

# Canada



# Cassin's Auklet at-sea distribution and exposure to stressors such as shipsource 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



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# **Spatial Risk Analysis Model**

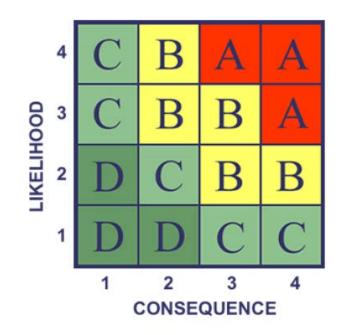
### Risk = Likelihood x Consequence

### Likelihood

of stressor

### Consequence

of stressor should it occur

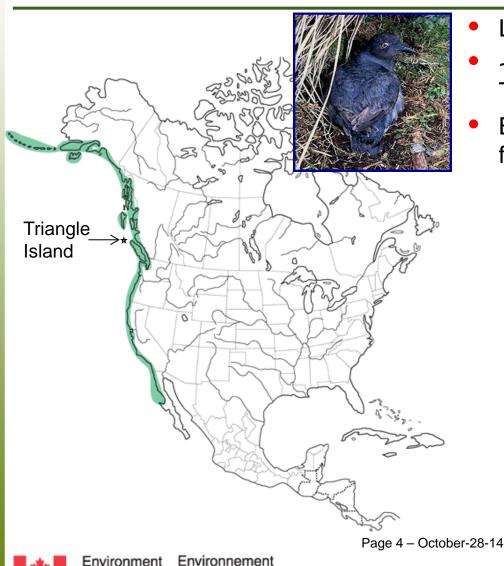




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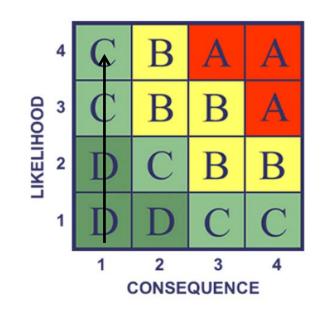
# Cassin's Auklet (CAAU)



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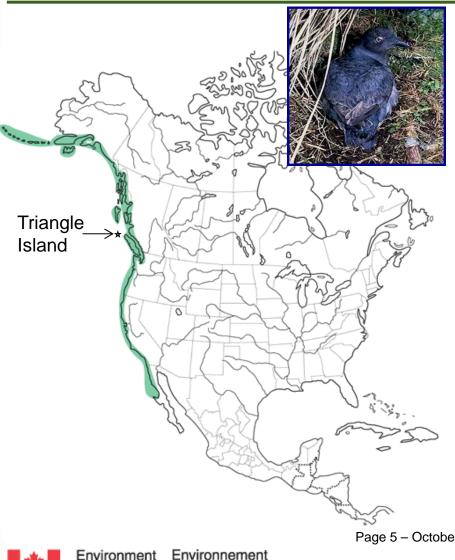
Canada

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





# Cassin's Auklet (CAAU)

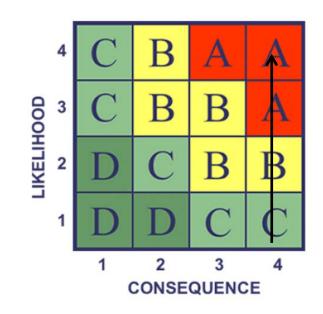


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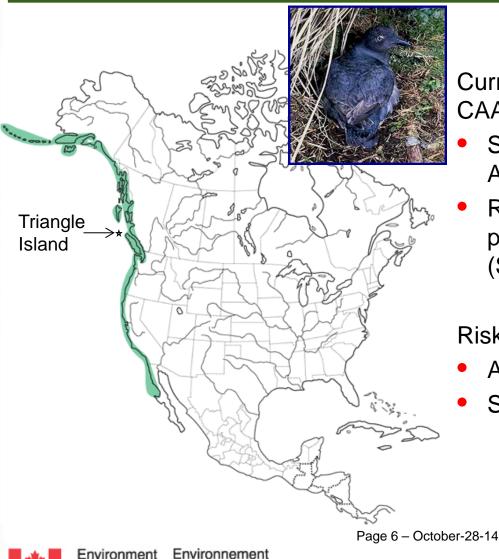
- Long-lived/low reproductive rates
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# Cassin's Auklet (CAAU)



