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Environment and Climate Change Canada

Movement and foraging ecology affect
mercury exposure in breeding seabirds





Coauthors:

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1



McGill

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Climate Change Canada

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Changement climatique Canada

Acknowledgements

- Ján Veizer Stable Isotopes Lab



Parks Canada Parcs Canada

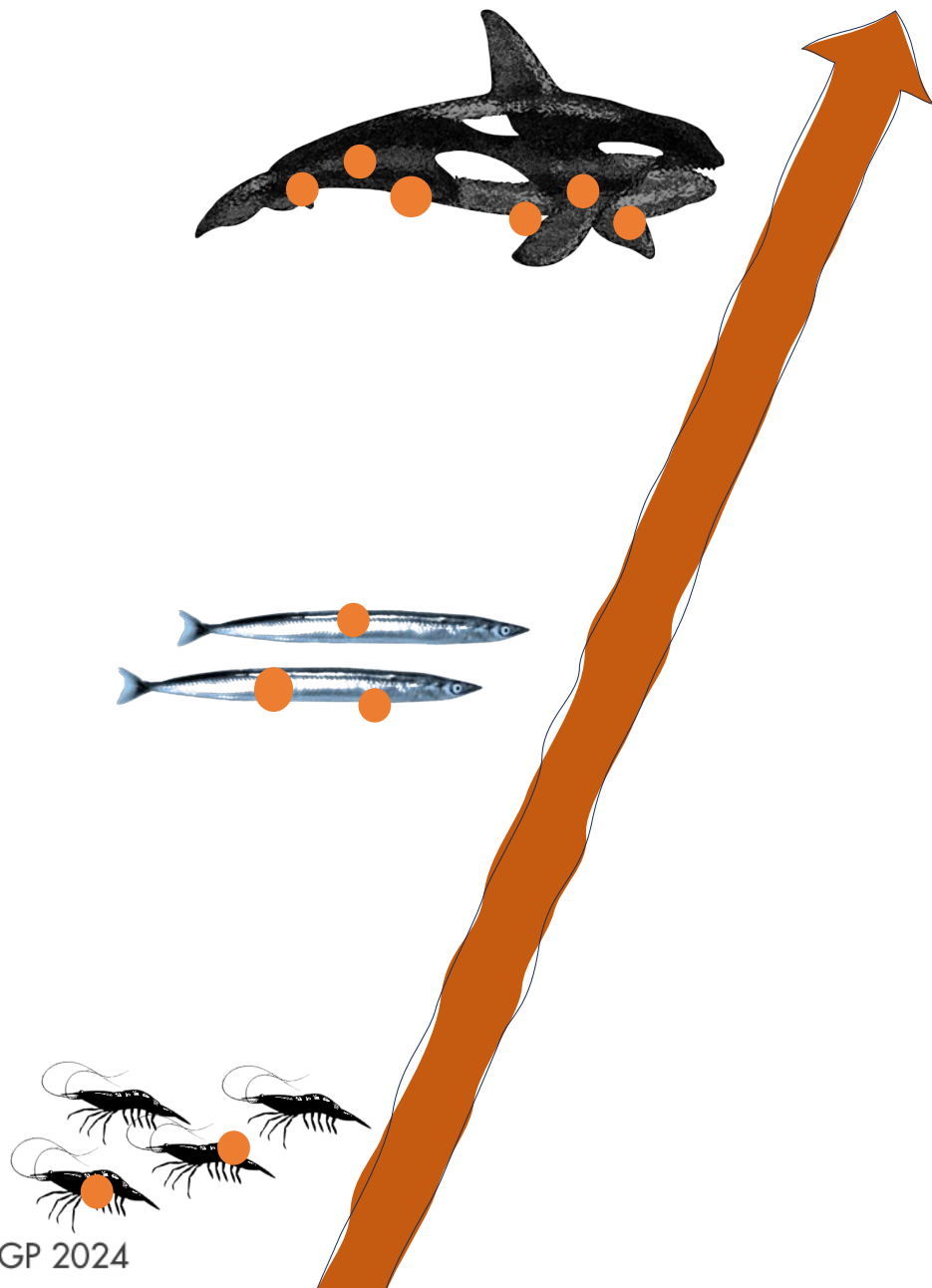


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Manon Sorais, Francis St-Pierre, Francis Van Oordt, Marie-Claude Roy, Adam Desjardins, Phil Bertrand





Mercury in our oceans

- Bioaccumulates and biomagnifies in aquatic ecosystems
- Concern for top predators

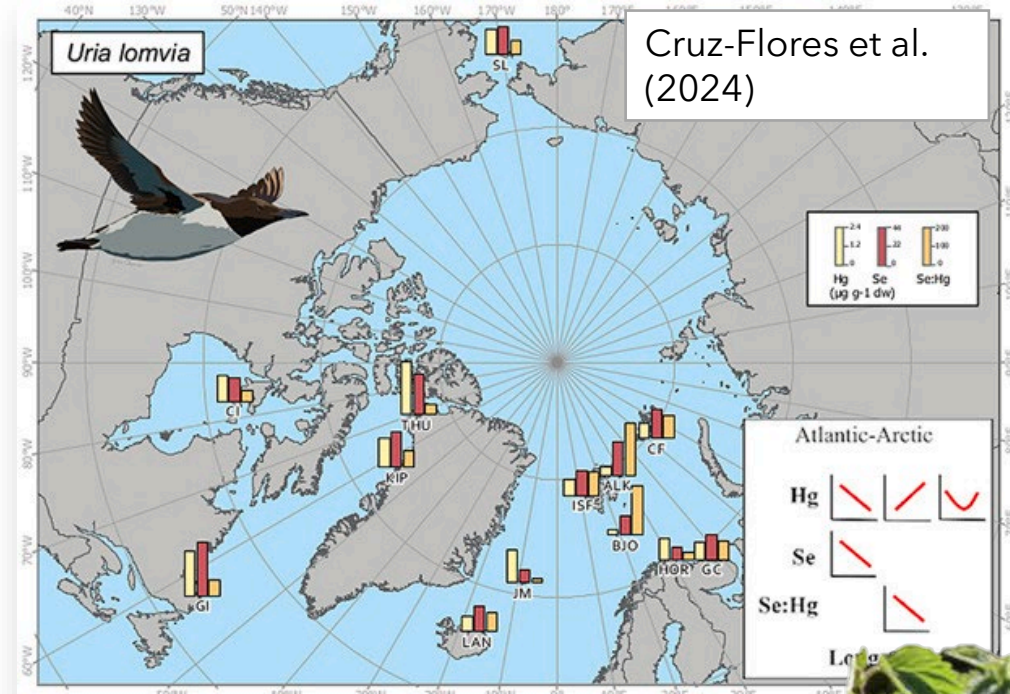
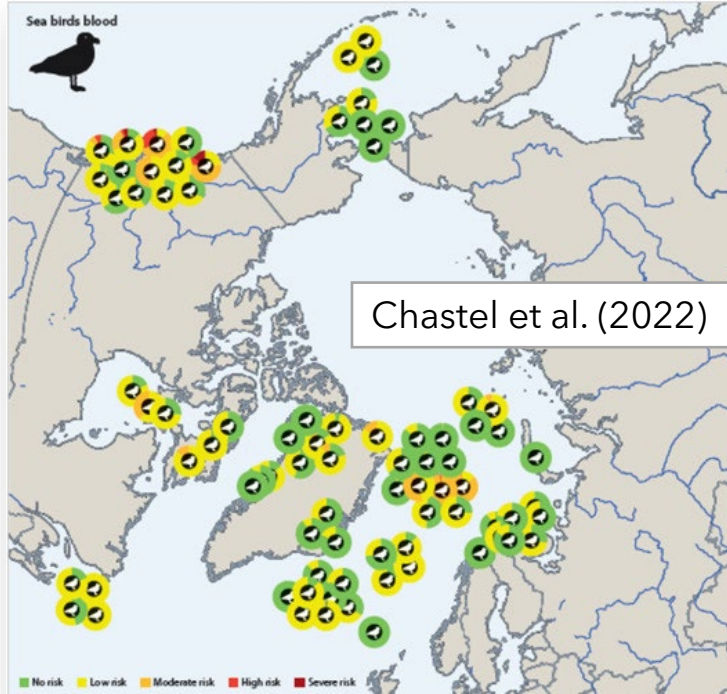
Mercury in our oceans

- Bioaccumulates and biomagnifies in aquatic ecosystems
- Concern for top predators
- Seabirds have the highest concentrations of Hg among birds Cherel et al. 2018
- Decrease reproductive success Whitney and Cristol. 2017

