Apr 28th, 8:30 AM - 10:00 AM

The health and habitat use of Glaucous-winged gulls wintering in the Salish Sea

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Physiological Health of Glaucous-winged Gulls Wintering in the Salish Sea

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John Cornell

Seabirds are useful “biomonitors”

Gulls are versatile, generalist foragers

Glaucous-winged gulls in the Salish Sea

- GWGU populations have been tracked for > 100 years
- Over 150 years - diet less marine, fewer eggs
- Large population decline since mid-1980s
- Increasingly nesting on urban roofs
- Environment and Climate Change Canada has designated it a priority to study GWGUs

(Blight et al., 2011; 2015; 2019)

Overall project objectives:

1. Understand the movements and habitat use of wintering GWGUs in the Salish Sea using GPS tags.

2. Examine the relationships between GWGU **diet**, **contaminant loads**, **parasitic infections**, and **physiological health** to assess how anthropogenic activity may impact gull health.

Gull health objectives:

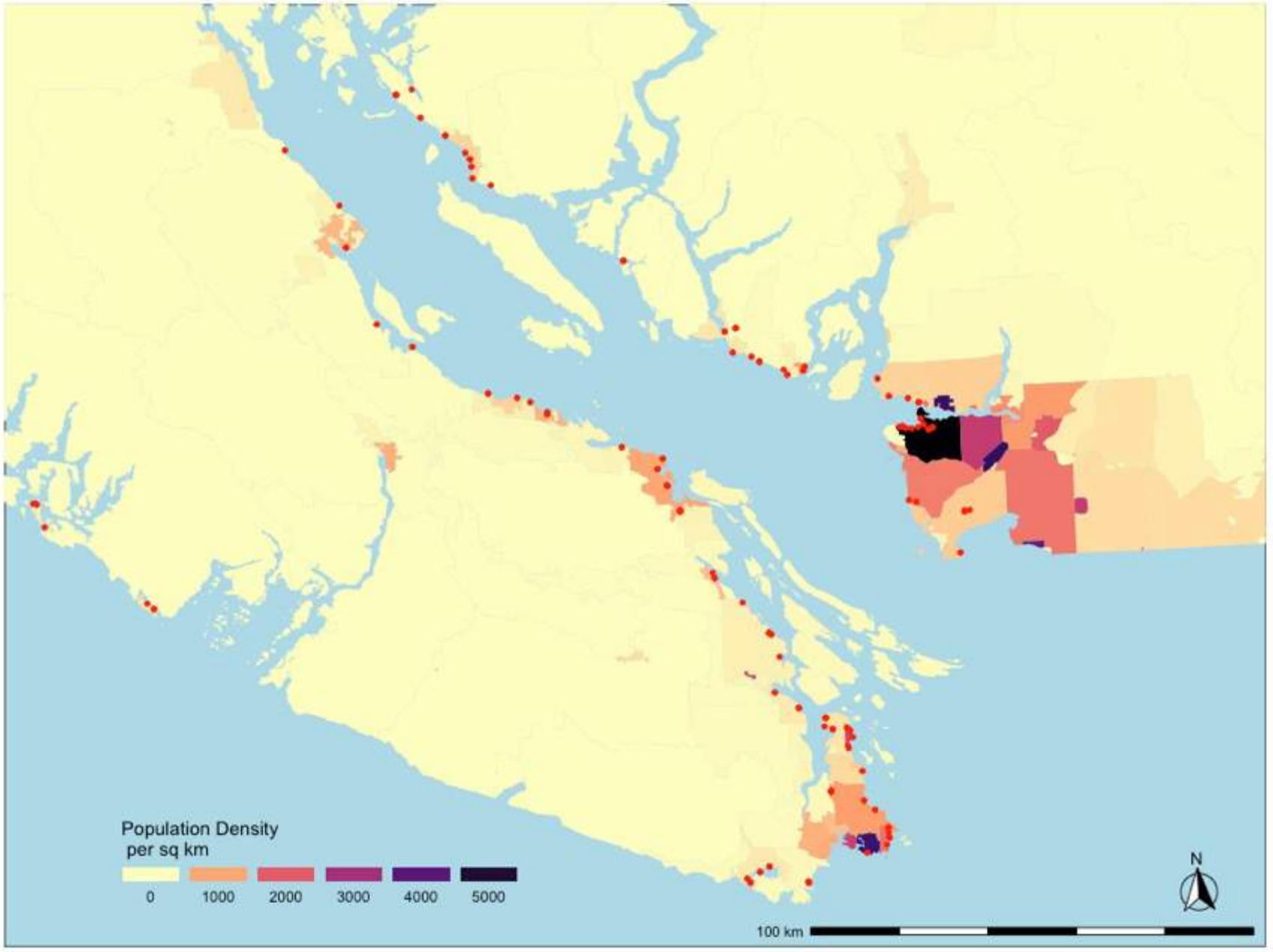
- Measure physiological biomarkers:
  - **“Nutritional or Energy state”** = Glucose and free triglycerides
  - **“Aerobic capacity”** = Hematocrit and hemoglobin
  - **“Oxidative stress and damage”** = OXY (total antioxidant titres) and dROMs (reactive oxygen metabolites)
- Determine whether gull health varies by region or habitat type of capture locations.

