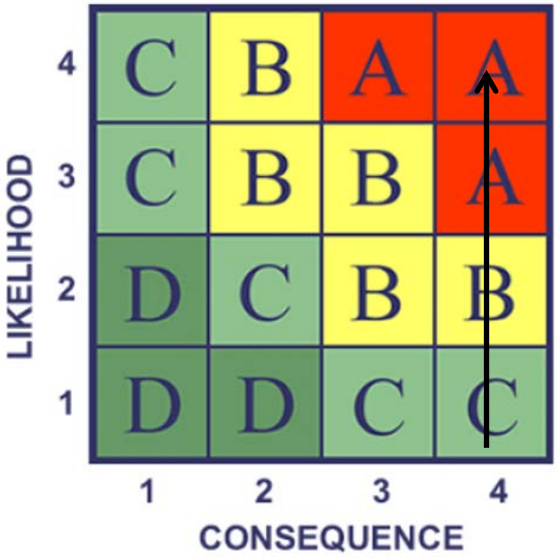

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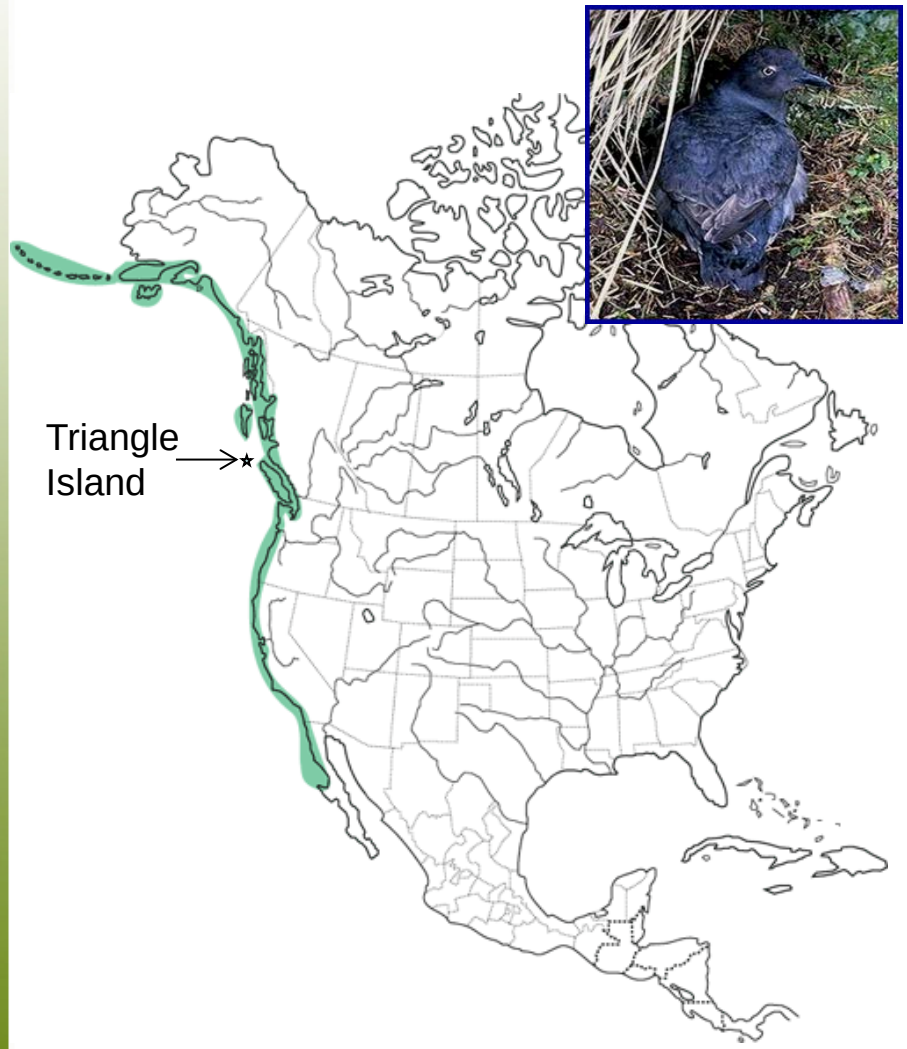


