Geology 105 Paleontology

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- Placer 1019 T 10:30 am-noon, Th 3-4 (TWTh in general are good times to find me in the building)
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- On a piece of paper, please do this:
- Name
- Major & year in school
- Prereqs? Geology 10 & 10L, Geology 12 & 12L
- Something interesting I should know about you
- Draw a picture I can use to identify you. Labels help.

ET the exopaleontologist arrives at Earth in 1 million AD after humans are long extinct. What evidence of human existence might he find?

Fossils are data

- So… how good is the database?
- Does it accurately represent the range of organisms on earth?
  - Taxonomically
  - Stratigraphically

Taxonomic composition

Protists	15%	Cephalopoda	11.4%
Porifera	1.5%	Other Molluscs	0.3%
Cnidaria	6.5%	Echinoidea	1.9%
Bryozoa	5.1%	Other Echinodermata	2.5%
Brachiopoda	6.9%	Insecta	3.4%
Gastropoda	14.3%	Other Arthropoda	17.3%
Bivalvia	10.8%	Others	3.0%

Data from Raup, 1976, Paleobiology 2:279-288

Living species

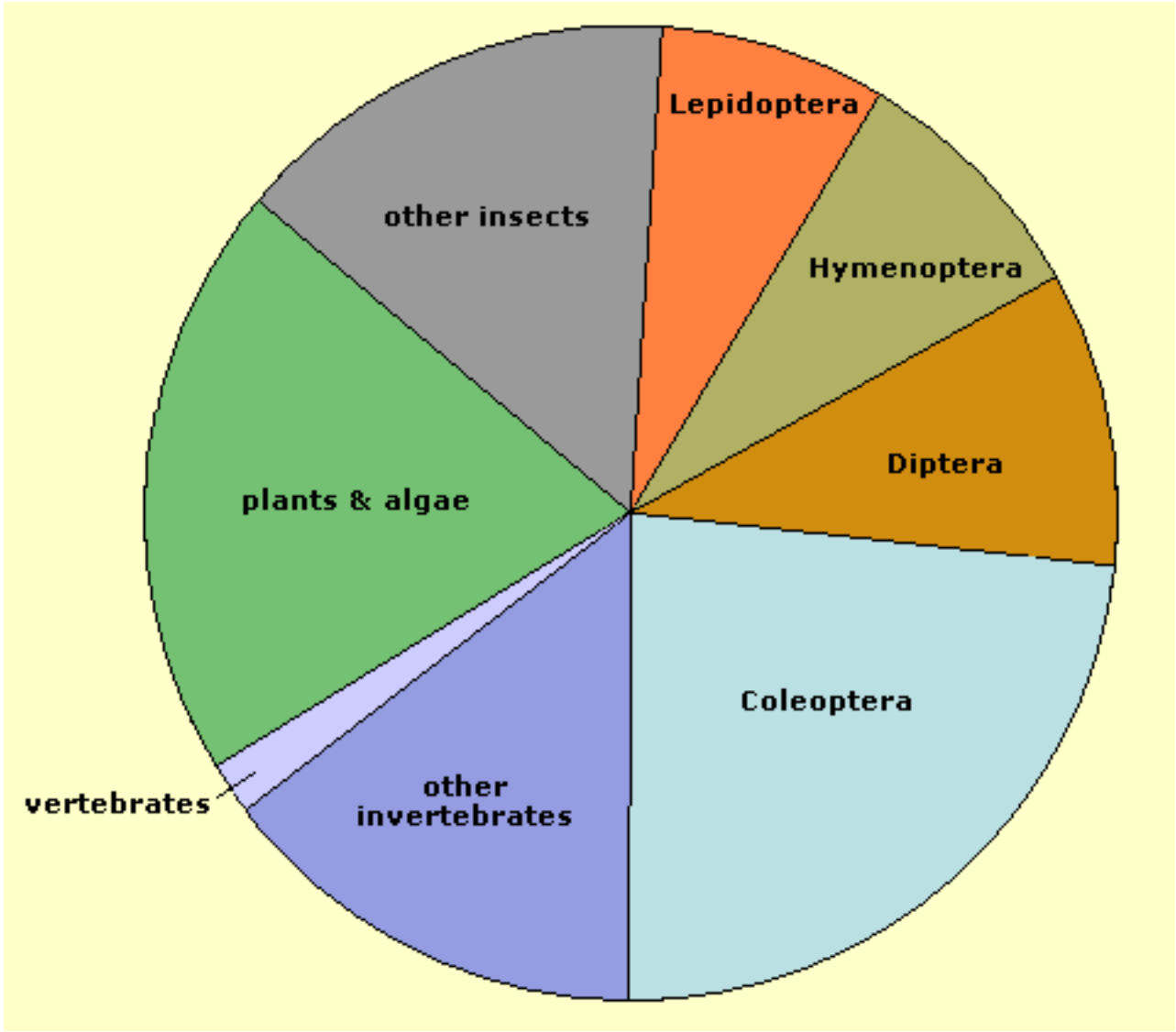

TABLE 1.4

Proportion of Living Taxa with a Fossil Record

Group	Taxonomic Level	Percent
Sponges	Family	48
Corals	Family	32
Polychaetes	Family	35
Malacostracan crustaceans	Family	19
Ostracodes	Family	82
	Genus	42
Bryozoans	Family	74
Brachiopods	Family	100
	Genus	77
Crinoids	Family	50
Asterozoans	Family	57
	Genus	5
Echinoids	Family	89
	Genus	41
Bivalves	Family	95
	Genus	76
Gastropods	Family	59
Cephalopods	Family	20
Cartilaginous fishes	Family	95
Bony fishes	Family	62
Arachnids	Genus	2
	Species	< 1

SOURCES: Raup (1979); Foote & Sepkoski (1999); Valentine et al. (2006). Data are global.

TABLE 1.3

Estimated Completeness of Genera Within Some Paleontologically Important Groups

Group	Probability of Preservation per Genus per Time Interval
Sponges	0.4–0.45
Corals	0.4–0.5
Polychaetes	0.05
Malacostracan crustaceans	0.2–0.35
Ostracodes	0.5
Trilobites	0.7–0.9
Bryozoans	0.7–0.75
Brachiopods	0.9
Crinoids	0.4
Asterozoans	0.25
Echinoids	0.55–0.65
Bivalves	0.45–0.5
Gastropods	0.4–0.55
Cephalopods	0.8–0.9
Graptolites	0.65–0.9
Conodonts	0.7–0.9
Cartilaginous fishes	0.1–0.15
Bony fishes	0.15–0.3

SOURCE: Foote & Sepkoski (1999)

NOTE: Time intervals are roughly 5 million years long on average. Estimates are based on the principle that the probability of preservation is likely to be lower in groups where a higher proportion of genera are confined to a single time interval (Box 1.3). Details of the calculation are found in Foote and Sepkoski (1999).

