

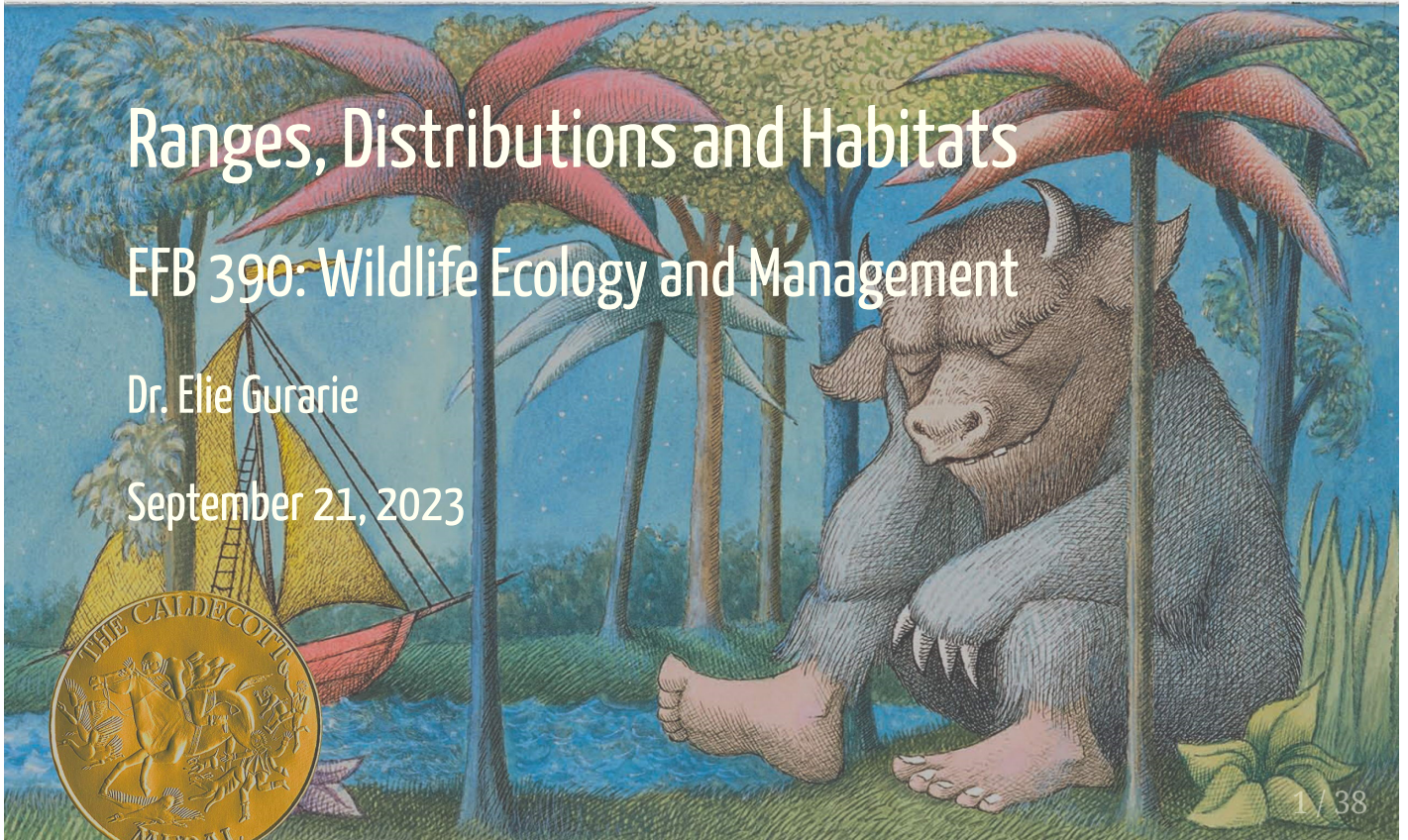
WHERE THE WILD THINGS ARE

Ranges, Distributions and Habitats

EFB 390: Wildlife Ecology and Management

Dr. Elie Gurarie

September 21, 2023



Definition:

A species **range** (or **distribution**) is the area where a particular species can be found during its lifetime. Species range includes areas where individuals or communities may migrate or hibernate.

