

Comparative Macroinvertebrate Community Structure and Food Web Dynamics in an Acid Mine Drainage Watershed, AZ



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Acid Mine Drainages (AMD)

- Impacts form and function
 - Low abundance and richness
 - Poor evenness
- Population level effects may have the potential to affect food web dynamics



Discharge from World's Fair Mine

Macroinvertebrates

- Indicators of water quality
 - Sensitivity to pollutants
 - EPT –Mayflies, Stoneflies, and Caddisflies (Ephemeroptera, Plecoptera, Trichoptera)
- Ecosystem function
 - Nutrient cycling
- Food web dynamics
 - **Fish Food**

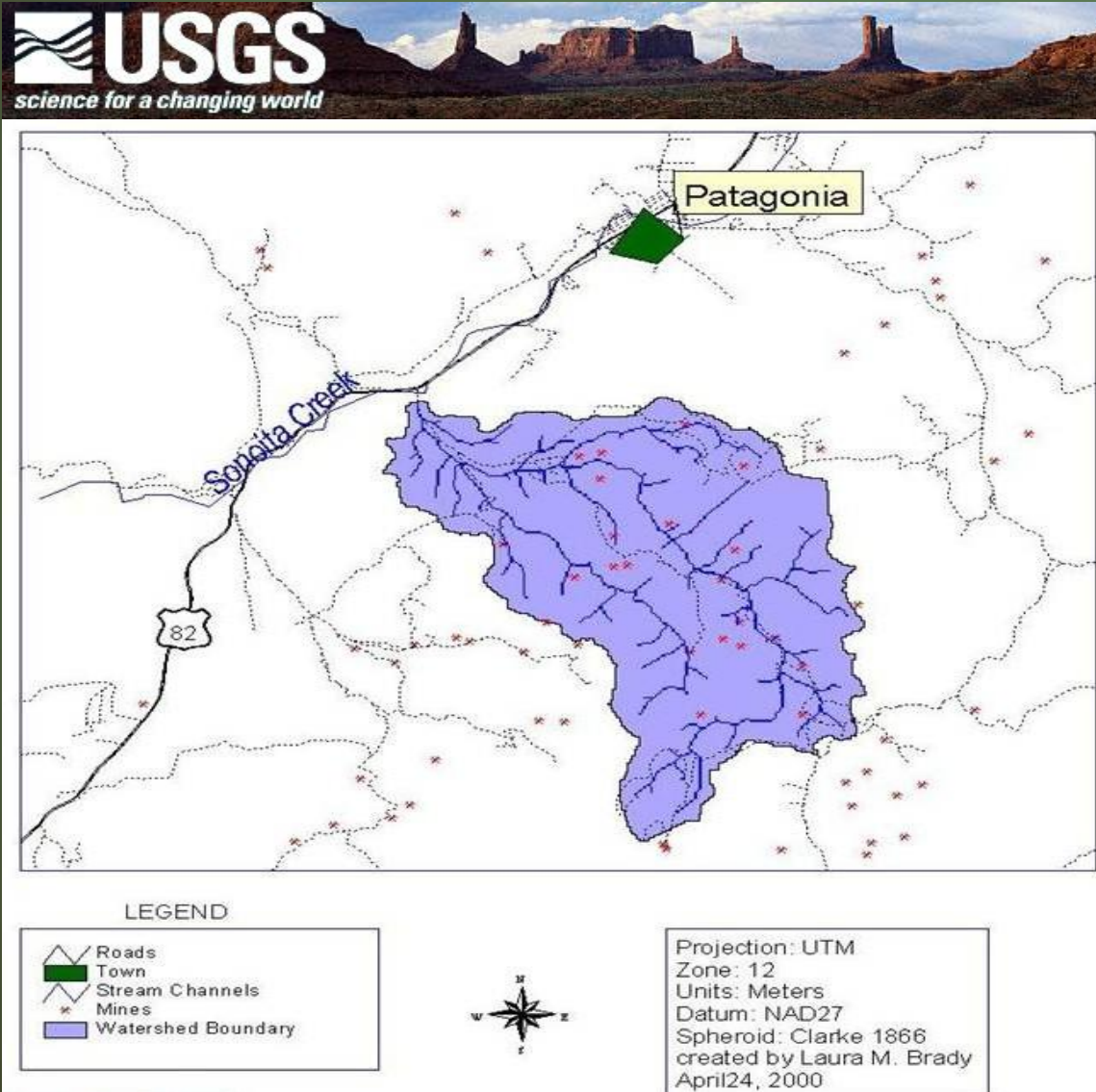


Mayfly- Ephemeroptera



Caddisfly-Trichoptera

Alum Watershed Description



- Alum Gulch-Flux Canyon Watershed
 - 3 sites
- Sonoita Creek - Native fish species
- Patagonia Lake - Sport fishery

Alum Gulch (AMD)

vs.

Humboldt vs. Harshaw

	Metals	pH
Alum Gulch (AMD)	High Lead: 0.13 ppm	Low 3.1-4.6
Humboldt Canyon	Low Lead: 0.004 ppm	Low 2.7-3.7
Middle Harshaw	Trace Lead: 0.0002 ppm	Neutral 7.3-8.6

Study Goals

- Community structure
- Pollution tolerance
- Functional feeding groups and food web

