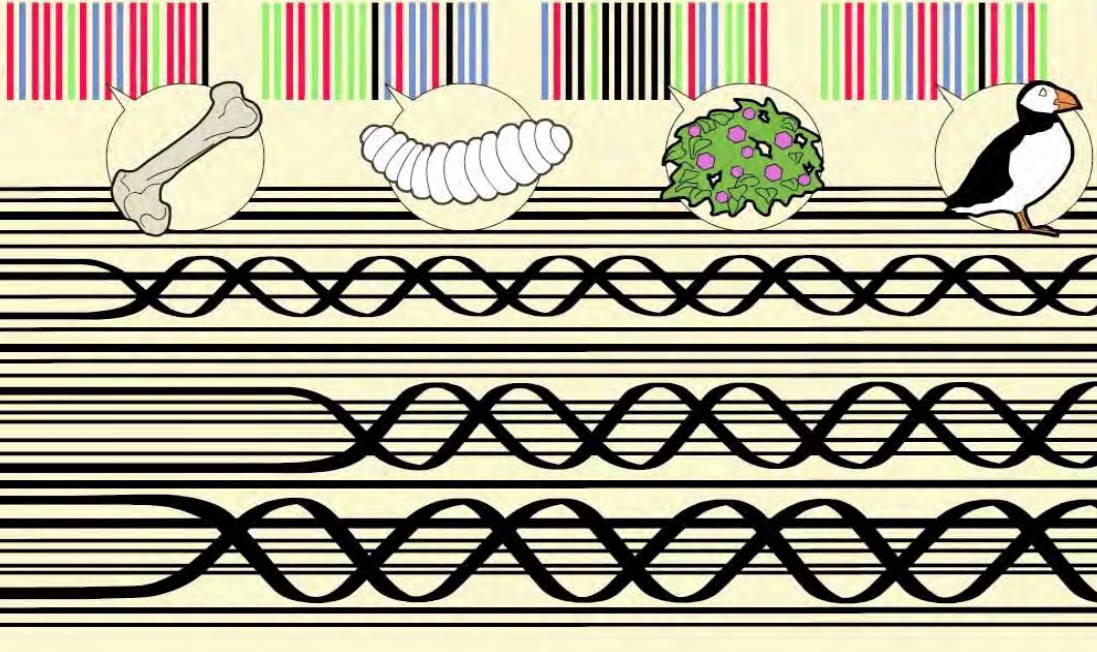


DNA Barcodes

what they are and why they matter

**DNA
BARCODES**

1
SPECIES OF EARTH
0



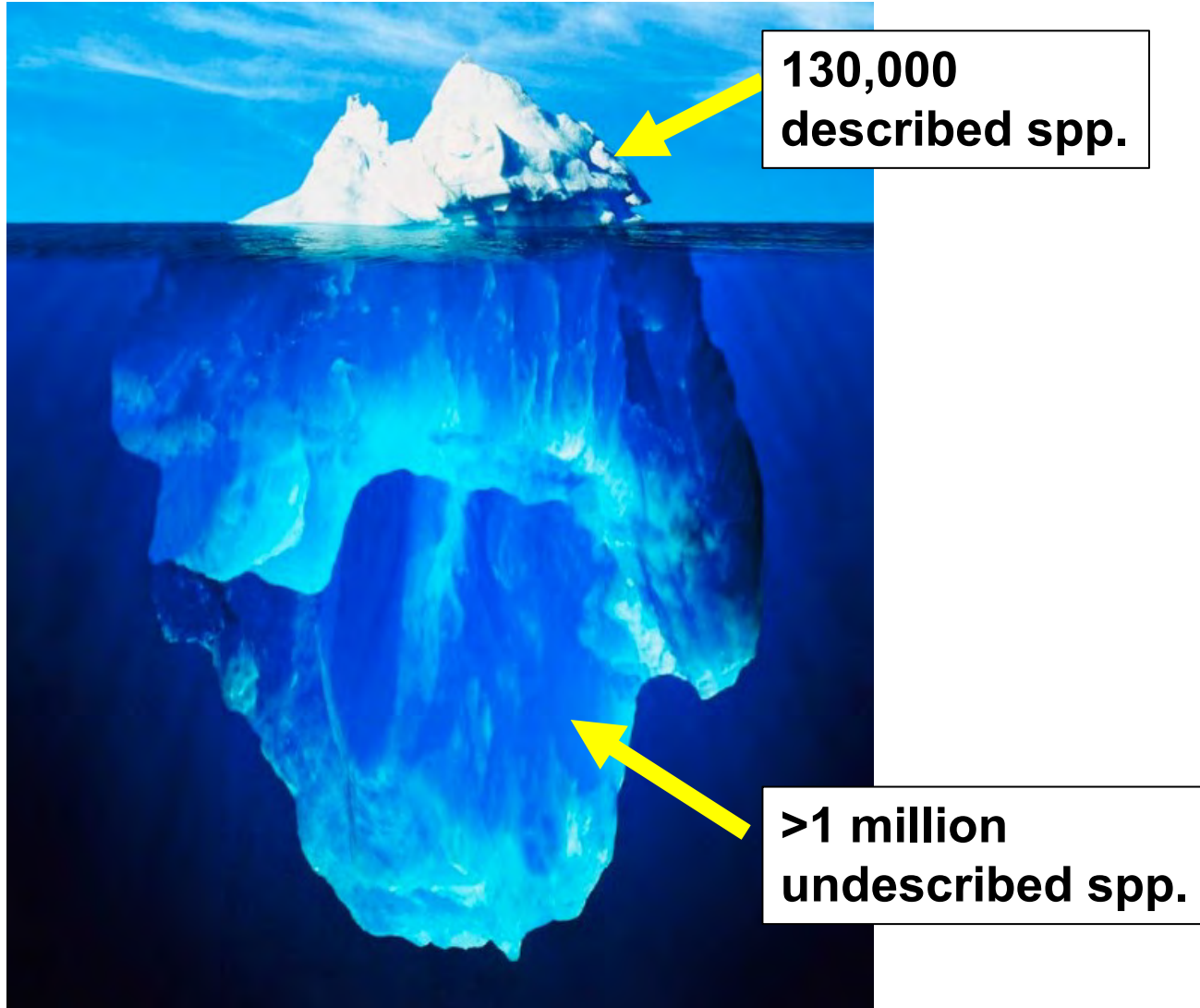
Matthew E. Smith
University of Florida (USA)

Our lab works on fungi....