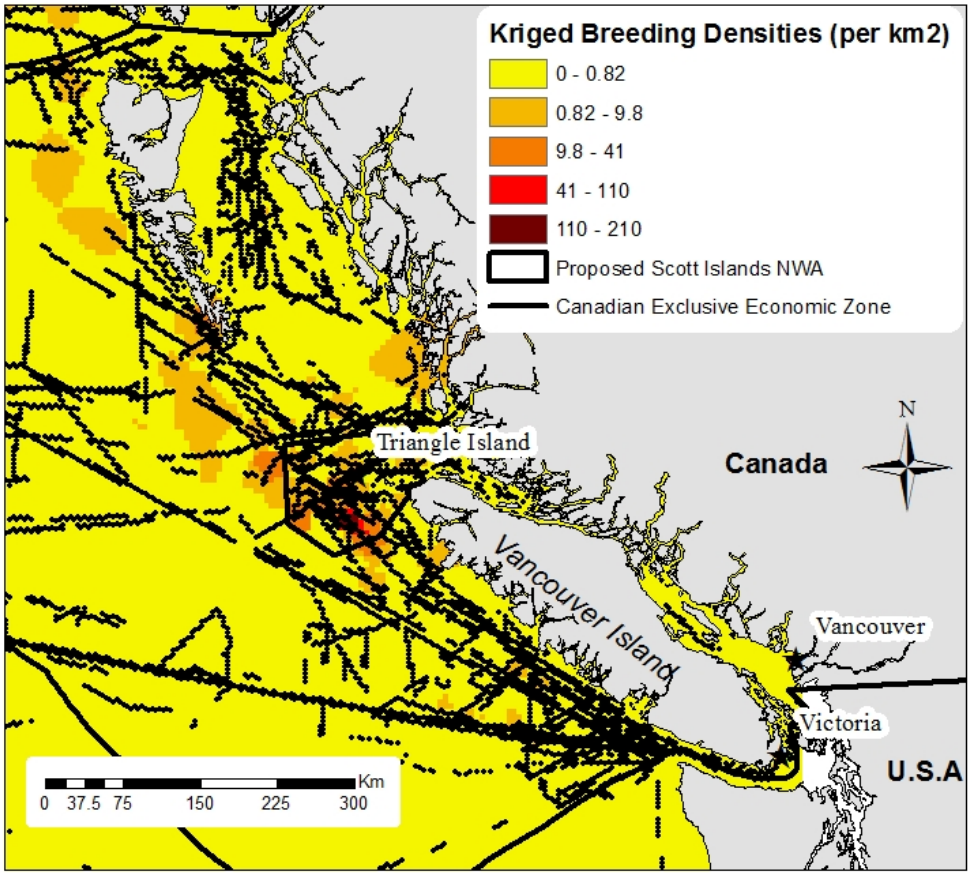

Current efforts in Canada to ensure CAAU conservation:

- Scott Island Marine National Wildlife Area (MWA)
- Review for designation for protection under Species at Risk Act (SARA)

Risk assessment:

- At-sea foraging distributions
- Stressors

# Exposure for Cassin's Auklet




At-sea survey data

- Ships of Opportunity
- 1995-2010
- Breeding (15 Mar – 31 Aug)

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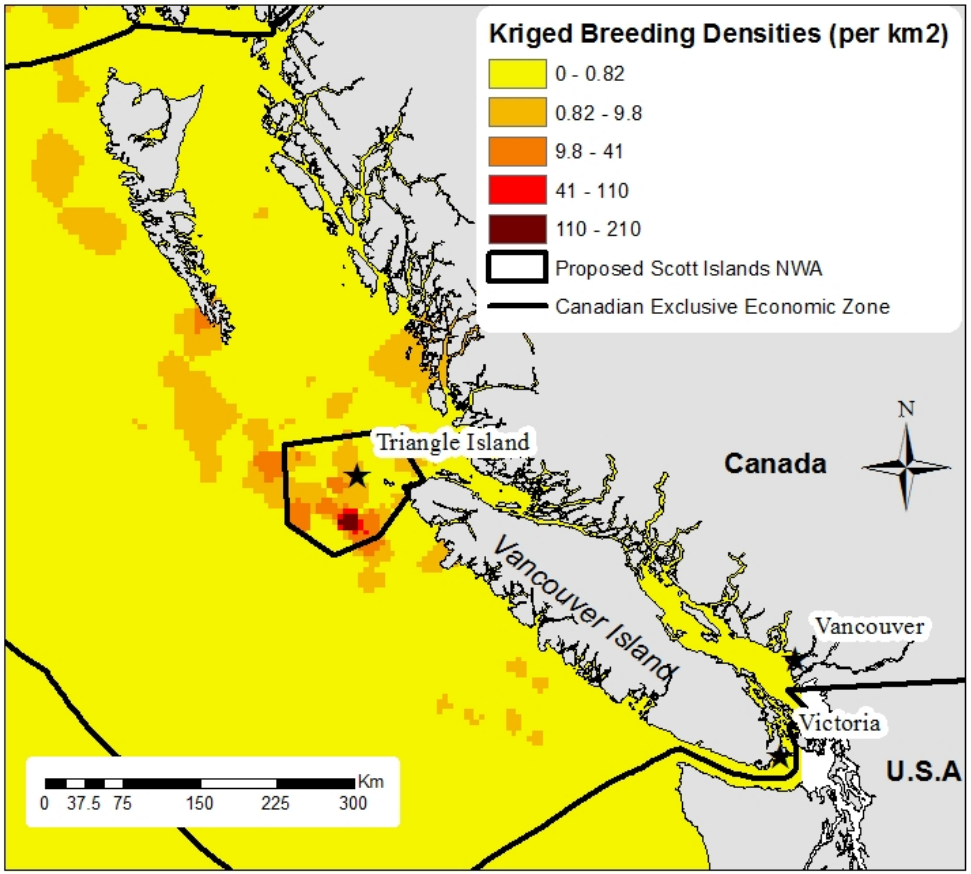


