

# Biogeography

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Michael Noonan

Biol 417: Evolutionary Ecology

1. Housekeeping & Review
2. Classical Biogeography
3. Biogeographic Rules
4. Biogeography and Evolutionary Ecology

## Housekeeping & Review

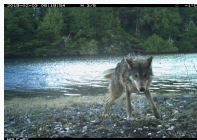
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## Remote Camera Trap Image Processing Technician Temporary, Part-time Position

University of British Columbia Okanagan

### Job Description:

The [WiRE](#) lab is seeking 1 part-time technician to assist with research studying wolf spatial and temporal patterns in Pacific Rim National Park Reserve, British Columbia. This is part of a larger collaborative project studying human-wolf coexistence with the [Wild About Wolves](#) project led by Parks Canada. The technician will assist the graduate student with the goal of classifying camera trap image data on ungulates, small mammals, carnivores, birds, and people. Technician duties will include data entry, image processing, and interacting with collaborators. This is a great opportunity to gain experience with data management, camera trapping, and contribute to an applied wildlife research project.



The technician must follow [UBC Okanagan Covid-19 protocols](#), [declare their vaccination status for rapid testing requirements](#), and take [mandatory Covid-19 safety training](#). Non-medical masks must be worn when working in the WiRE lab.

**Start Date:** February 28<sup>th</sup>, 2022 (flexible)

**Location:** Based in Kelowna – image processing must be completed in the WiRE lab.

### Qualifications:

- Undergraduate student at UBCO.
- Ability to work in Canada (citizenship or valid work permit).

### Preferred:

- B.Sc. biology, natural resources, or environmental studies and an interest in wildlife research.
- No camera trapping experience required. On-the-job training will be provided, although preference will be given to those with prior mammal and bird classification experience.
- Ability to work independently with regular check ins.
- Knowledge of TimeLapse and experience managing large datasets.
- Ability to follow detailed protocols and communicate effectively.

**Compensation:** \$15.20/hr CAD up to 130 hours

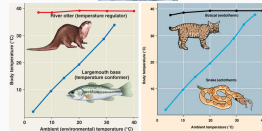
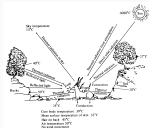
**To Apply:** Send cover letter, CV, and contact information for 3 references in ONE PDF via email to MSc student Jenna Scherger ([jenna.scherger@ubc.ca](mailto:jenna.scherger@ubc.ca)) and Dr. Adam Ford ([adam.ford@ubc.ca](mailto:adam.ford@ubc.ca)) with email subject as "Remote Camera Trap Image Processing Technician".

**Application Deadline:** February 18<sup>th</sup>, 2022.

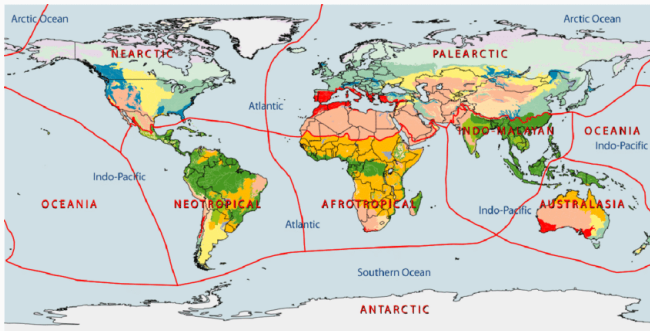
**Contact Email:** [jenna.scherger@ubc.ca](mailto:jenna.scherger@ubc.ca)



Last lecture we covered how organisms must balance long term inputs/outputs (heat, water, energy, etc...), and how meteorology govern the rates of input/output of different resources.



Today we will cover how, by dictating which strategies are effective/not in any environment, meteorology, climate, and geography govern the structures of ecosystems, a phenomenon termed 'Biogeography'.

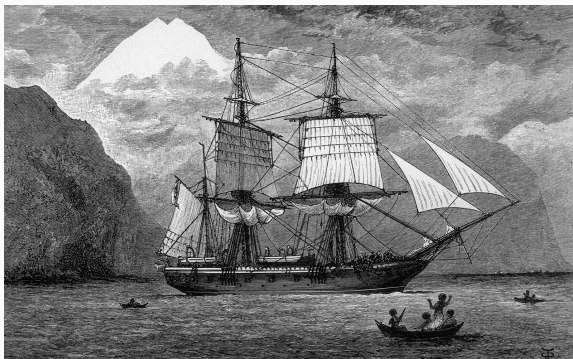


Source: WWF

# Classical Biogeography

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During the Age of Exploration and Age of Sail Europeans explored the world.