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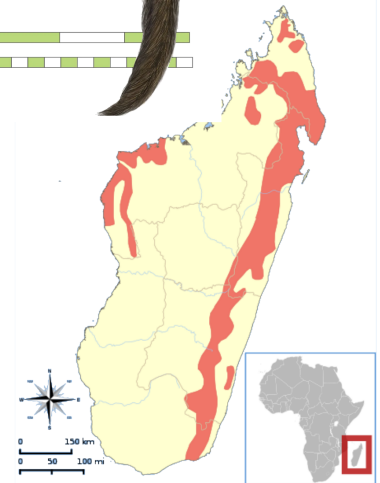
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some ranges are small



aye-aye
(*Daubentonia madagascariensis*)

30 centimetres 
12 inches 



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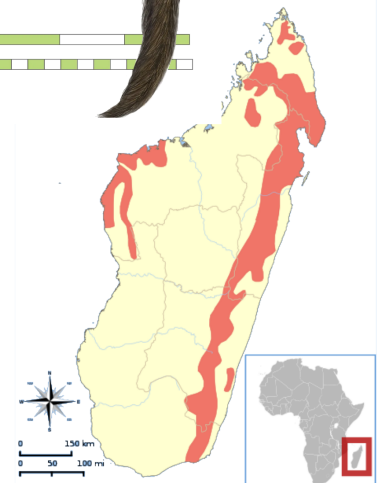
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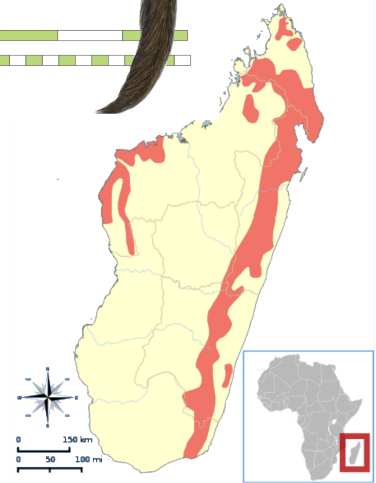
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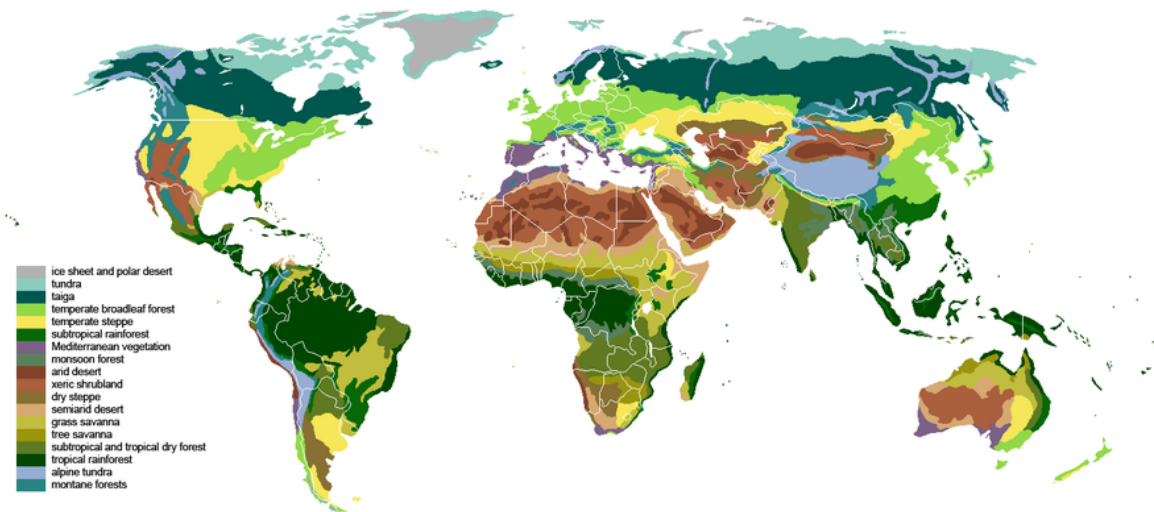