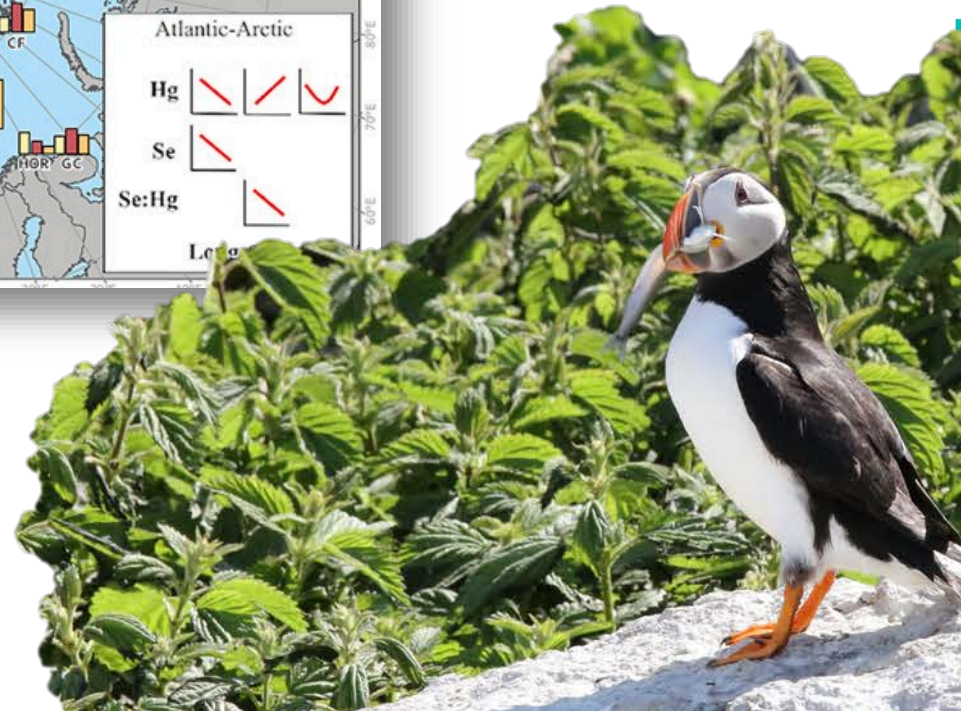


Seabirds – bioindicators of mercury

- Occupy high trophic levels, long-lived, colonial

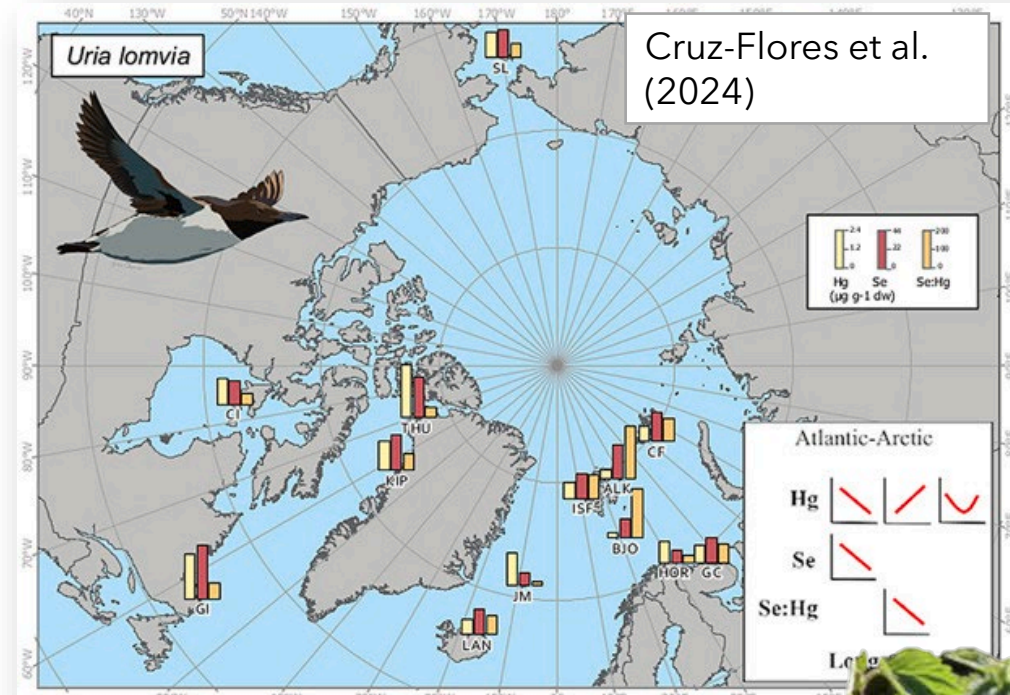
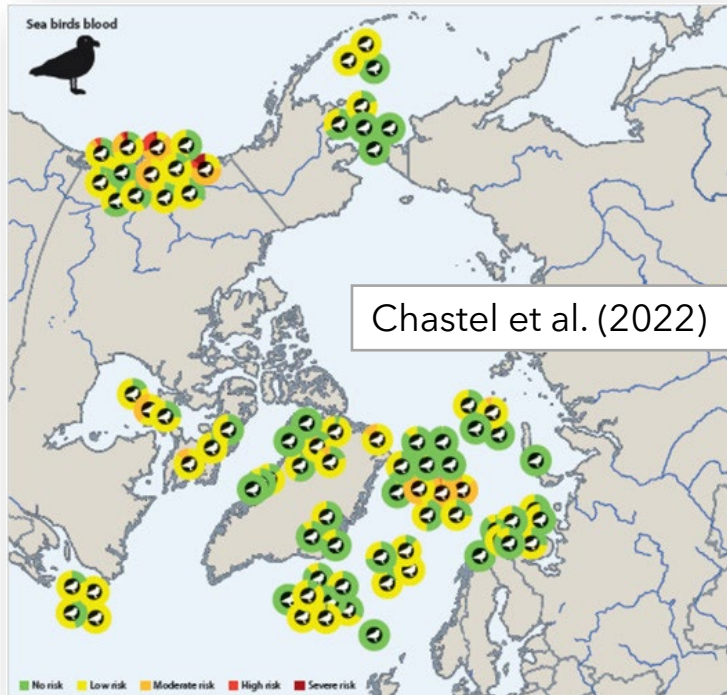


Large-scale risk assessment



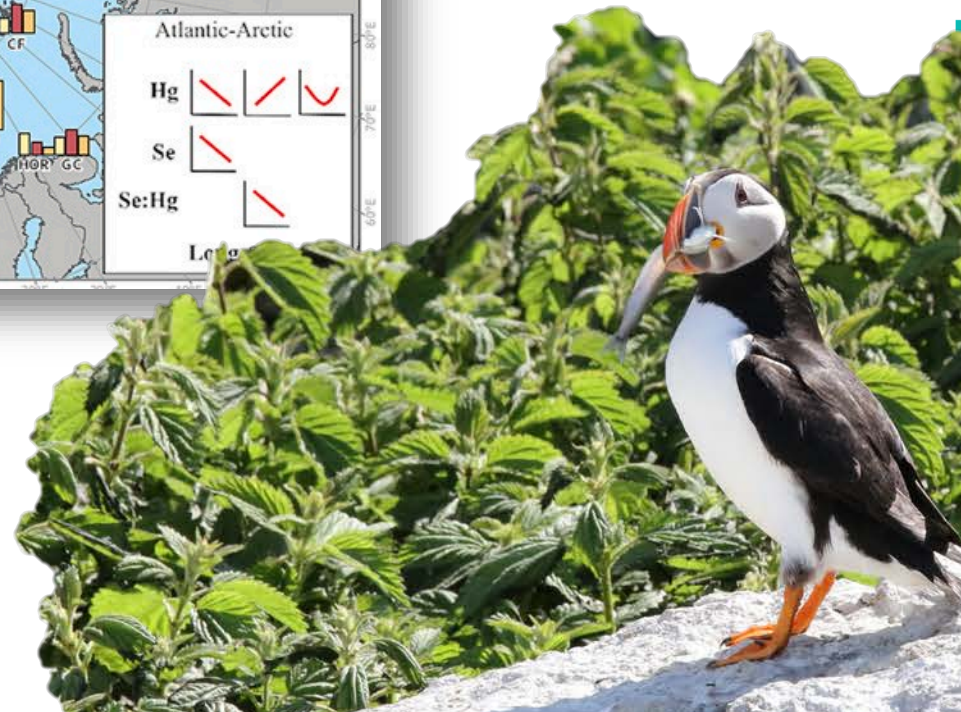
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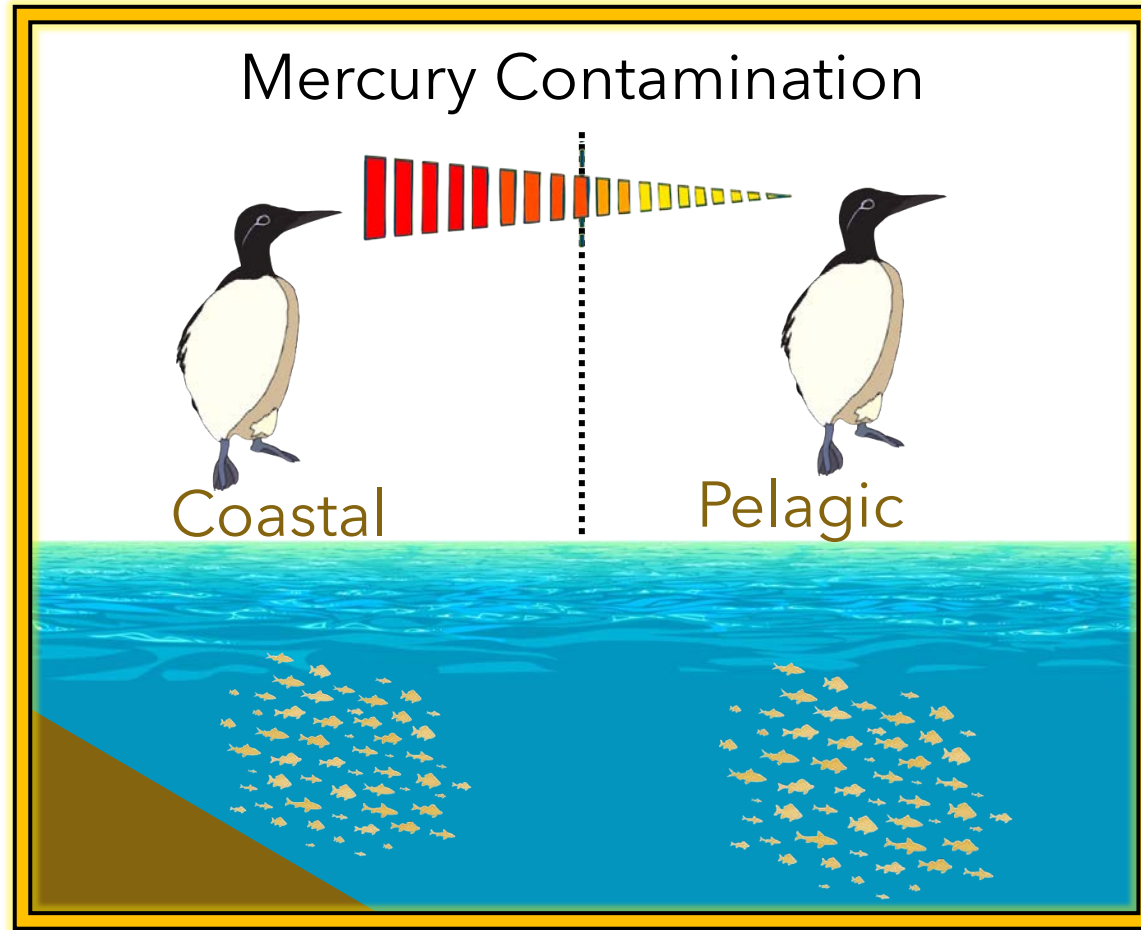
Large-scale risk assessment

How does mercury exposure vary among individuals?



How does mercury exposure vary among individuals? ^{Introduction | 4}

Variation in foraging strategy ^{Ochoa-Acuna et al. 2002}



Foraging area?