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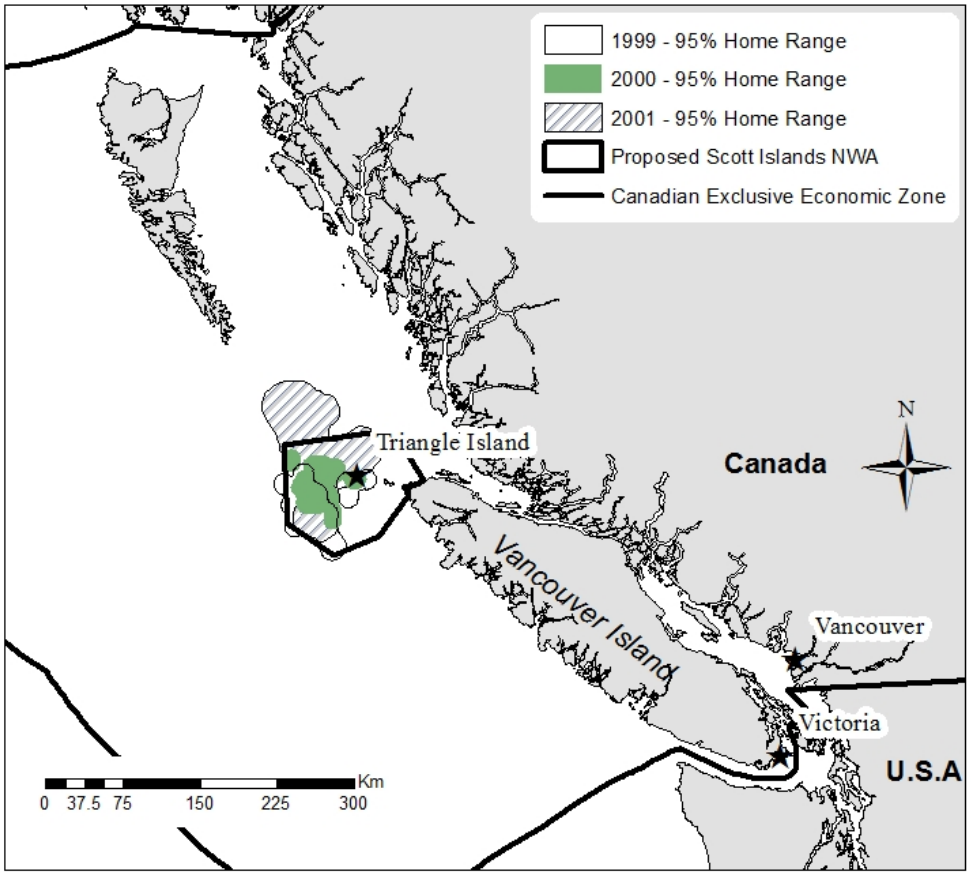
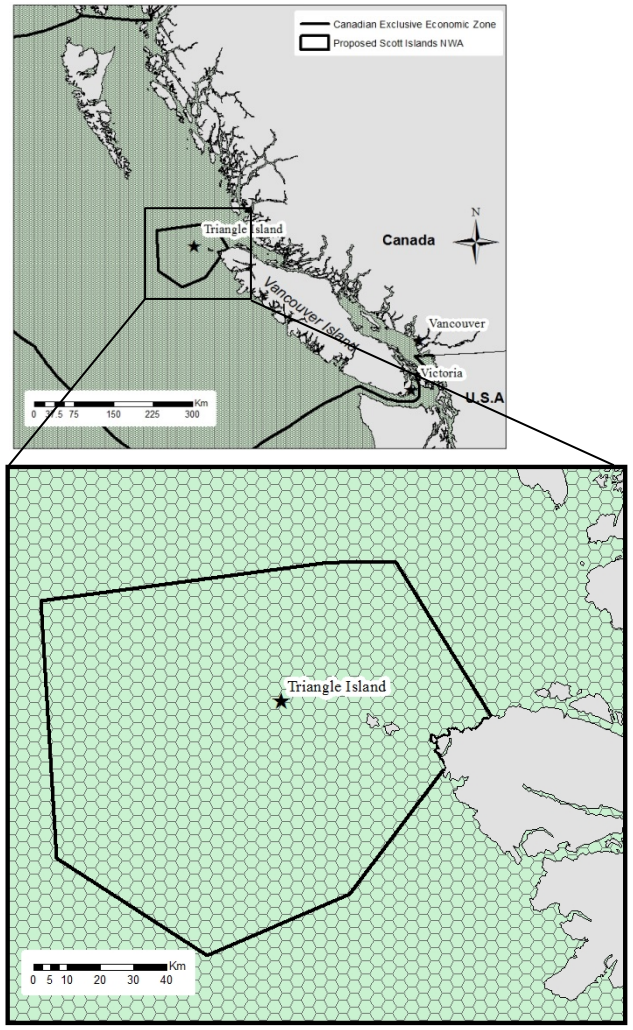



At-sea survey data
- Ships of Opportunity
- 1995-2010
- Breeding (15 Mar – 31 Aug)