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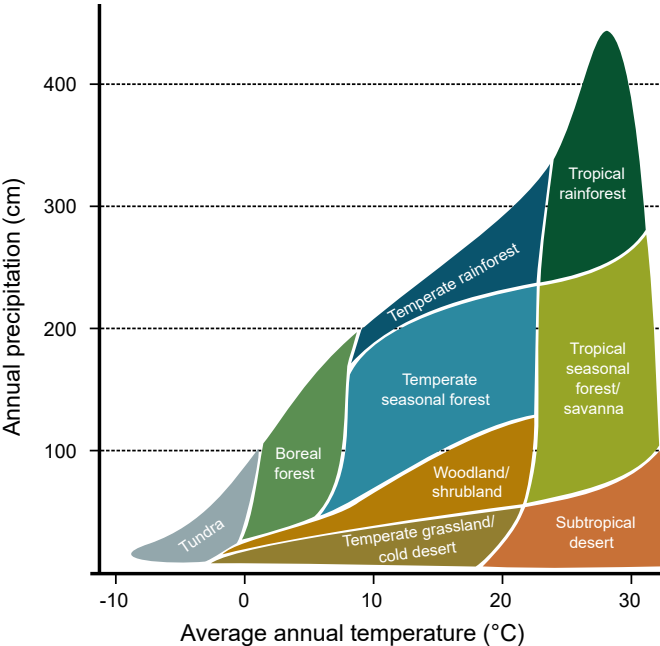
At the broadest scale



the world is divided into *biomes*

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Constrained by climate



This (mainly) constrains / determines vegetation communities.

Which is reflected in the wildlife that inhabits those biomes.

Example: Muskox (*Ovibos moschatus*)

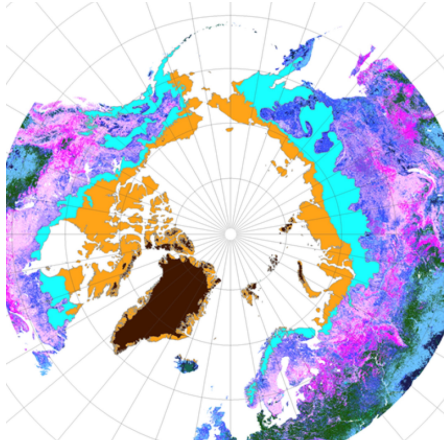


pretty much only found in Arctic Tundra.

Range



Tundra and treeless



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 Guinness

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To think about:

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

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

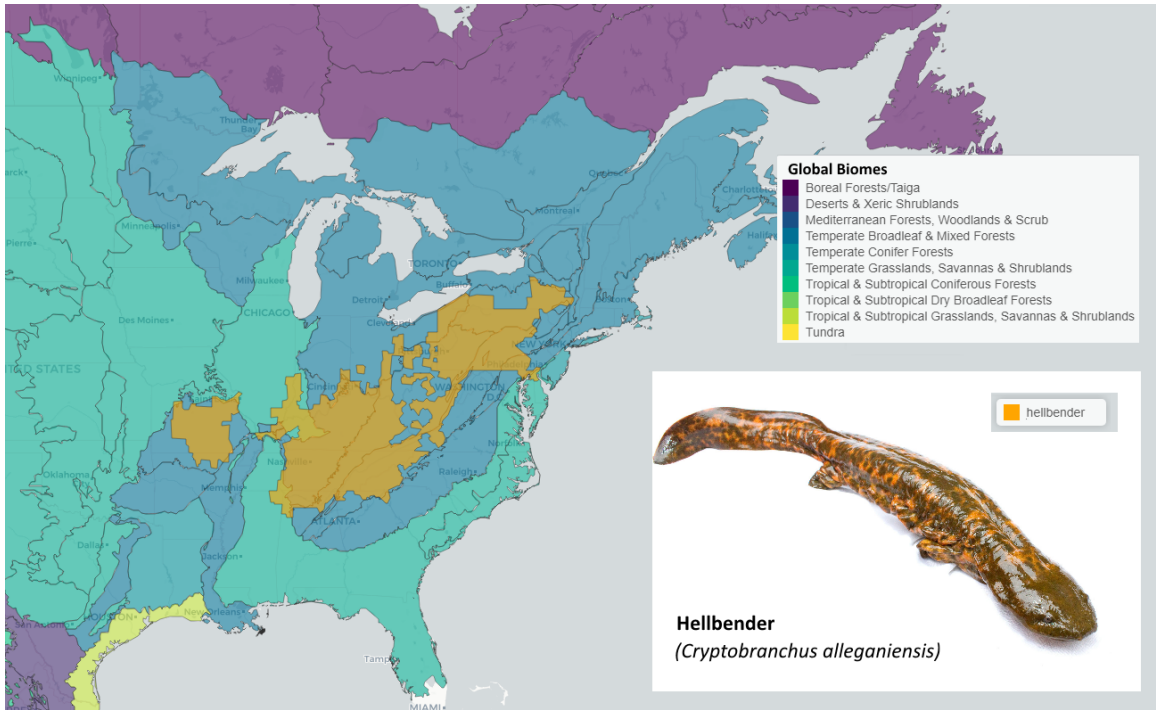
What does it really *need*?