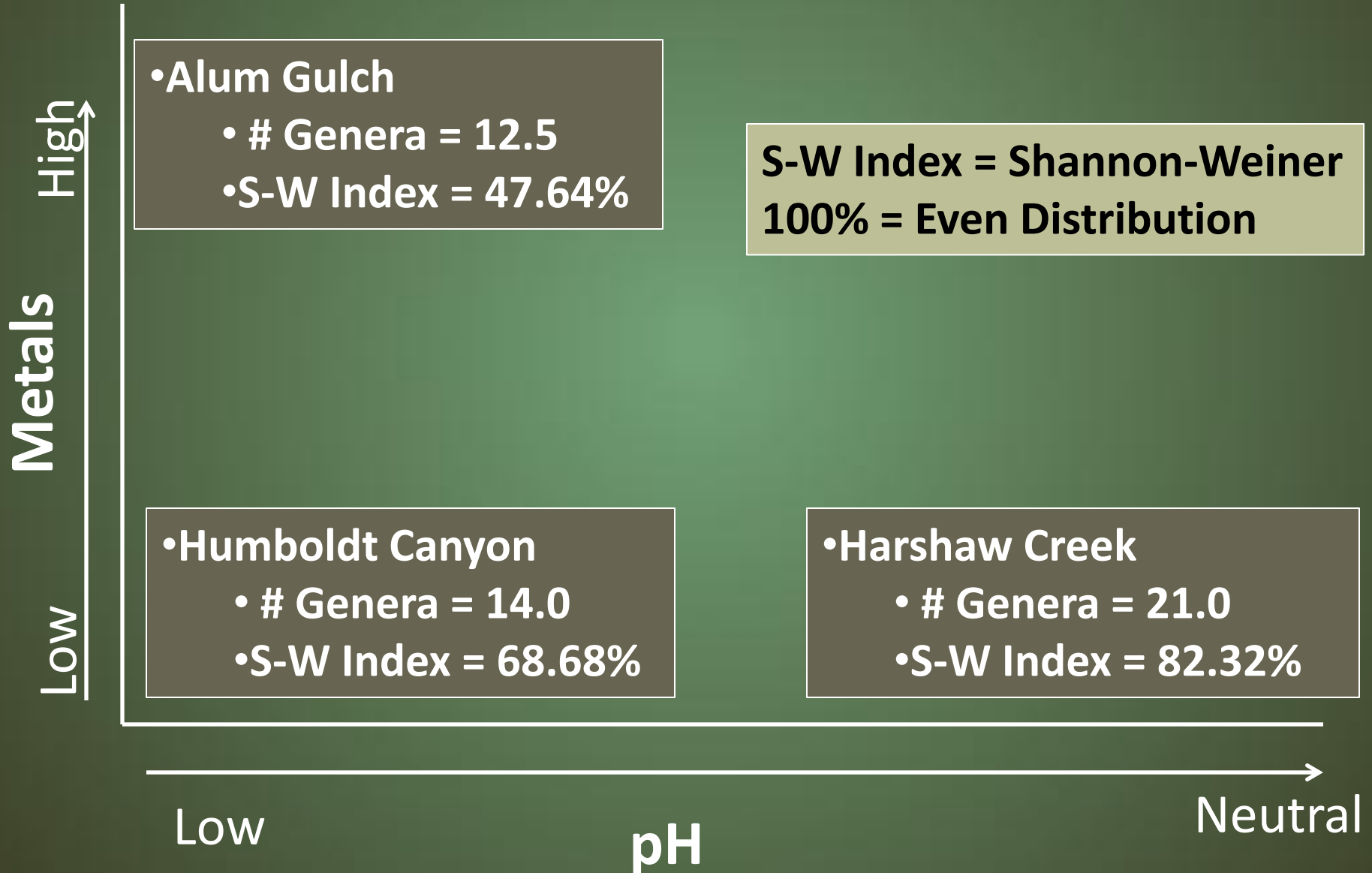


Methods

- Collect and freeze invertebrates
 - Strainers and D-shaped nets
- Pre- and post-monsoon
 - Alum = high metals, low pH
 - Humboldt = low metals, and low pH
 - Harshaw = low metals, neutral pH
- Identify, categorize, indices
- Food web: C & N isotopes



Results: Community Structure



Results: Pollution Tolerance

- Alum Gulch
 - MTV = 7.18
 - EPT = 0

Range: 1 (sensitive) – 10 (tolerant)
MTV = Mean Tolerance Value
EPT = # of Ephemeroptera,
Plecoptera, Trichoptera

