

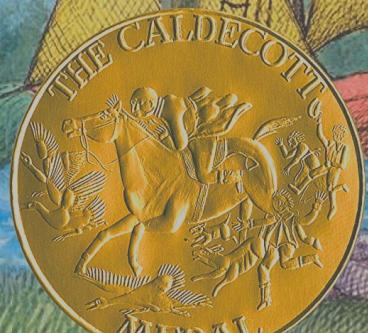
# WHERE THE WILD THINGS ARE

Ranges, Distributions and Habitats

EFB 390: Wildlife Ecology and Management

Dr. Elie Gurarie

February 21, 2022



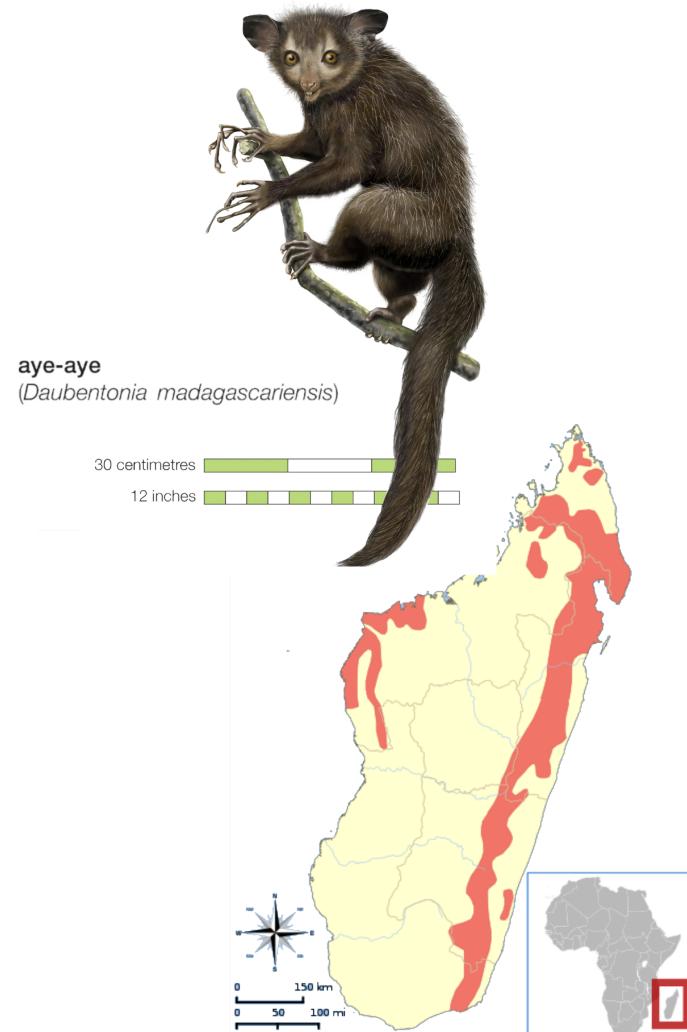
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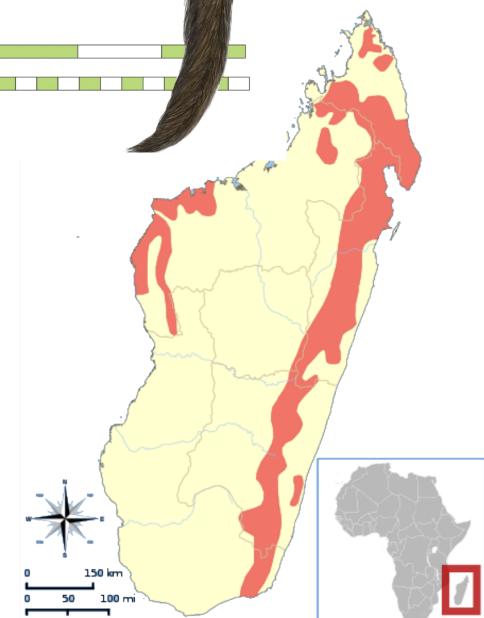
some ranges are small