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Consider the Eastern Hellbender

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



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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**.

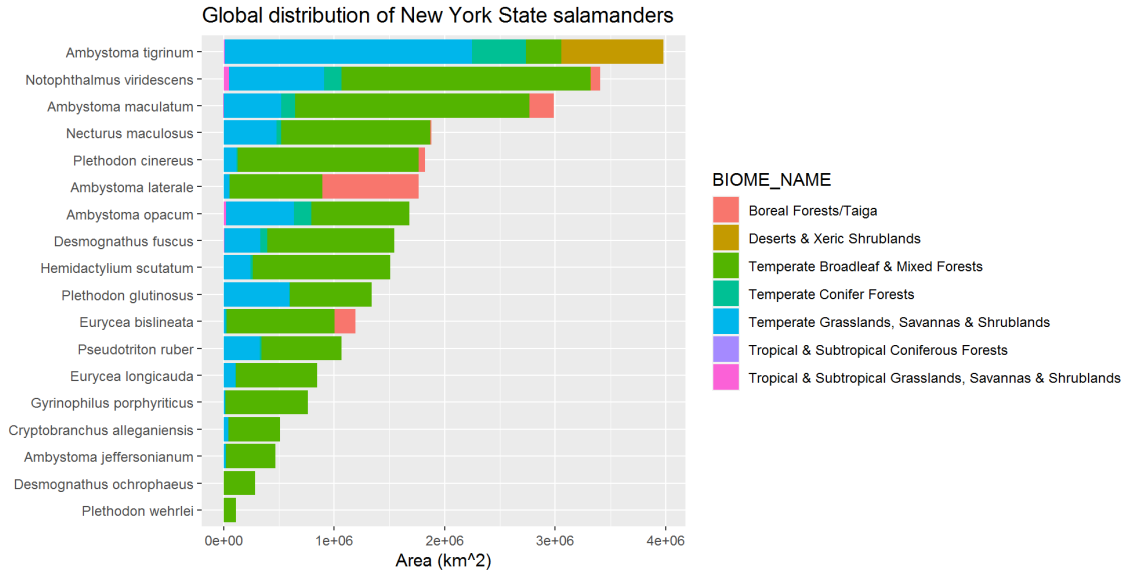
CHECKLIST OF AMPHIBIANS, REPTILES, BIRDS AND MAMMALS OF NEW YORK STATE		AMPHIBIANS				
Including Their Legal Status		COMMON NAME	SCIENTIFIC NAME	FEDERAL	STATE	
 <p>Blue-spotted Salamander Artwork by Jean Gawalt</p> <p>New York State Department of Environmental Conservation Division of Fish and Wildlife February 2019</p> <p>NEW YORK Department of Environmental Conservation</p>		Hellbender, Mudpuppy and Salamanders				
		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 ^c	<i>Ambystoma jeffersonianum</i>	Un	GN-SC	
		Blue-spotted Salamander ^c	<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](#)