- Humboldt Canyon
 - MTV = 7.71
 - EPT = 0

- Harshaw Creek
 - MTV = 6.29
 - EPT = 5

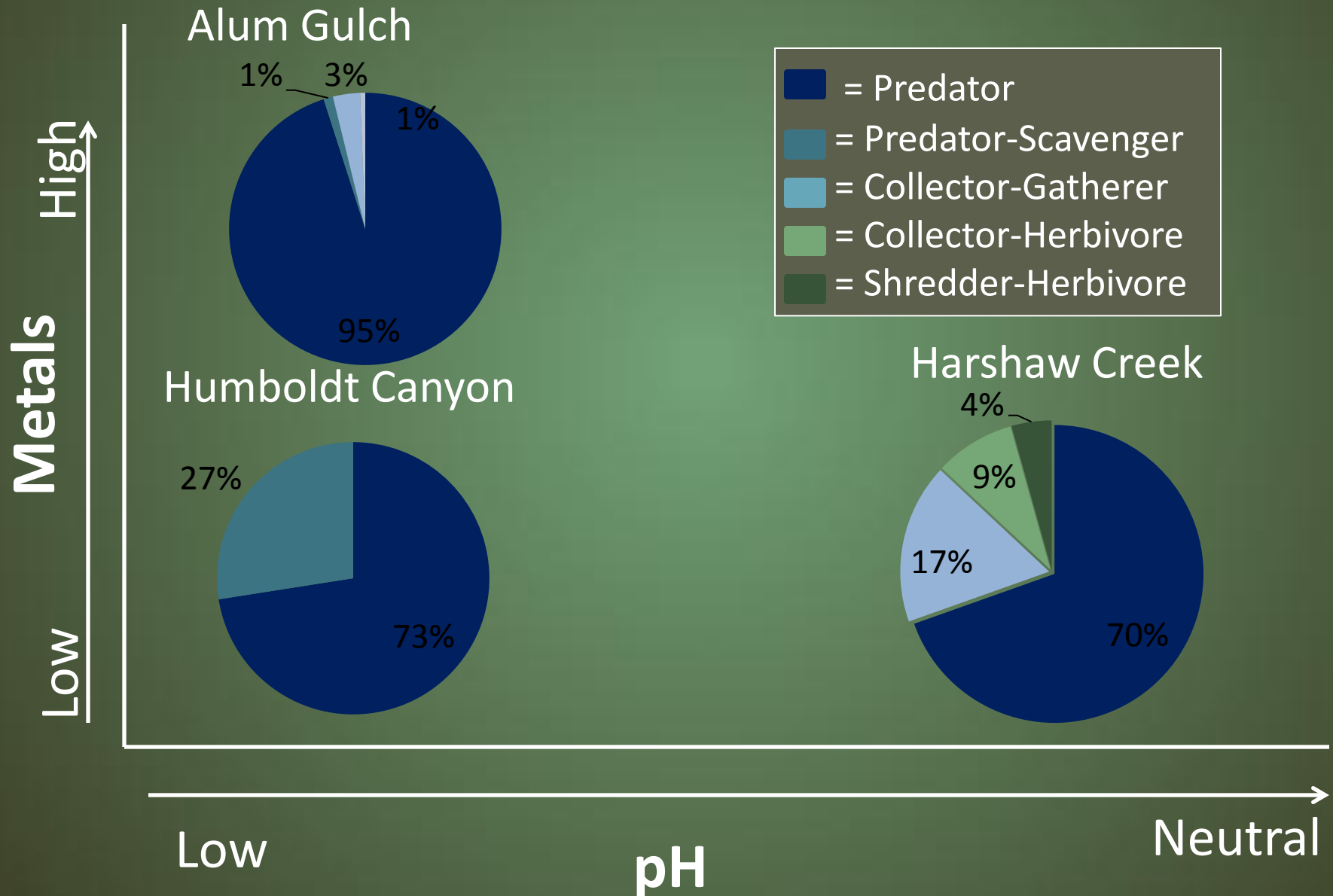
Low

pH

Neutral

Metals
High
Low

Results: Functional Feeding Groups



Basics of C & N Stable Isotopes

- Stable isotopes – C & N
 - Heavy vs. Light
- C = Food Source
- N = Trophic Level
- Fractionation
 - Separation Process
 - Light isotopes first