aye-aye  
*(Daubentonia madagascariensis)*

30 centimetres  
12 inches

some ranges are large



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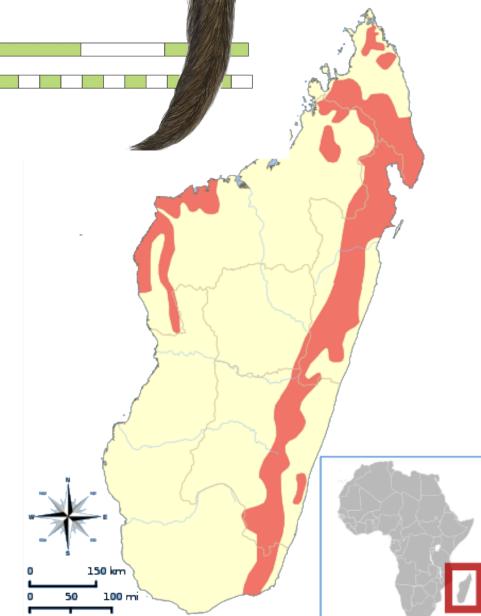
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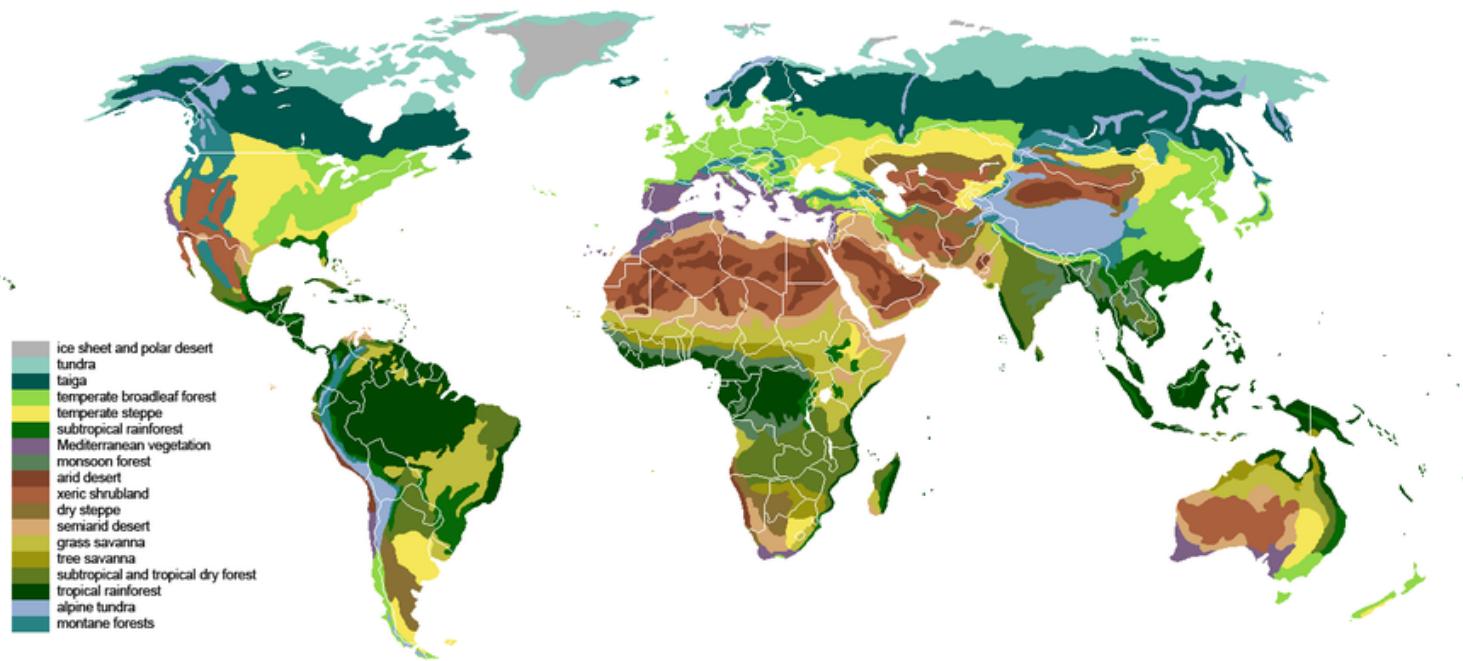
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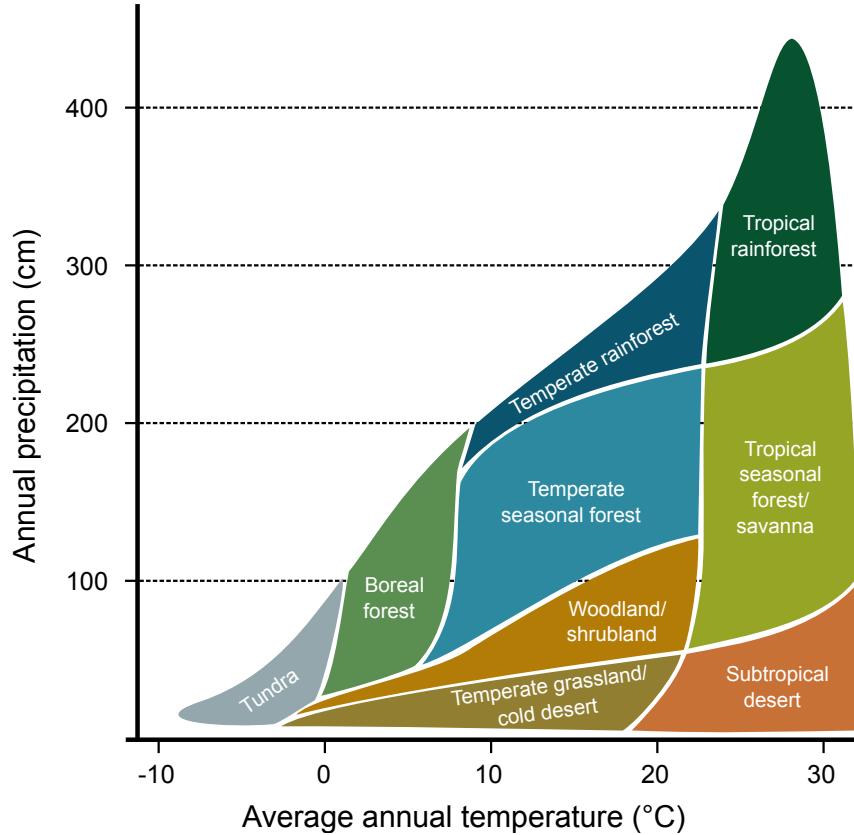


# At the broadest scale



the world is divided into *biomes*

# Constrained by climate



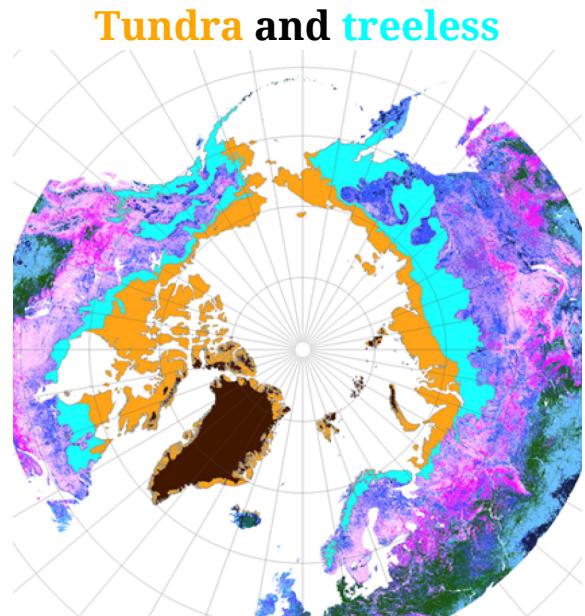
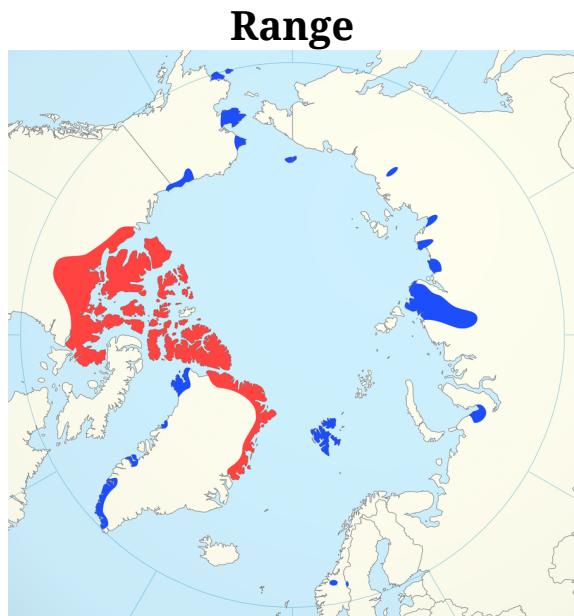
This (mainly) constrains / determines vegetation communities.

Which is reflected in the wildlife that inhabits those biomes.

# Example: Muskox (*Ovibos moschatus*)



pretty much only found in Arctic Tundra.



# Example: Muskox



# Spider monkey (*Ateles fusciceps*)

Sometimes it's hard to tell which is the **range** and which is the **biome**.