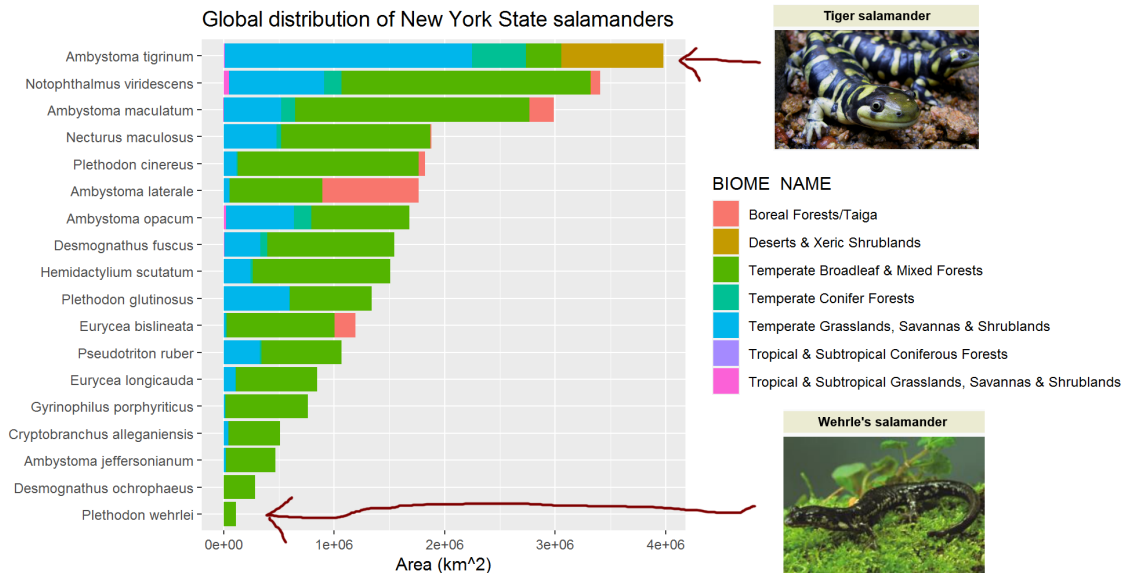
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In fact ... quite a few "biome generalist!"



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Let's look at a couple more species more closely



Predictably, the smaller the range, the more specialized.

But **why?**

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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

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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)

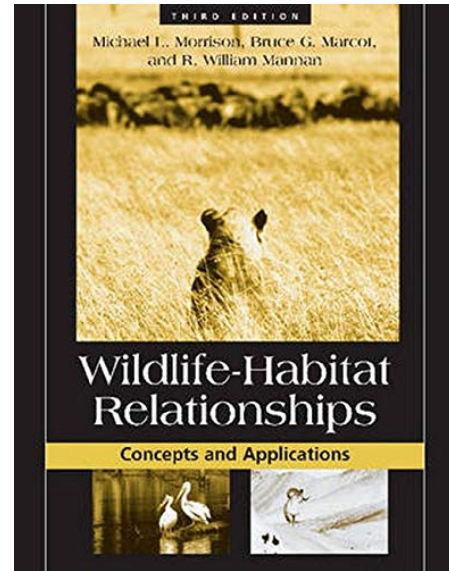
What does **normally** mean?

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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



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Components of Wildlife Habitat

Habitat: Biotic and abiotic factors

Typically, enumerated as:

component	description
food	Very important (obviously)!
water	Also important
shelter	Dens / burrows / nesting sites / predator avoidance
space	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.

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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.**"

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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 for "habitat types". The search bar contains "habitat types". Below the search bar, under "People also ask", there is a list of four questions:

- 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?

Each question has a downward arrow icon to its right. At the bottom right of the search results, there is a "Feedback" link.

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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)

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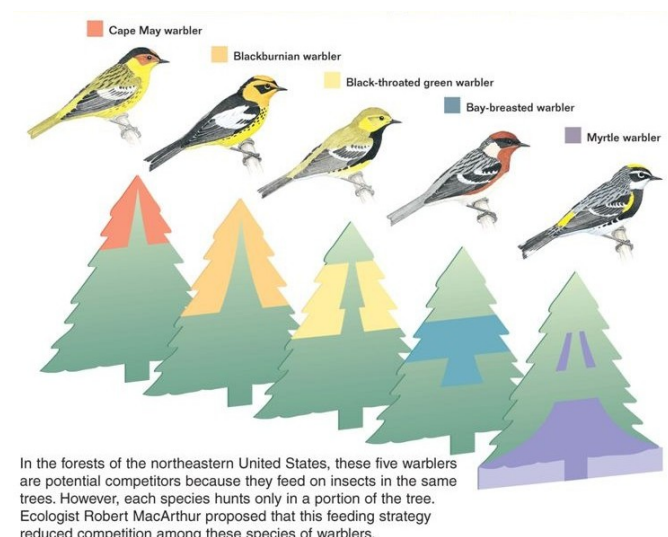
Habitat can be VERY specific

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



(MacArthur 1958)

By sharing very specific portions of the tree!