Field methods

- January – February 2020 and 2021
- Capture with bait and noose mats
- Measure and band
- Collect a few feathers & a small blood sample
- Release

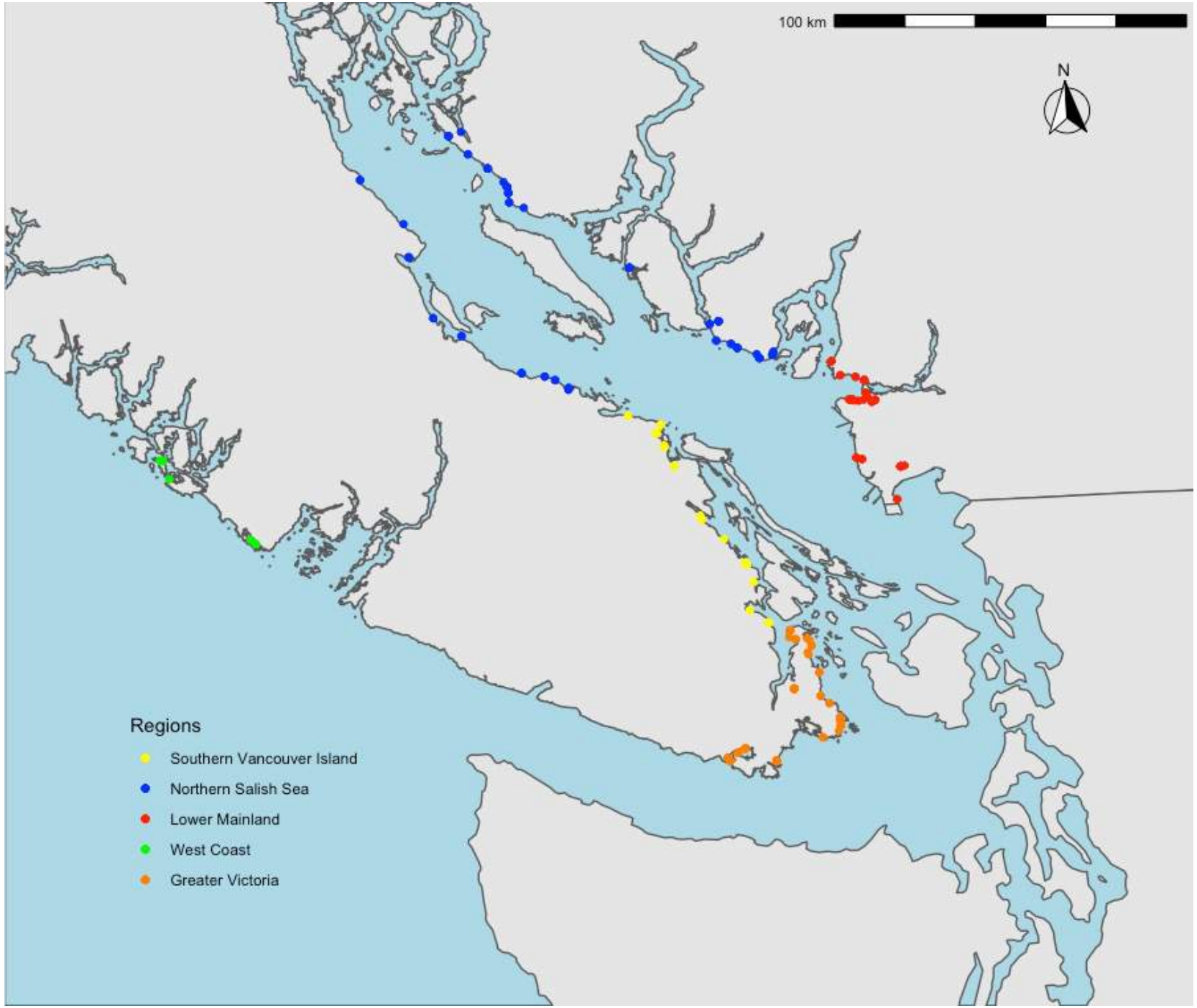
Capture locations

- Sampled throughout Canadian portion of the Salish Sea
- Captured 202 adult gulls
- 10 gulls sampled from west coast of Vancouver Island
- Varying levels of urban development and human density
- Habitats:
  - Natural
  - Urban
  - Landfills



Canadian census subdivision data obtained from Statistics Canada (2016)