# Other animals laugh at your adorable biomes

Quiz: What mammal has the most common names?\*

*Puma concolor*

Cougar. Catamount. Painter. Panther. Ghost Cat.  
Puma. Shadow Cat. Mountain lion. Nittany lion.



The **Erie People** (victims of the beaver wars) are the "long-tailed" (cat people), named after the puma that inhabited areas in western New York / Ohio / Ontario.

\*\* according to Guiness

# To think about:

Why does *Puma concolor* have such a large range?

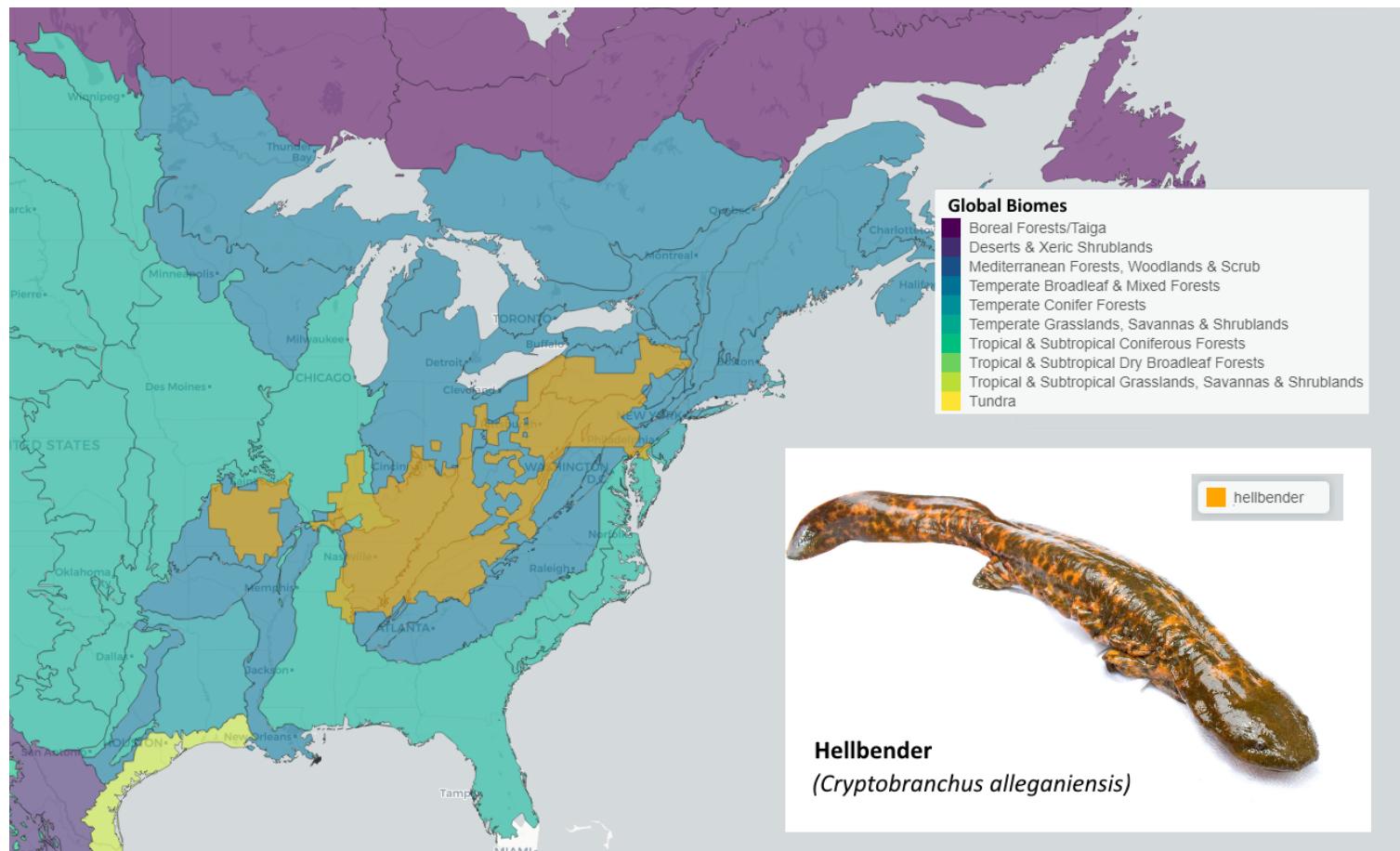
Why does *Puma concolor* have so many common names?

What does it really *need*?



# Consider the Eastern Hellbender

Near threatened in New York State. Range restricted, mainly, to "**temperate broadleaf and mixed forest**" biome.



# Other salamanders?

Let's compare other salamanders present in New York State.

**My *Naive* Prediction:** They will mainly be limited to the principle biome of New York State ("temperate broadleaf and mixed forest").

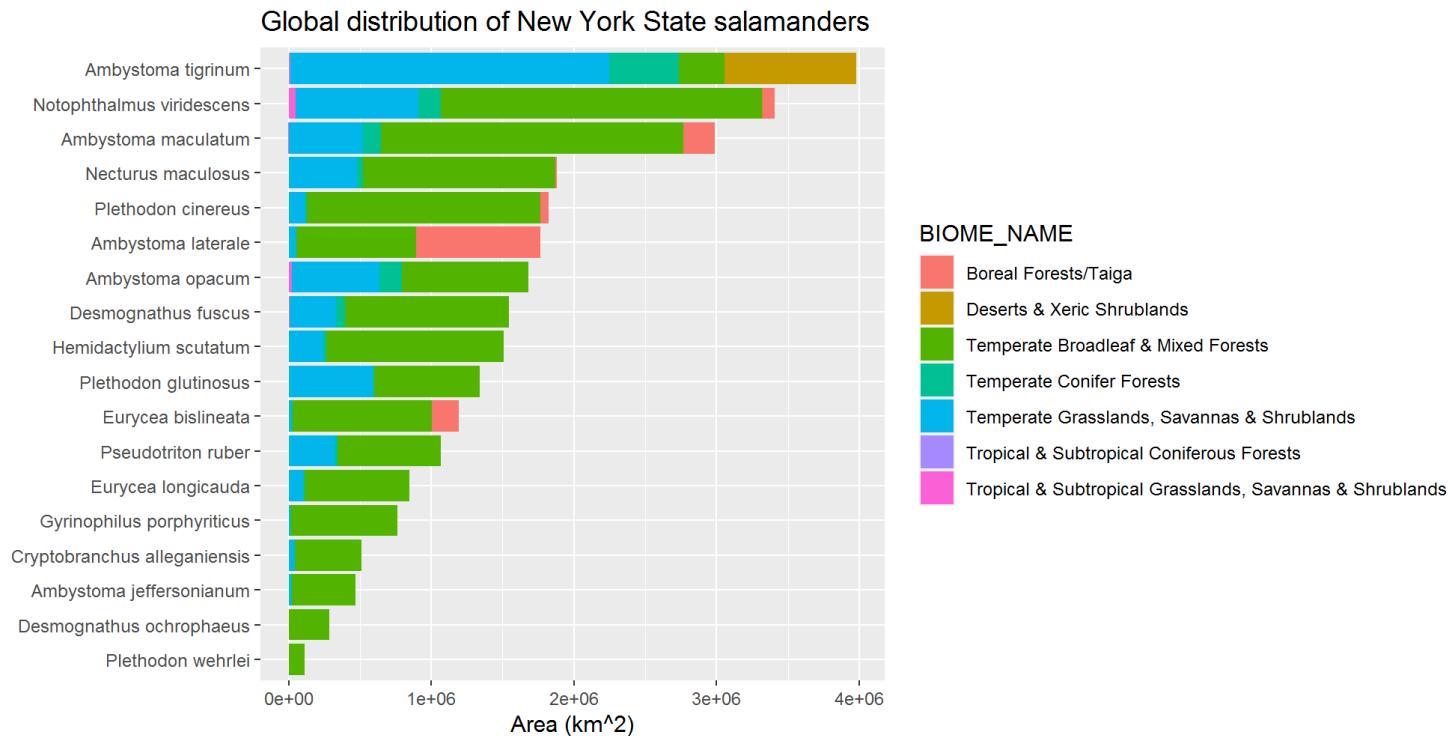
Because generally: **small ranges and confined to streams.**