Radiotelemetry
- Triangle Island breeders
- 1999-2001

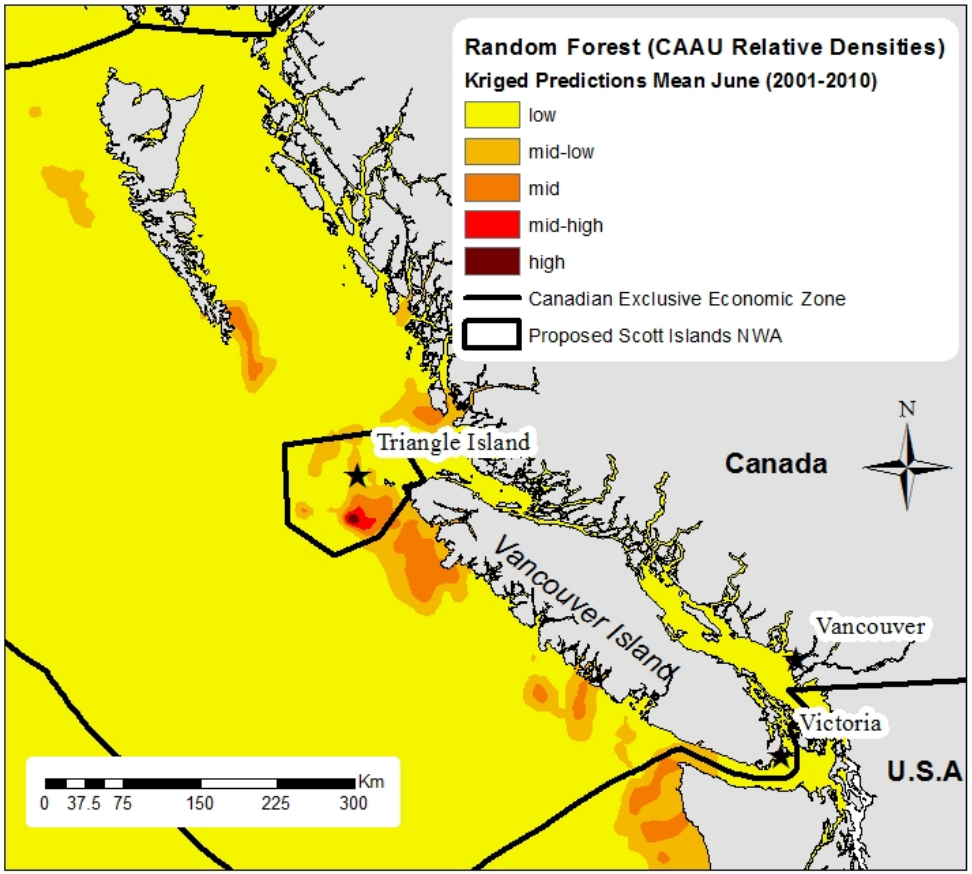
*Boyd et al./The Auk 125 (2008)158–166*

# Random Forest




- Variables:
  - Response = Density
  - Temporally constant predictors
    - Latitudes/Longitudes
    - Proximity (colonies, shore, canyons, shelf break, sea mounts)
    - Bottom topography (depth, slope, aspect, rugosity)
  - Temporally variable predictors
    - SST, SST gradients, $Chl_{a,}$Sea-Surface-Height
    - Proximity to eddies
    - Years, Julian days
- Ensemble of 500 trees with minimum nodesize of 5
- Cross-validation techniques
  - Out Of Bag (OOB)
  - Random subsampling (30 iterations)

# Random Forest




## Prediction Accuracy

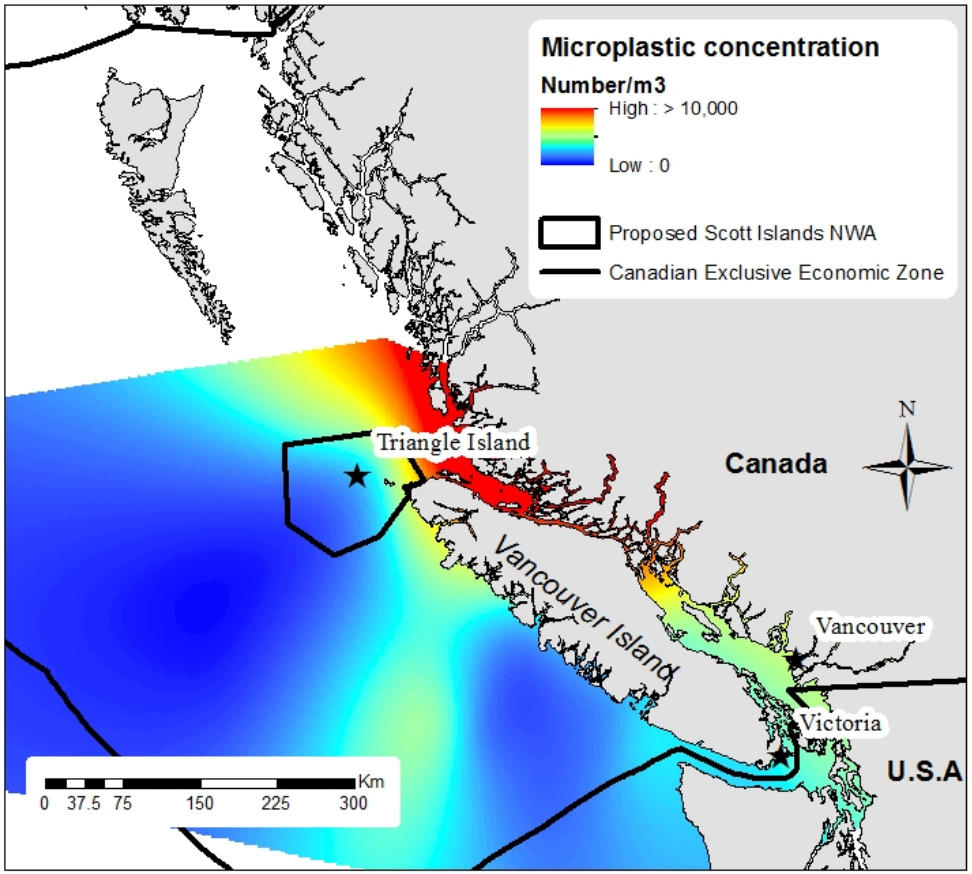
### Out of Bag (OOB)

