

FIGURE 15.3 Food Webs. An Antarctic food web. Small crustaceans called krill support nearly all life in Antarctica. Krill are eaten by 6 species of baleen whales, 20 species of squid, over 100 species of fish, 35 species of birds, and 7 species of seals. Krill feed on algae, protozoa, other small crustaceans, and various larvae.

ESRM 350

Wildlife Communities

Autumn 2016

“Mosquitoes remind us that we are not as high up on the food chain as we think”

- Tom Wilson

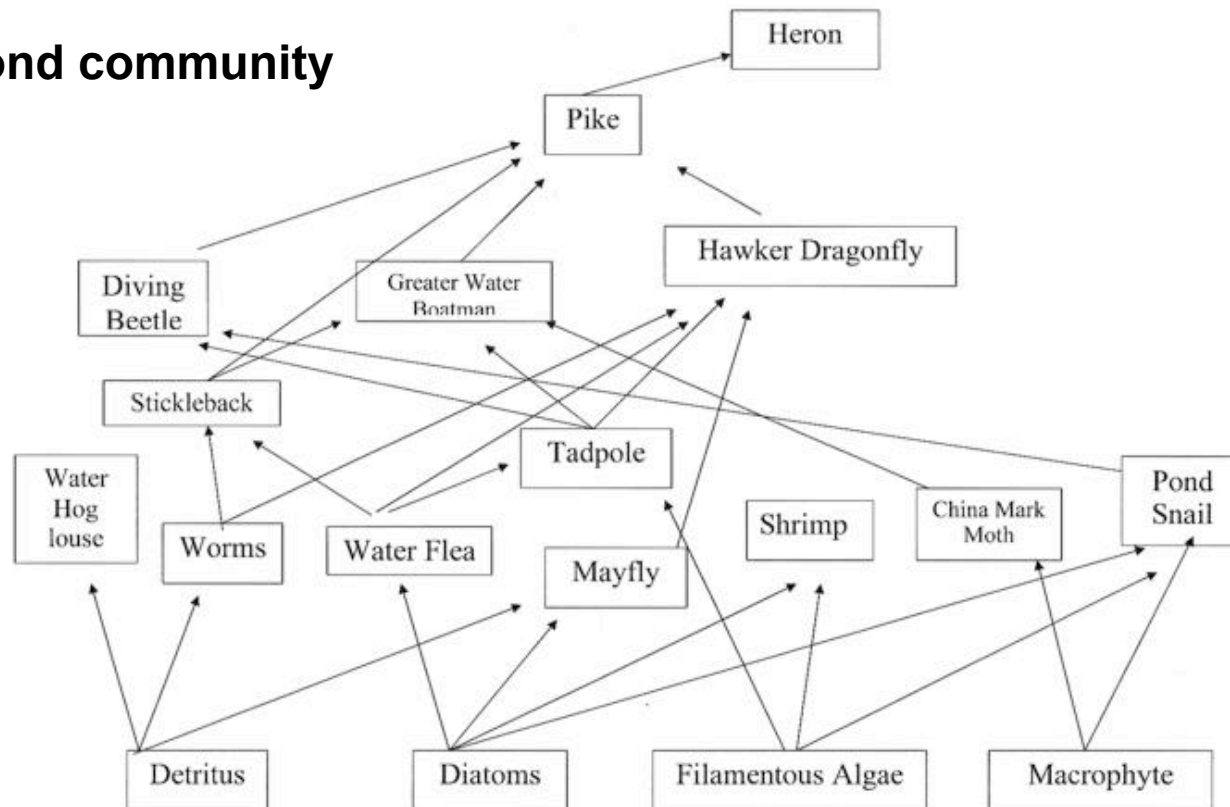
Ecological Communities

- Sets of interacting or potentially interacting species living in the same area

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e.g., pond community



Types of Interactions in Communities

0,0	Neutral
+,+	Mutualism
+,0	Commensalism
,-	Competition
-,0	Amensalism*
+,-	Predation, parasitism

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*e.g., black walnut (*Juglans nigra*) secretes a chemical that harms neighboring plants

Community Structure

- The mix of species in a community, including the number of species, relative abundances, and trophic interactions
 - **Relative abundance:** percentage of individuals a species contributes to the total number of individuals in a community
 - **Trophic interactions:** interactions involving the flow of biomass (energy) from one species to another
 - via predation, herbivory, scavenging, etc.