CHECKLIST OF	AMPHIBIANS, REPTILES, BIRDS AND MAMMALS	COMMON NAME	SCIENTIFIC NAME	LEGAL STATUS	LEGAL STATUS
OF NEW YORK STATE				FEDERAL	STATE
<b>Hellbender, Mudpuppy and Salamanders</b>					
Blue-spotted Salamander	Artwork by Jean Gewart	Hellbender	<i>Cryptobranchus alleganiensis</i>	Un	GN-SC
		Common Mudpuppy	<i>Necturus maculosus</i>	Un	GN
		Marbled Salamander	<i>Ambystoma opacum</i>	Un	GN-SC
		Jefferson Salamander <sup>C</sup>	<i>Ambystoma jeffersonianum</i>	Un	GN-SC
		Blue-spotted Salamander <sup>C</sup>	<i>Ambystoma laterale</i>	Un	GN-SC
		Spotted Salamander	<i>Ambystoma maculatum</i>	Un	GN
		Eastern Tiger Salamander	<i>Ambystoma tigrinum</i>	Un	GN-E
		Eastern Red-spotted Newt	<i>Notophthalmus viridescens</i>	Un	GN
		Northern Dusky Salamander	<i>Desmognathus fuscus</i>	Un	GN
		Allegheny Mountain Dusky Salamander	<i>Desmognathus ochrophaeus</i>	Un	GN
		Eastern Red-backed Salamander	<i>Plethodon cinereus</i>	Un	GN
		Northern Slimy Salamander	<i>Plethodon glutinosus</i>	Un	GN
		Wehrle's Salamander	<i>Plethodon wehrlei</i>	Un	GN
		Four-toed Salamander	<i>Hemidactylium scutatum</i>	Un	GN
		Northern Spring Salamander	<i>Gyrinophilus porphyriticus</i>	Un	GN
		Northern Red Salamander	<i>Pseudotriton ruber</i>	Un	GN
		Northern Two-lined Salamander	<i>Eurycea bislineata</i>	Un	GN
		Long-tailed Salamander	<i>Eurycea longicauda</i>	Un	GN-SC

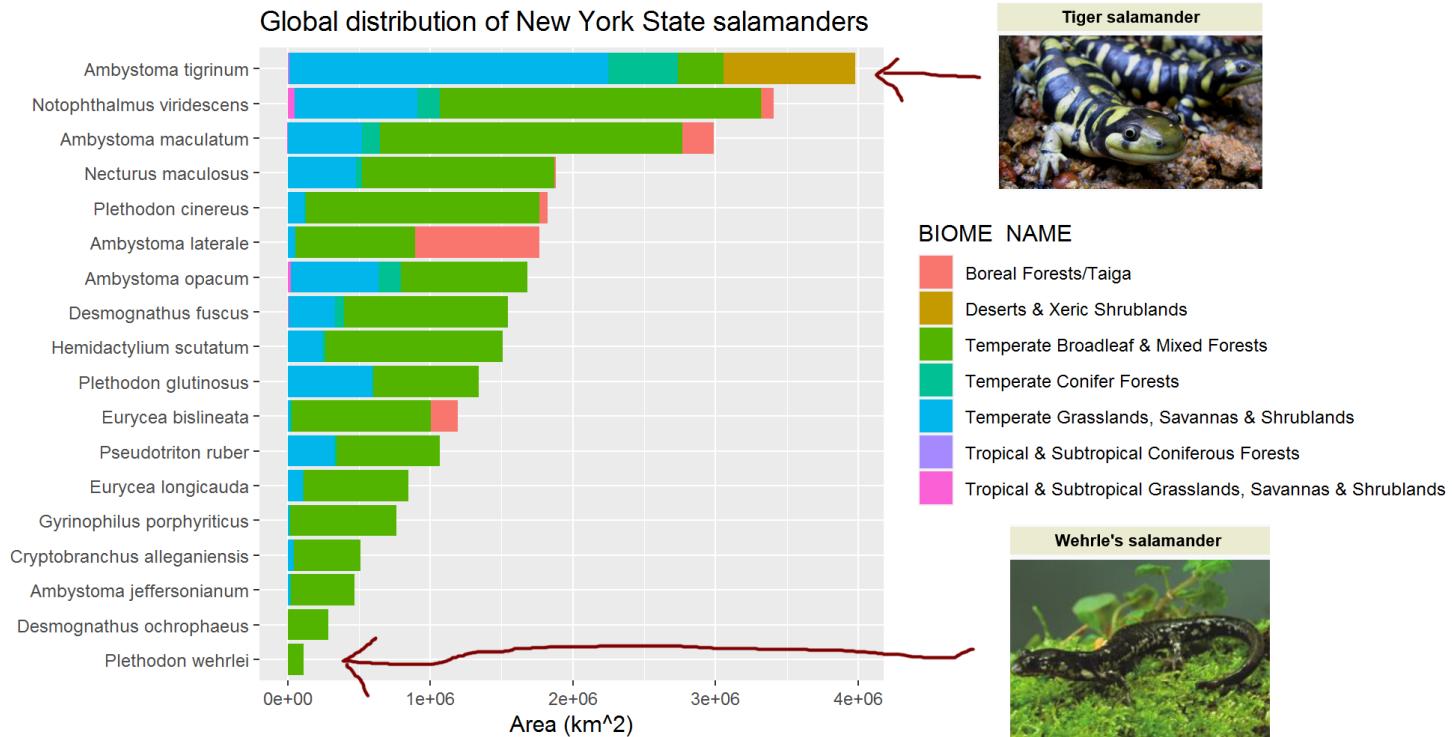
Quick analysis:

- Download Ecoregions (e.g. from [here](#))
- Get species ranges of all amphibians from [IUCN](#)

# In fact ... quite a few "biome generalist!"



# Let's look at a couple more species more closely



Predictably, the smaller the range, the more specialized.