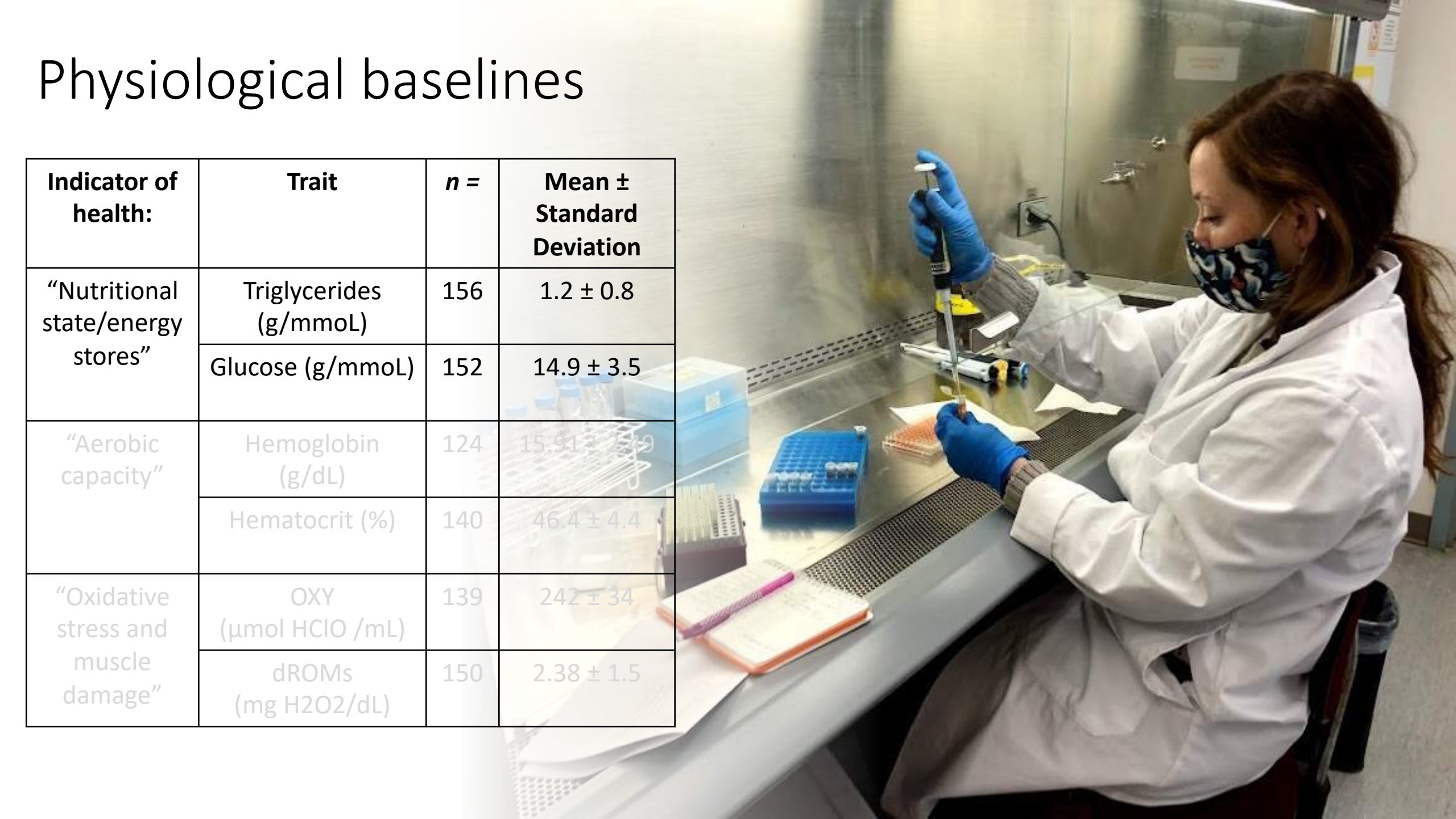
Does health vary with region?



Does health vary with habitat type?

Physiological baselines

Indicator of health:	Trait	*n* =	Mean ± Standard Deviation
"Nutritional state/energy stores"	Triglycerides (g/mmoL)	156	1.2 ± 0.8
	Glucose (g/mmoL)	152	14.9 ± 3.5
"Aerobic capacity"	Hemoglobin (g/dL)	124	15.9 ± 1.9
	Hematocrit (%)	140	46.4 ± 4.4
"Oxidative stress and muscle damage"	OXY (µmol HClO /mL)	139	242 ± 34
	dROMs (mg H2O2/dL)	150	2.38 ± 1.5