^{13}C & ^{14}C

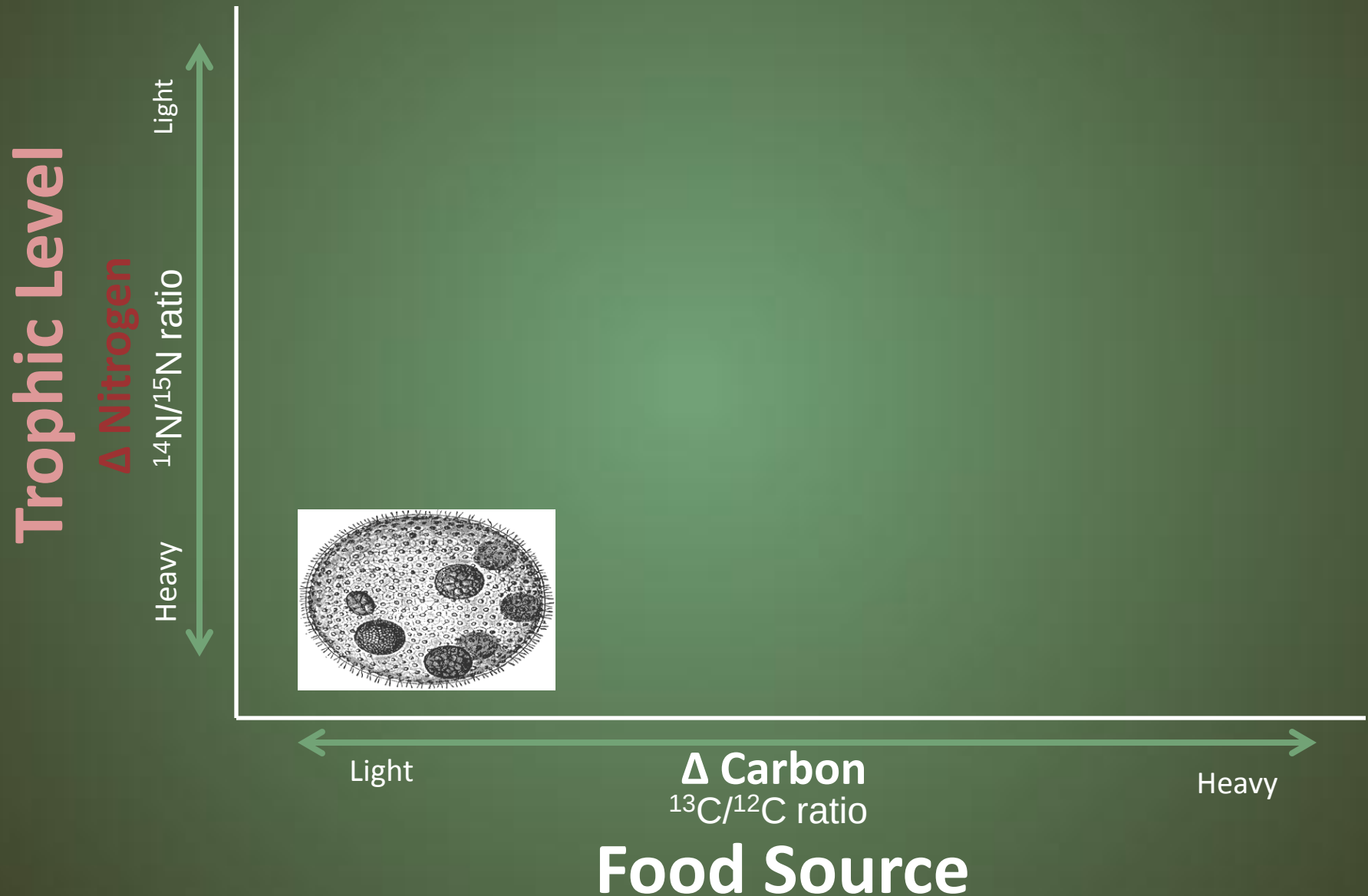
^{14}N & ^{15}N



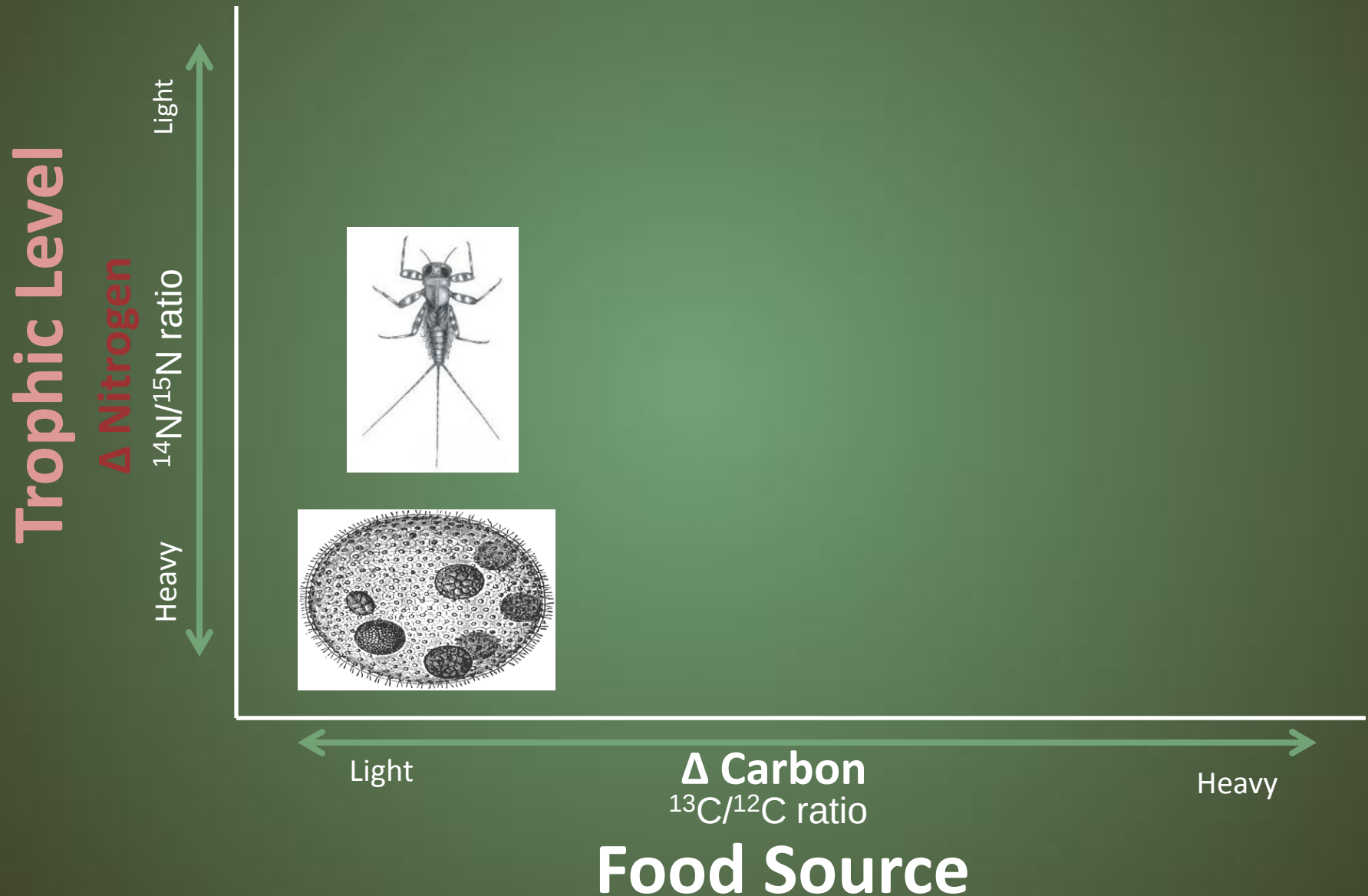
How C & N Stable Isotopes Work



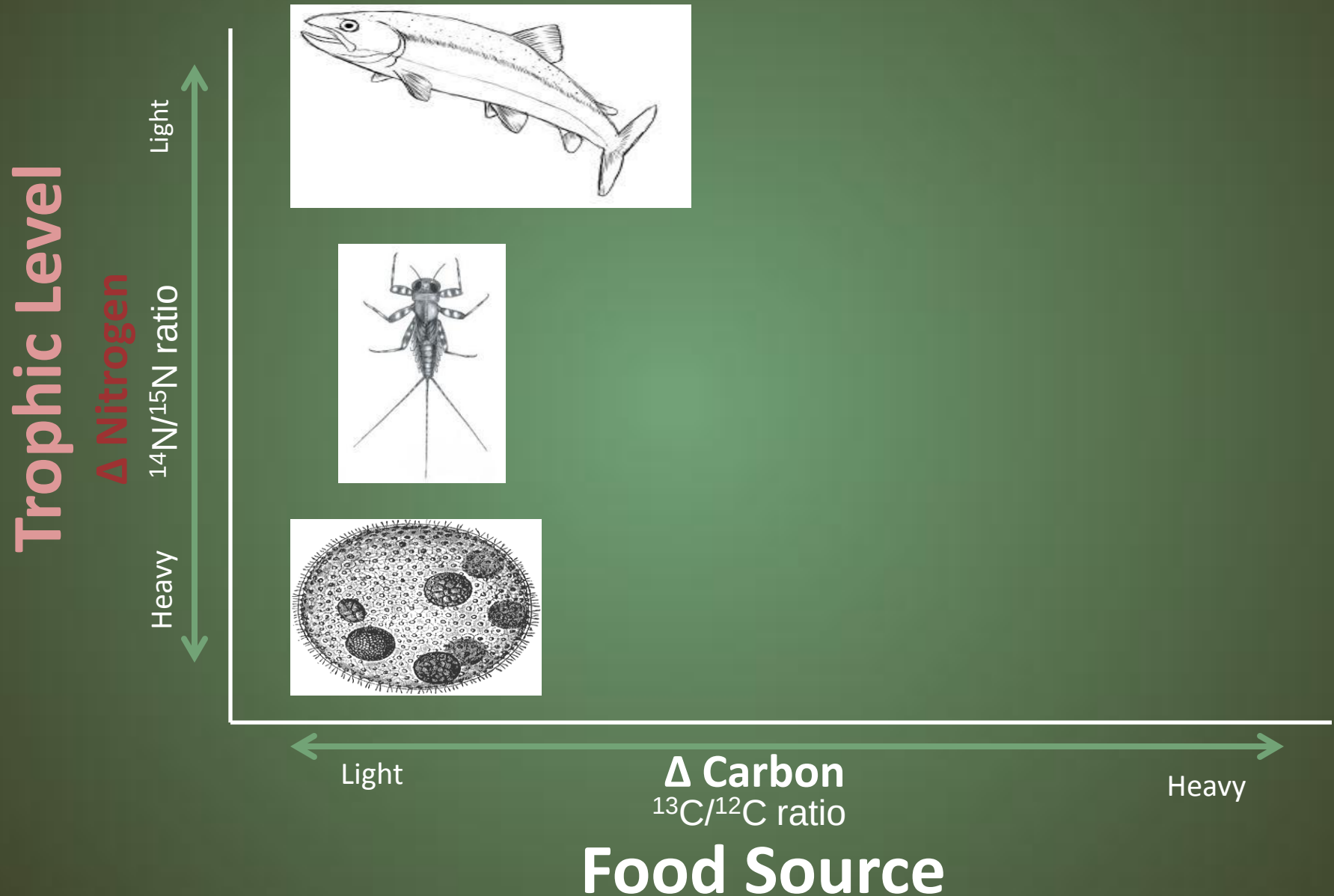
How C & N Stable Isotopes Work



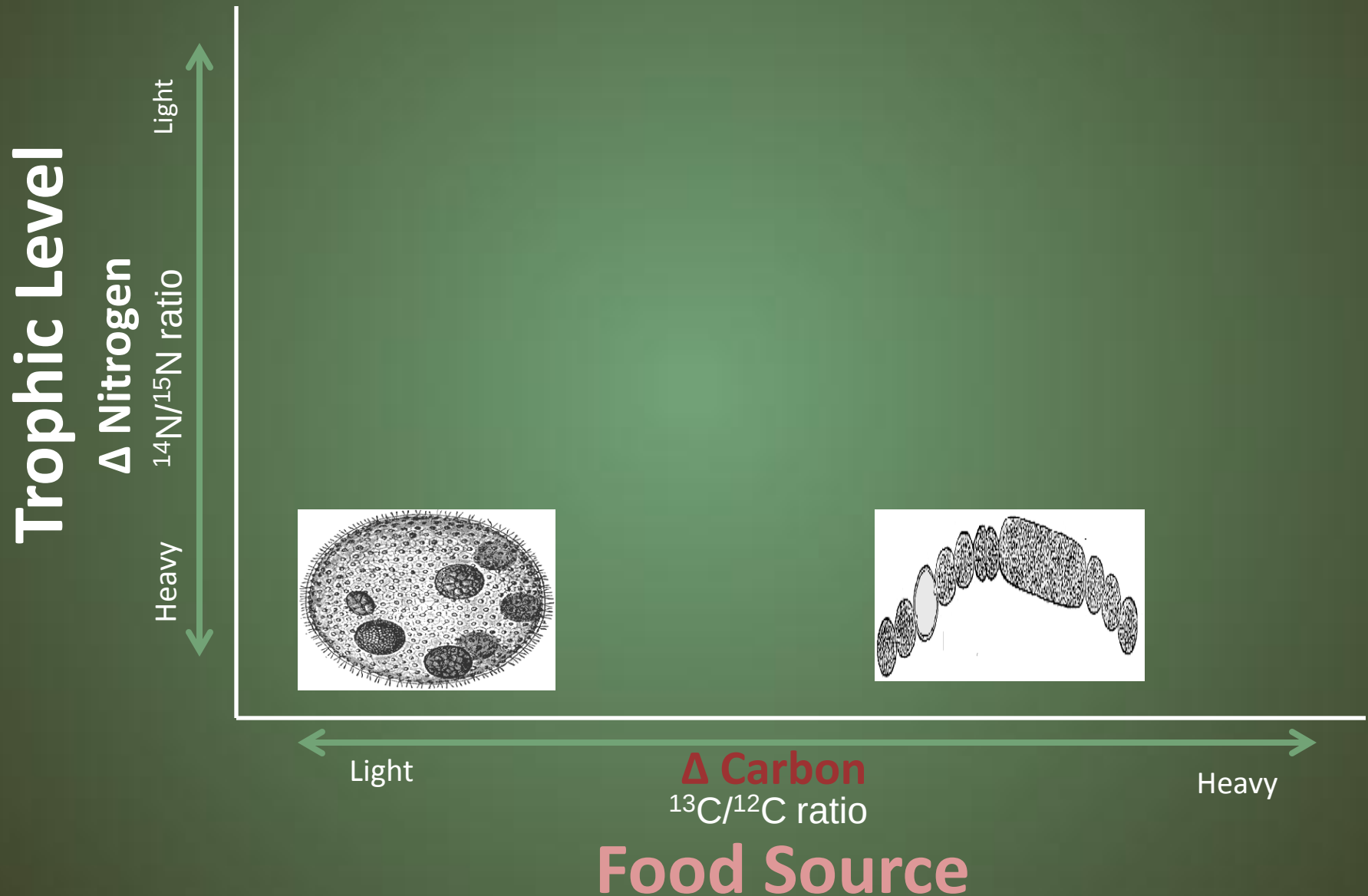
How C & N Stable Isotopes Work



How C & N Stable Isotopes Work