But why?

# Ask the question: What do they really need?

## Wehrle's Salamander



"... found in upland forests and woodlands (e.g., red spruce-yellow birch, mixed deciduous). Found in rock crevices, under rocks, logs, and leaves, and in twilight zone of caves (at lower elevations). Eggs are laid in damp logs, moss, cave crevices, and other protected sites."

IUCN - Wehrle's Salamander

## Tiger Salamander



"Can be found in virtually **any habitat**, providing there is a terrestrial substrate suitable for burrowing and a body of water ... for breeding. Terrestrial adults usually are underground, in self-made burrows or in those made by rodents, shrews, or other animals ... This species seems tolerant of habitat disturbance."

IUCN - Eastern Tiger Salamander

# What do they really need = **Habitat**

lots of possible definitions ... from very limiting ones:

"the place where an organism lives; where one would go to find it"  
(Odum, 1971)

*But isn't that just range!?*

To somewhat vague ones:

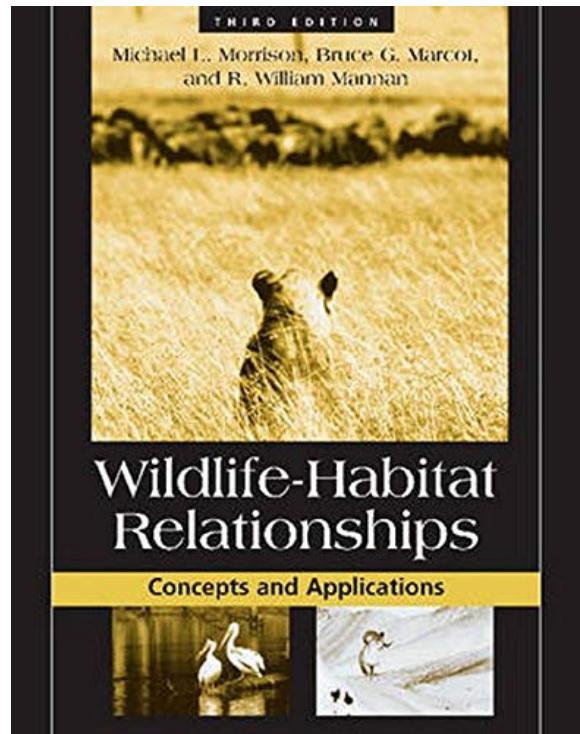
"the place where a plant or animal *normally* (!?) lives, often characterized by a dominant plant form or physical characteristic." (Ricklefs, 1973)

What does **normally** mean?

# Decent working definition:

"An **area** with the combination of **resources** (like food, cover, water) and the **environmental conditions** (temperature, precipitation, presence or absence of predators and competitors) that **promotes occupancy** by individuals of a given species (or population) and allows those individuals to **survive and reproduce.**"

Morrison 2012



# Components of Wildlife Habitat

*Habitat: Biotic and abiotic factors*

Typically, enumerated as:

component	description
<b>food</b>	Very important (obviously)!
<b>water</b>	Also important
<b>shelter</b>	Dens / burrows / nesting sites / predator avoidance
<b>space</b>	Important, especially, for territorial animals. But ultimately linked with food & shelter.

These interact in complex ways, but are often used as a "checklist" for direct habitat restoration efforts.

# Components of Wildlife Habitat

I would definitely add ...

component	description
food / water	...
shelter	...
space	...
reproduction	Minimal presence of conspecifics
survival	Ability to avoid predation

Coming back to definition:

"An area with the combination of resources (like food, cover, water) and the environmental conditions (temperature, precipitation, **presence or absence of predators and competitors**) that promotes occupancy by individuals of a given species (or population) and **allows those individuals to survive and reproduce.**"

# Definition: Habitat type

Description of an *ecological community* (much finer than **biome**), often used synonymously with *vegetation type*.

- **Habitat** is species specific
- **Habitat type** describes an area that includes many species

## How many are there?

Google search results for "habitat types". The search bar shows "habitat types". Below it, a "People also ask" section lists four questions with dropdown arrows:

- What are the 5 types of habitats?
- What are the 7 types of habitats?
- What are the 3 types of habitat?
- What are the 2 types of habitat?

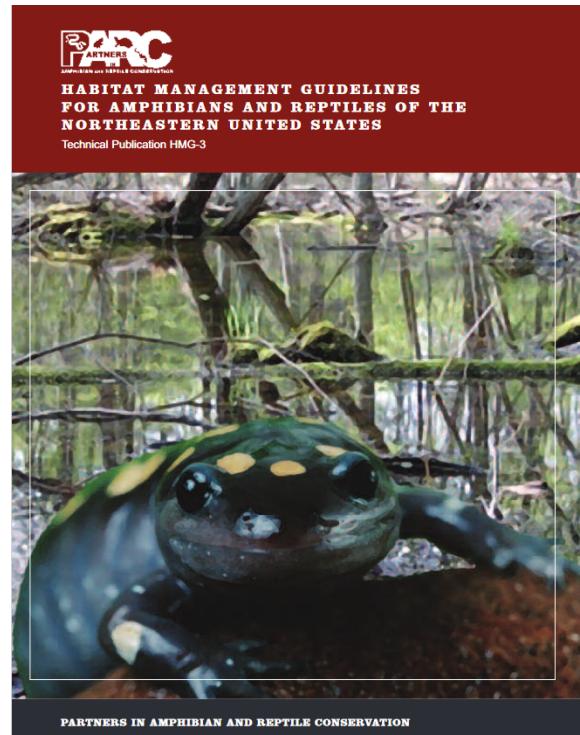
Feedback

# How many habitat types are there?

Totally depends on context and group of interest!