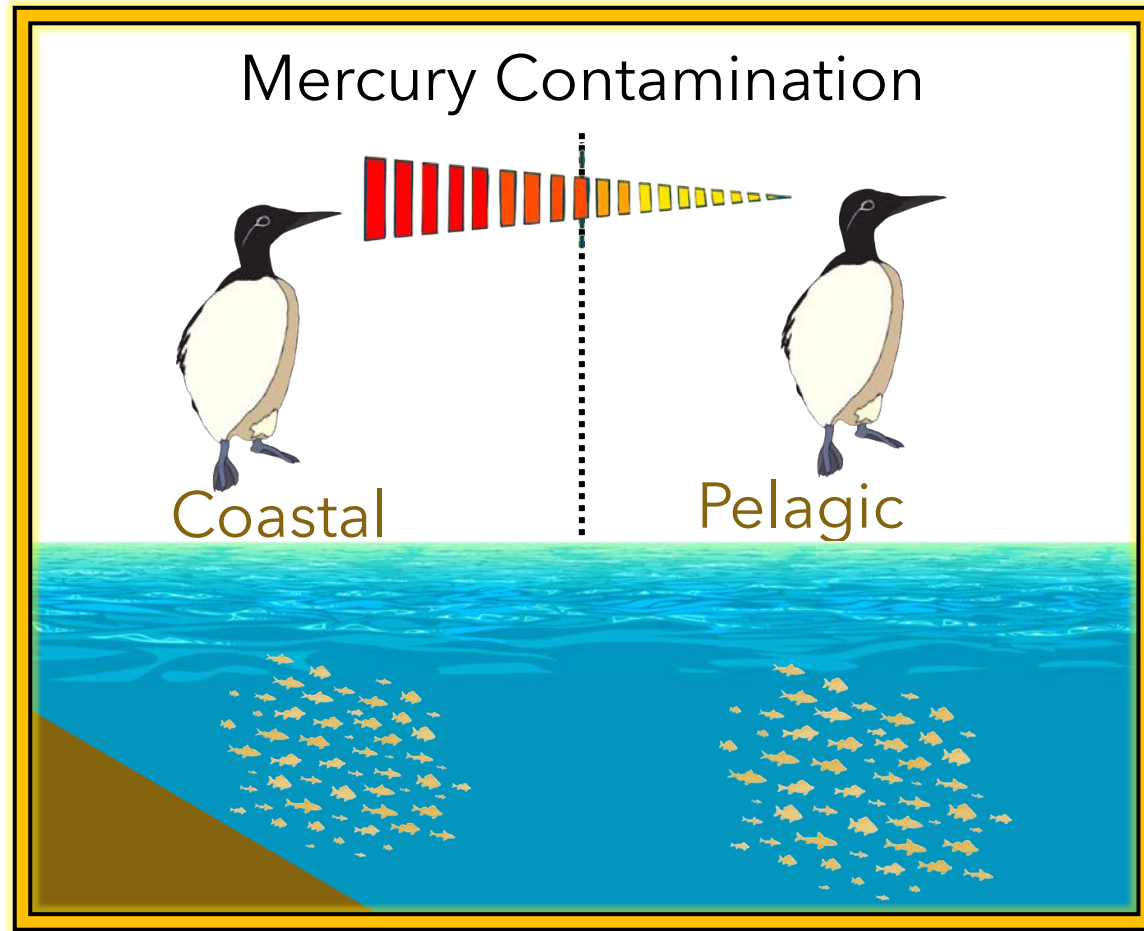
Amélineau et al. 2021

Elliott and Elliott, 2016



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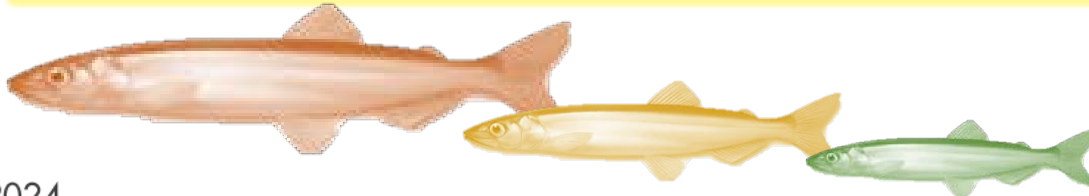
Foraging area?

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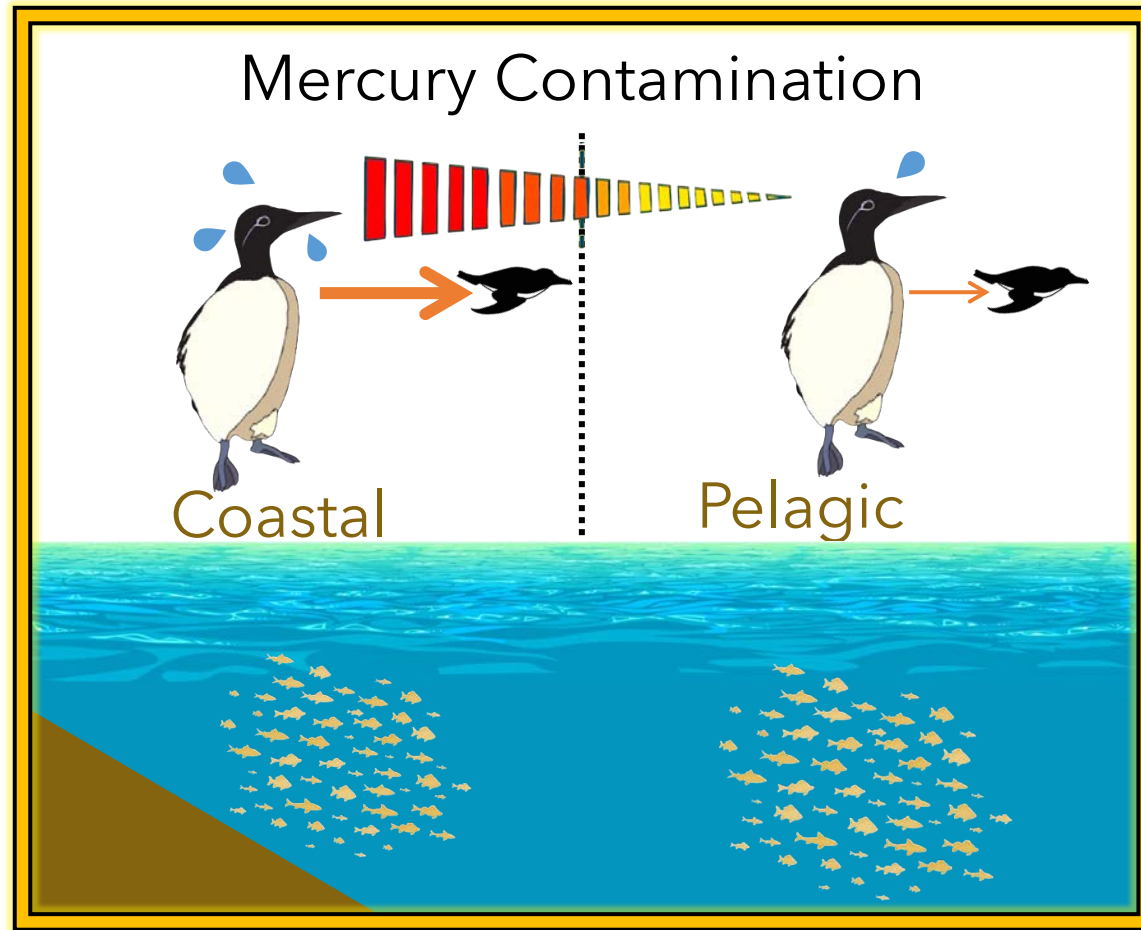
Diet?

Descamps et al. 2022



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Foraging area?

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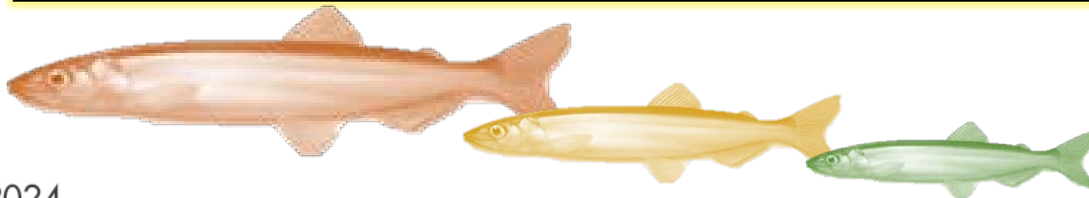
Elliott and Elliott, 2016

Diet?

Descamps et al. 2022

Body condition?

Baert et al. 2021

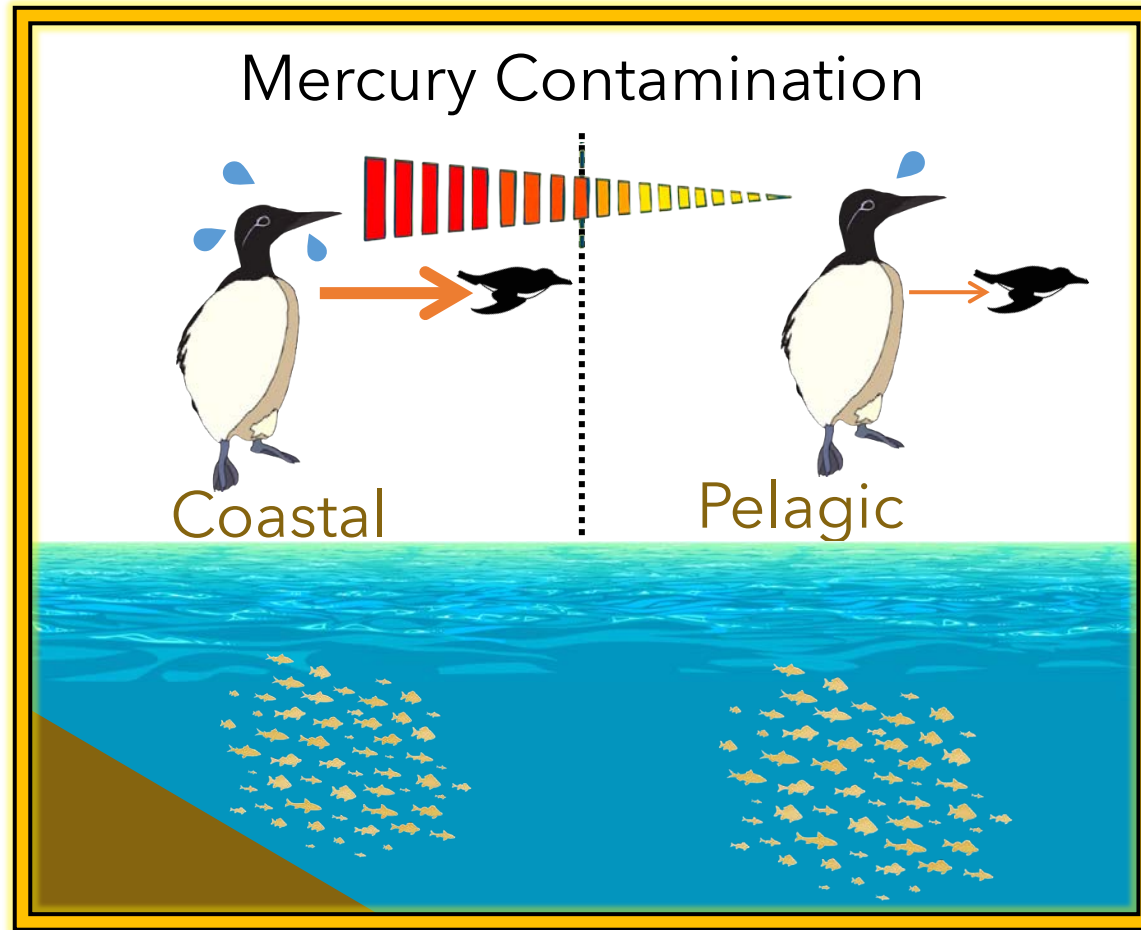


How does mercury exposure vary among individuals?