....but fungi have challenges:

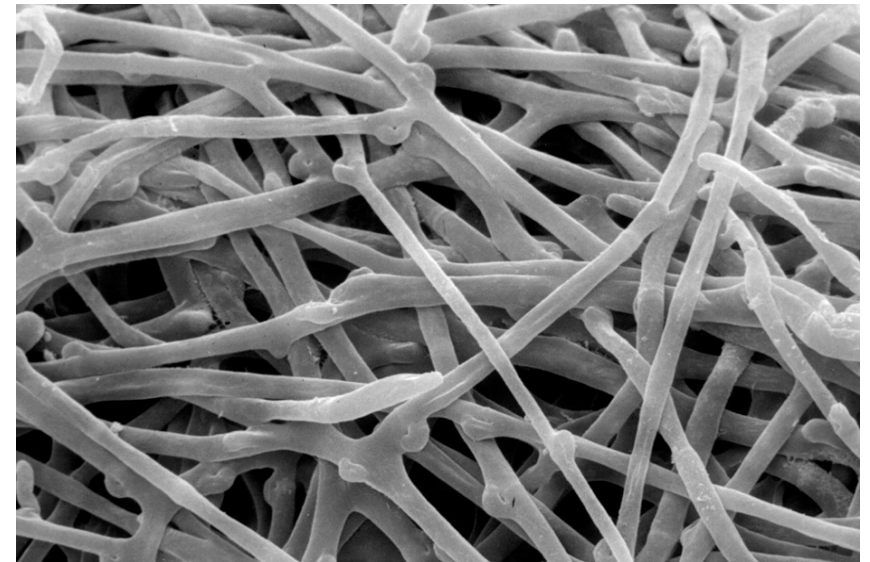
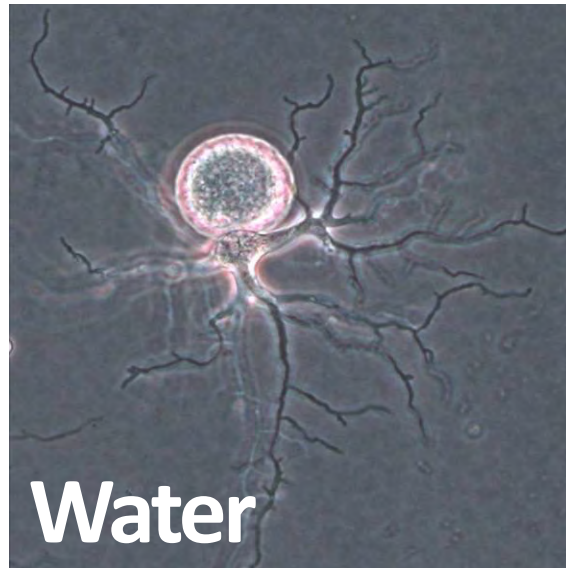
1. High Species Diversity



**Total Estimated Diversity
1.5 to 5 million species**

....but fungi have challenges:

2. Fungi have simple bodies & often remain hidden



....but fungi have challenges:

3. Species are tough to tell apart from each other

Cortinarius = 5000+ described species



Fungi also provide amazing natural compounds

Antifungals



Statins



Immunoinhibitors



Antibiotics



Psychoactive



Anti-Cancer



What is a species?

How do we recognize them?

What is a species & how do we recognize them?

Morphological Species Concept



What is a species & how do we recognize them?