- Mean Standard Error (MSE) = 39.1
- Pseudo-$r^2$ = 0.882

### Cross-Validation (20 iterations)

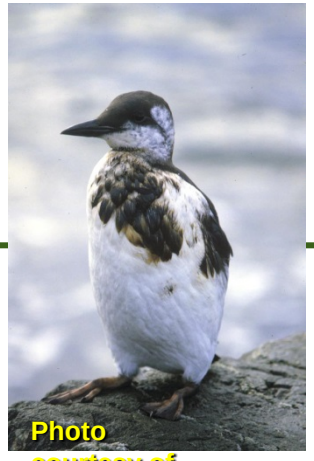
- MSE = 42.5 ± 2.2
- Pseudo-$r^2$ = 0.867 ± 0.038

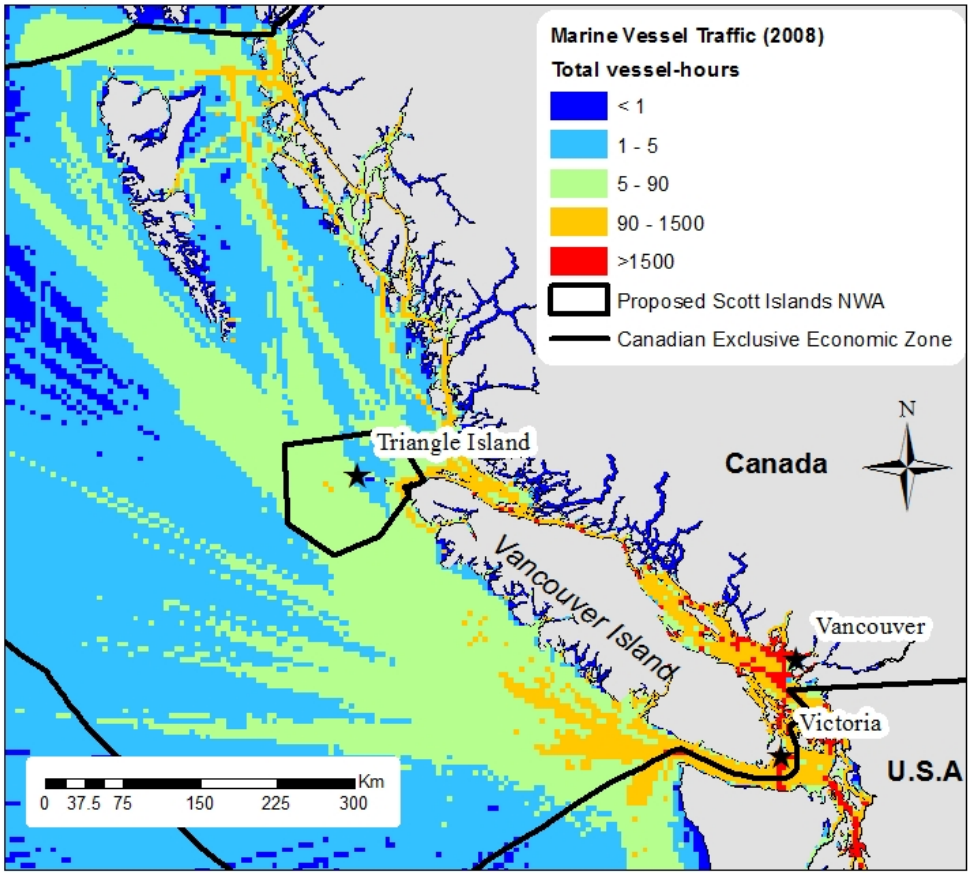
# Microplastic distribution




*Desforges et al./Marine Pollution Bulletin (2014)*