Canada

Canada

Current efforts in Canada to ensure CAAU conservation:

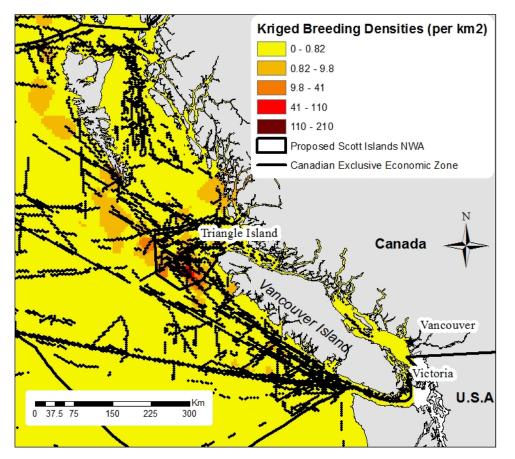
- Scott Island Marine National Wildlife Area (MWA)
- Review for designation for protection under Species at Risk Act (SARA)

Risk assessment:

- At-sea foraging distributions
- Stressors



# **Exposure for Cassin's Auklet**



### At-sea survey data

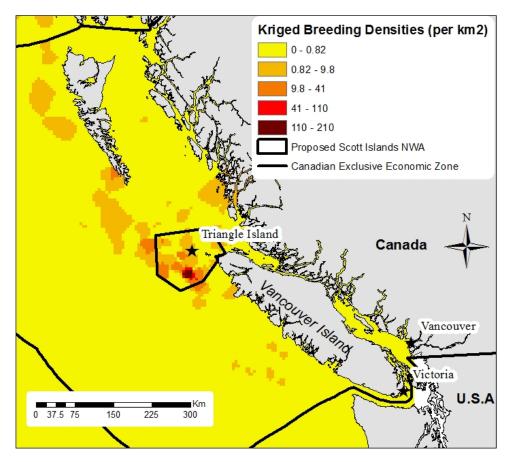
- Ships of Opportunity
- 1995-2010
- Breeding (15 Mar 31 Aug)



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# **Exposure for Cassin's Auklet**



#### At-sea survey data

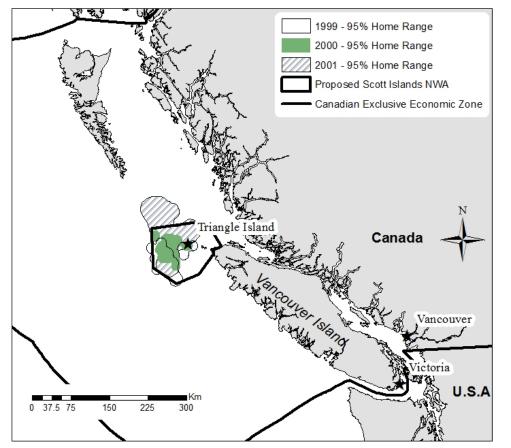
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# **Exposure for Cassin's Auklet**