Biological Species Concept



+



=



+

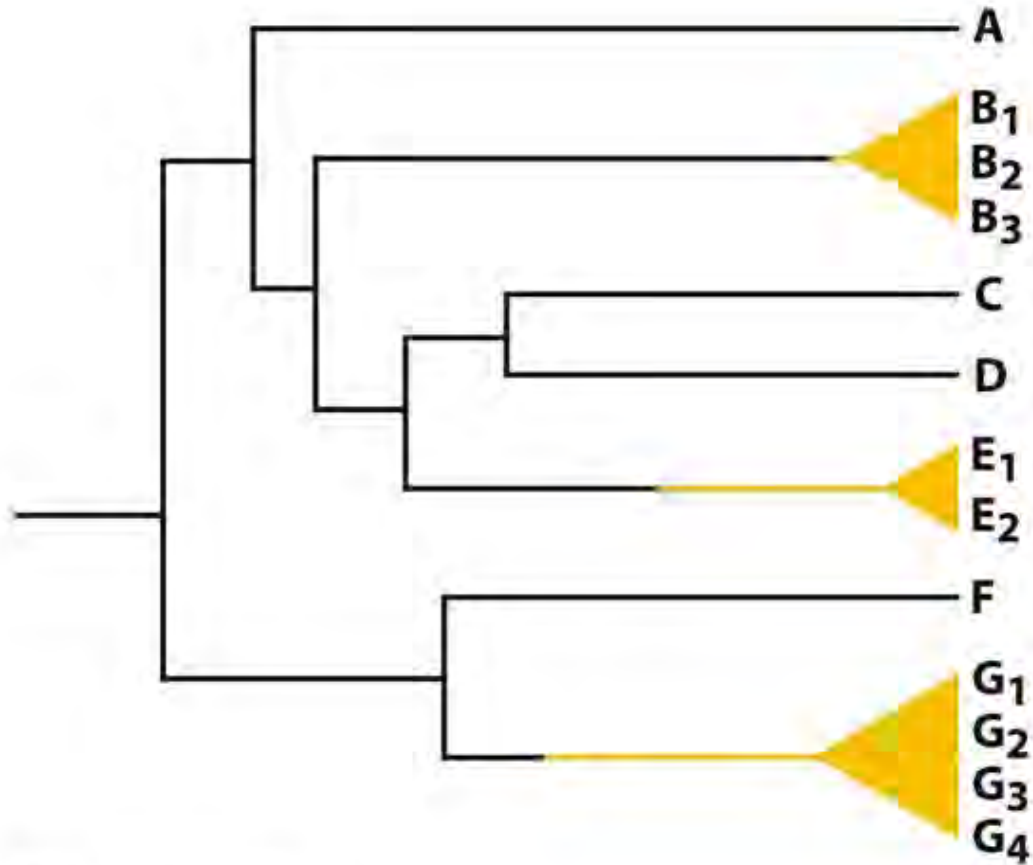


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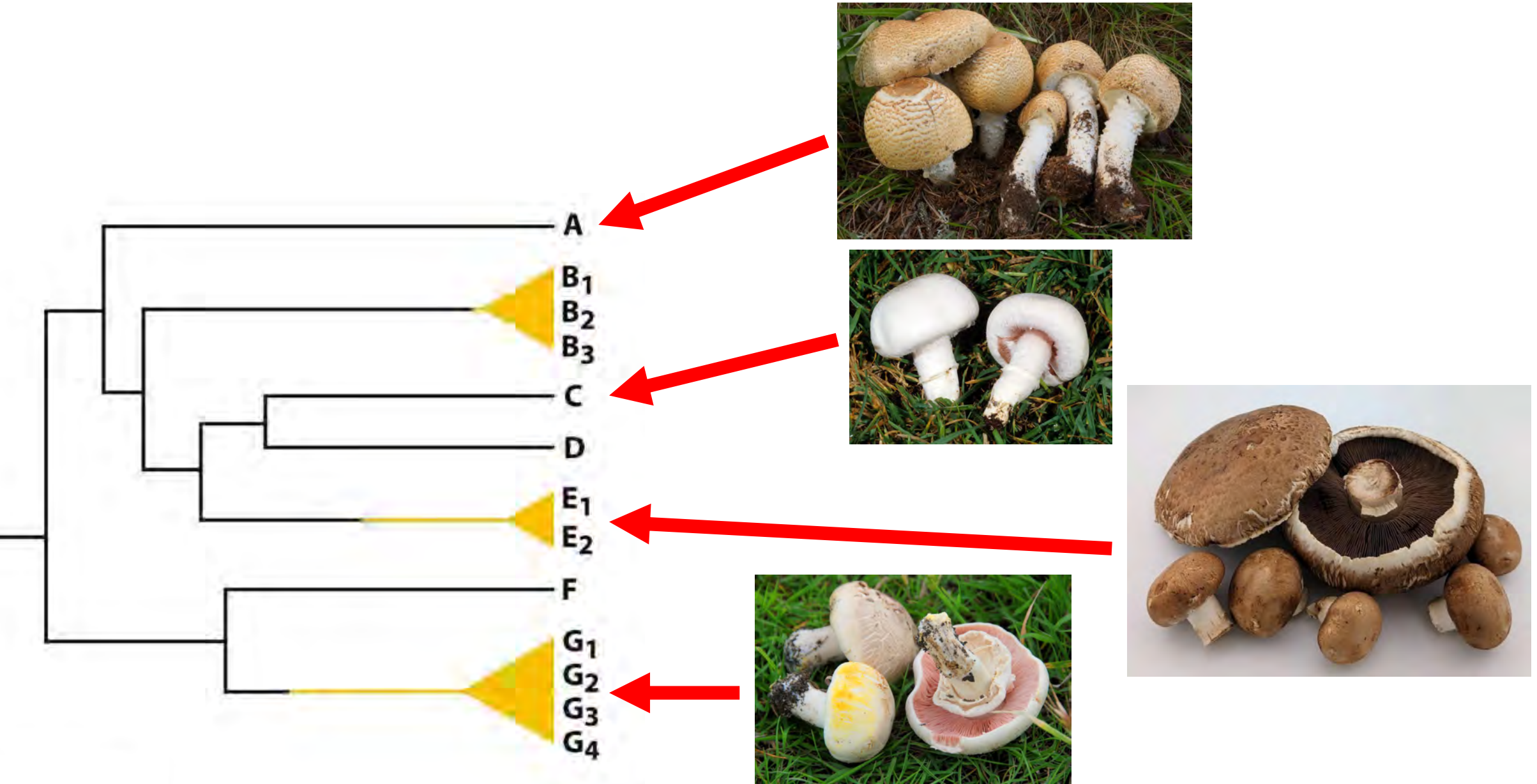
What is a species & how do we recognize them?