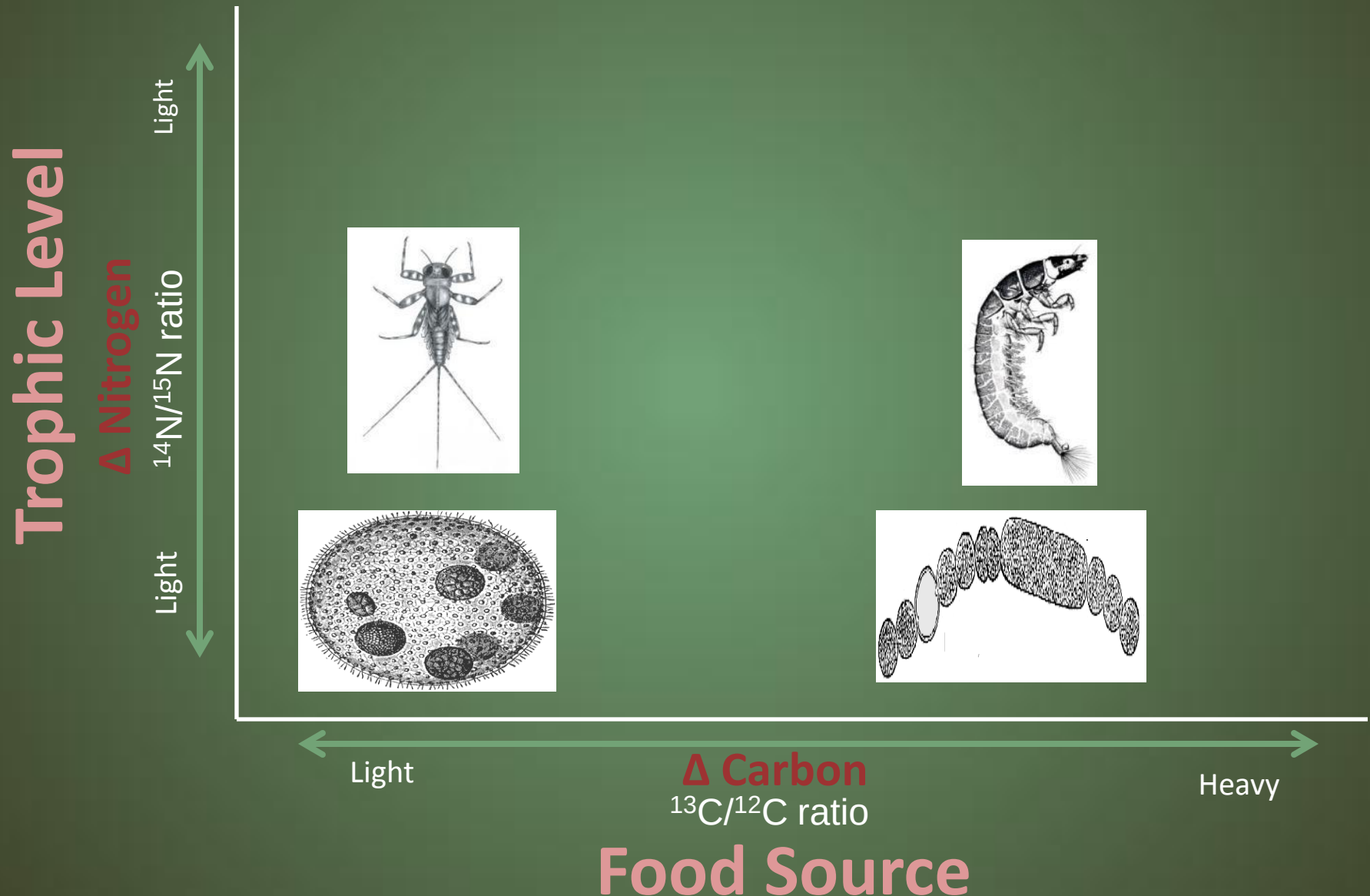
How C & N Stable Isotopes Work



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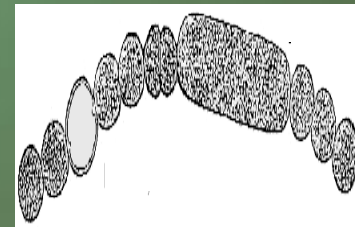
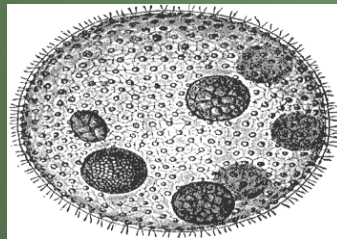
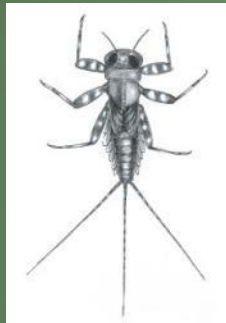
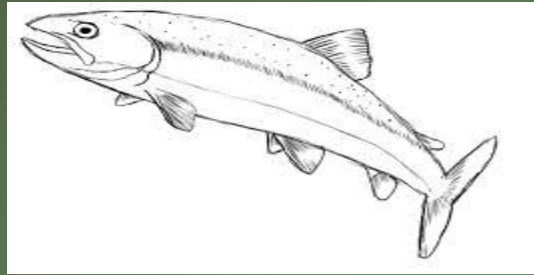
Trophic Level

Δ Nitrogen

$^{14}\text{N}/^{15}\text{N}$ ratio

Light

Light