#### At-sea survey data

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

### Radiotelemetry

- Triangle Island breeders
- 1999-2001

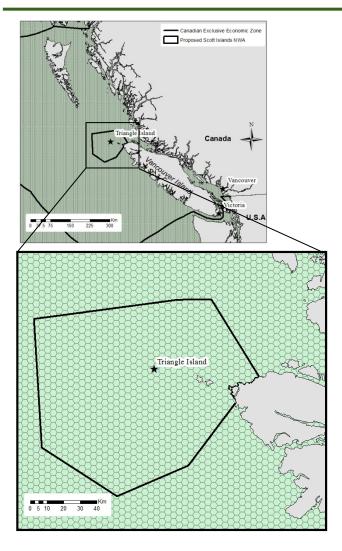
Boyd et al./The Auk 125 (2008)158–166



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## Random Forest



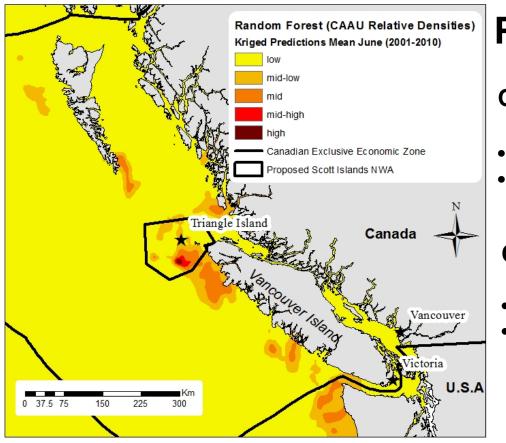
- Variables:
  - Response = Density
  - Temporally constant predictors
    - Latitudes/Longitudes
    - Proximity (colonies, shore, canyons, shelf break, sea mounts)
    - Bottom topography (depth, slope, aspect, rugosity)
  - Temporally variable predictors
    - SST, SST gradients, Chl<sub>a</sub>,Sea-Surface-Height
    - 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)



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## **Random Forest**



### **Prediction Accuracy**

### Out of Bag (OOB)

- Mean Standard Error (MSE) = 39.1
- Pseudo-r<sup>2</sup> = 0.882

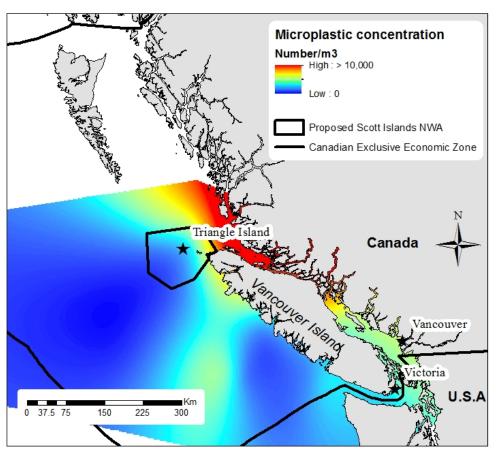
### **Cross-Validation (20 iterations)**

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





## **Microplastic distribution**





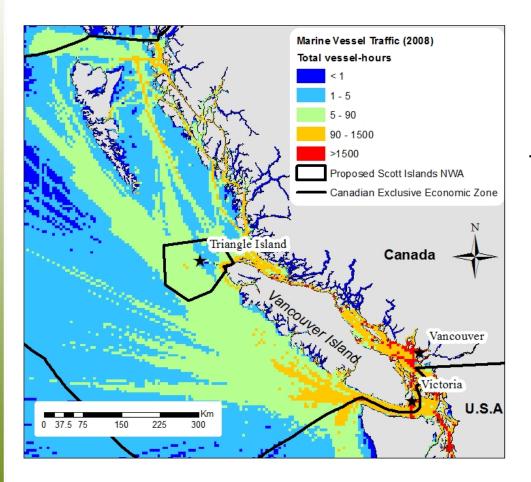
Desforges et al./Marine Pollution Bulletin (2014)