# Oily Discharges




Traffic as a proxy for likelihood

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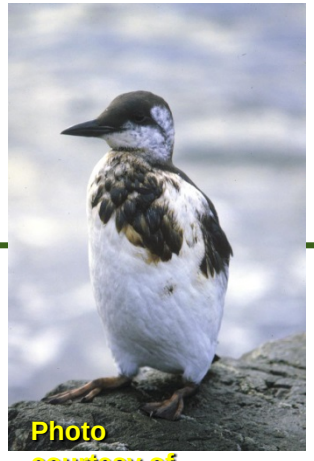
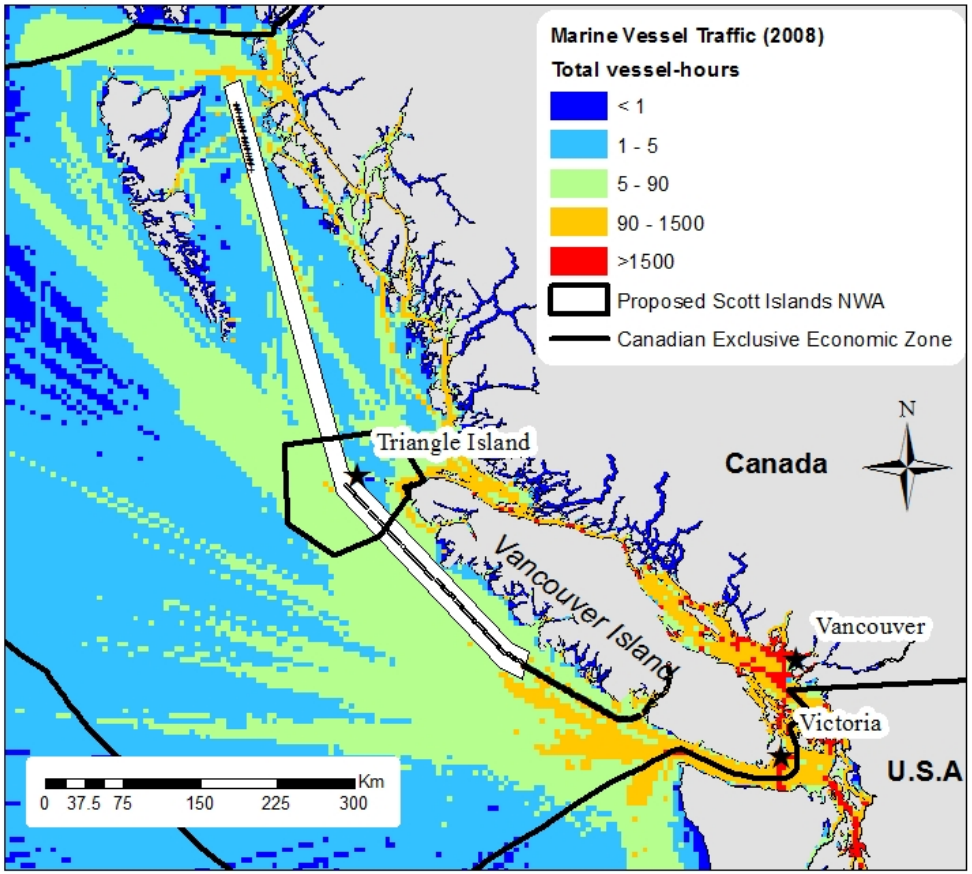
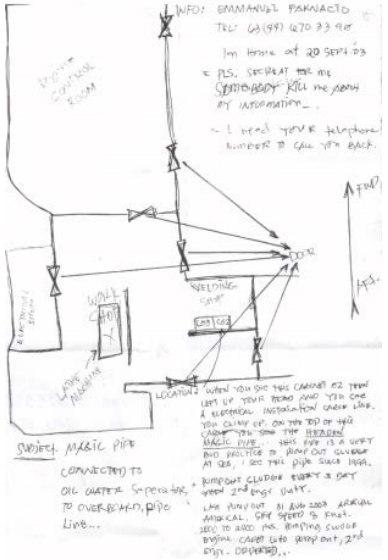
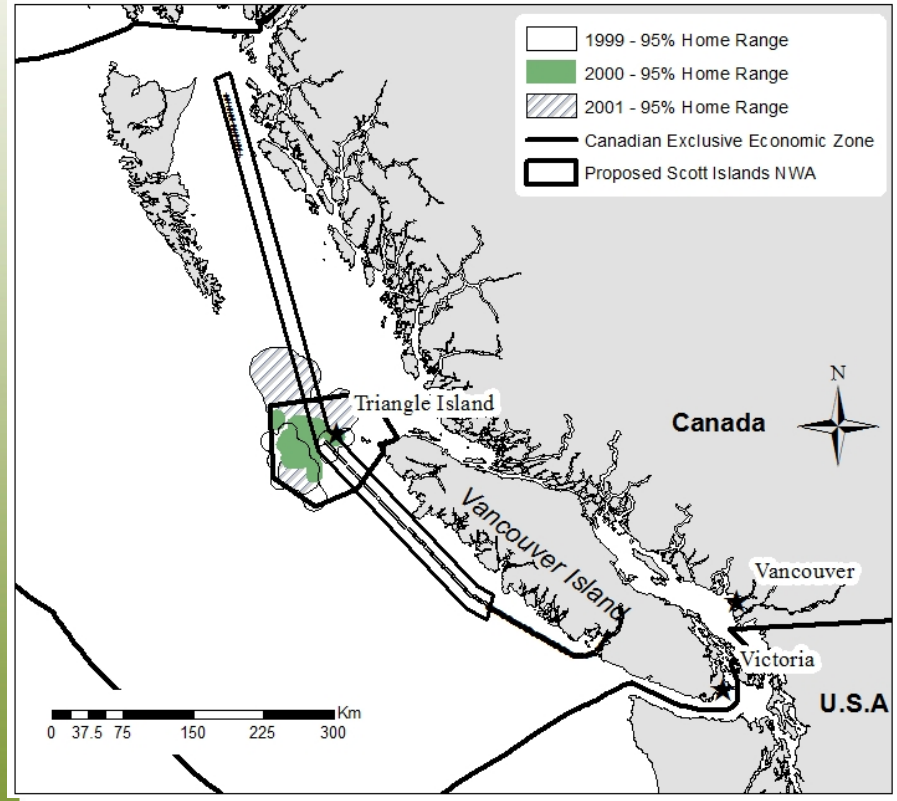