Phylogenetic Species Concept

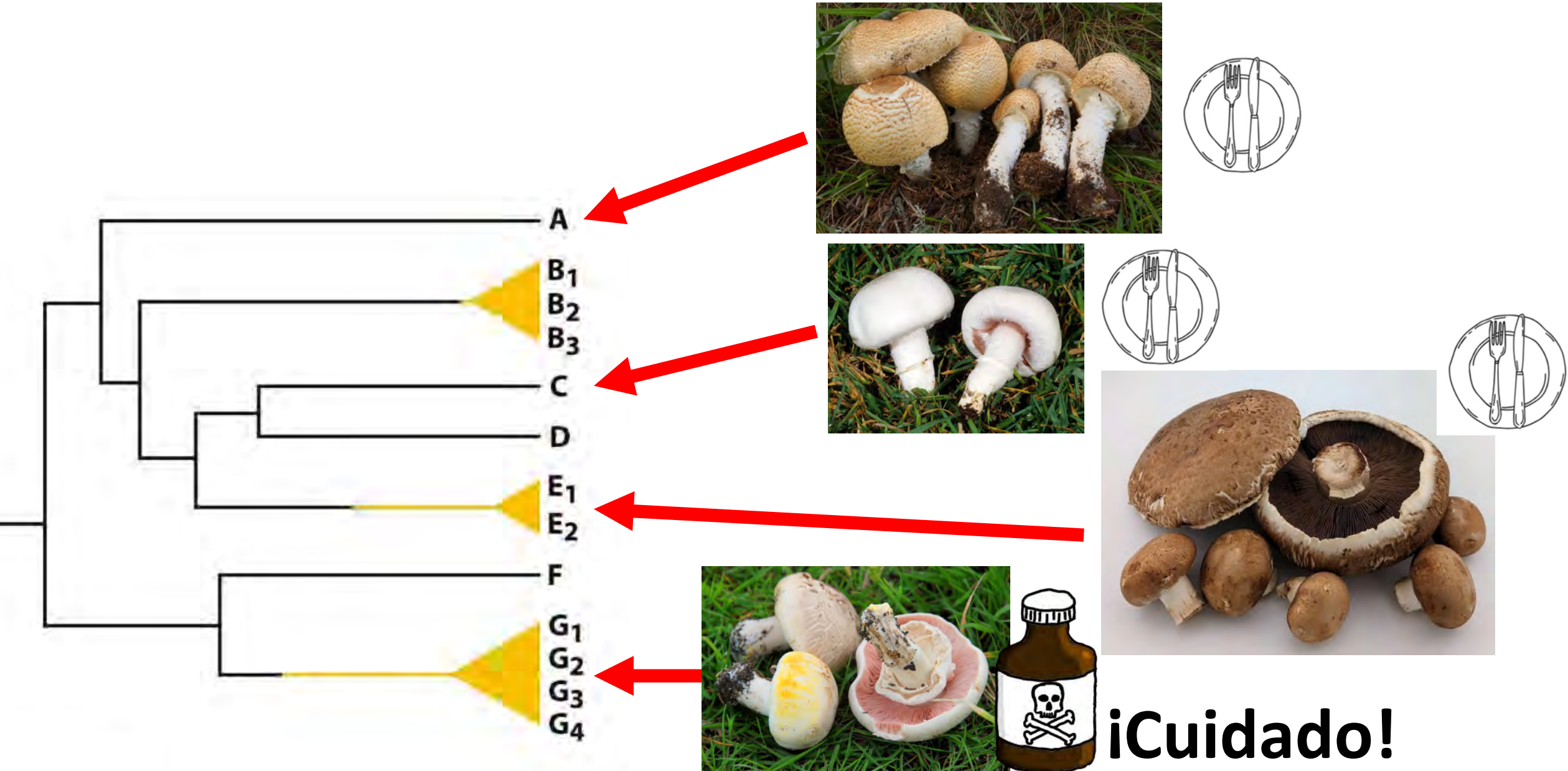


Species are monophyletic groups with shared unique genetic history

Phylogenetic Methods for understanding evolution



Phylogenetic Methods for understanding ~~evolution~~ edibility

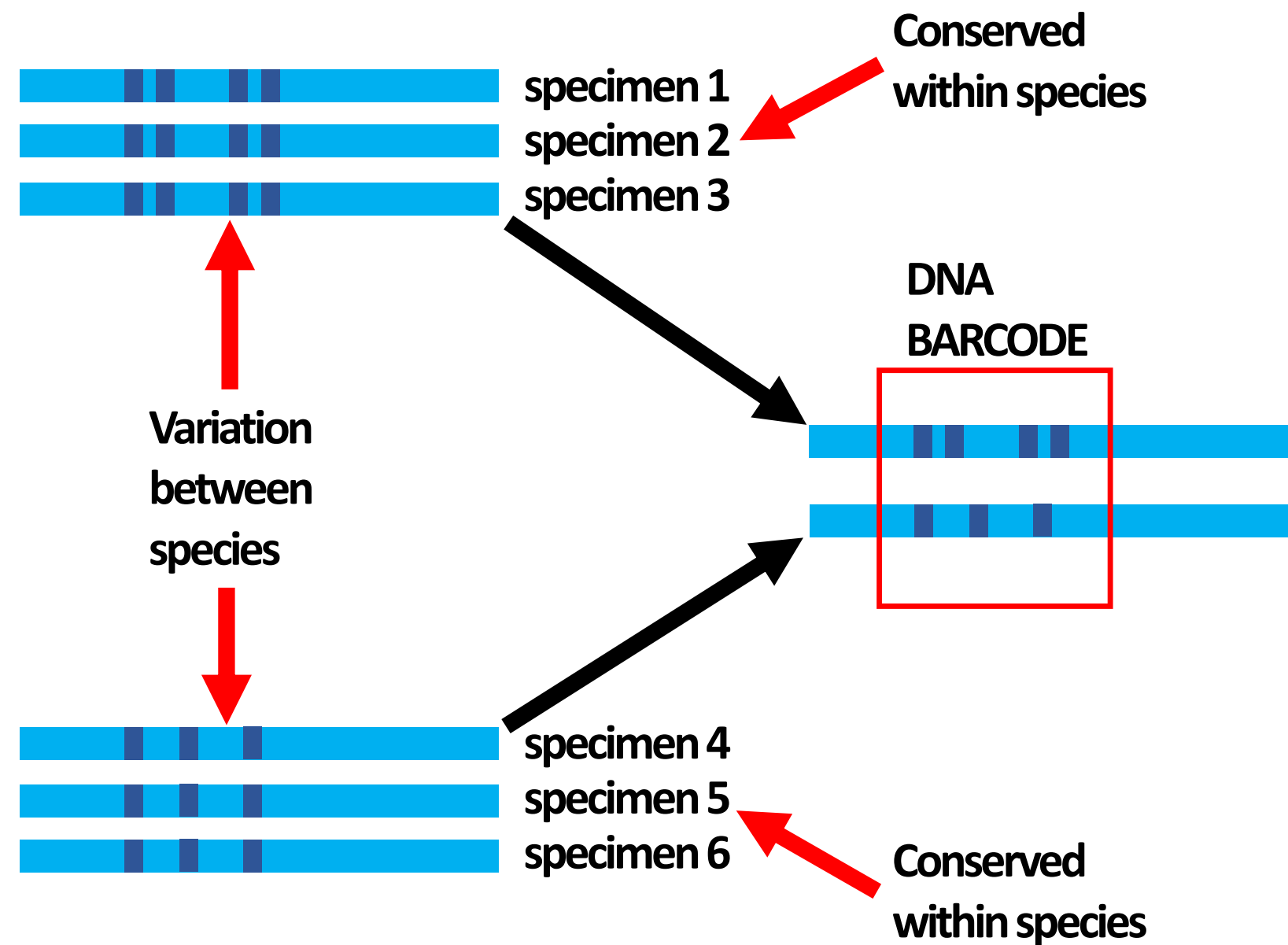


The Quest for DNA Barcodes



1. Small chunk of DNA
2. Diagnoses species
3. Easy to sequence from poor samples
4. Large library of “known species”

The Quest for DNA Barcodes