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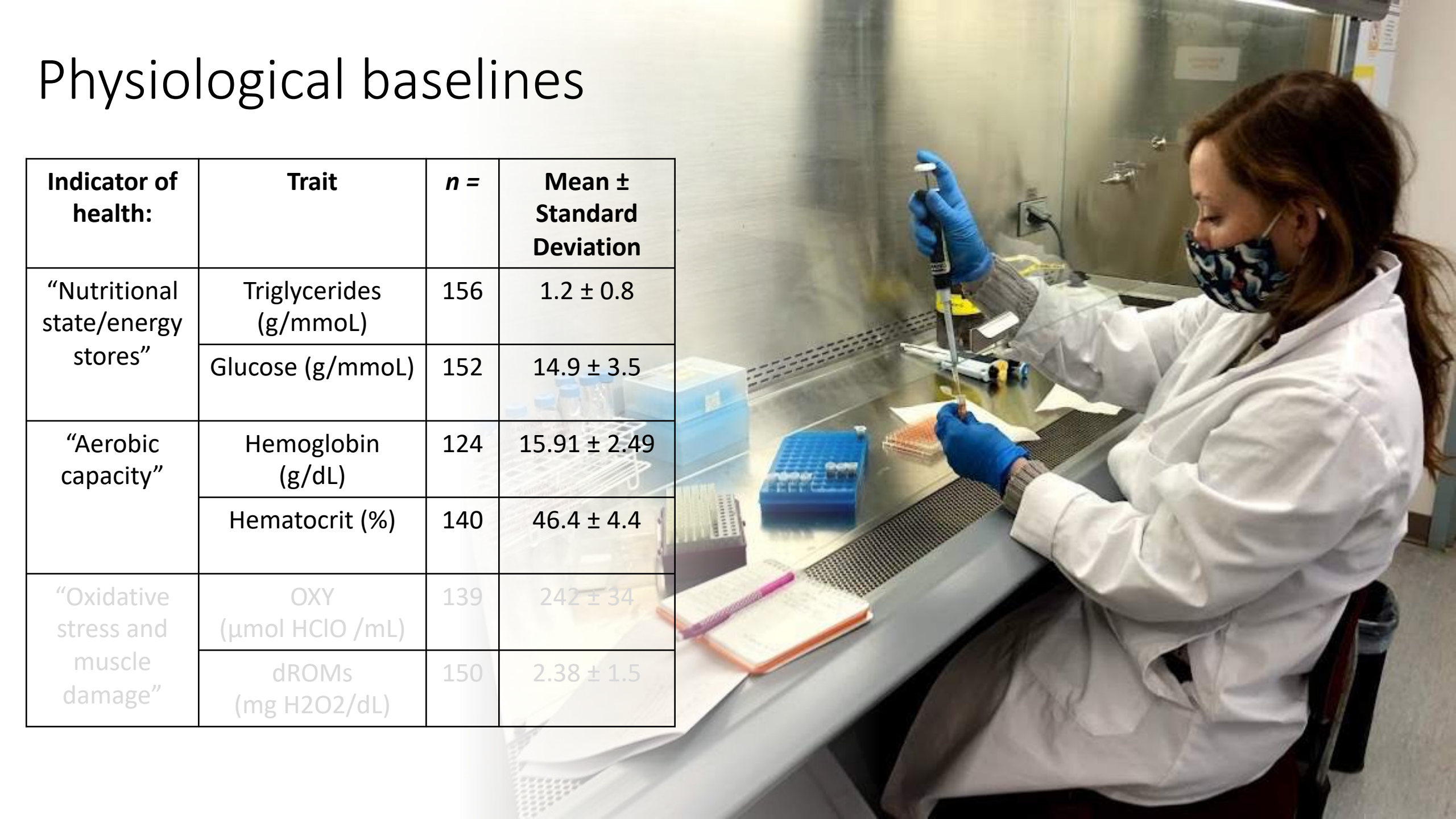

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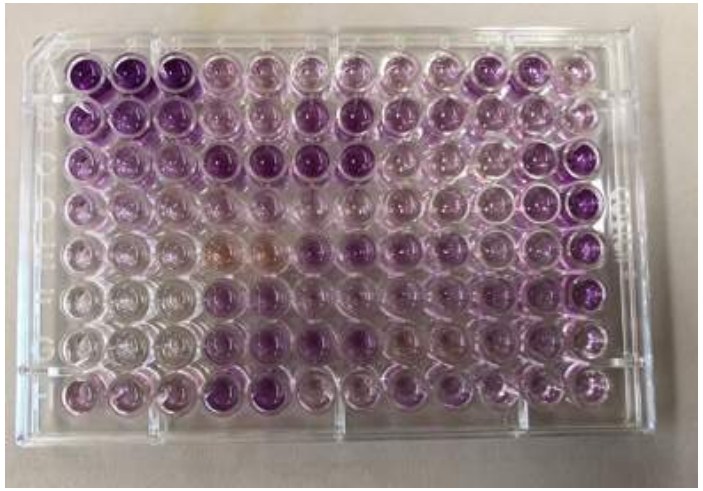
Correlation of physiological traits

Comparison	*r*	P value
Triglycerides vs Glucose	0.206	0.013
Hemoglobin vs Hematocrit	0.292	0.0009
OXY vs dROMs	0.198	0.022
Triglycerides vs dROMs	0.246	0.002
Hematocrit vs Glucose	-0.287	0.0005
Hematocrit vs dROMs	0.282	0.0007

All other comparisons were non-significant (P > 0.18 in all cases).