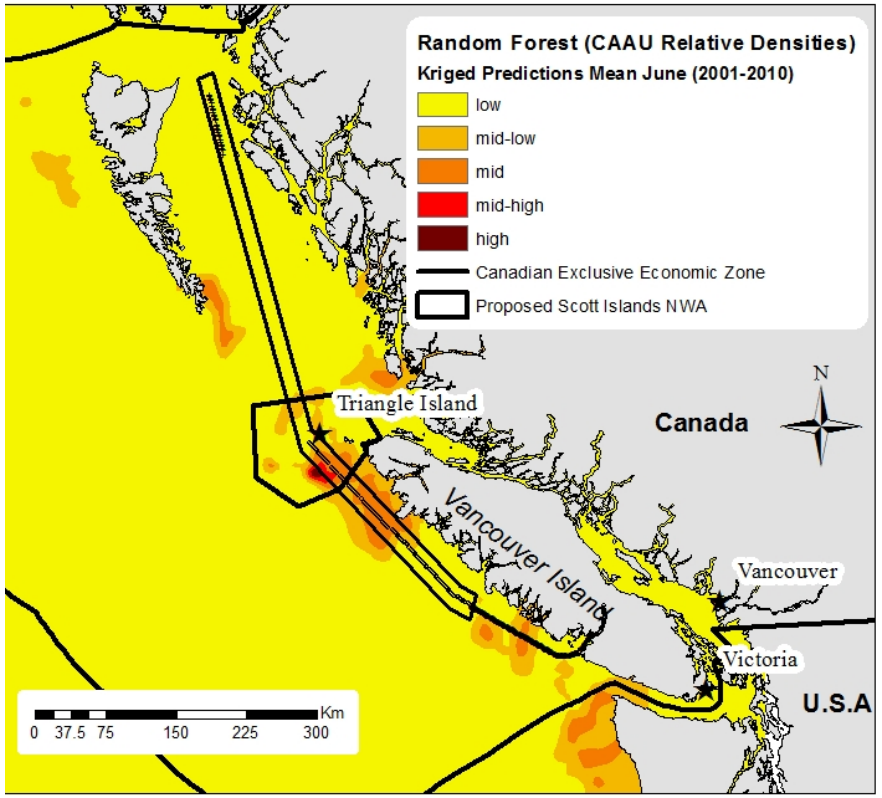




Traffic as a proxy for likelihood
Vessel tracks of known polluters

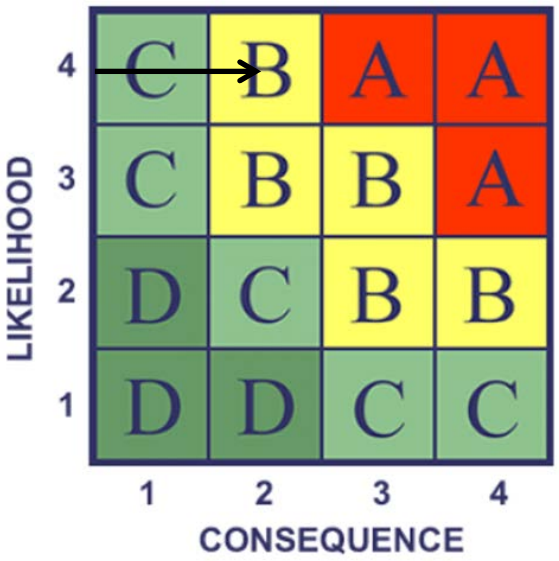


# Polluter and CAAU



# Conclusion




- Increased Consequence = CAAU aggregated breeding distributions makes them particularly vulnerable to coastal stressors
  - Likely exposed to microplastics – not clear how vulnerable/sensitive CAAU are

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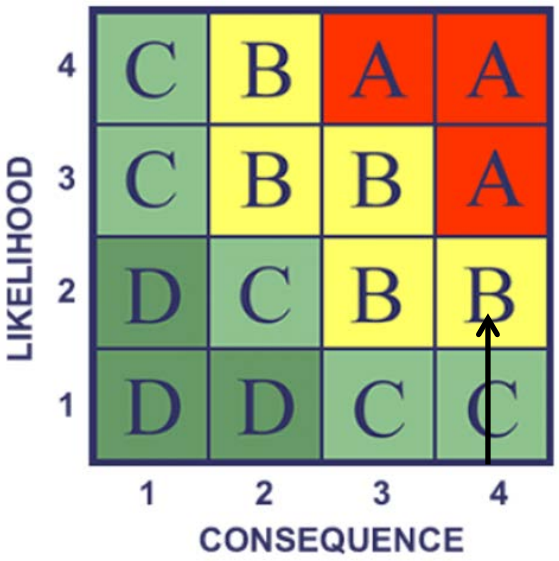


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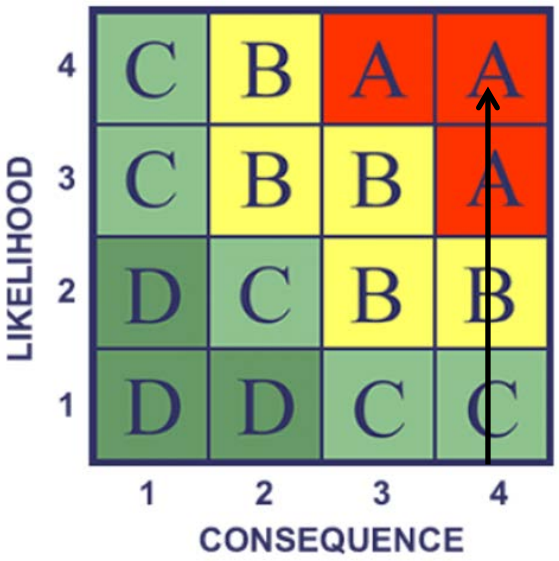


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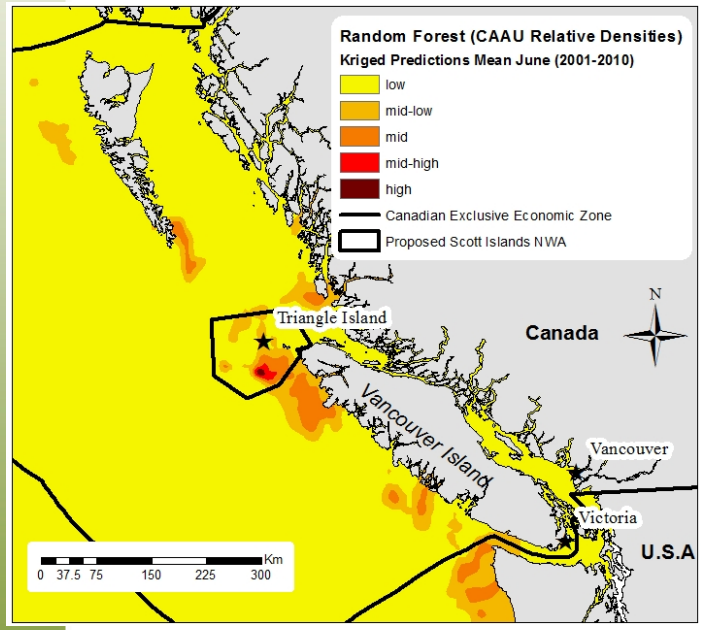