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# **Oily Discharges**





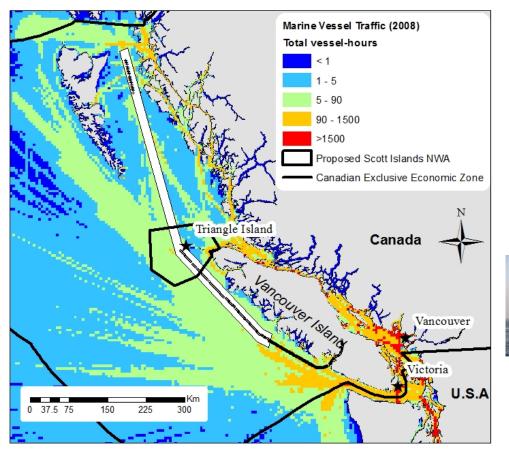
courtesy of Ken Morgan

### Traffic as a proxy for likelihood





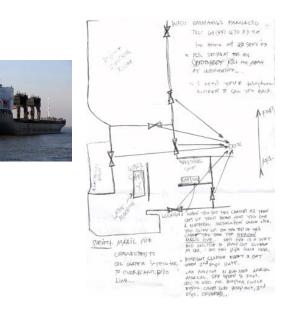
# **Oily Discharges**





Ken Morgan

### Traffic as a proxy for likelihood Vessel tracks of known polluters

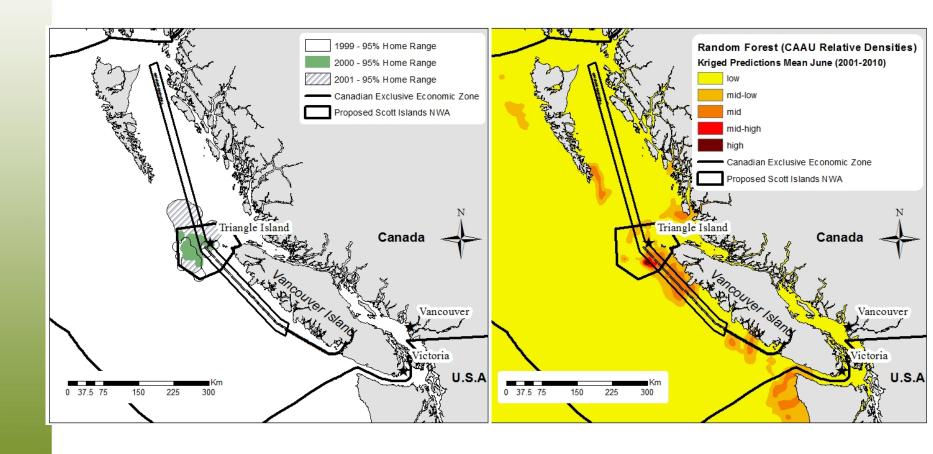




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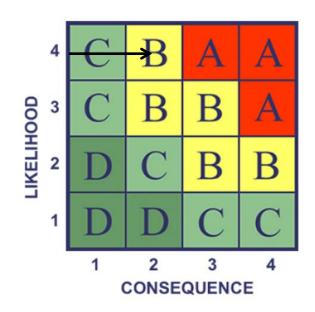
# **Polluter and CAAU**





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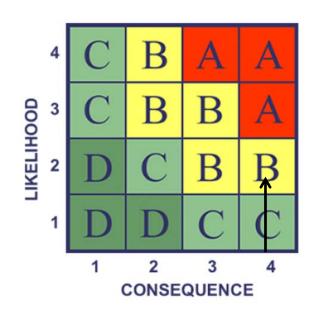




- Increased Consequence = CAAU aggregated breeding distributions makes them particularly vulnerable to coastal stressors
  - Likely exposed to microplastics not clear how vulnerable/sensitive CAAU are



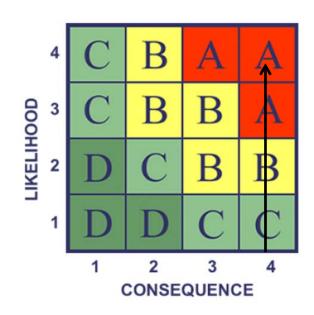




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  - Highly sensitive to exposure to oil, large proportion of global population exposed, likelihood unclear as this is an episodic stressor