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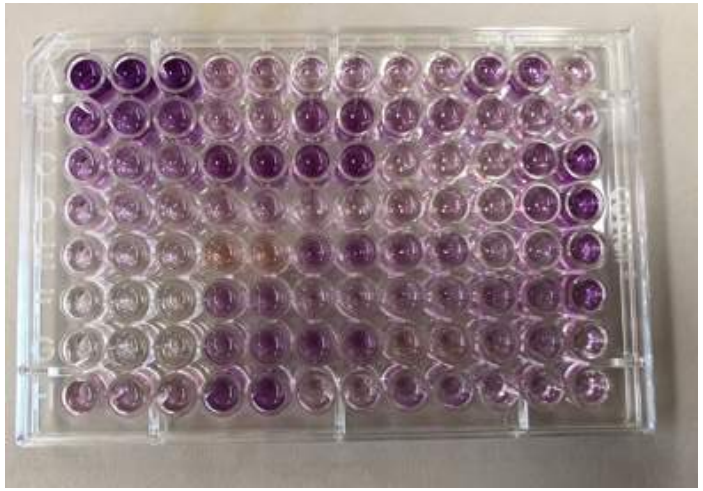

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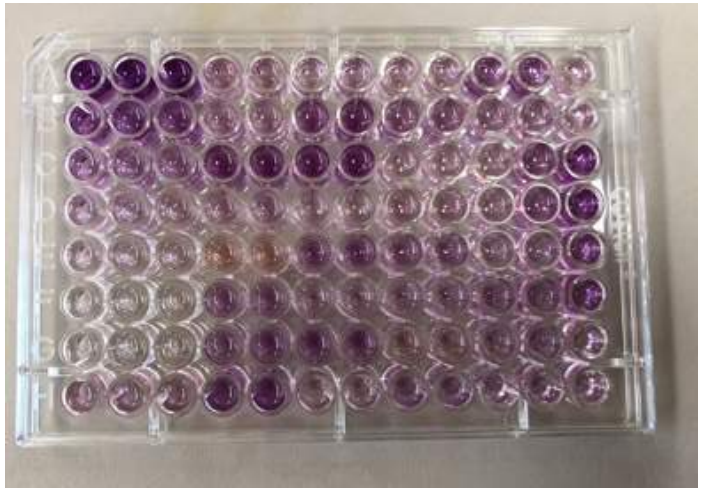


Models and covariates

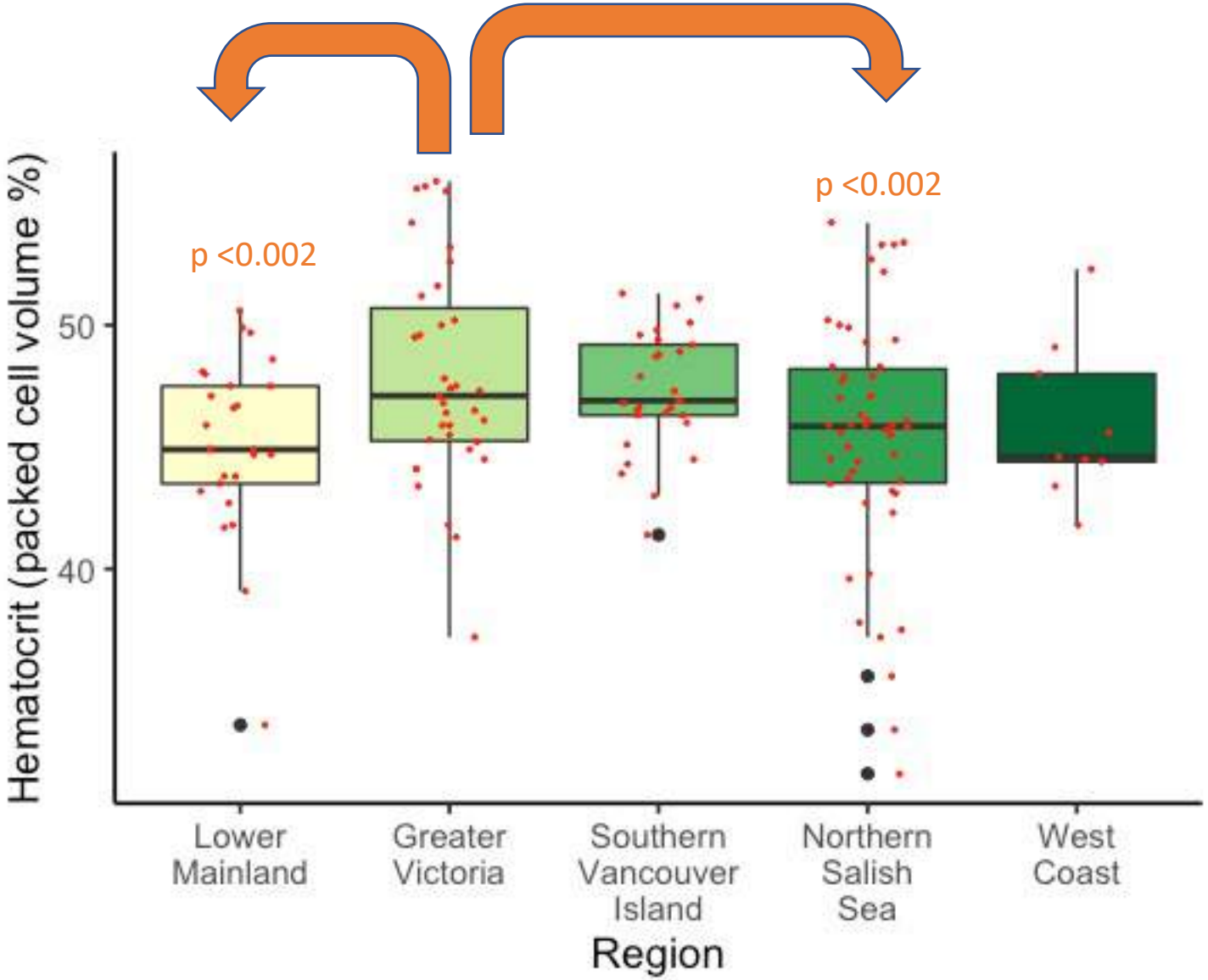
- ANOVAs used to test if traits vary with region or habitat type
- Sex bias: Females > Males (X^2 = 28.6; DF = 1; P < 0.00000001)
- AICc used to select covariates
  - Sex and/or mass
- Covariates included:
  - Triglycerides = sex
  - Hemoglobin = sex*mass
  - dROMs = triglycerides
- Year included as a random effect