Introduction | 4

Variation in foraging strategy

Ochoa-Acuna et al. 2002



Foraging area?

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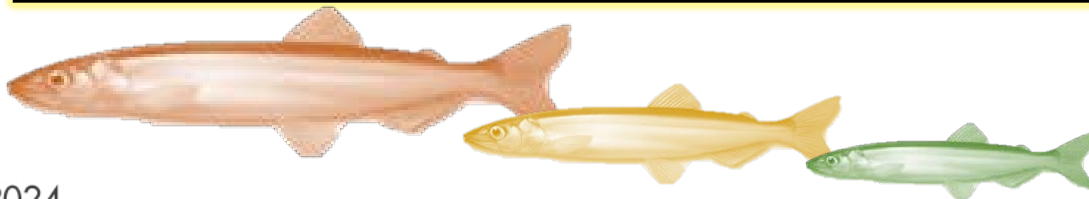
Diet?

Descamps et al. 2022

Body condition?

Baert et al. 2021

How does foraging specialization
determine mercury burden?



2021 & 2022 breeding seasons



Mingan Archipelago, Québec

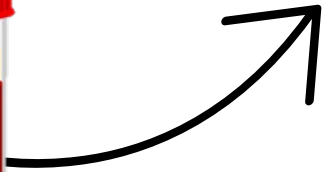


2021 & 2022 breeding seasons

Short-term marker
Red Blood Cells



Mercury



2021 & 2022 breeding seasons

Short-term marker

Red Blood Cells



Mercury

Three isotopic markers

Trophic Position $\rightarrow \delta^{15}\text{N}$

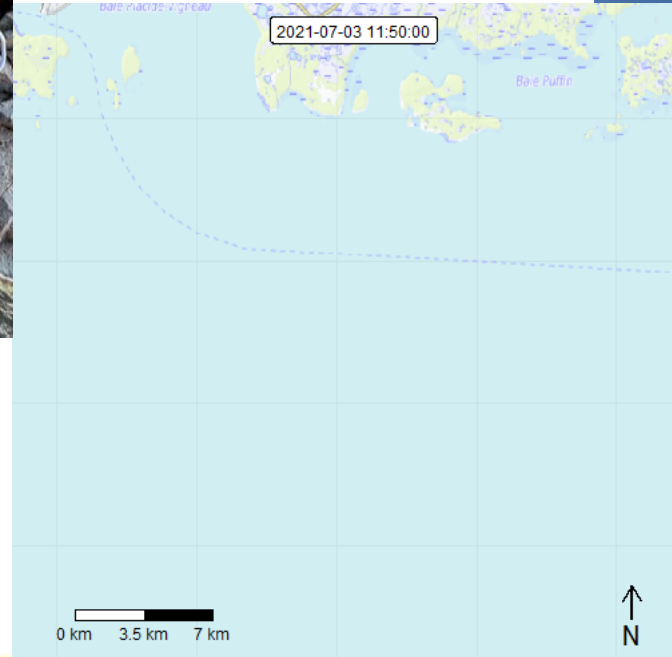
Feeding ecology $\rightarrow \delta^{13}\text{C}$ and $\delta^{34}\text{S}$



2021 & 2022 breeding seasons

GPS loggers (Ecotone®)