## Habitat types for herps in NE. USA:

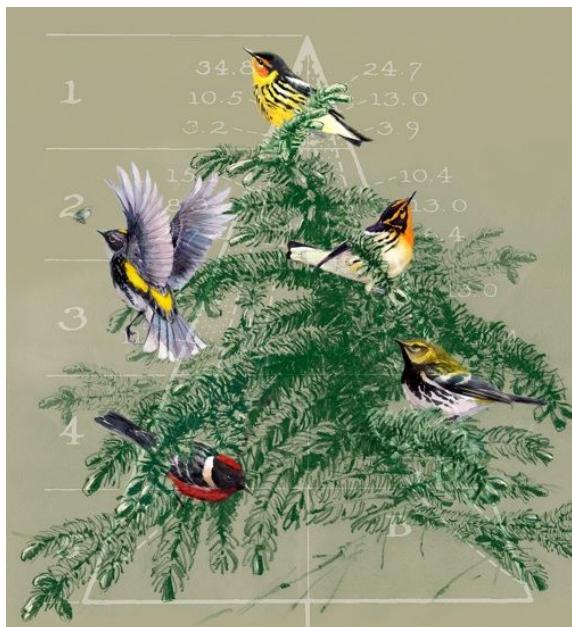
- Seasonal Isolated Wetlands
- Wet Meadows, Bogs, and Fens
- Permanent Wetlands
- Small Streams, Springs, and Seepages
- Rivers
- Estuarine and Coastal
- Hardwood Forests
- Spruce and Fir Forests
- Xeric Upland and Pine Forests
- Grasslands and Old Fields
- Rock Outcrops and Talus
- Caves and Karst
- Agricultural Lands
- Urban and Residential Systems



(Mitchell et al. 2010)

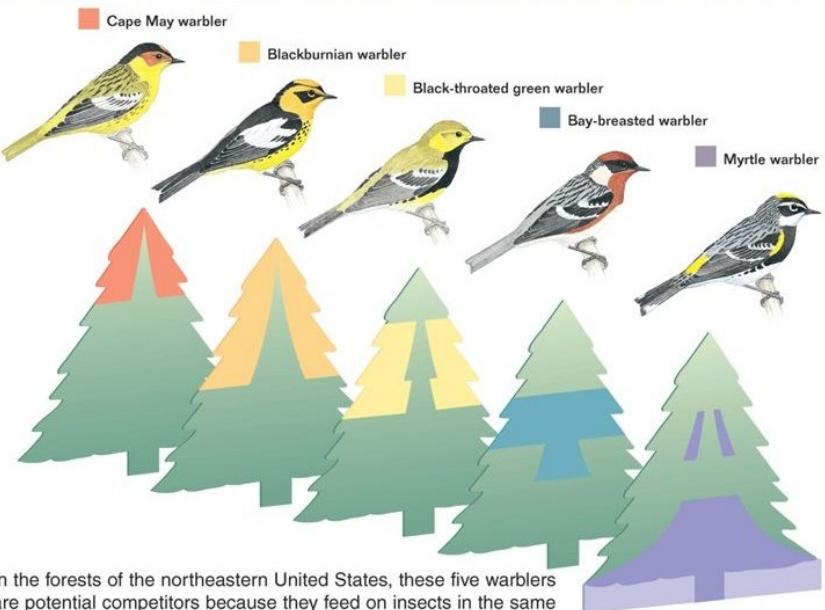
# Habitat can be VERY specific

How do 5 species of warbler co-exist in one tree?



(MacArthur 1958)

By sharing very specific portions of the tree!



In the forests of the northeastern United States, these five warblers are potential competitors because they feed on insects in the same trees. However, each species hunts only in a portion of the tree. Ecologist Robert MacArthur proposed that this feeding strategy reduced competition among these species of warblers.

# Habitat depends on life cycle

## Reproduction / early rearing habitat

- Can be extremely specific
- Tends to prioritize *shelter/protection*

## Dispersal/migration habitat

- Tends to be ... just about *anything*

## Foraging habitat

- Good food to get fat!

## Breeding habitat

- Mainly requires presence of conspecifics!
- (often but not always same as "reproduction" habitat)



**Spotted owl (*Strix occidentalis*)** - very picky about nesting habitat

What is Pacific salmon (*Oncorhynchus spp.*) habitat?

# Habitat Specialists vs. Generalists

Raccoon (*Procyon lotor*)



Koala (*Phascolarctos cinereus*)



- very **catholic** diet (omnivorous)
- very **behaviorally adaptable**
- deciduous / mixed forests,  
mountains, urban/suburban  
environments, coastal marshes

- Strict eucalyptus diet
- Strict arboreal lifestyle
- Pretty small range

Generalist species make very good invaders (see raccoons in Europe).  
Specialist species are (generally) more vulnerable to environmental change /

# Very closely related species can be quite different

**Brown bear (*Ursus arctos*)**



**Polar bear (*Ursus maritimus*)**



- Highly adaptable diet
- Found in forest / mountain / savannah / tundra

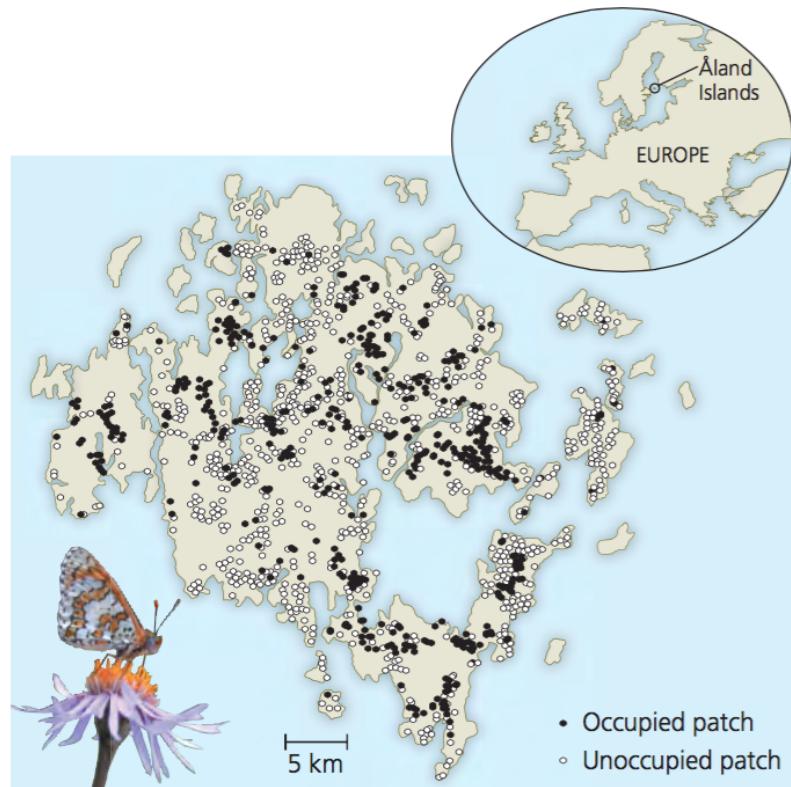
- Reliant almost entirely on seal meat on floating sea ice.