Measuring Community Structure

- Species richness (**s**): the number of species
 - relatively easy to measure for many wildlife species (present or not)
 - good for capturing broad regional differences in species representation

Global Bird Richness

(a) all birds ($n = 8,919$; $r = 1 \pm 0$)

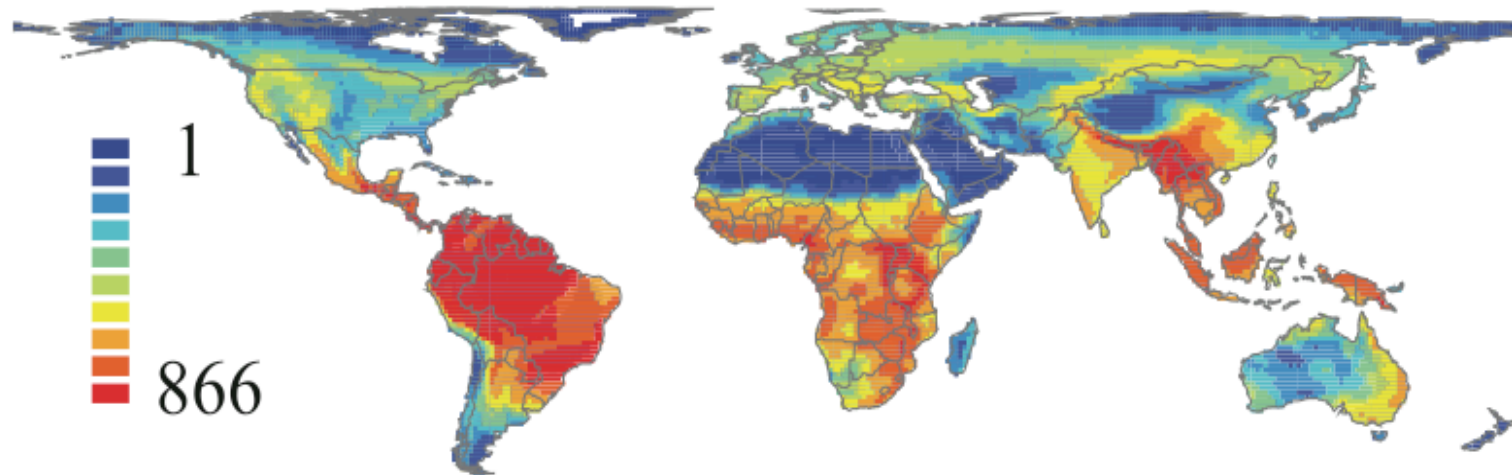


Figure 1 Geographic patterns of (a) overall and (b)–(j) guild species richness across an equal-area grid of 110×110 km resolution (quantile classification, world cylindrical equal area projection). Total species richness of each guild (n) and cross-correlations with overall bird richness (Pearson correlations r , mean \pm SD from randomly sampling 1000 grid cells for each guild over 100 runs) are given in brackets. For taxonomic composition of each guild see Table S4 in Appendix S2.

Measuring Community Structure

- Species richness (**s**): the number of species
 - relatively easy to measure for many wildlife species (present or not)
 - good for capturing broad regional differences in species representation
 - *but*, misses differences in relative abundance
 - important for conservation: many species may be present but scarce

Measuring Community Structure

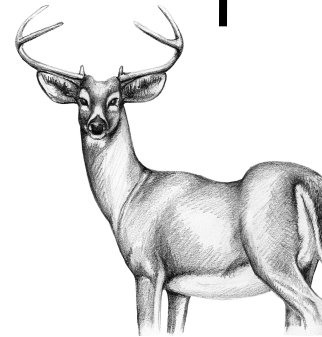
- Species **diversity**: accounts for both the number of species and their relative abundance
 - i.e., diversity indices take into account the proportion of individuals each species contributes to the total
 - rare species given less weight
 - For a given **s**, diversity increases with evenness
 - i.e., diverse communities are those with lots of well represented species