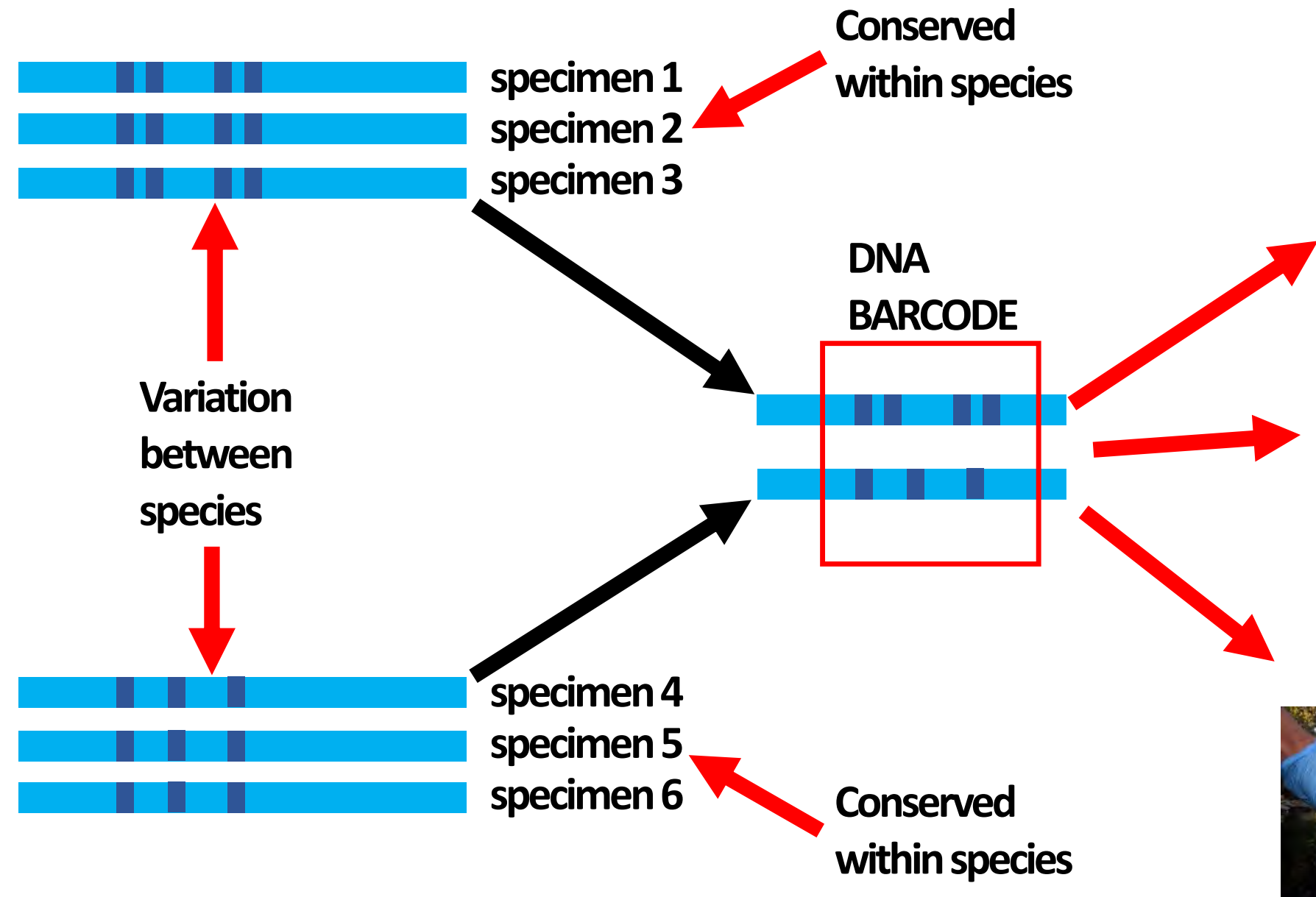
Cantharellus sp. 1



Cantharellus sp. 2

The Quest for DNA Barcodes

Many Types
of Samples



Species Identity Has Consequences



Tuber brumale vs. *Tuber melanosporum*

\$400 per Kg

\$1100 per Kg



mycorrhiza samples

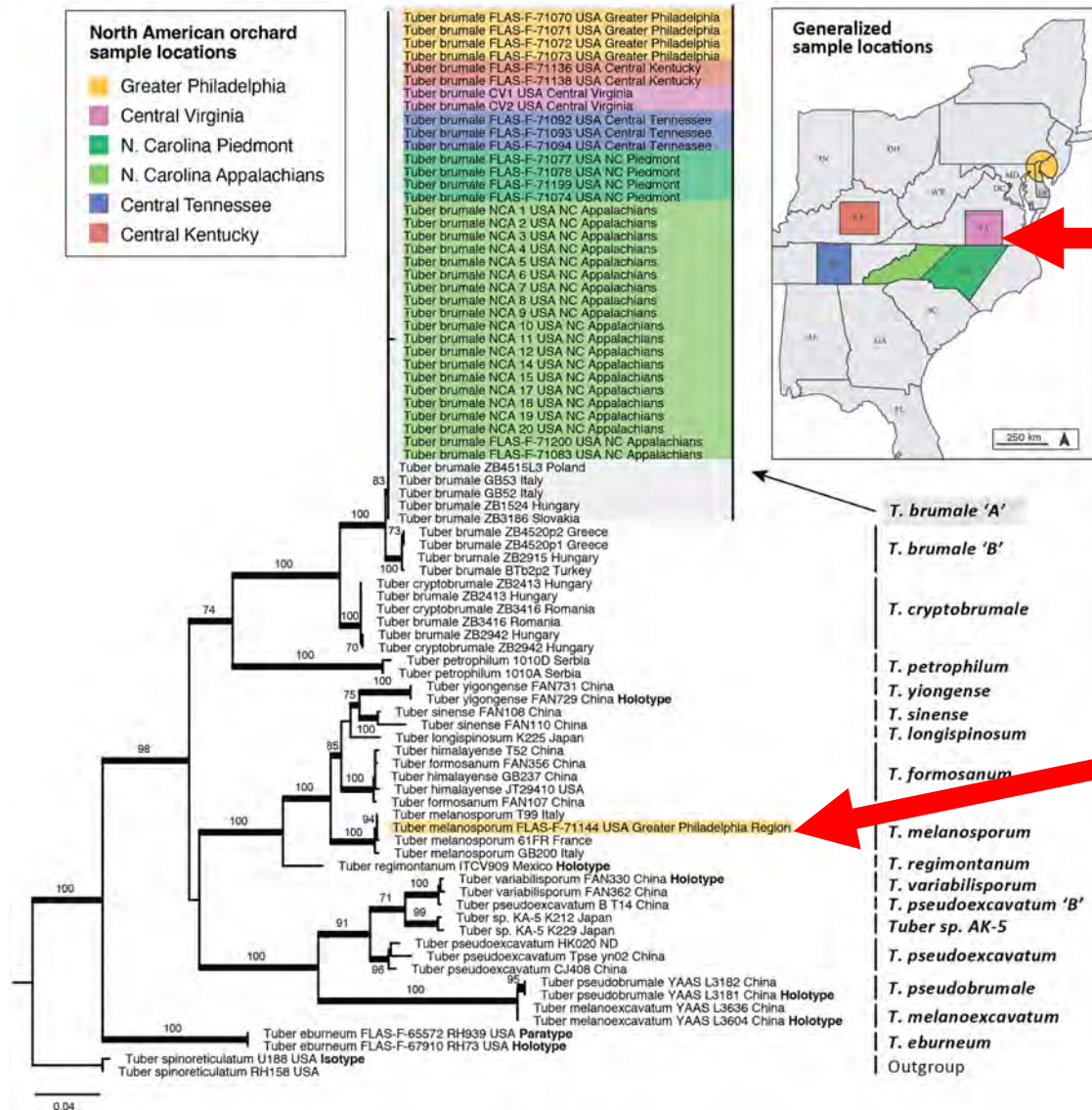


Tuber brumale
accidentally
introduced to
North America



Accidental cultivation of the European truffle *Tuber brumale* in North American truffle orchards