Light

Δ Carbon
 $^{13}\text{C}/^{12}\text{C}$ ratio

Heavy

Food Source

How C & N Stable Isotopes Work

Trophic Level

Δ Nitrogen

$^{14}\text{N}/^{15}\text{N}$ ratio

Heavy

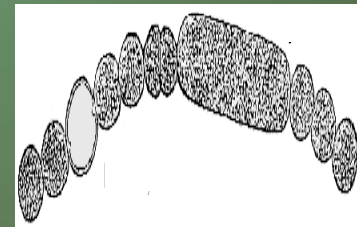
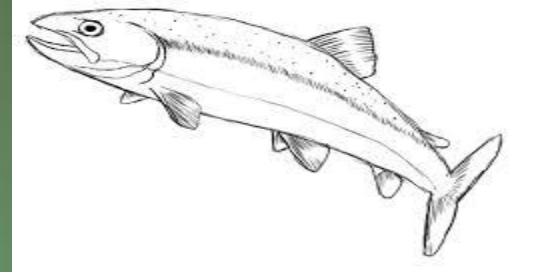
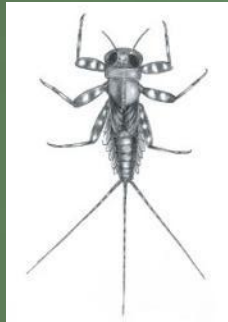
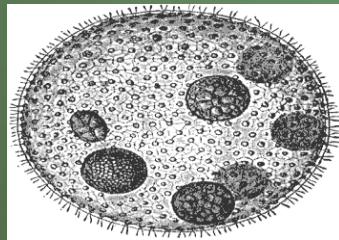
Light