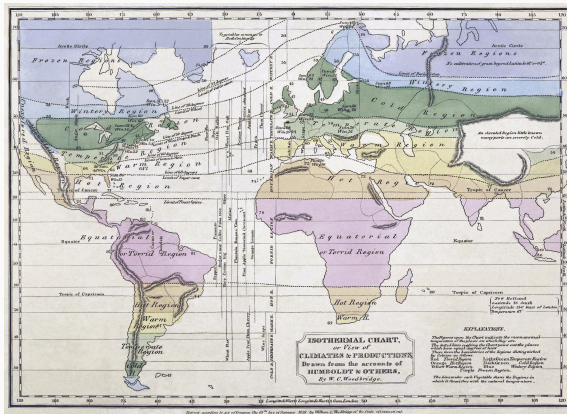
Source: Encyclopedia Britannica

Along the way the collected biological samples, recorded environmental conditions, and described biodiversity.



Source: Sotheby's Institute of Art

When they started overlaying records of environmental conditions onto their new maps they observed that conditions changed in predictable ways across the planet.







Source: Humboldt Foundation

One of the key figures during this period was Alexander von Humboldt.

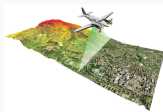
Humboldt's work was a major 'lightbulb' moment that spawned an entirely new scientific discipline: 'Biogeography' (i.e., the geography of life).

This is why so many things are named 'Humboldt'



The tools that modern biogeographers use are more advanced, but the questions are the same:

‘What shapes patterns in the distribution of life on earth?’



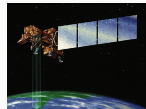
Source: aurora



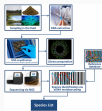
Source: Movebank



Source: eBird



Source: NASA



Source: Aarhus University



Source: re-Work

# Biogeographic Rules

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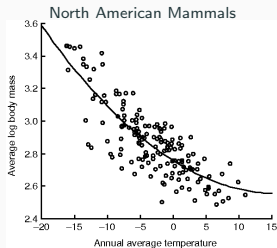
As data from around the world continued to trickle in, early biogeographers began piecing together patterns.

Recurring patterns of adaptation led to the generation of a number of 'biogeographic rules':

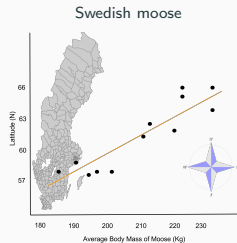
- Bergmann's Rule
- Allen's Rule
- Gloger's Rule
- Jordan's Rule
- Rapoport's rule
- Island Rule
- and so on ...

Bergmann's rule (Bergman, 1848) states that species living regions with lower temperatures should have larger body sizes than species inhabiting regions with high temperatures.

Bergmann's explanation was that larger animals have a lower surface area to volume ratio than smaller animals, so they radiate less body heat per unit of mass.

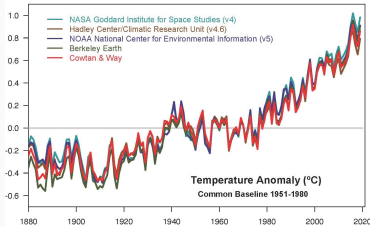


Source: Blackburn & Hawkins (2004)

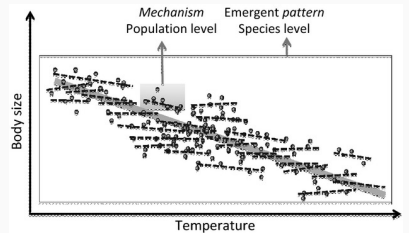


Source: Sand *et al.* (1995)

If true, Bergmann's rule has important implications for the future of life on Earth.



Source: NASA

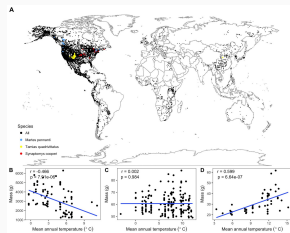


Source: Teplitsky & Millien (2014)

The problem is that recent, more comprehensive tests have found no evidence for Bergmann's Rule.

## Birds and Mammals

Rierner *et al.* (2018): “We assessed the strength and direction of the intraspecific relationship between temperature and individual mass for 952 bird and mammal species. For 87% of species, temperature explained less than 10% of variation in mass, and for 79% of species the correlation was not statistically significant.”