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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

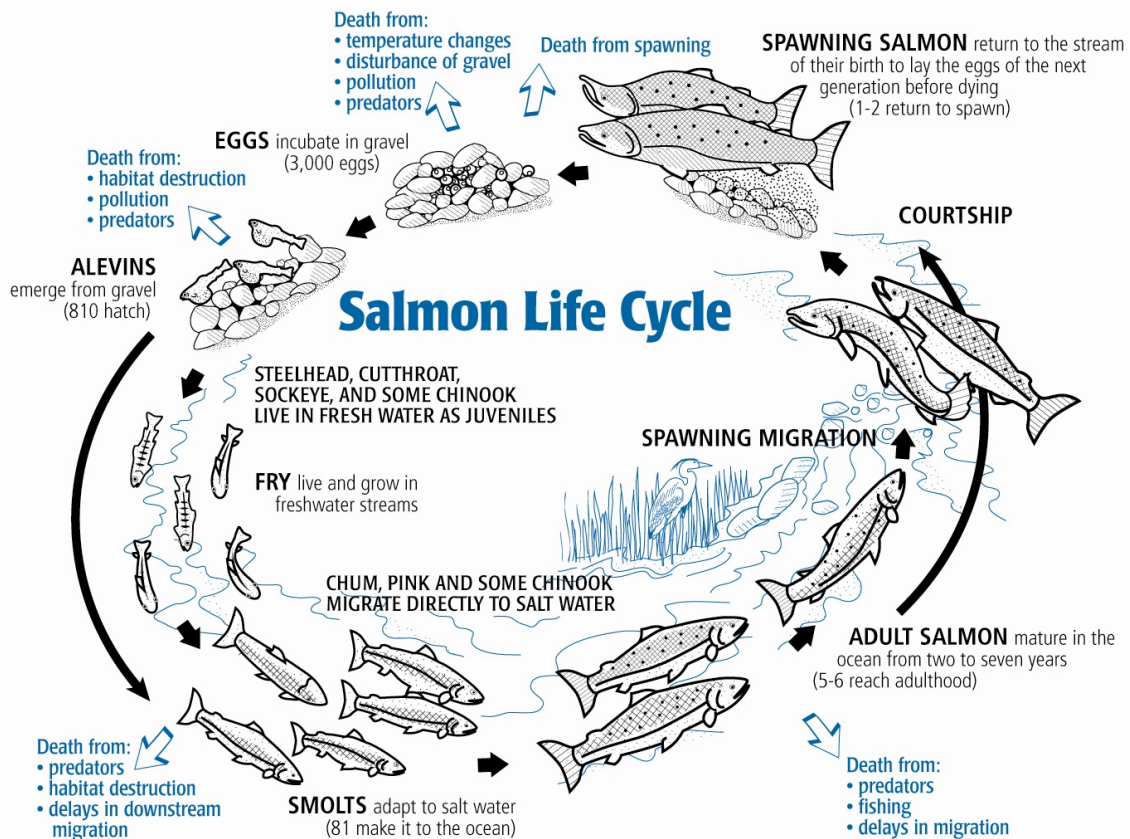
- Mainly requires presence of conspecifics!
- (often but not always same as "reproduction" habitat)



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

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



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Habitat Specialists vs. Generalists

Raccoon (*Procyon lotor*)



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

Generalists are good invaders.

Koala (*Phascolarctos cinereu*)



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

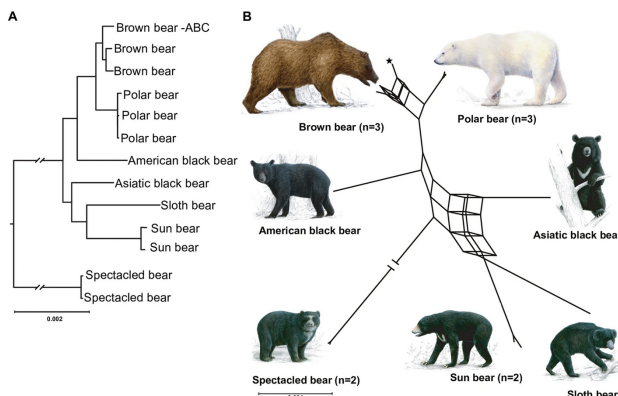
Specialists are (generally) more vulnerable to environmental change / fragmentation / perturbation / habitat loss.