Benjamin Lemmond¹ · Alassane Sow² · Gregory Bonito^{2,3} · Matthew E. Smith¹



Species Identity Has Consequences



Reishi, Lingzhi
“mushroom of immortality”

Identified compounds:

- **Antimicrobial**
- **Anticancer**
- **Antidiabetic**
- **Anti-inflammatory**



Species Identity Has Consequences



Reishi, Lingzhi
“mushroom of immortality”

Identified compounds:

- **Antimicrobial**
- **Anticancer**
- **Antidiabetic**
- **Anti-inflammatory**



- Originally considered one species: *Ganoderma lucidum*
- Recently more species recognized, e.g. *Ganoderma lingzhi*

Species Identity Has Consequences

DNA barcoding of Reishi



grow kits



consumables

Identifying the “Mushroom of Immortality”: Assessing the *Ganoderma* Species Composition in Commercial Reishi Products

Andrew L. Loyd^{1*}, Brantlee S. Richter², Michelle A. Jusino², Camille Truong^{2,3},
Matthew E. Smith², Robert A. Blanchette⁴ and Jason A. Smith¹

Species Identity Has Consequences

DNA barcoding of Reishi



grow kits



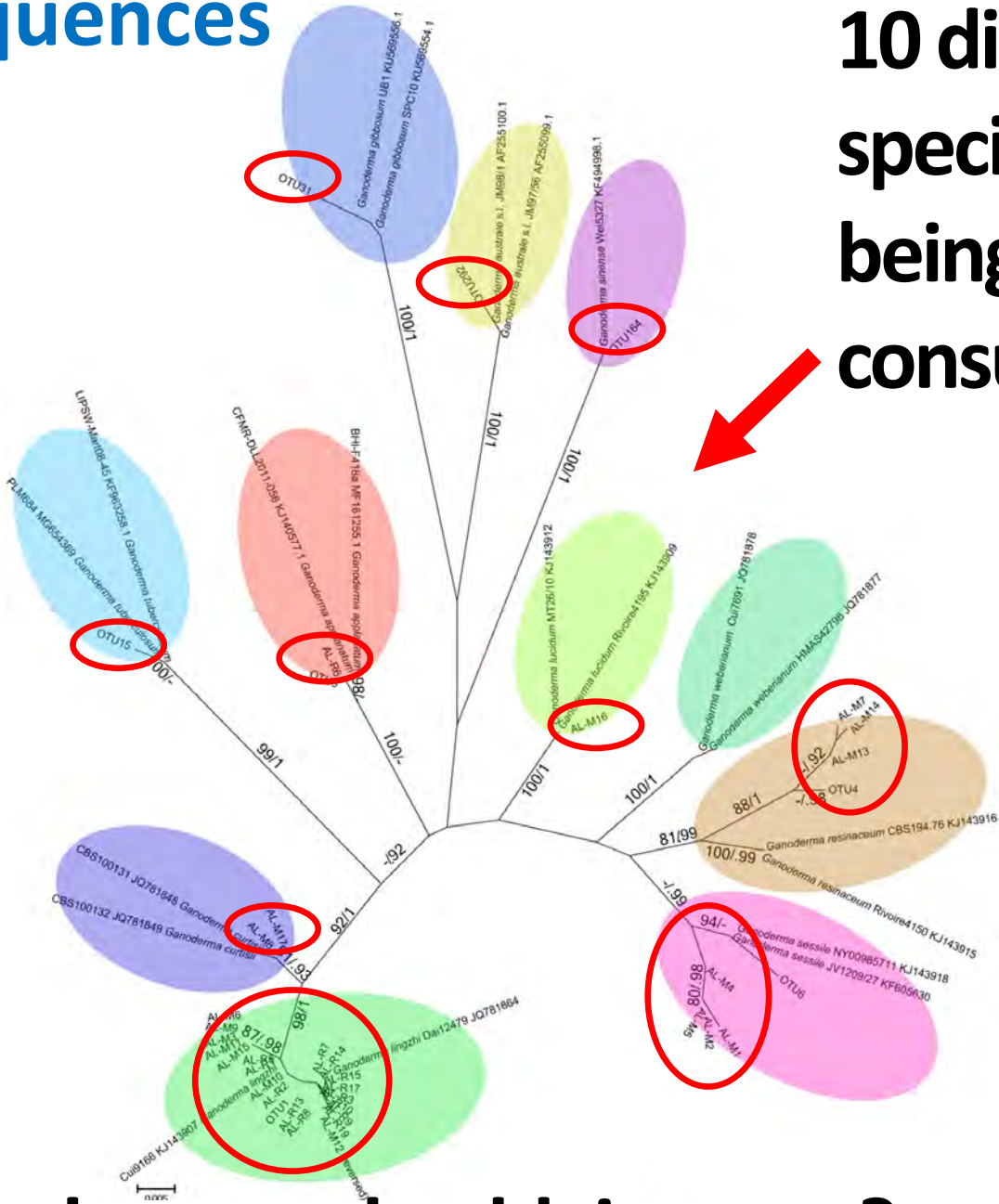
consumables



ORIGINAL RESEARCH
published: 10 July 2018
doi: 10.3389/fmicb.2018.01557

Identifying the “Mushroom of Immortality”: Assessing the *Ganoderma* Species Composition in Commercial Reishi Products

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10 different species being sold & consumed

Do they have the same health impacts?

Do birds consume truffles?



Scelorchilus rubecula



Pterotochos tarnii



Marcos Caiafa
(former Ph.D. Student)



Do birds consume truffles?