Source: Rierner *et al.* (2018)

## Amphibians

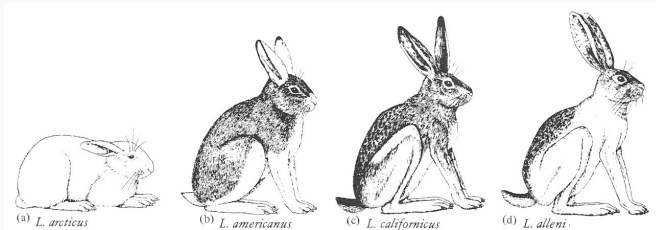
Adams & Church (2008): *"We measured 96,996 adult Plethodon from 3974 populations to test for the presence of Bergmann's clines in these salamanders. Only three Plethodon species exhibited a significant negative correlation between body size and temperature consistent with Bergmann's rule, whereas 37 of 40 species did not display a pattern consistent with this prediction."*

## Insects

Shelomi (2012): *"... the majority of studies suggested no clines at all. ... The validity of Bergmann's rule for any group and range of insects is highly idiosyncratic and partially depends on the study design."*

Allen's rule (Allen, 1877) states that animals living in cold climates should have shorter limbs and bodily appendages than animals adapted to warm climates.

Allen's explanation was that animals living in cold climates need to conserve as much heat as possible, and should therefore have a lower surface area to volume ratio than animals in warmer climates.



Source: MUN



Gloger's rule (Gloger, 1833) states that animals living in humid environments should be more heavily pigmented than animals living in dry environments.

Gloger noticed that over 90% of 52 North American bird species he looked at conformed to this rule.

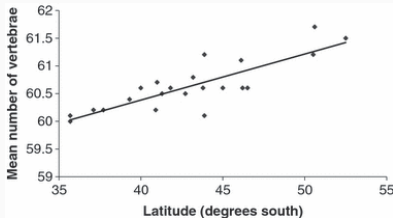


Source: biologyexams4u

Explanation? Increased resistance of dark feathers to feather-degrading bacteria that thrive in humid environments.

Jordan's rule (Jordan, 1891) states that there is an inverse relationship between water temperature and meristic characteristics (i.e., things you can count: vertebrae, scales, fins, etc.) in various species of fish.

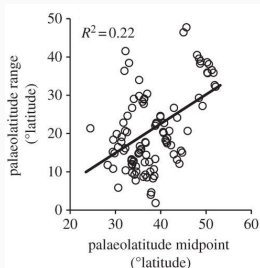
There is support for the existence of this rule,



Source: McDowall (2008)

But no explanation as to why it exists. “...it appears that Jordan's rule is not really meaningful...” McDowall (2008).

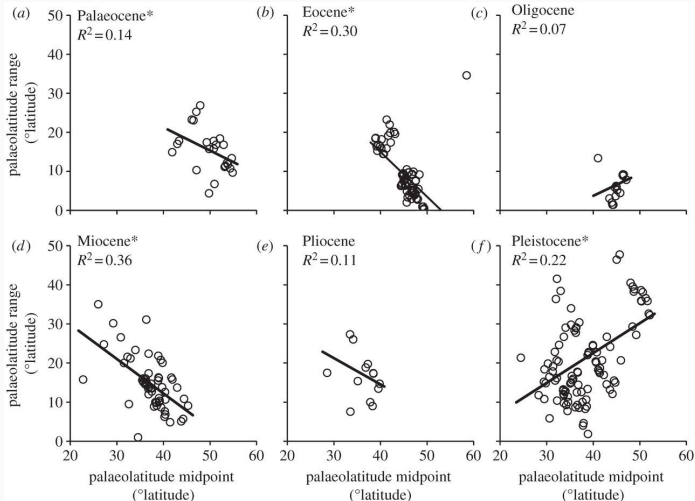
Rapoport's rule (Rapoport, 1975) states that the latitudinal ranges of plants and animals are generally smaller at lower latitudes than at higher latitudes.



Source: Veter *et al.* (2013)

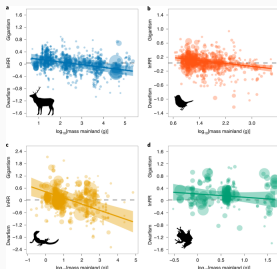
Rapoport gave no explanation, but it has been suggested that one possible mechanism is that seasonal variability selects for greater climatic tolerances and therefore wider latitudinal ranges.

Fossil evidence suggests it may only be a recent phenomenon.



Source: Vetter *et al.* (2013)

The Island Rule (Foster, 1964) states that if placed on an islands, small species should increase in size (insular gigantism) and large species should decrease in size (insular dwarfism).



Source: Benítez-López *et al.* (2021)

The suggested mechanisms include changes in competition and access to resources.

There are lots of biogeographic rules with varying levels of support.

So what?

# **Biogeography and Evolutionary Ecology**

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Biogeographers study patterns in species and ecosystems in geographic space and through geological time.

For the past ca. two centuries biogeographic rules have spurred a massive amount of research focused on identifying the underlying mechanisms for these patterns.

In other words, what combination of proximate and ultimate mechanisms can conspire to cause life to evolve in such a way that the net result are the observed biogeographic patterns.

Biogeography is therefore deeply rooted in evolutionary ecology and an important generator of 'Why?' questions.



Next week we will focus on the ecological niche.

# References

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