Photo: Anneka Vanderpas

Health by region

Hematocrit ~ region + (1|year)

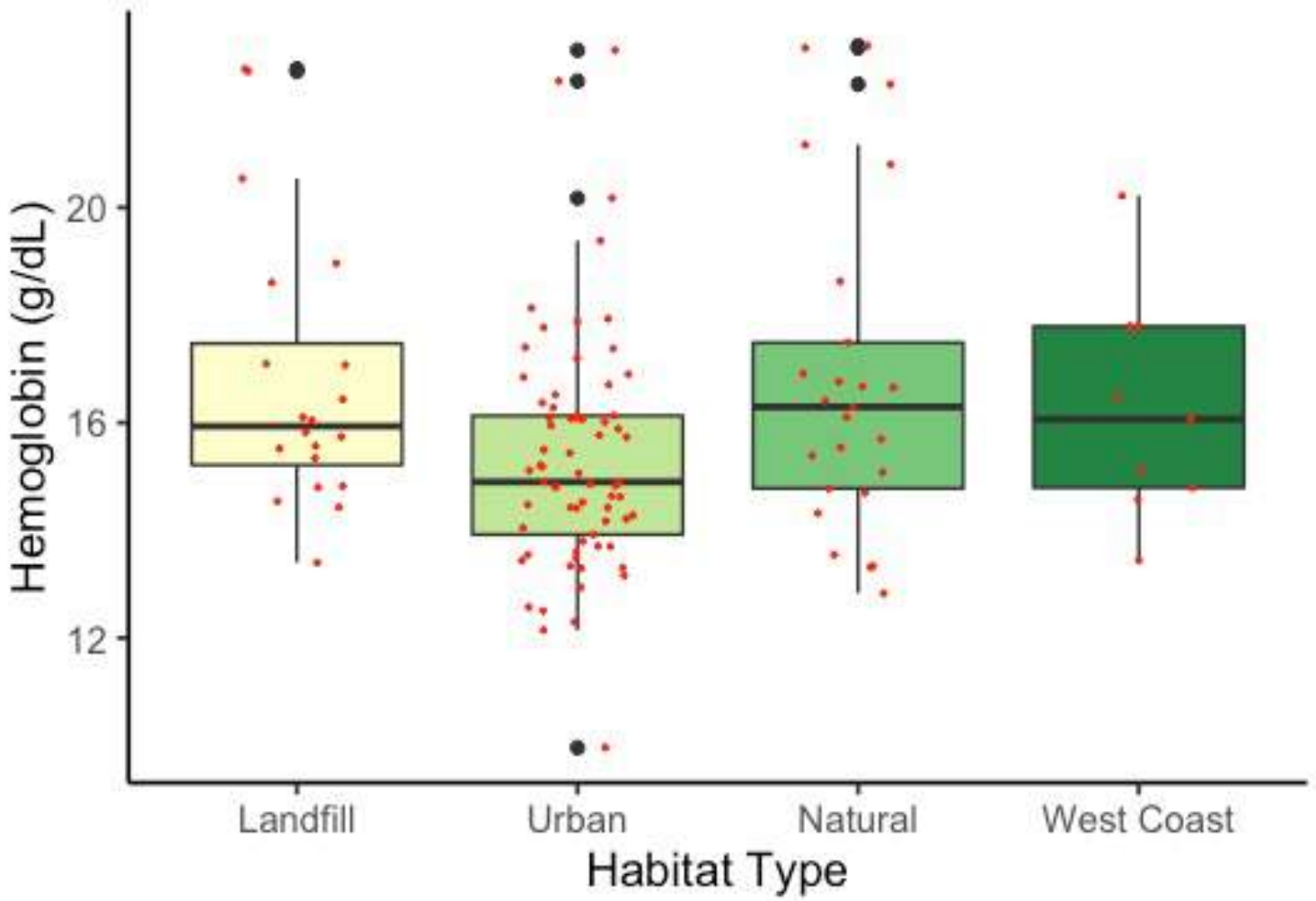
- $F_{4,142} = 5.4$
- P = 0.0005



Health by habitat type

Hemoglobin varied significantly by habitat type

- $F_3 = 3.68$
- $P = 0.01$
- No pairwise comparisons were significant.