- Foraging areas
- Foraging metrics:
 - Distance from coast



2021 & 2022 breeding seasons

$n = 11$ & $n = 7$ razorbills

Installed cameras during chick-rearing to determine
prey species and size

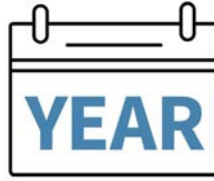


Combined approach to explain Hg



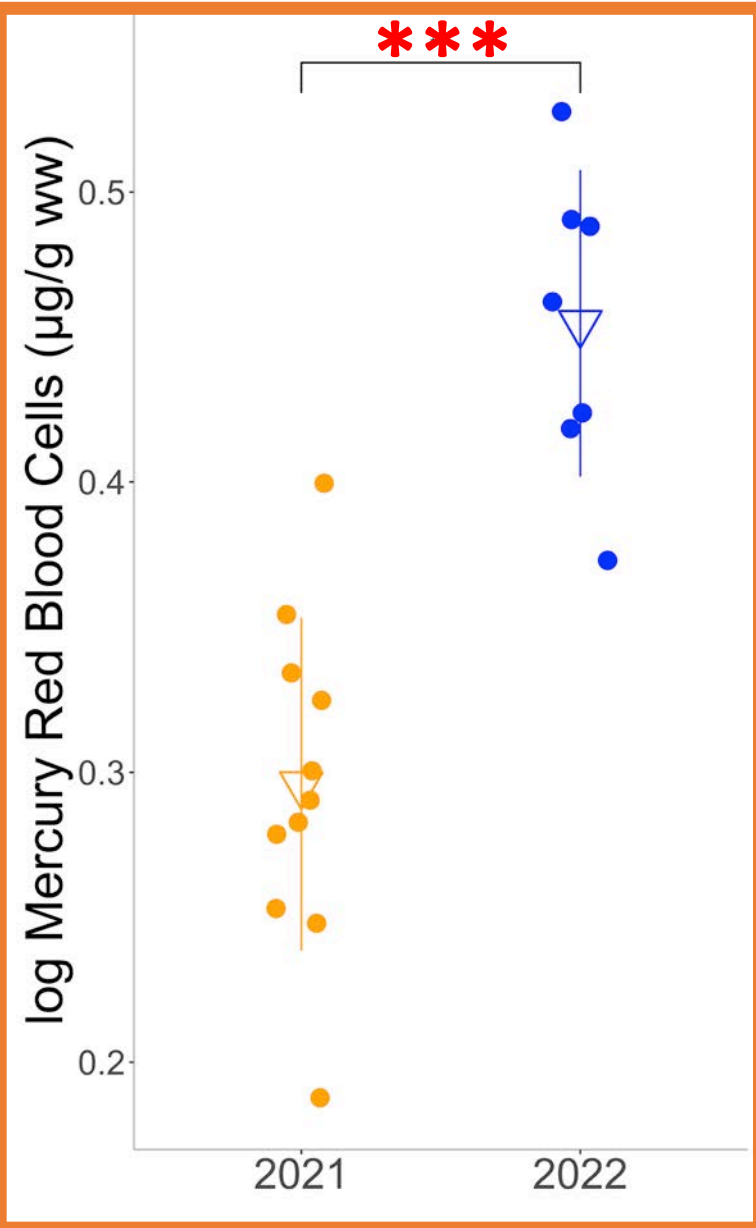
Photo: R. Lavoie



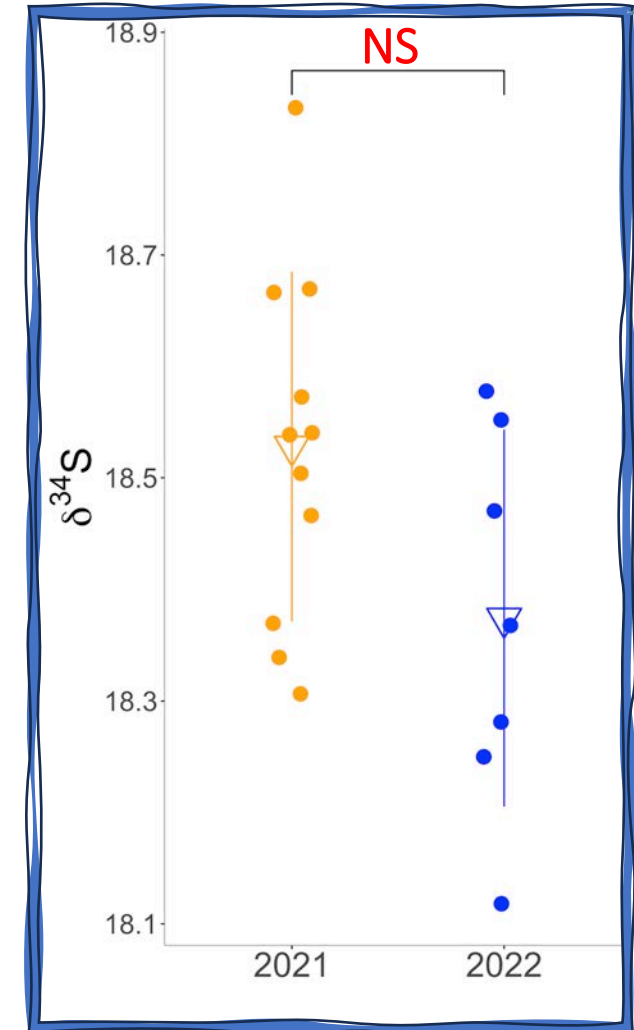
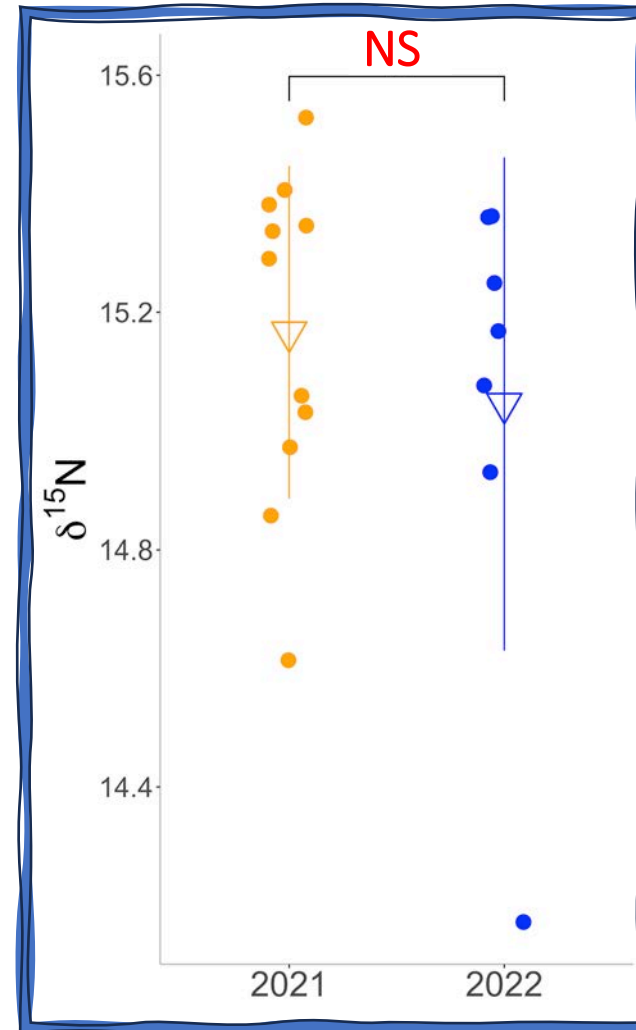
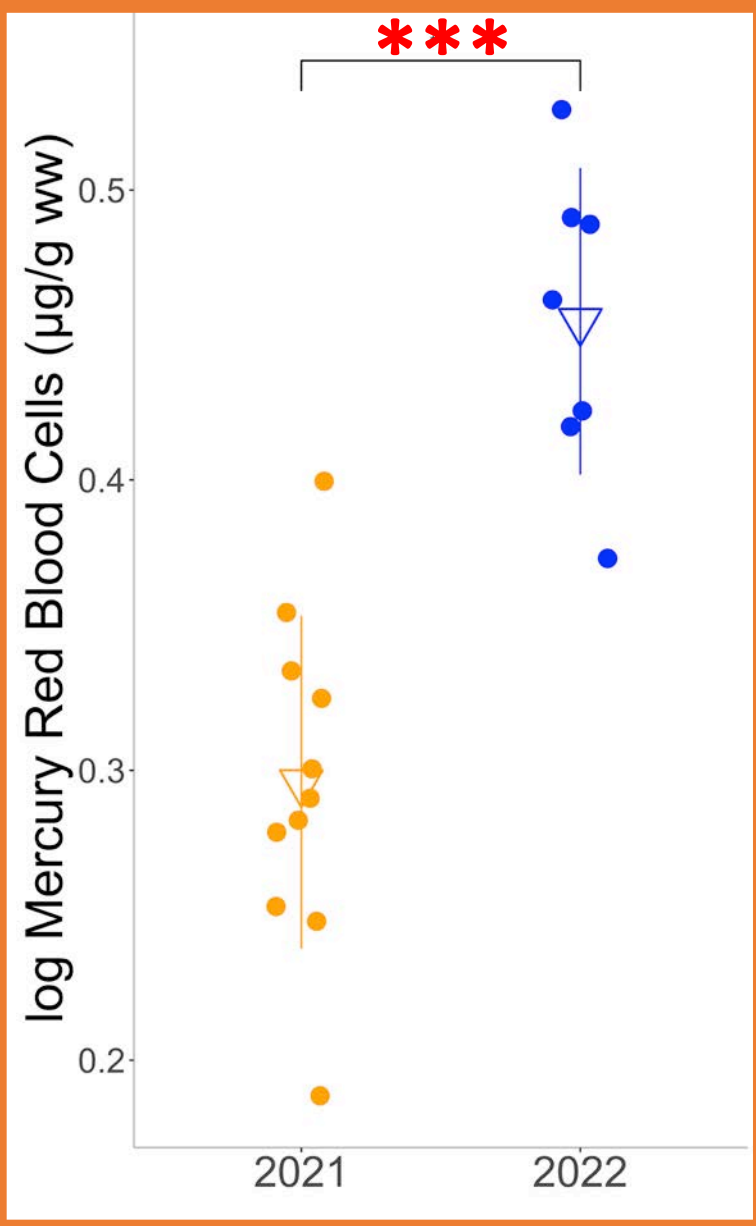
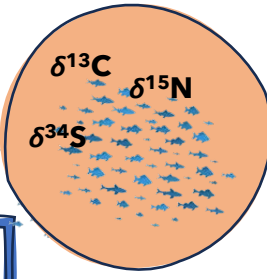


Mercury and isotopes between years

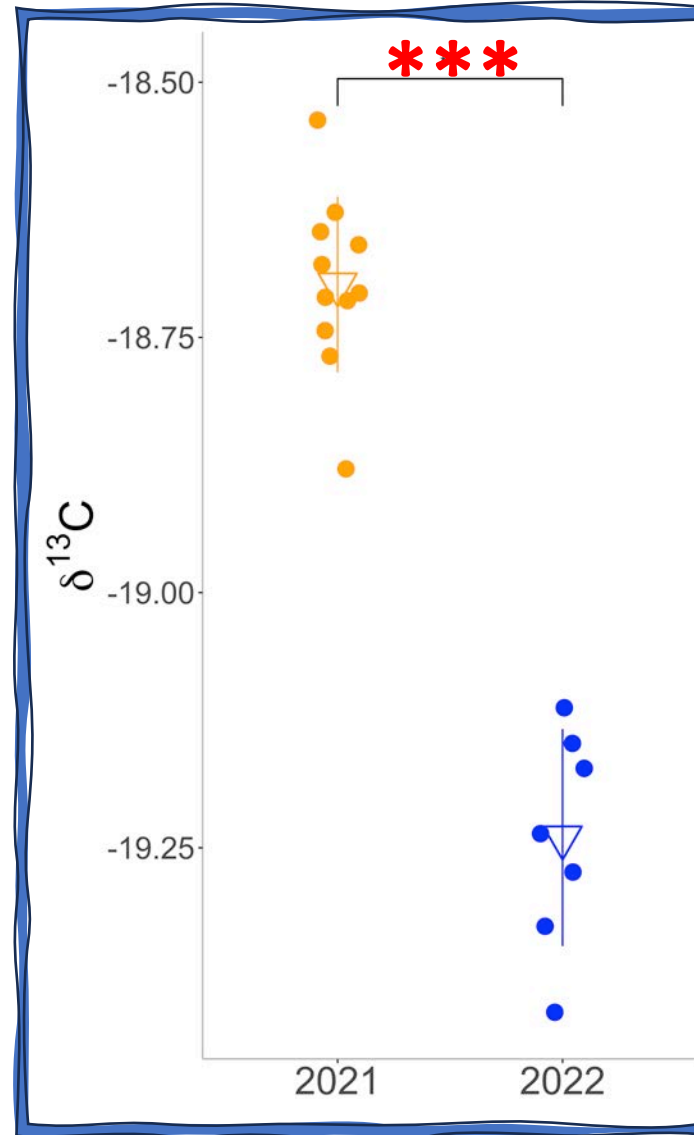
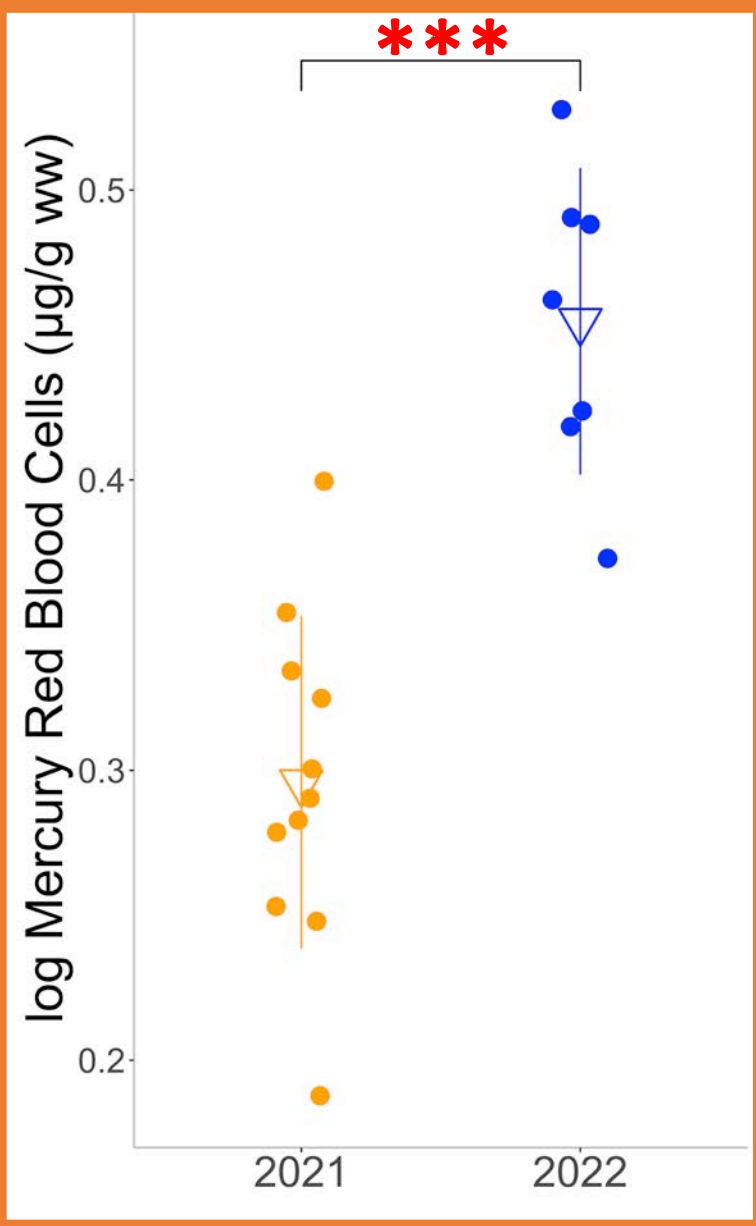
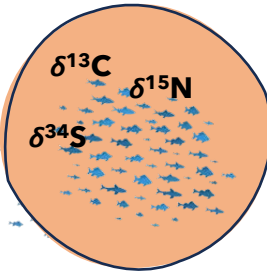
Hg higher in 2022 (LMM: $p < 0.0001$)



Mercury and isotopes between years



Mercury and isotopes between years



$\delta^{13}\text{C}$ different
(LMM: $p < 0.0001$)

