

From genes to flyways: Polar biodiversity & evolution in a changing world



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BEHAVIOUR: Too hot to hunt?... *Nothing* to hunt?



SHORT NOTE

Observations of a wild polar bear (*Ursus maritimus*) successfully fishing Arctic charr (*Salvelinus alpinus*) and Fourhorn sculpin (*Myoxocephalus quadricornis*)

M. G. Dyck - S. Romberg

- 300\$
reduction
per person

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FEB 2014

DOI: 10.1098/rspb.2013.3128

Longer ice-free seasons increase the risk of nest depredation by polar bears for colonial breeding birds in the Canadian Arctic

Samuel A. Iverson¹, H. Grant Gilchrist², Paul A. Smith², Anthony J. Gaston² and Mark R. Forbes¹

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No reproduction = population declines = extinctions



2006 & 2007 - fjords on W Svalbard ice-free
Ringed-seal reproduction unsuccessful.

Kovacs & Christian Lydersen (2008)

GENETIC MISMATCHES: ... *Not* blending in?

7360–7365 | PNAS | April 30, 2013 | vol. 110 | no. 18

Camouflage mismatch in seasonal coat color due to decreased snow duration

L. Scott Mills^{a,1}, Marketa Zimova^a, Jared Oyler^b, Steven Running^b, John T. Abatzoglou^c, and Paul M. Lukacs^a

Can evolution proceed fast enough?



OTHER GENETIC MISMATCHES: ... *Not* in-tune?

- **Under genetic control or genetic + environmental cues**
 - **Phenology**
 - Behaviour (migration, hibernation, reproduction)
 - Physiology
 - Mismatches between peak of food prey and reproduction, pollinators and blooming
- **Genes = enzymes and proteins (temperature is important!)**

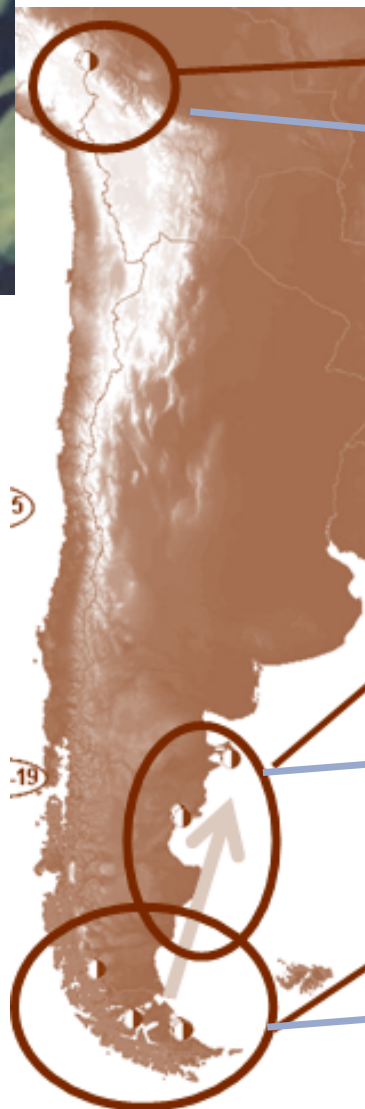


HEMOGLOBINS: locally adapted - genetic dilution?

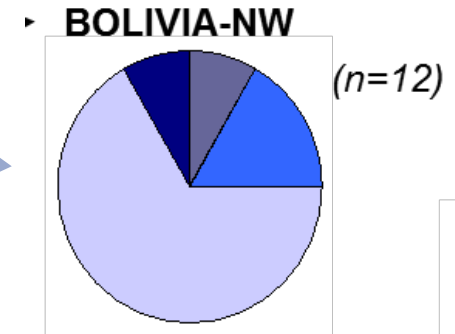
- **Hemoglobins in the cold: Higher O_2 affinity at low temperature**
 - PROBLEM: releasing bound oxygen at peripheral tissues
 - SOLUTION: e.g. increase sensitivity to/or binding sites for regulators (e.g. chlorine ions)
- **Hemoglobins in low oxygen conditions: evolve O_2 affinity**
 - PROBLEM: trade-off and may become sensitive to warm temperatures!