“Overall health” using principle components analysis

Trait	PC1	PC2
Triglycerides	0.177	0.655
Glucose	-0.177	0.432
Hemoglobin	**0.438**	-0.199
Hematocrit	**0.501**	-0.436
OXY	**0.393**	0.302
dROMs	**0.583**	0.253

- PC1:
  - Strong positive effect of aerobic capacity
  - OXY + dROMs both positive
  - Potentially represents “good health”

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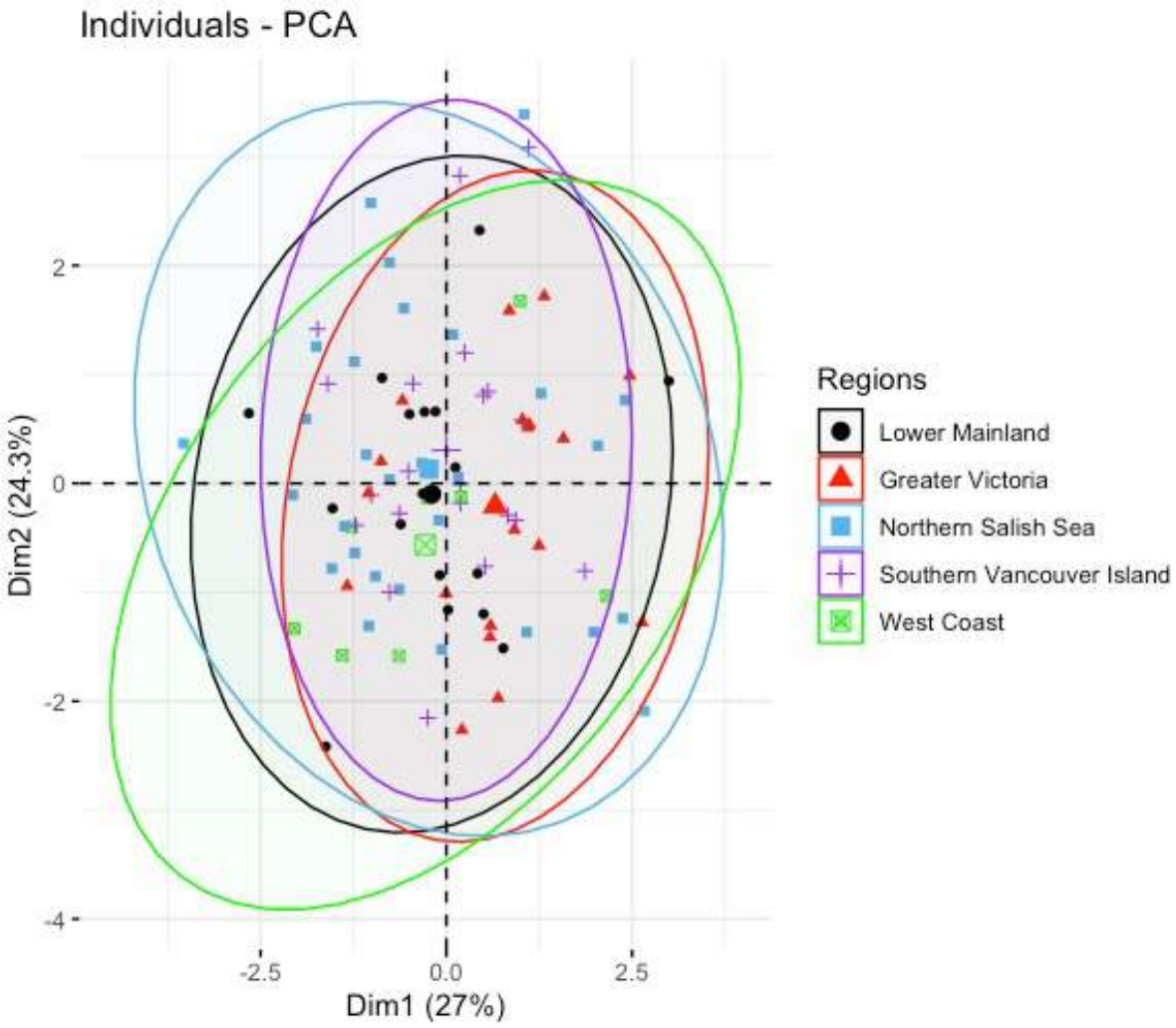
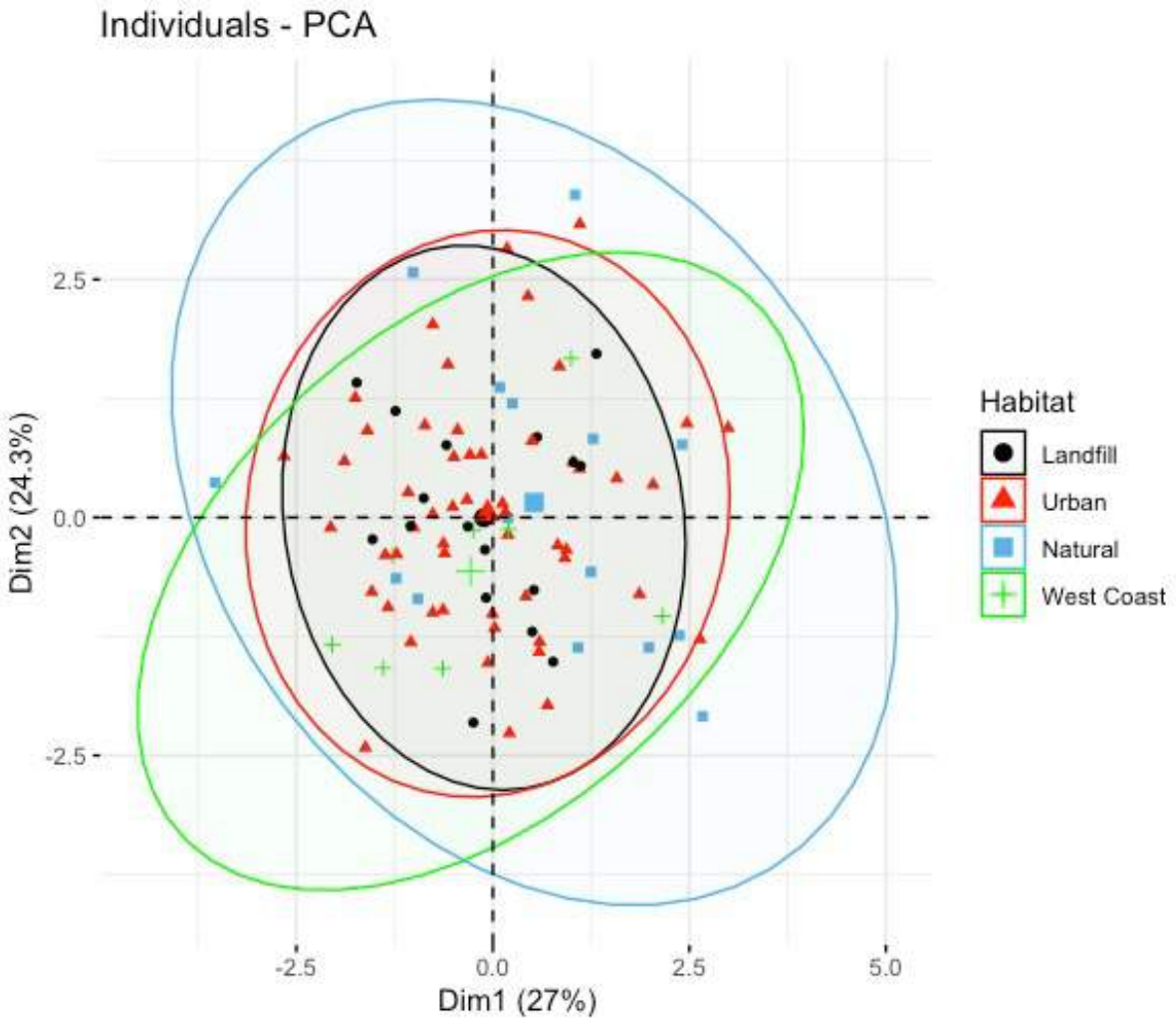
- PC2:
  - Triglycerides and glucose have strong positive influence
  - Negative influence of aerobic capacity
  - Potentially representative of “nutritional or energy status”

Health did not cluster by region or habitat





Conclusions

- Baseline reference physiology values provide a foundation for long-term monitoring.
- Traits were geographically comparable, even with the west coast.
- Sex is an important factor to consider.
- "Overall health" = relationship among traits, but no obvious clustering by region or habitat.
- Future analysis of diet, contaminant, and habitat data will provide further insight into health and use of GWGU as a bioindicator.

(Photo by Vivian Pattison)

Acknowledgements – thank you!

- Dr. Tony Williams
- Dr. Mark Hipfner
- Dr. David Green
- Alice Domalik
- Dr. Nik Clyde
- Anneka Vanderpas
- Vivian Pattison
- Josh Green
- Sarah Hudson
- Kristina Hick
- The many First Nation communities, regional districts and municipalities for permitting access to sampling sites

Environment and Climate Change Canada

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Questions?