Foraging ecology influenced Hg

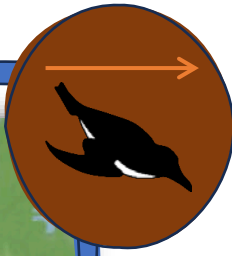
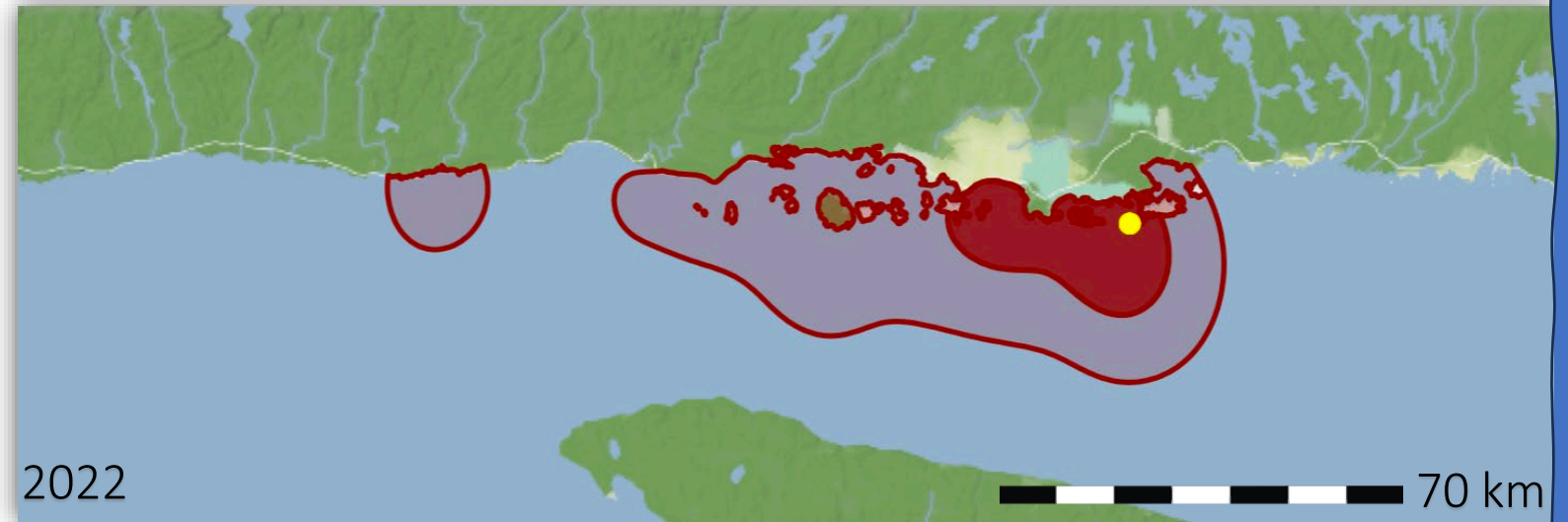
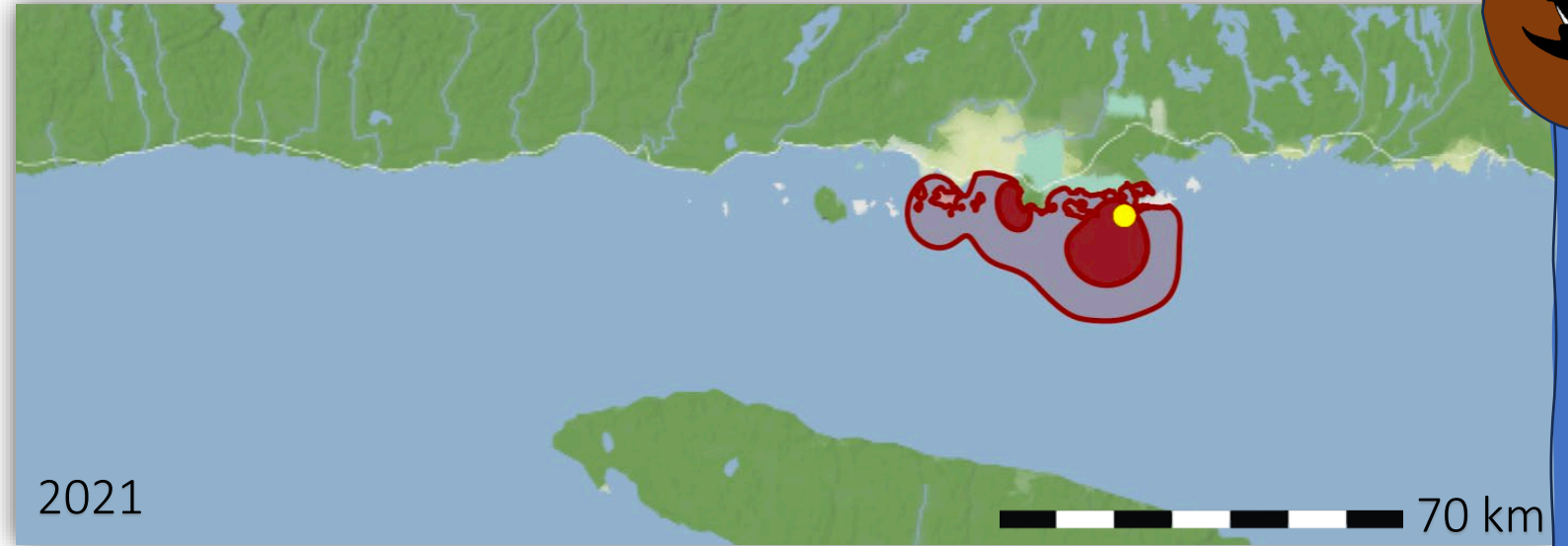


Foraging strategy between years



 Core range
(50% occurrence)

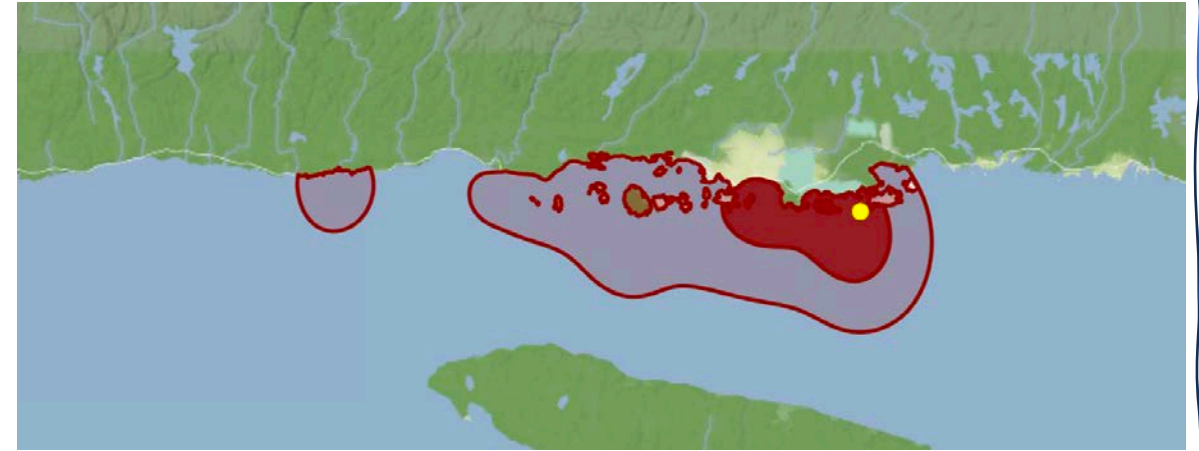
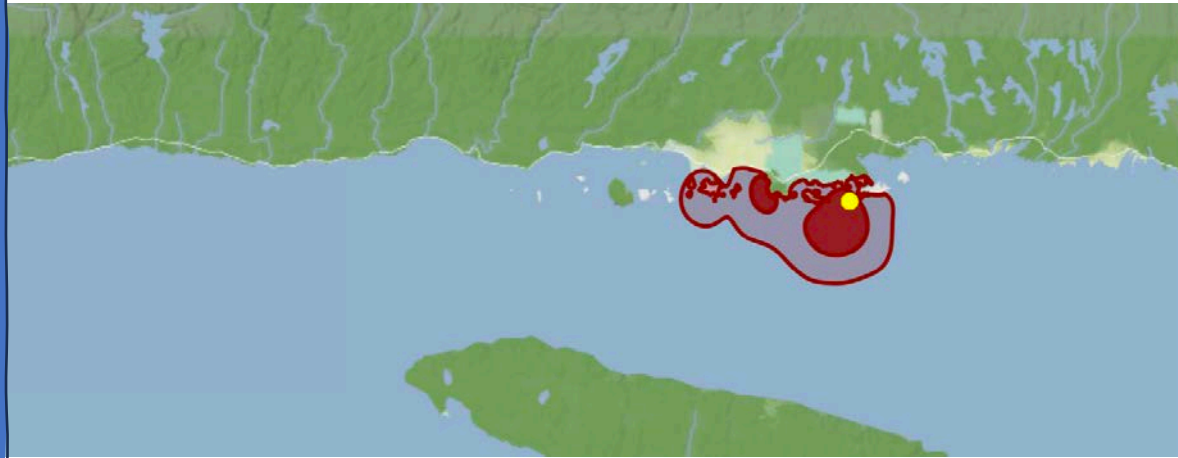
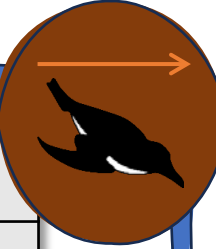
 Home range
(95% occurrence)