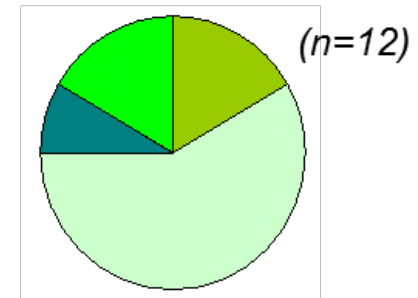
Hemoglobins αA – The Andean Seedsnipes (Thinocoridae)



HIGH ELEV
+ COLD

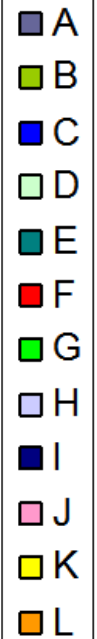
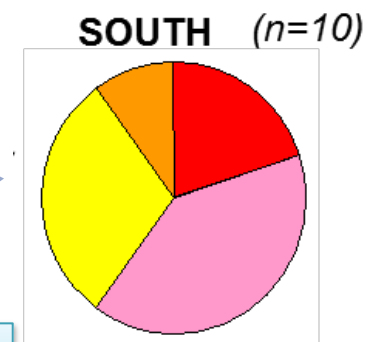


PATAGONIA
(& TF-PAT migrants)



LOWLANDS +
TEMPERATE

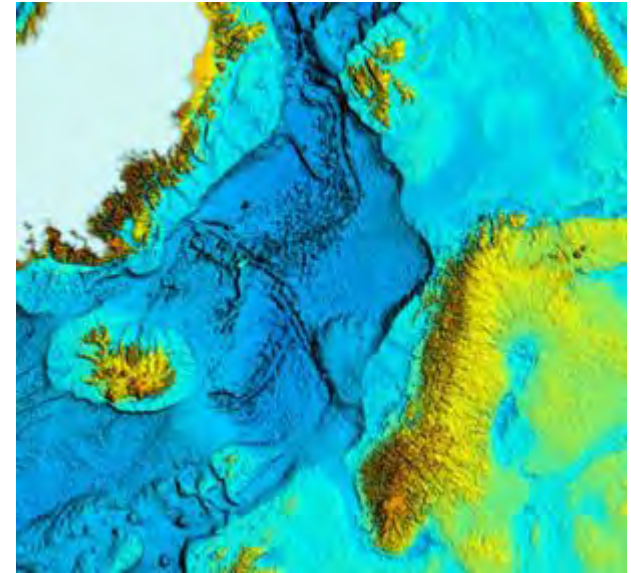
LOWLANDS +
VERY COLD



No shared alleles or protein variants among regions

HEMOGLOBINS: Cold adapted ... genetic dilution?

- Hemoglobins - local adaptation in Atlantic cod and other species:
 - low O₂ near bottom
 - different temperatures
 - Migratory or sedentary...



PROCEEDINGS
OF
THE ROYAL
SOCIETY **B**

Proc. R. Soc. B (2009) 276, 833–841
doi:10.1098/rspb.2008.1529
Published online 25 November 2008

Haemoglobin polymorphisms affect the oxygen-binding properties in Atlantic cod populations

Øivind Andersen^{1,2,ψ}, Ola Frang Wetten^{3,4}, Maria Cristina De Rosa⁵,
Carl Andre⁶, Cristiana Carelli Alinovi⁷, Mauro Colafranceschi^{8,9},
Ole Brix^{10,11} and Alfredo Colosimo^{8,9}