Very closely related species ...

Brown bear (*Ursus arctos*)



Polar bear (*Ursus maritimus*)



VERY RECENT divergence
~100,000 ya

(Kumar et al. 2017)

Very closely related species can be quite different

Brown bear (*Ursus arctos*)



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

Polar bear (*Ursus maritimus*)



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

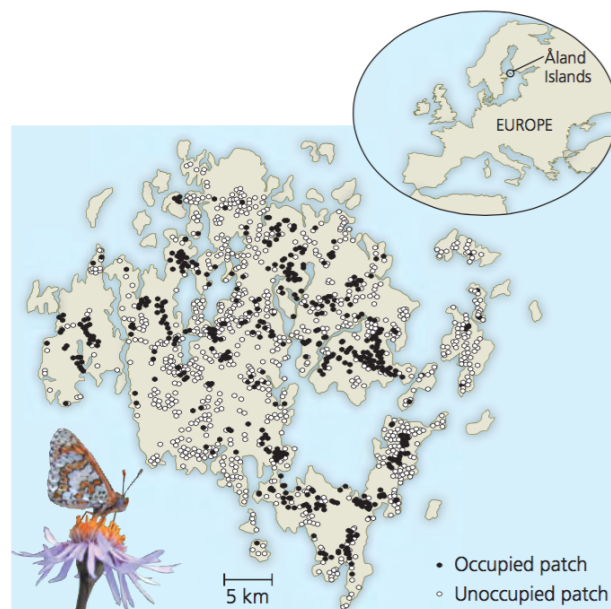
shift in diet completely transformed their "habitat". Polar bears are (in consequence) more vulnerable to climate change / sea-ice loss.

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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.

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Specialists vs. Fragmentation

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

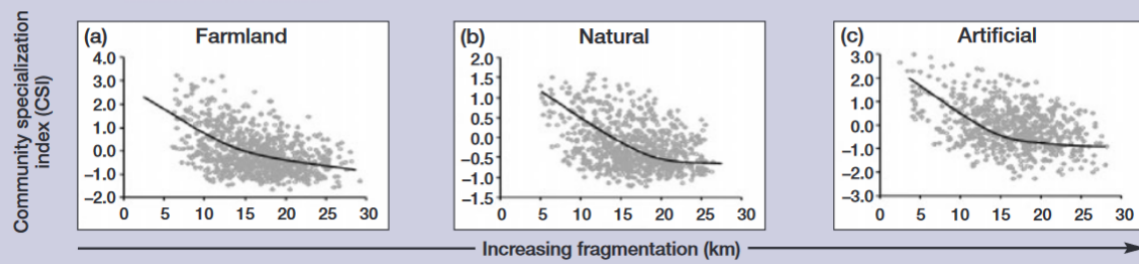
Panel 1. Community specialization index: an indicator of functional homogenization

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).