Foraging strategy between years



	2021	2022
Distance from coast (km)	3.2 ± 1.0	<u>2.4 ± 1.2</u>

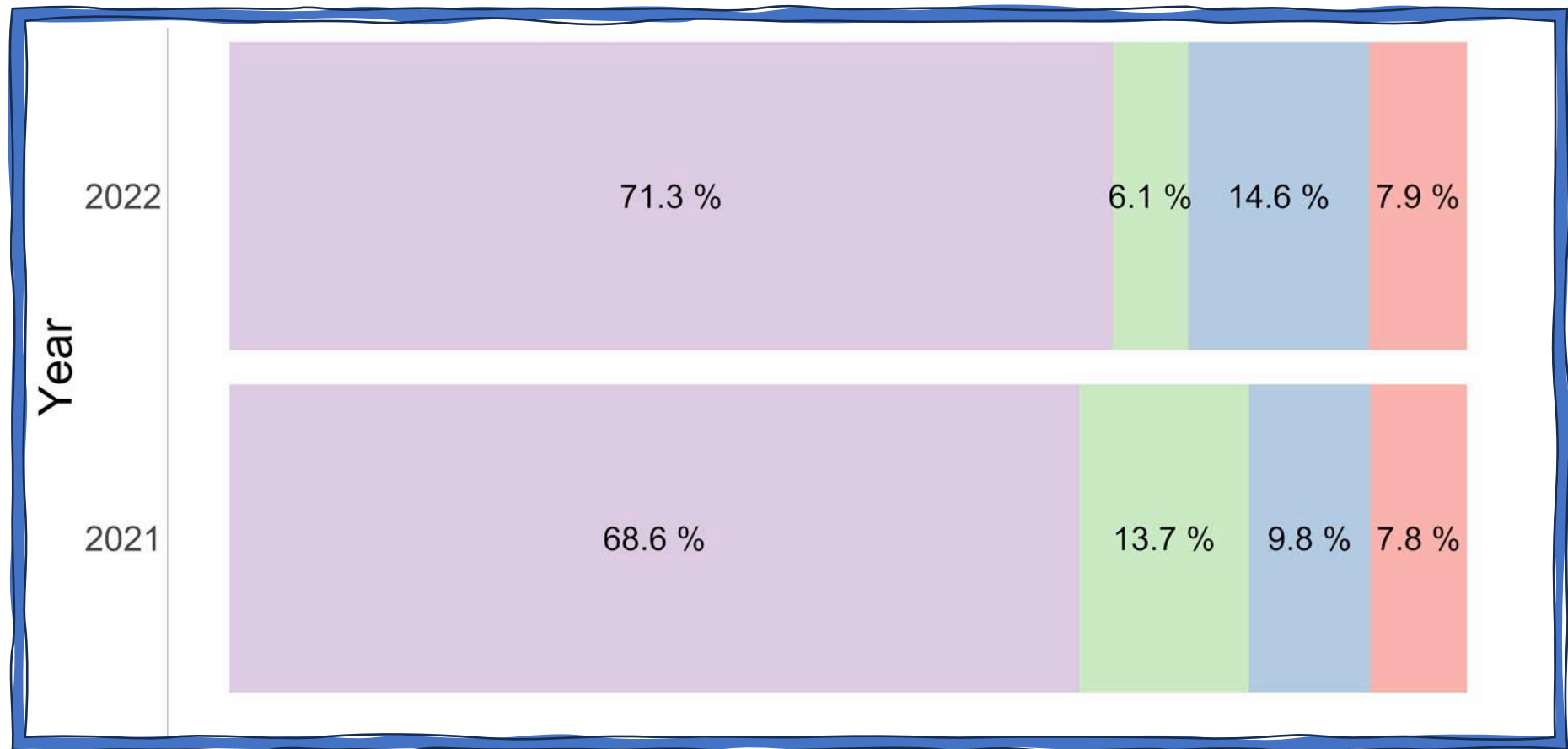


Distance from coast different (LMM: $p < 0.05$)
Foraging characteristics influenced Hg