Light

Δ Carbon
 $^{13}\text{C}/^{12}\text{C}$ ratio

Heavy

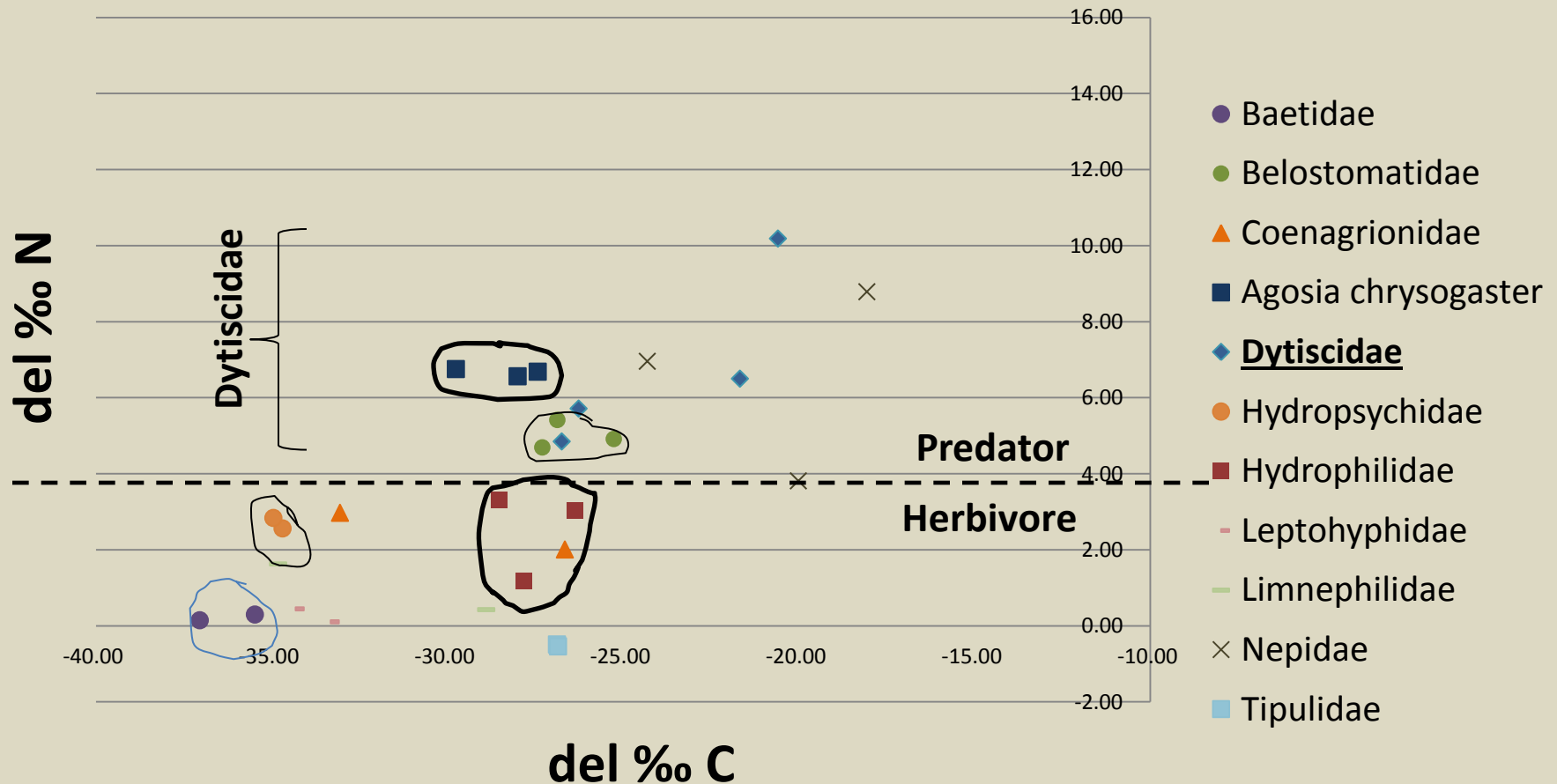
Food Source



Results: C & N Isotopes: Food Web



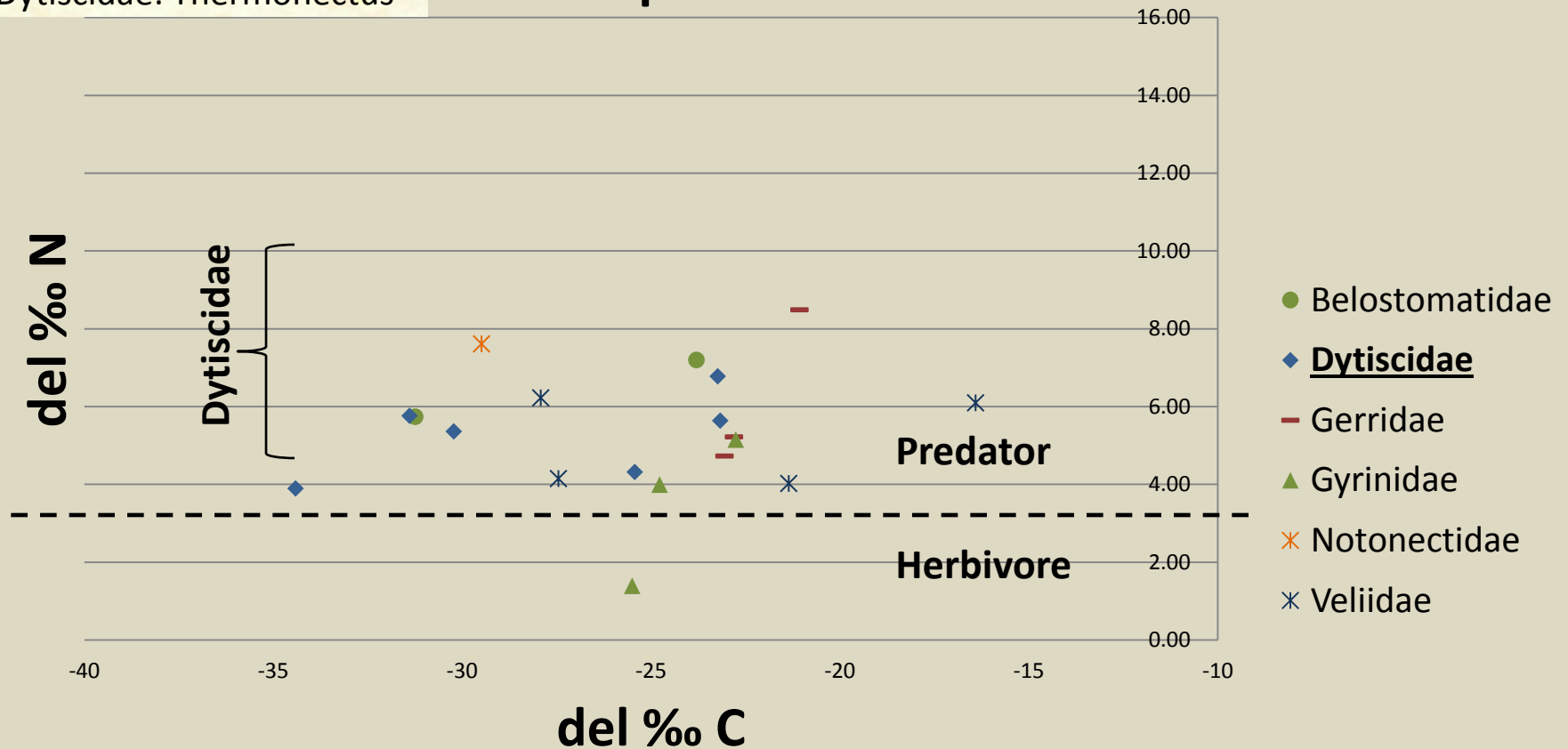
Middle Harshaw Creek Neutral pH & Trace Metals