**VERY RECENT** divergence (~100,000 ya) ... shift in diet completely transformed their "habitat". Polar bears are (in consequence) more vulnerable to climate change / sea-ice loss.

# Habitat Connectivity is very important for specialists

**Habitat Fragmentation** is decrease in connectivity.

For **specialists**, patchily distributed resources HAVE to be accessible.



▲ **Figure 53.21 The Glanville fritillary: a metapopulation.**  
On the Åland Islands, local populations of this butterfly (filled circles) are found in only a fraction of the suitable habitat patches (open circles) at any given time. Individuals can move between local populations and colonize unoccupied patches.

# Specialists vs. Fragmentation

French breeding birds: **More fragmented** environments leads to **less specialized communities**

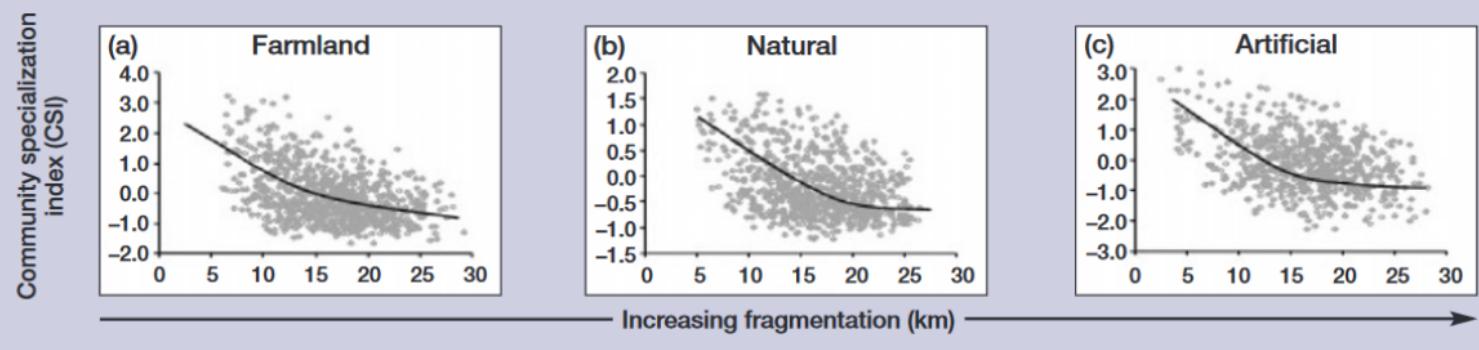
## Panel 1. Community specialization index: an indicator of functional homogenization

Julliard et al. (2006) have quantified the specialization of species as the coefficient of variation (standard deviation/average) of their densities among habitat classes. The species specialization index (SSI) may be useful in building a sensitive (yet simple) index of biotic homogenization at the community level. The community specialization index (CSI) could, in turn, be used to test the role played by human-induced disturbances, such as habitat fragmentation, in functional biotic homogenization.

We used data from the French Breeding Bird Survey and considered 100 common species. We investigated the response of the CSI to habitat fragmentation and quantified these pressures using a land-cover survey (CORINE Land Cover database; Figure 3). The CSI was then calculated as the weighted average of the SSI in the site  $j$  (weighted by the number of individuals at the  $j$  site).

$$CSI_j = \frac{\sum_{i=1}^N a_{ij}(SSI_i)}{\sum_{i=1}^N a_{ij}},$$

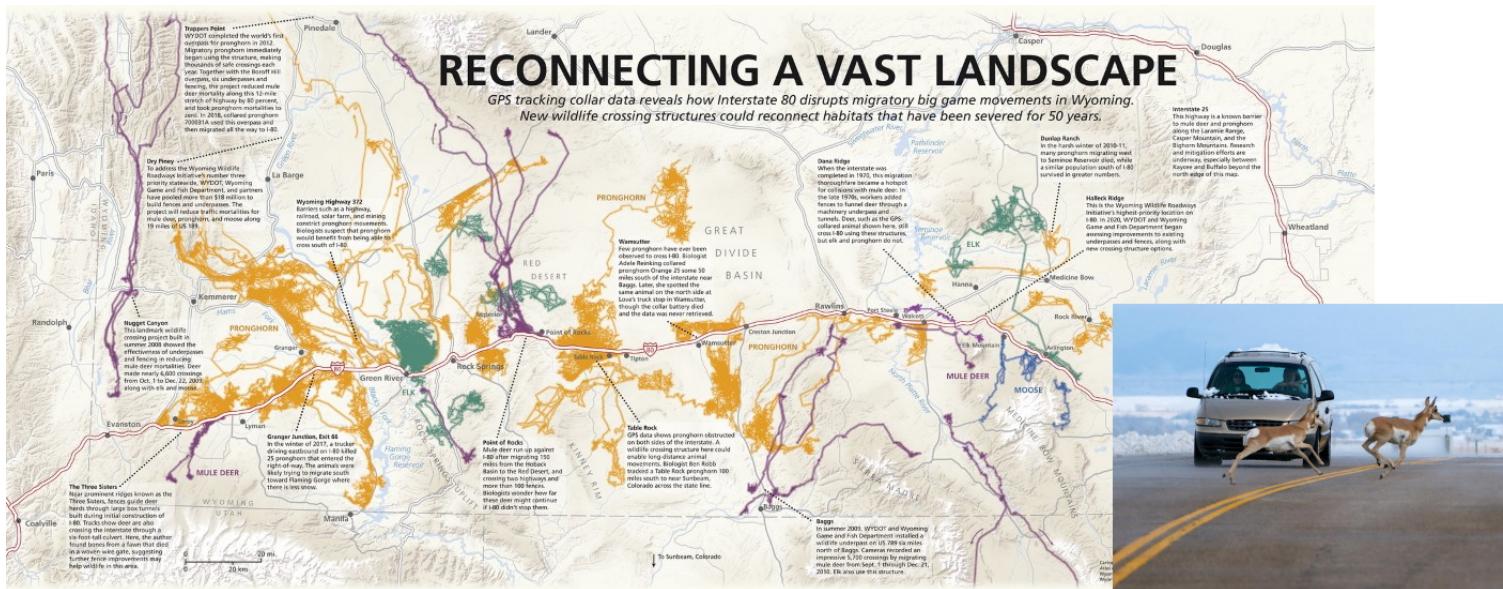
Where  $N$  was the total number of species recorded,  $a_{ij}$  the abundance of individuals of species  $i$  in plot  $j$ , and  $SSI_i$  its specialization index.