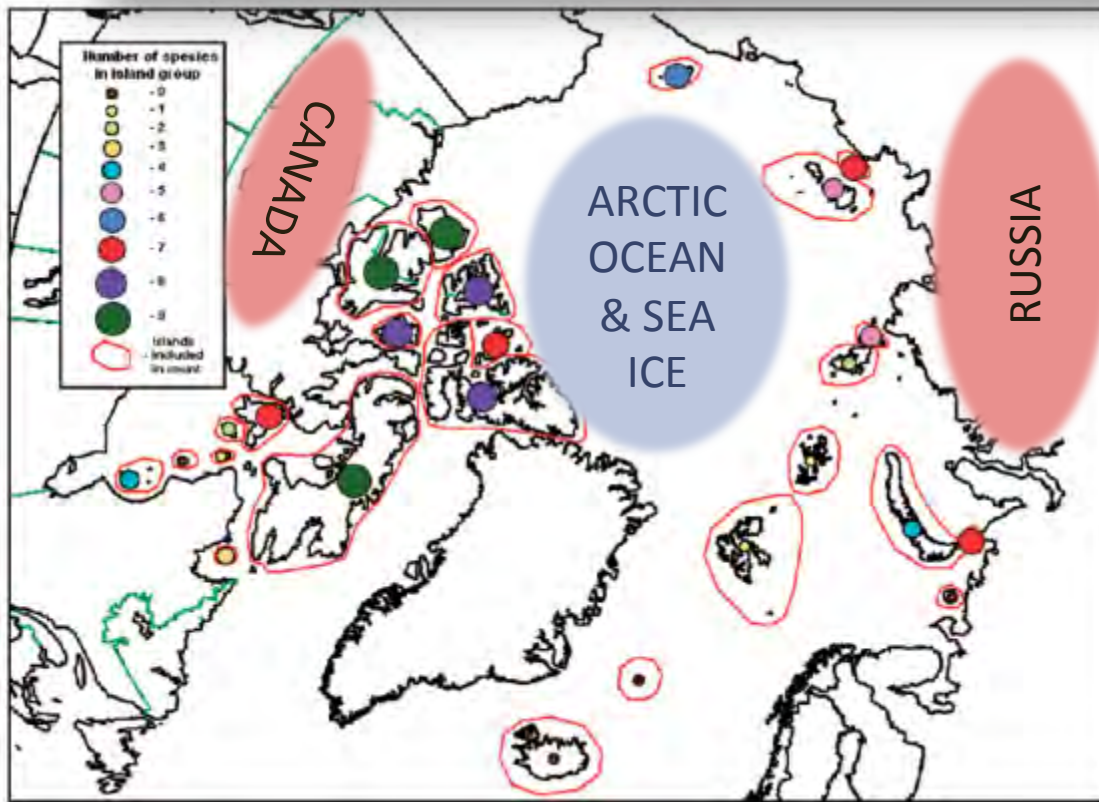
ISLAND BIOGEOGRAPHY: Sea ice, connectivity

BIODIVERSITY

Vol. 13, Nos. 3–4, September–December 2012, 182–190

Ice bridging as a dispersal mechanism for Arctic terrestrial vertebrates and the possible consequences of reduced sea ice cover