Diet

n = 120



Species



Sandlance



Atlantic Herring



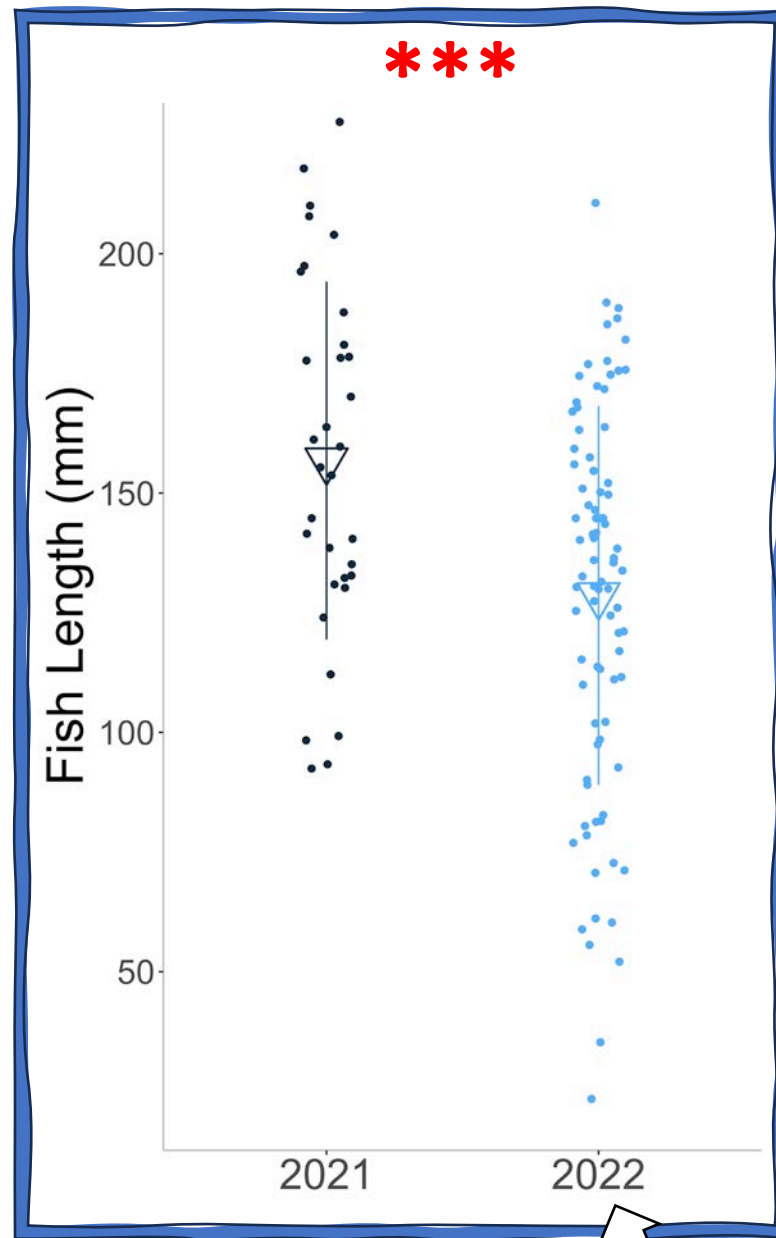
Capelin



Unknown



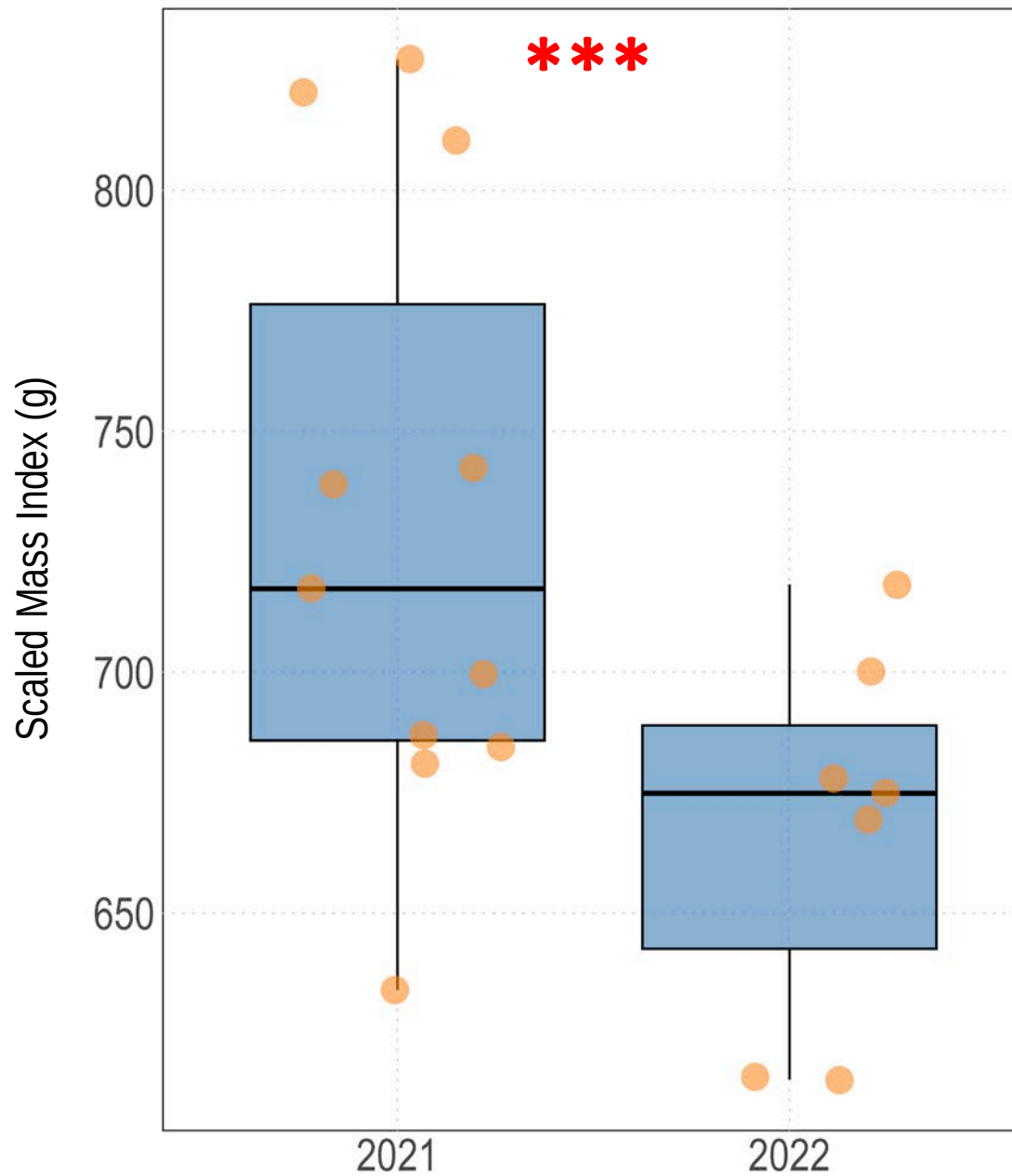
Diet



High mercury year



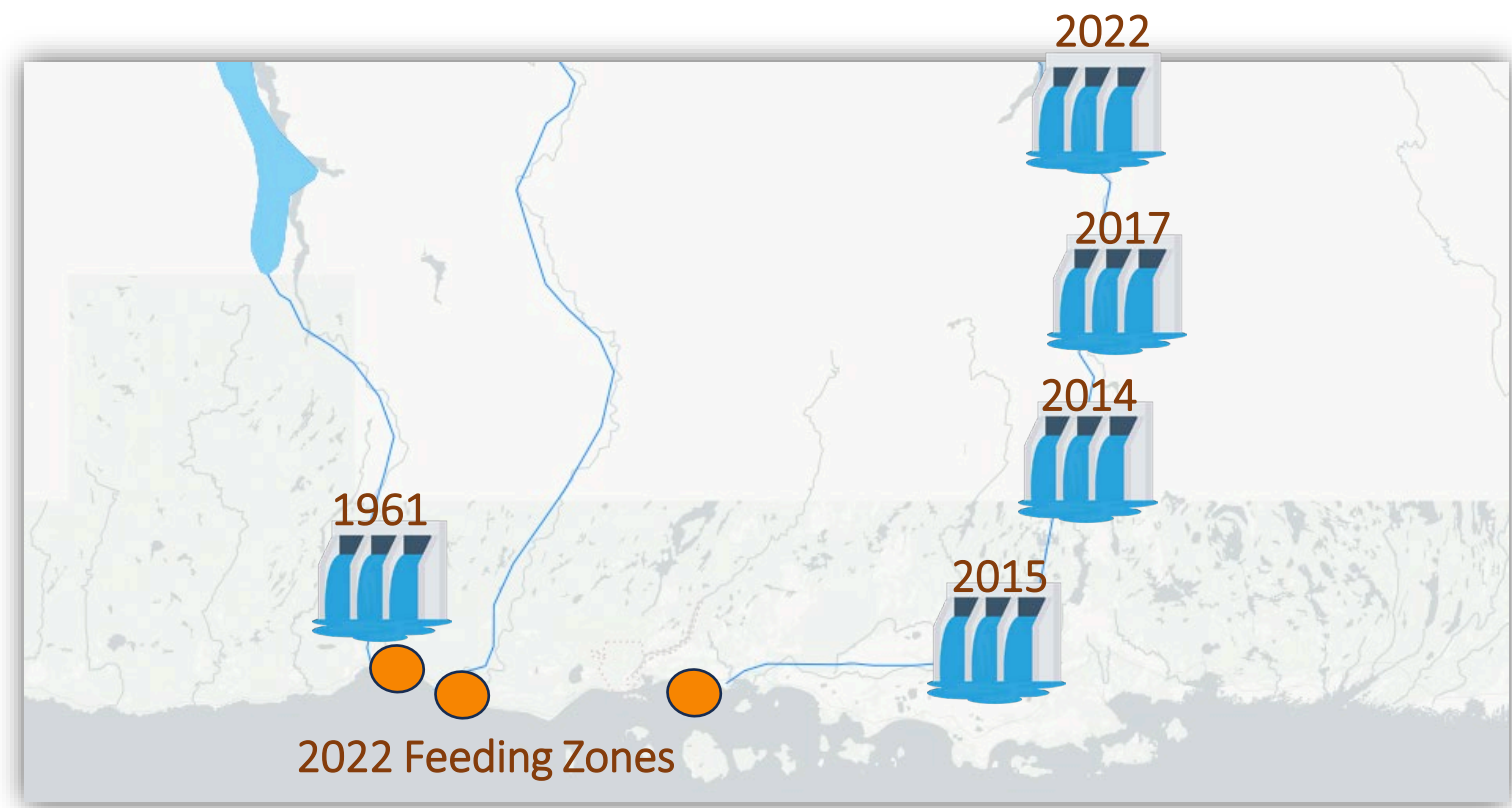
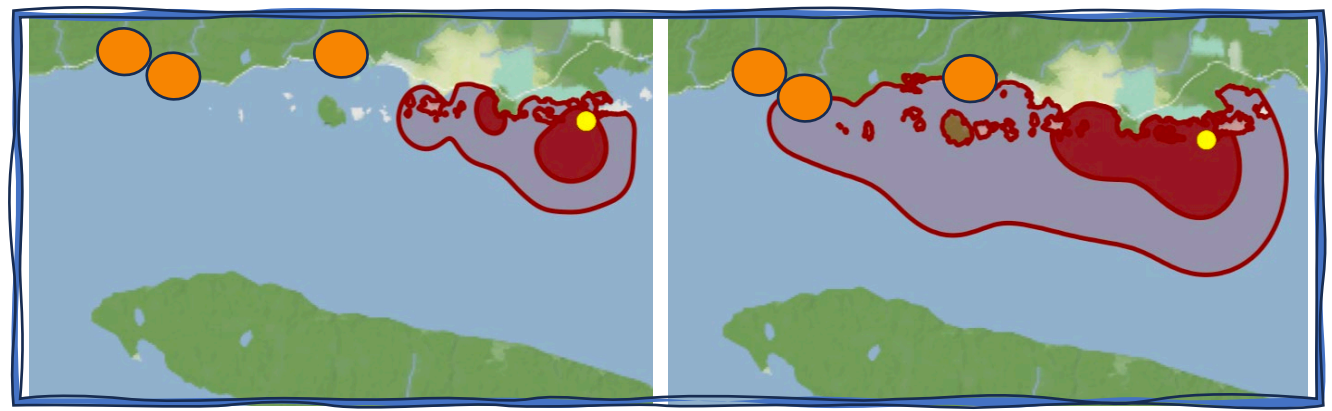
Body Condition



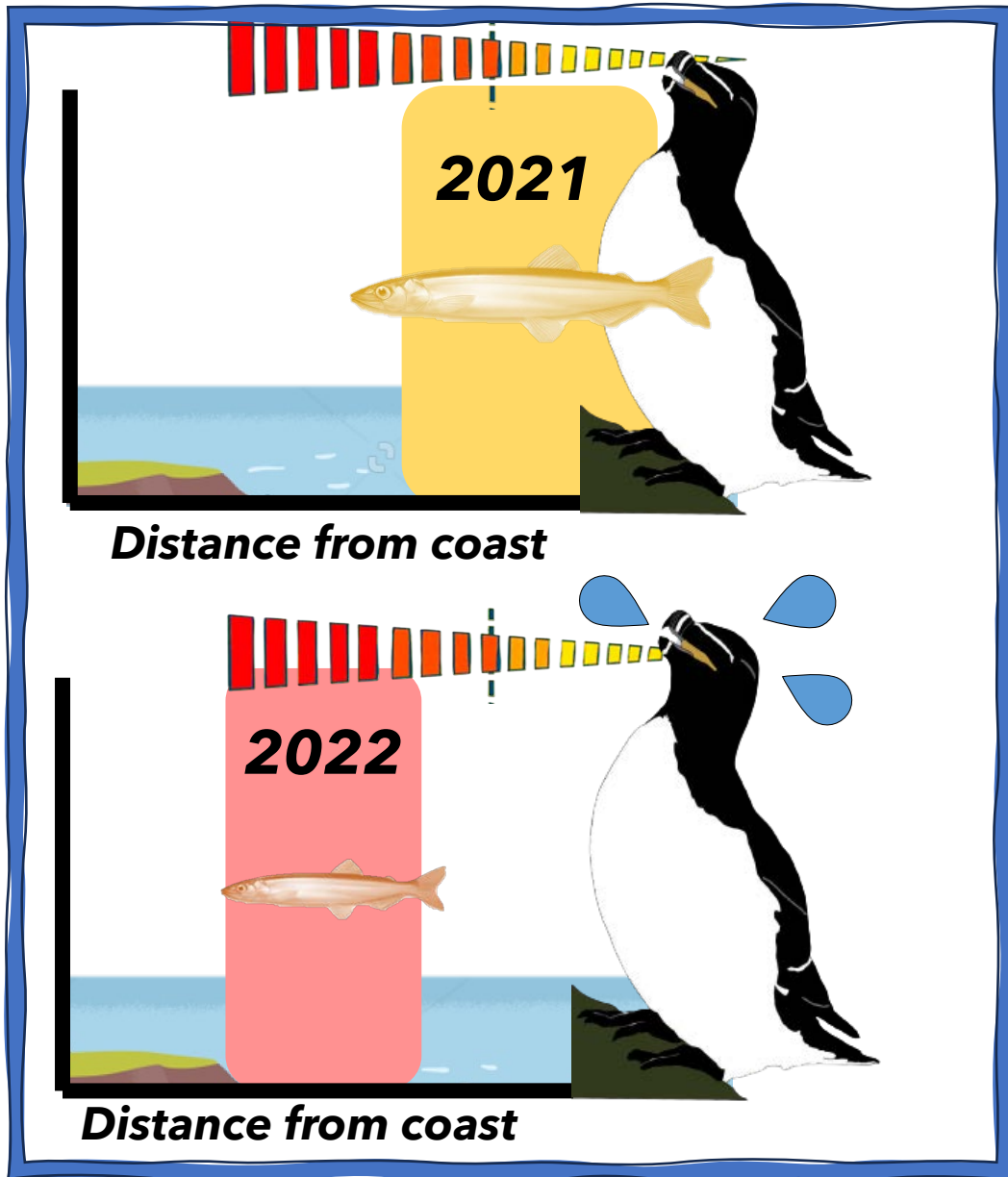
Environment

Hg inputs from upwellings and rivers

Cossa et al. 2017

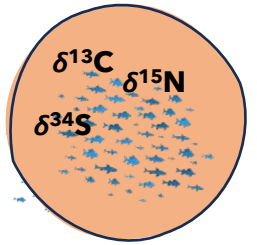
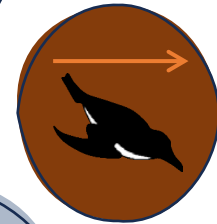


Conclusion



Foraging strategy

- Smaller prey
- Closer to the coast



Body condition



Hg Concentration/Dilution



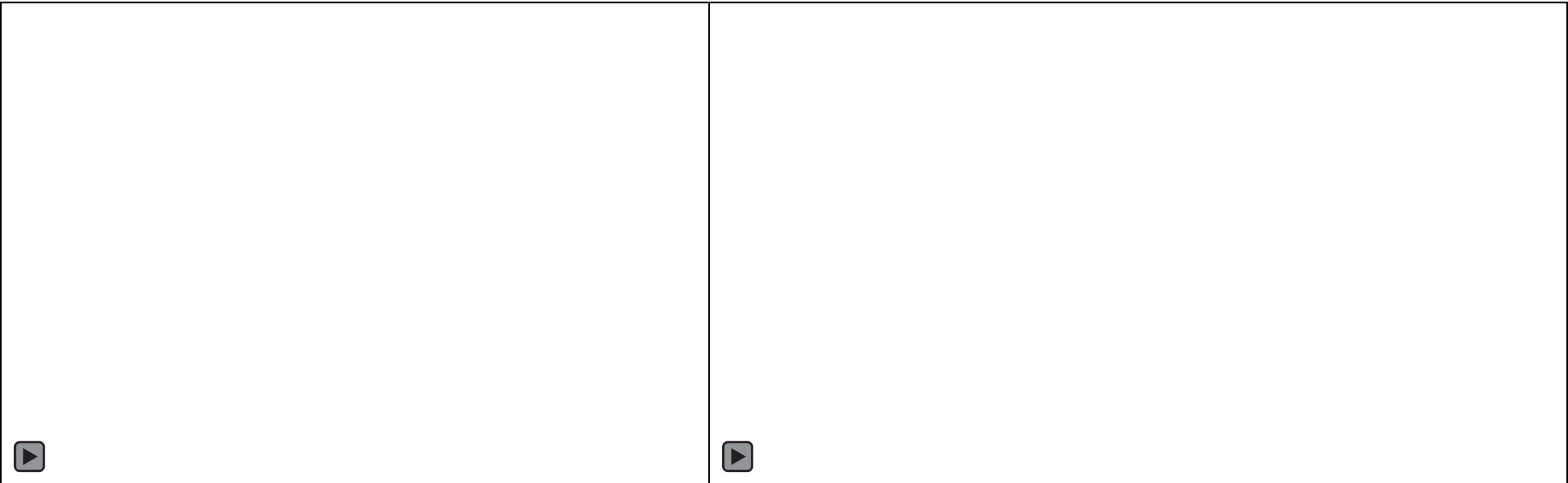
Increase in Hg burden in 2022

Trudel & Rasmussen, 2006, Peterson et al. 2018



Questions?

Necessity to continue to monitor mercury burden on local scales using **combined approaches**



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