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

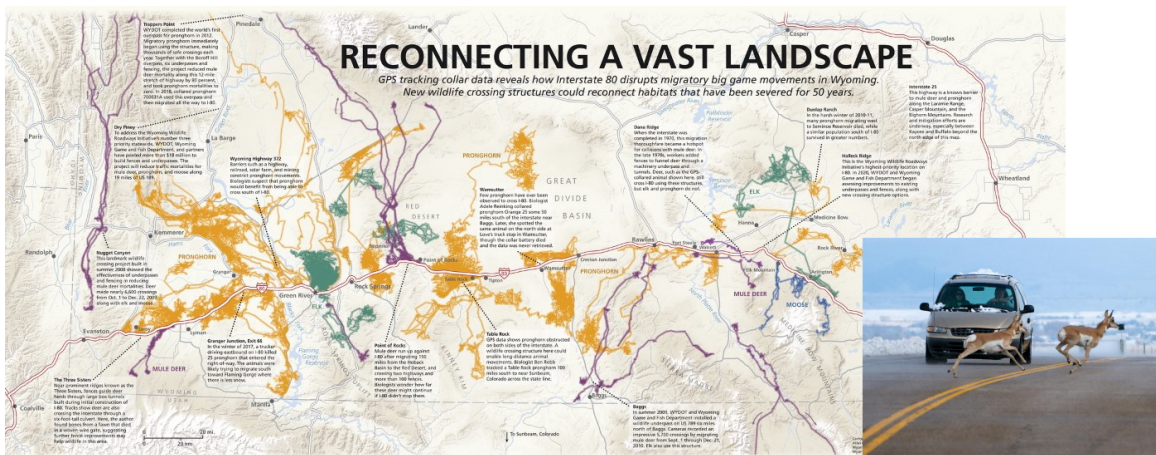
Where N was the total number of species recorded, a_{ij} the abundance of individuals of species i in plot j , and SSI_i its specialization index.



(Clavel *et al.* 2011)

Habitat connectivity is also good ...

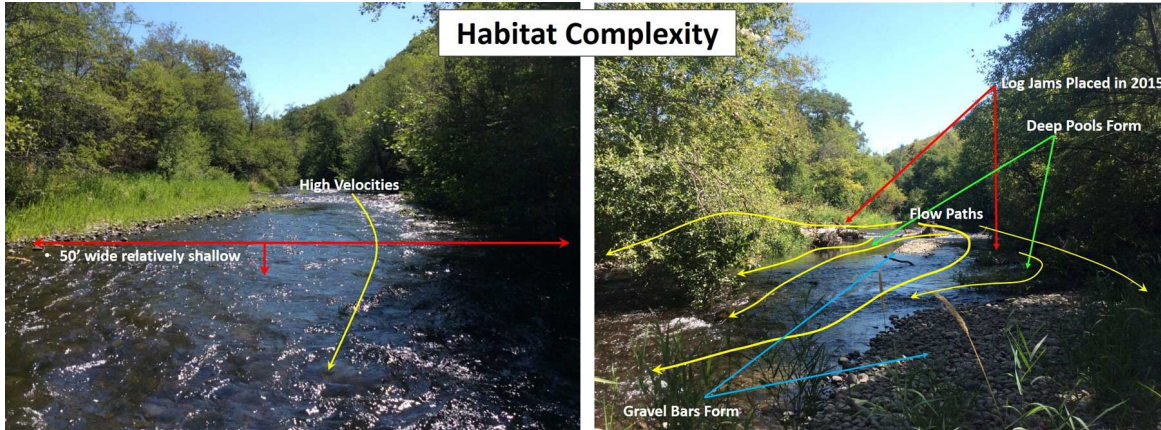
... for wide-ranging animals (esp. terrestrial migrants) to connect ranges. I-80 is a major barrier seasonal ranges for migratory mammals.



(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**.

(Snake River Salmon Recovery)

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Habitat depends on scale

Hierarchy of scale:

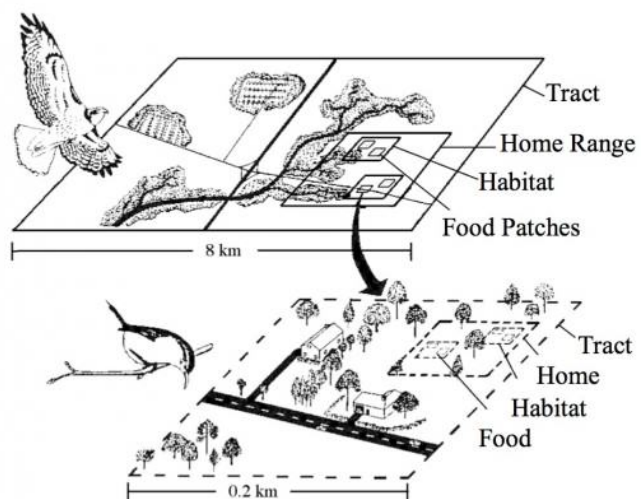
1st order: Geographical range

2nd order: Selection of home range

3rd order: Patches within home range

4th order: Resource patch

(Johnson 1980)



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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

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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**

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Next time ...

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

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