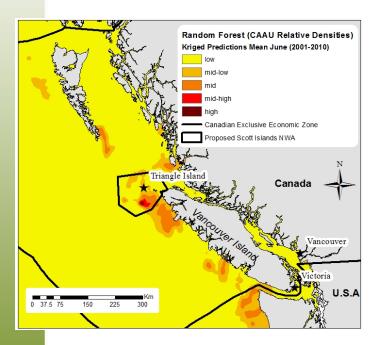




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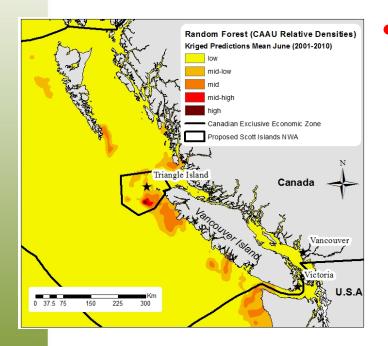


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- Are current Canadian efforts to ensure their conservation sufficient?
  - Scott Island Marine MWA
    - Boundary designation
    - Enforcement legislation, policy, infrastructure
  - Species at Risk designation for protection
    - Trends dependent
    - Little precedent for protecting marine habitat

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- 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!**

## 감사합니다



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## **Variable Importance**

Variable Importance for CAAU

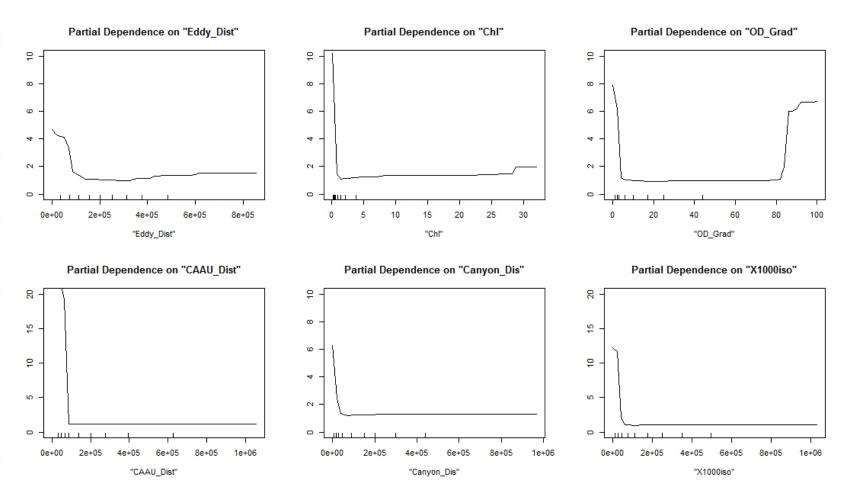
Eddy_Dist	······o	Chl	••••••	
OD Grad	0	CAAU_Dist	•••••	
CAAU Dist	••••••	Eddy Dist	•••••	
Chl –	0	Canyon_Dis	⊙	
OD_Std	·····	X1000iso	•••••	
MSLA	Θ	Shore_Dist	⊖	
Terr_Rug	0	Terr_Rug	•••••	
Y_Coord	•••••	OD_Grad	••••	
X1000iso		Y_Coord	••••	
Shore_Dist	Θ	OD_Std	•••••	
SeaMtn_Dis	0	X_Coord	•••••	
OD_Slope	0	OD_Mean	00	
Canyon_Dis	Θ	SeaMtn_Dis	•••••	
SST_Grad	0	SST	0	
X_Coord	•••••	MSLA	••••	
OD_Aspect	•••••	Tidal_Curr	00-	
julianDay	00	OD_Aspect	••••	
SST	⊙	OD_Slope	00	
Tidal_Curr	00	SST_Grad	•••	
Month	•••	julianDay	•••	
OD_Mean	0	Month		
4 6 8 10 0		e+00 4e+05 8e+05		
%IncMSE			IncNodePurity	



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### **Partial Prediction Plots**





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