(Clavel et al. 2011)

**Habitat connectivity** is also good ...

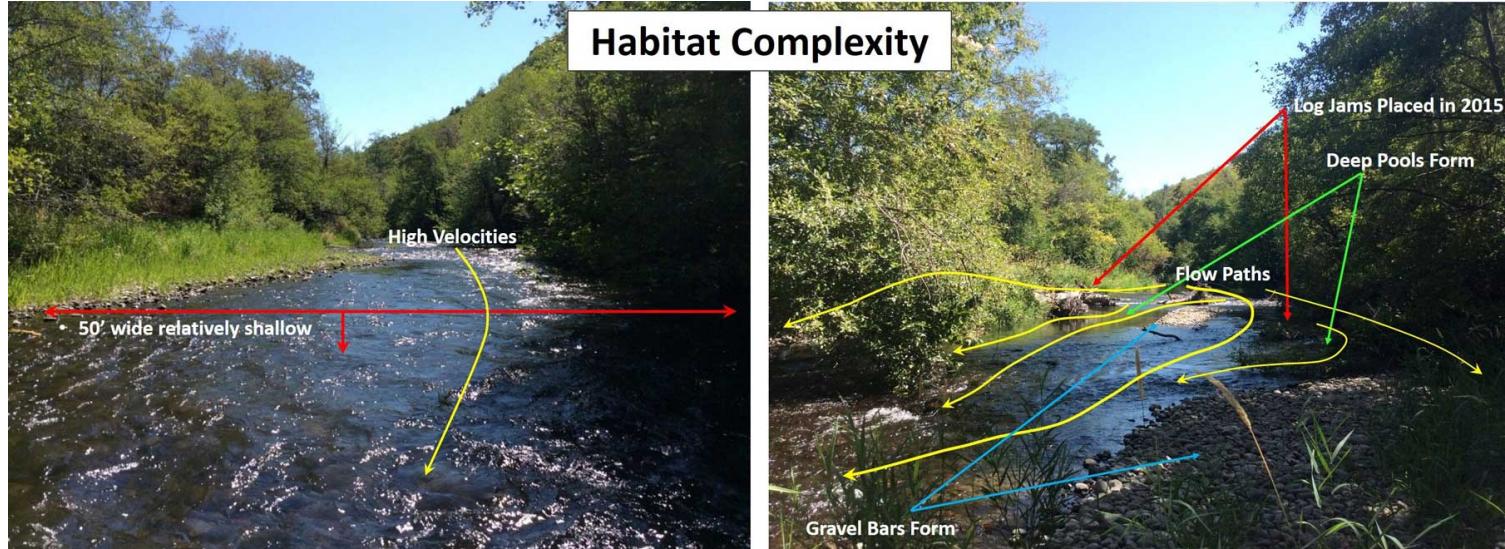
... for **wide-ranging animals** (esp. terrestrial migrants) to connect ranges. I-80 is a major barrier seasonal ranges for migratory mammals.



(Wyoming migration initiative)

# Habitat complexity is good

Even when considering a single species (e.g. Chinook salmon *Oncorhynchus tshawytscha*) in a single river ... the more **complexity** the better, because of different needs for *food, shelter, rearing, life stages*.



A very, very common goal in habitat restoration is enhancing **complexity**.

# Habitat depends on scale

Hierarchy of scale:

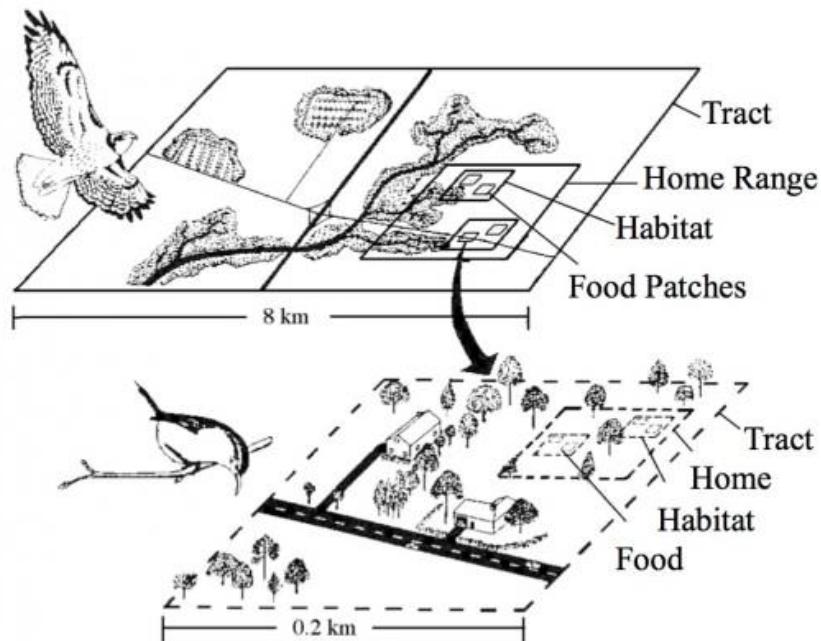
**1st order:** Geographical range

**2nd order:** Selection of home range

**3rd order:** Patches within home range

**4th order:** Resource patch

(Johnson 1980)



# Habitat alteration ...

is OVERWHELMINGLY the single greatest threat (& impact) to wildlife and ecosystems

## Habitat alteration types

### Habitat destruction/conversion:

- physical loss of one habitat (by necessity replaced by another)

### Habitat fragmentation:

- breaking large continuous blocks of habitat into smaller patches
- increasing barriers to movement

### Habitat degradation:

- changing composition, structure, or function of an ecosystem

### Habitat enhancement: habitat restoration

# Some takeaways

- Animals are not distributed uniformly in space
- There is wide variability in the **geographic ranges** of species
- Largely - animal communities vary with global **biomes**

The **habitat** concept ...

- is extremely **fundamental** but **very complex**
- depends on **scale**
- depends on ecological interactions
- depends on **life cycle** and **behavior** and **subpopulation** and **season**
- generally: **connectivity** and **complexity** are very important

**humans**

- Have mainly altered habitats **destructively**
- But are also capable of enhancing habitats
  - by emphasizing **complexity** and **connectivity** and **interactions** and **awareness of scale**

The background image is an aerial photograph of a rural landscape. It features large, open green fields with scattered clusters of small, dark green trees or shrubs. A winding, light-colored path or road cuts through the center of the image. The overall scene is a mix of agricultural land and natural vegetation.

# Next time ...

We will demystify the **quantification** and **estimation** and **assessment** of habitat with **modeling**...

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