Trophic Interactions

- Interactions involving flow of biomass (energy) between species
- Often characterized using **food chains**
 - linear representations of energy flow
 - arrows show direction of flow
 - simple abstractions of complex relationships
 - links represent **trophic levels**: broad feeding positions within communities (e.g., primary producers, herbivores, predators)



Predator
Coyote
(*Canis latrans*)



Herbivore
White-tailed deer
(*O. virginianus*)



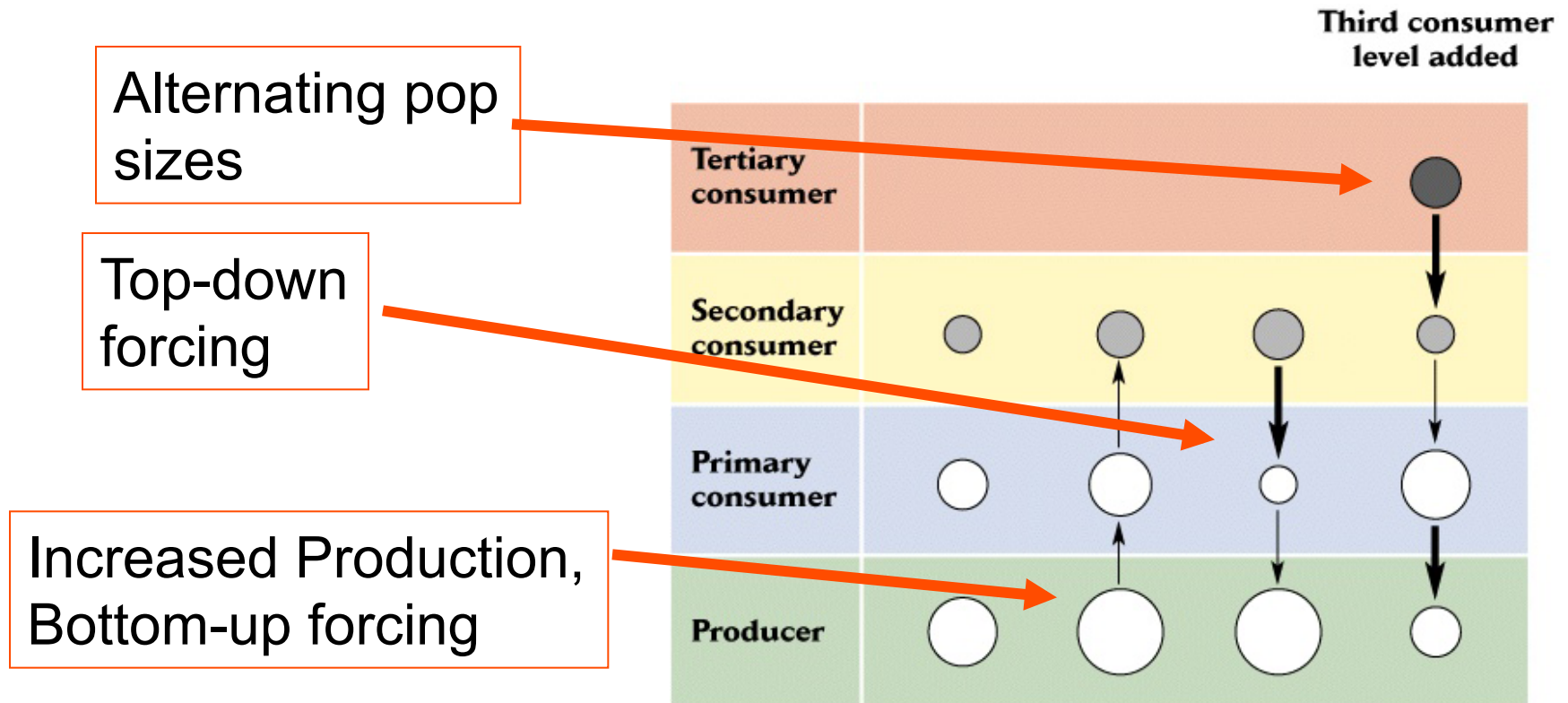
Primary producer
Willow (*Salix* spp.)