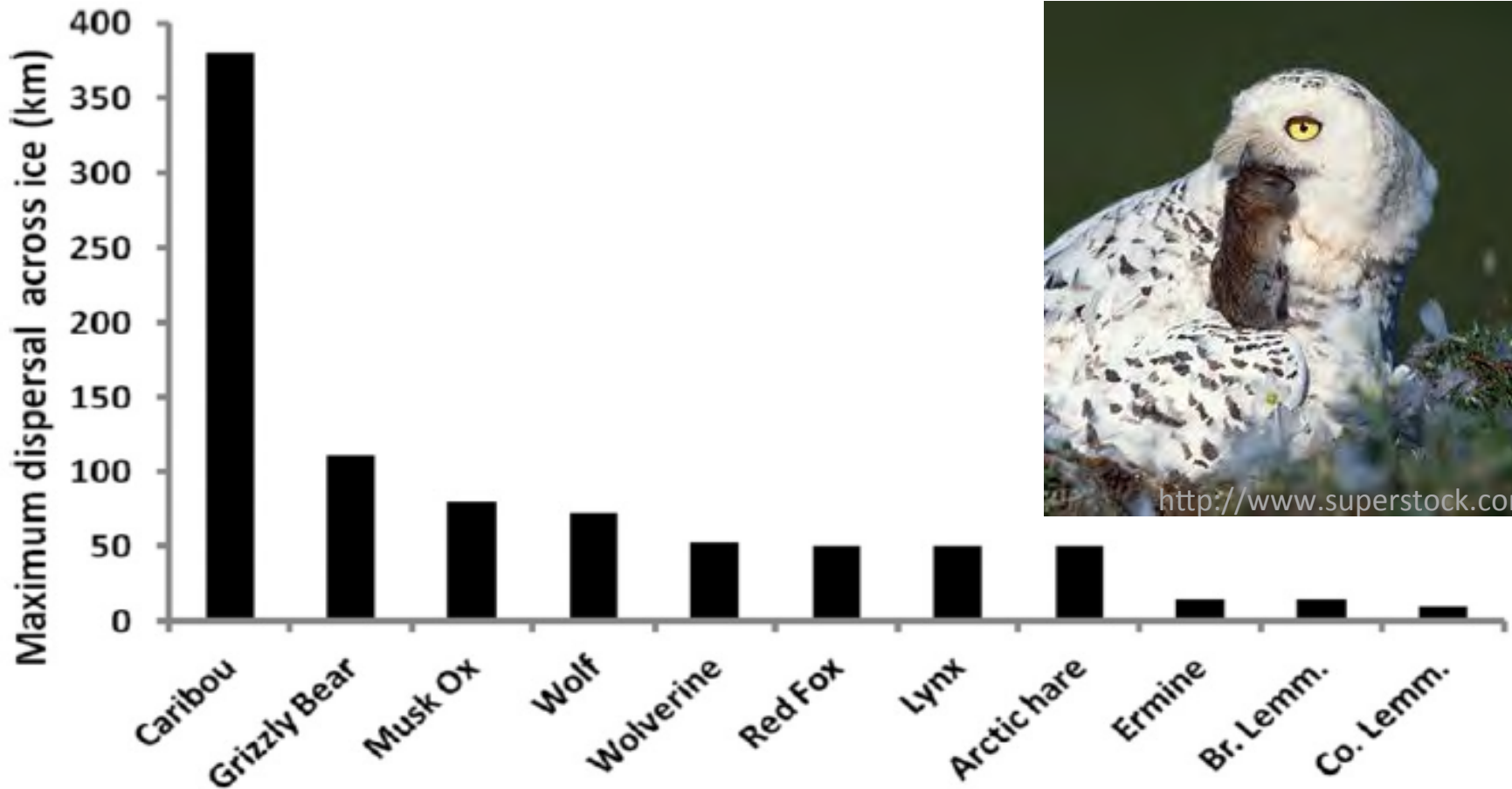
Anthony J. Gaston^{a*}, Maria Gavrilov^b and Christine Eberl^a



*ISLAND BIOGEOGRAPHY:
More species*

- *Larger, more habitat types*
- *Less isolated*

ISLAND BIOGEOGRAPHY: Sea ice, connectivity



Sea-ice loss: reduced dispersal over ice = SPECIES LOSS

- Small mammals (lemmings) – extinctions in small & isolated islands

Actitis macularis
Spotted sandpiper



Pan-American
LEGEND

- Year Round
- Summer (breeding)
- Winter (non-breeding)
- Migration

Map by Cornell Lab of Ornithology
Range data by NatureServe

In Arctic and elsewhere:

- Where is critical habitat located?
- What are key regions of diversity?



<http://www.gannett-cdn.com/>



<http://www.peer.org/>

Hotspots & sources – within species?

... Forecasting for future conservation & resilience:

- climate & environmental change
- preparing for future pathogens & invaders
- creating connectivity among protected areas
- preventing genetic diversity loss



Acknowledgments



Seabird speciation



Arctic ecosystems