Scelorchilus rubecula



Pteroptochos tarnii



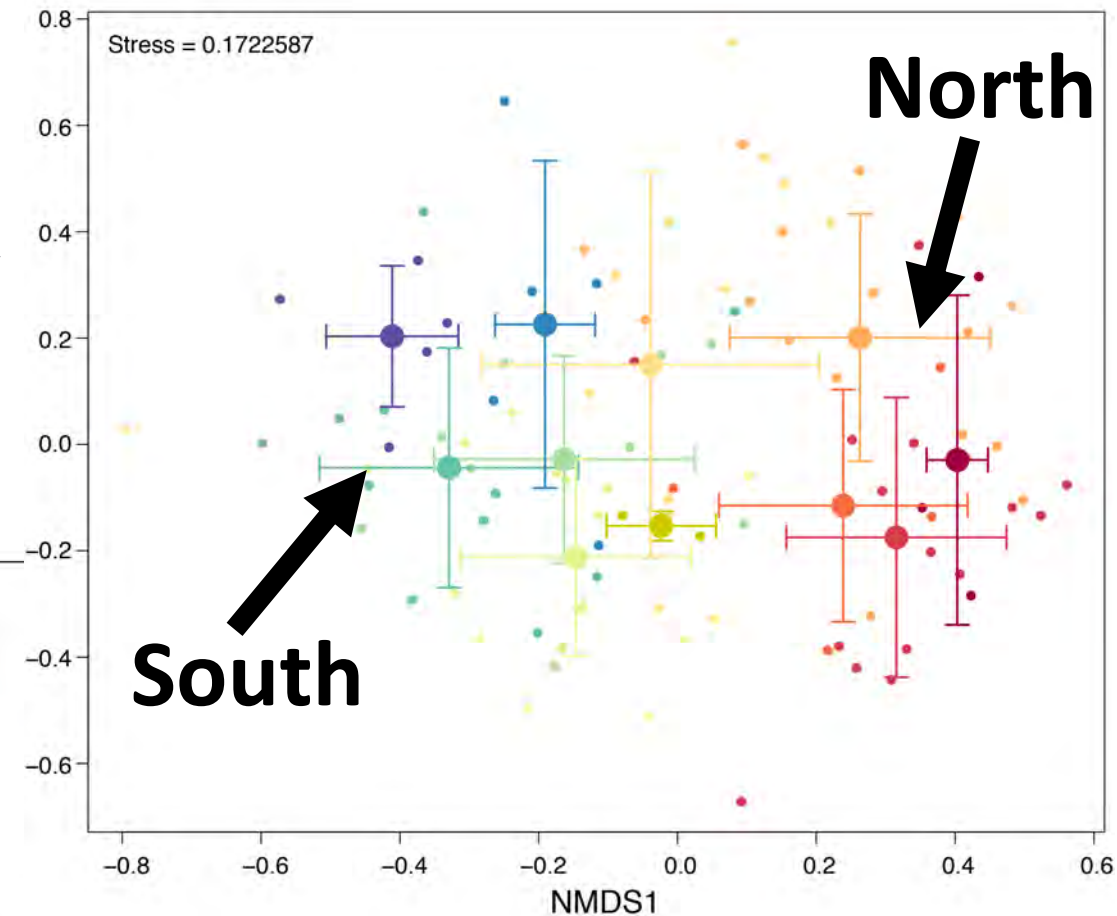
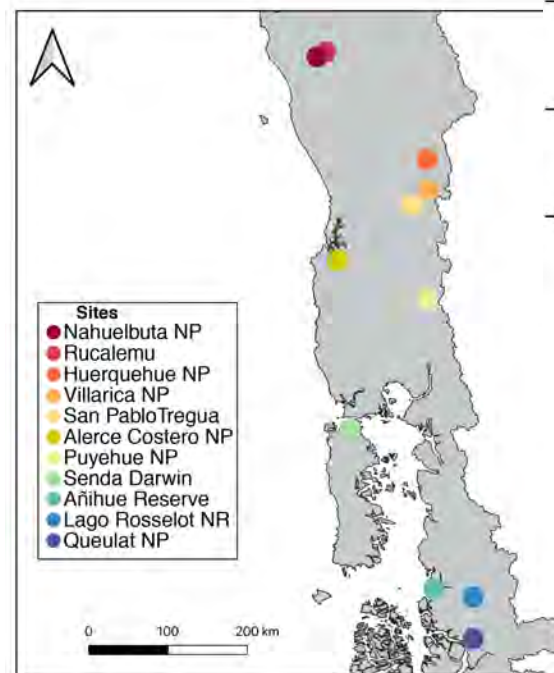
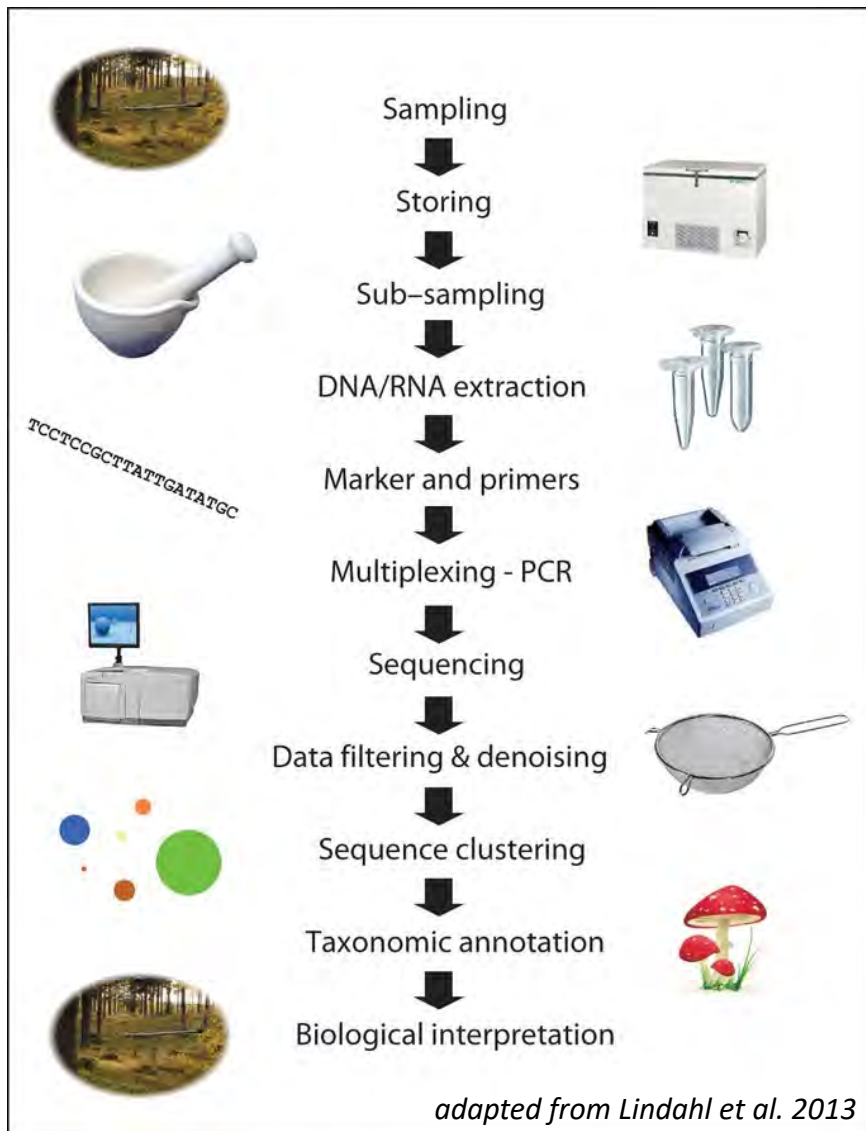
First you have to build the library....