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  - Likely exposed to microplastics – not clear how vulnerable/sensitive CAAU are
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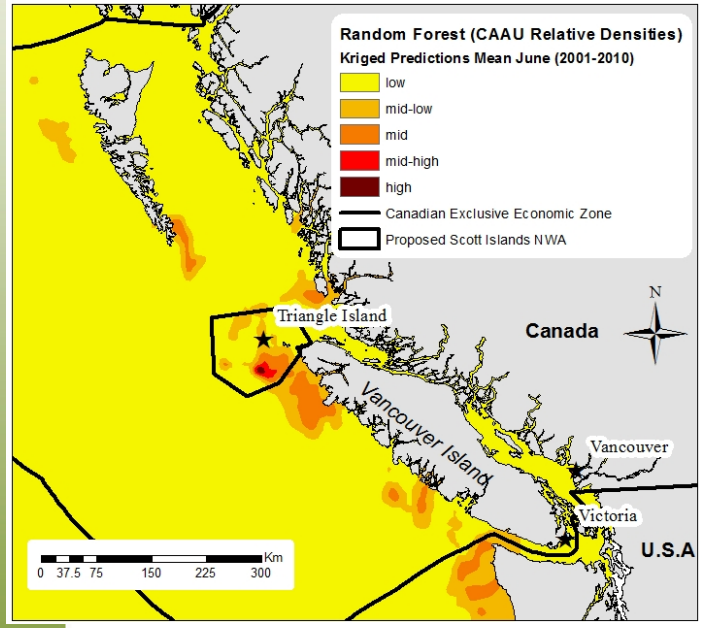
- Are current Canadian efforts to ensure their conservation sufficient?
  - Scott Island Marine MWA
    - Boundary designation
    - Enforcement legislation, policy, infrastructure
  - Species at Risk designation for protection
    - Trends dependent
    - Little precedent for protecting marine habitat

# Conclusion




- Random Forest works well for CAAU (apparently)
  - Compare with other SDM techniques/ensemble modeling
  - Predict radiotelemetry (1999-2001)
  - Compare and predict satellite tracking (current)

# Thank You!

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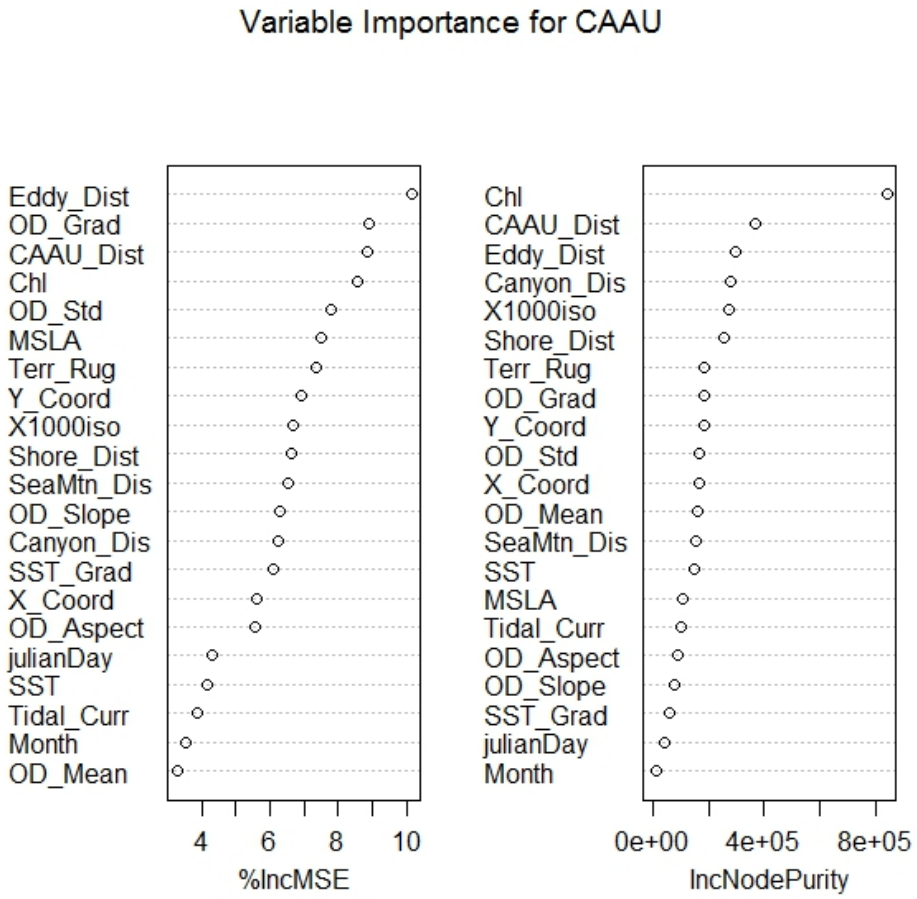
# Variable Importance



# Partial Prediction Plots