The Trophic Pyramid

- Primary productivity limited by light (or chemicals) and nutrients
- 8-13% efficiency between trophic levels (10%: “rule of 10”)
 - ecological efficiency: energy of a trophic level divided by the energy supplied to that trophic level

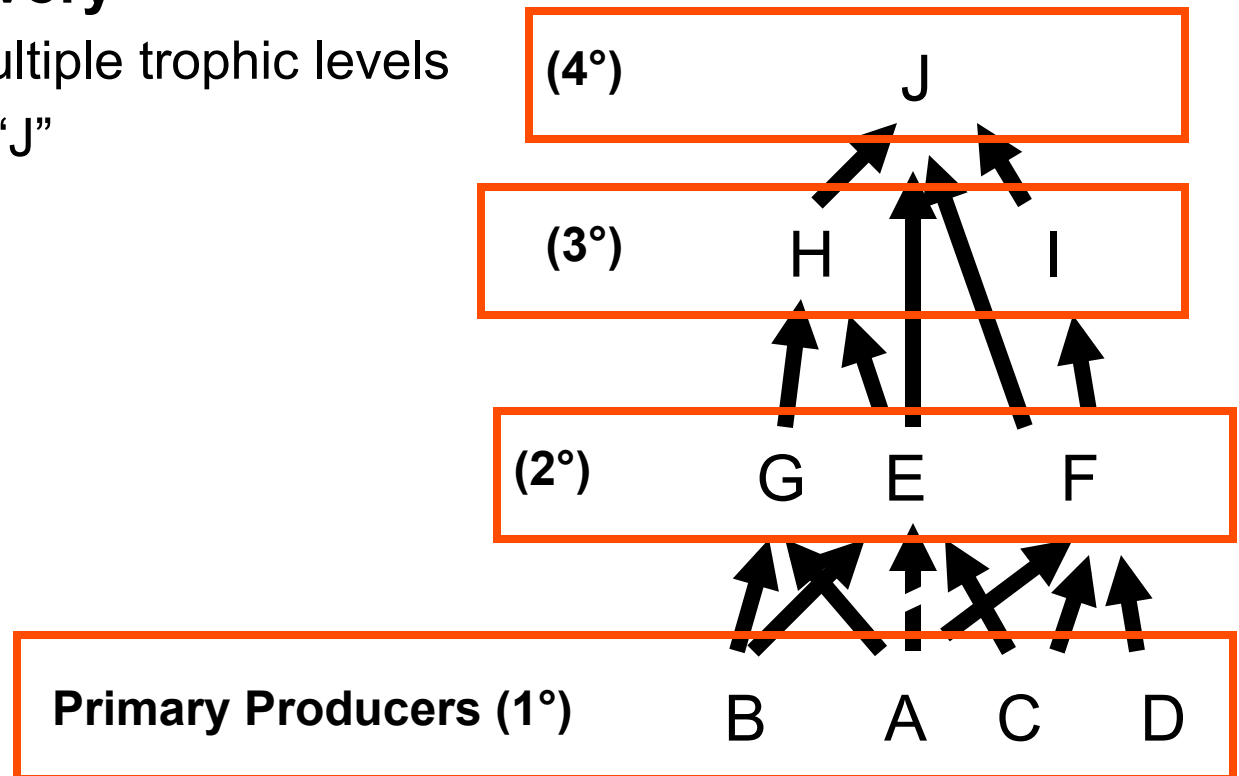


Trophic Levels Influenced by Predation and Production

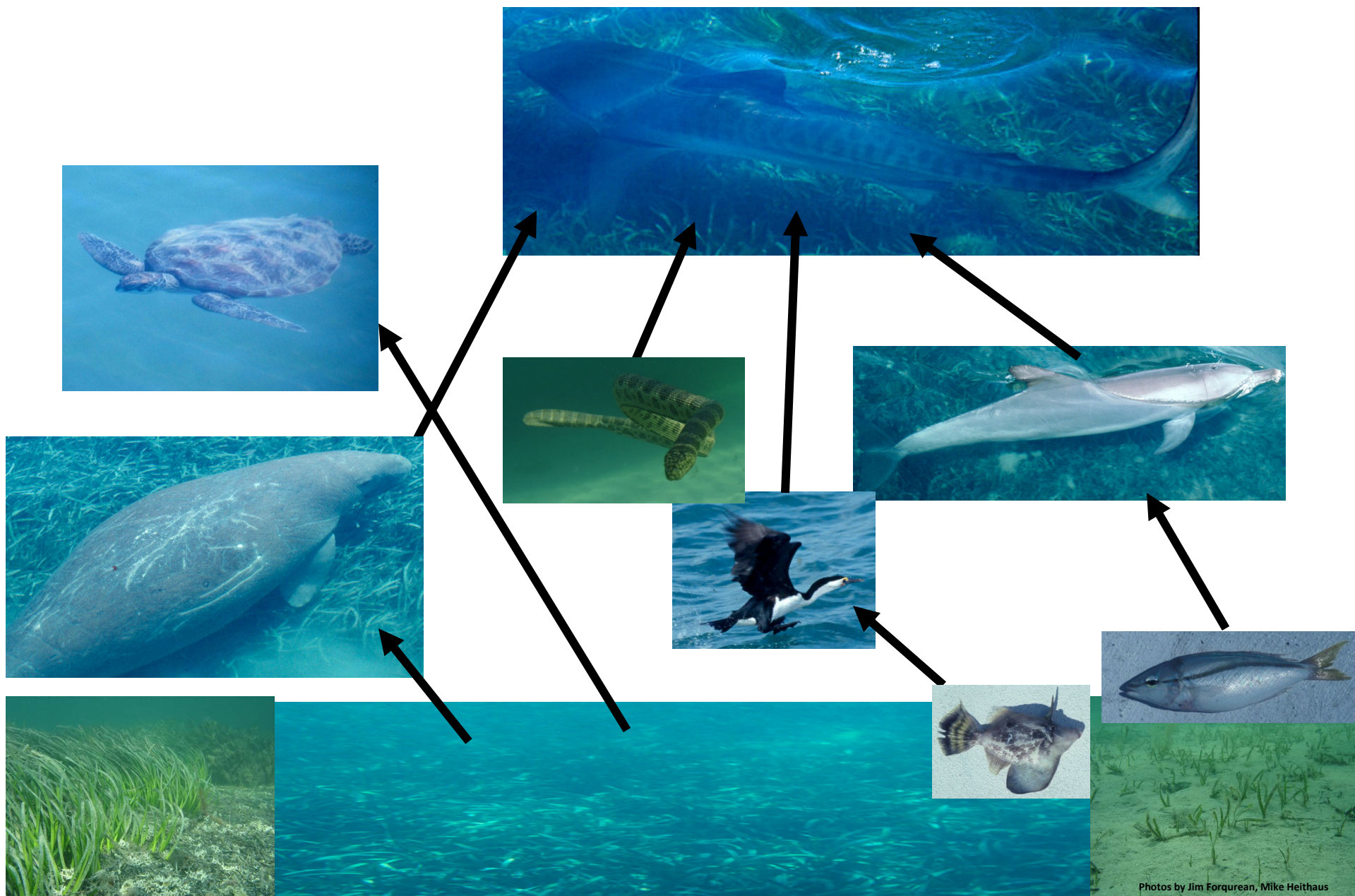


Trophic Interactions

- More typically depicted as **food webs**
 - systems of interlocking and interdependent food chains
 - more realistic
 - recognize **omnivory**
 - feeding on multiple trophic levels
 - e.g., species “J”



A Shark Bay Food Web



What Determines the Mix of Species?

- A species can persist in a community if...

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- A species can persist in a community if...
 - the community falls within its range, *and*
 - local conditions and resources promote occupancy, *and*
 - it is not excluded by other species (biotic interactions)
- If these circumstances are met, the community offers “space” for the species’ **niche**

Ecological Niche

- A species' place and role in a community/ecosystem
 - place: needs (conditions, resources)
 - role: nature of interactions with other species
- Two variants
 - **Fundamental niche**: the full range of environmental conditions and resources an organism can possibly occupy and use, *when limiting factors are absent*
 - **Realized niche**: the part of the fundamental niche an organism ends up using because of limiting factors
 - provides the organism with everything it needs
- Niche “space”, then, means room for an organism's lifestyle*

*Hutchinson, G.E. (1957)