Preservation Filters: Environment

1. Does organism live in a fossilizable environment?
   - Sedimentary environment
   - Some volcanic environments
   - Who gets eliminated?

   - Who makes it through the filter?

Preservation Filters: Environment

- Who gets eliminated?
  - Terrestrial organisms
  - Transitory sedimentary environments: lakes, sand dunes, floodplains to some degree
- Who makes it through the filter?
  - Marine organisms

Preservation Filters: Mechanical

2. Can organism escape mechanical destruction?
   - Energy of environment
   - Sturdiness of organism
   - Who gets eliminated?

   - Who makes it through the filter?

Preservation Filters: Mechanical

? Who gets eliminated?
  - High-energy environments: beaches, river channels
  - No hard parts
  - Non-robust hard parts

? Who makes it through the filter?
  - Quiet water environments: off-shore, floodplains, lakes
  - Robust skeletons

Preservation Filters: Biological

3. Can organism survive biological destruction?
   - Sturdiness of parts
   - “Tastiness”
   - Presence of scavengers/decomposers
   - Ability of scavengers/decomposers to access organism

Preservation Filters: Biological

- Who is eliminated?
  - Flimsy organisms
  - Tasty organisms
  - Organisms in high productivity environments
- Who makes it through the filter?
  - Robust organisms
  - Repugnant organisms
  - Organisms in low-oxygen environments
  - Organisms that are rapidly buried
  - Organisms that are rapidly covered in microbial mats

Preservation Filters: Chemical

4. Can organism avoid chemical destruction?
   - Solubility of skeleton
   - Chemical environment of diagenesis
   - Who is eliminated?

   - Who makes it through the filter?

Preservation Filters: Chemical

- Who is eliminated? Who remains?
  - More soluble skeletons go: calcium carbonate, chitin.
  - Less soluble skeletons remain: silica, apatite
  - Extremes of diagenesis dissolve more skeletons
    - $CaCO_3$ dissolves in acid, deposits in alkaline
    - SiO_2 dissolves in alkaline, deposits in acid
    - Apatite dissolves in high acidity

Who gets preserved?

Imagine a continuum from very likely to become a fossil to very unlikely to become a fossil.

Very unlikely Very likely

Think of three organisms that would be at the very likely end, and three organisms that would be at the very unlikely end. For each organism, explain your thinking. You can't use any of the organisms we used as examples.