To build the library, you need a team!

>15 researchers from 7 countries





**Geography influences
fungal communities in
feces**

Chucaos & Huet-huet (n = 102)
adonis; $r^2 = 0.51$, pseudo-F = 10.24, $p < 0.0001$

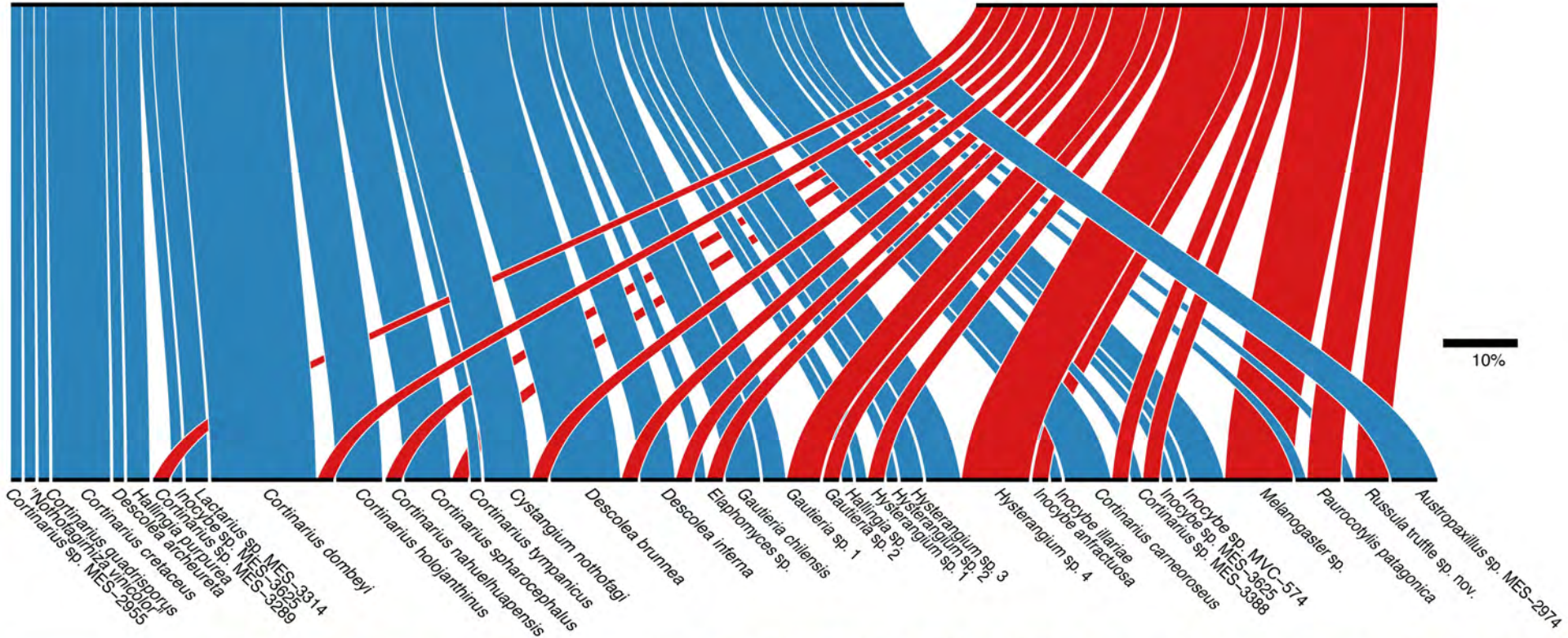
The birds consume truffles



Scelorchilus rubecula



Pteroptochos tarnii



The birds consume truffles*



*Yes, spore photos are from real fecal samples

Current Biology

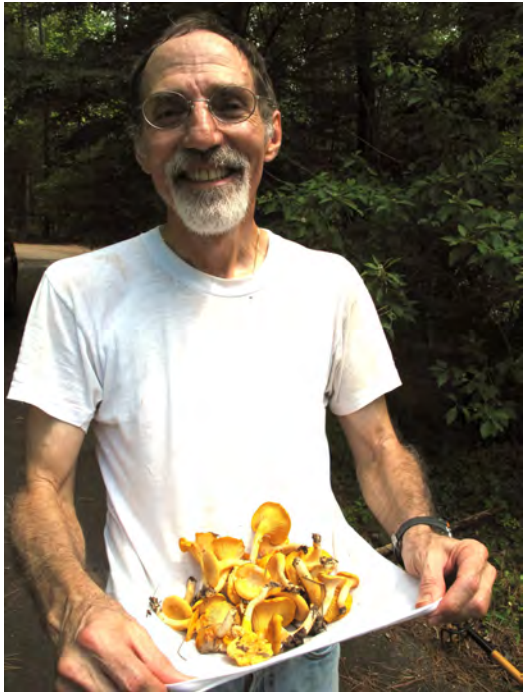
Volume 31
Number 24
December 20, 2021



Caiafa et al. 2022



1. Make Science Fun!
2. Provide Educational Resources
3. Build Teams
4. Engage with kids
5. Interact with citizen-scientists



Thank you for your attention!



Matthew E. Smith
<trufflesmith@ufl.edu>