Results: C & N Isotopes: Food Web



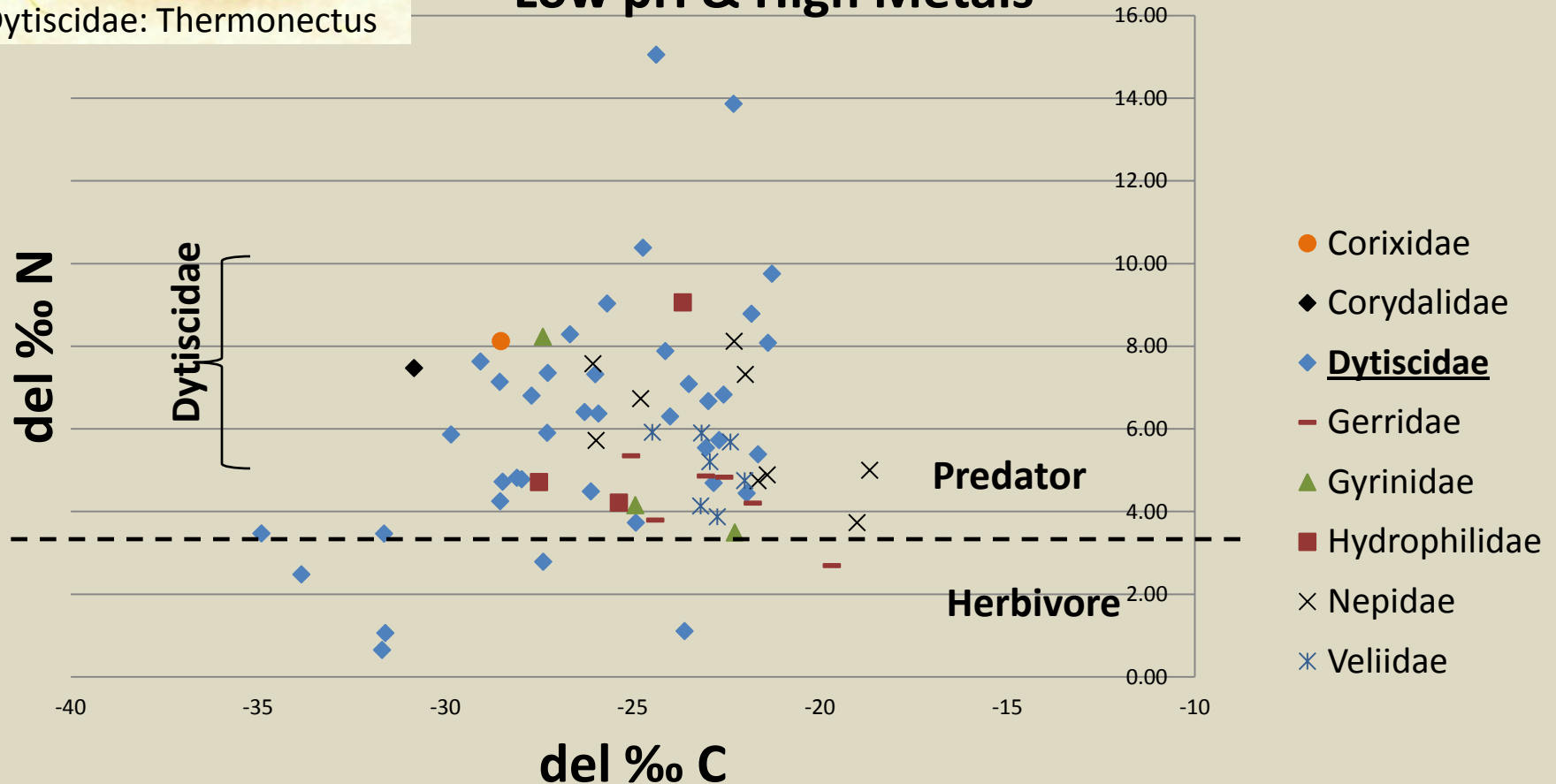
Humboldt Canyon Low pH & Low Metals



Results: C & N Isotopes: Food Web



Alum Gulch Low pH & High Metals



Summary: AMD Community Structure

- Alum Gulch
 - Low diversity
 - Richness and evenness
 - Coleoptera and Hemiptera



Hydrophilidae: Tropisternus



Dytiscidae: Thermonectus



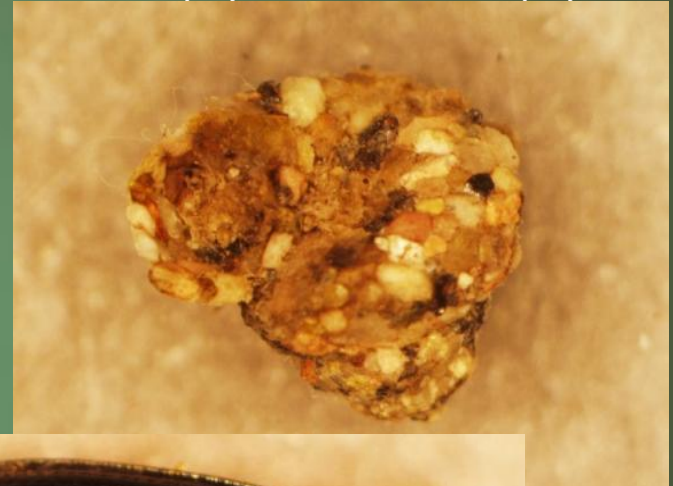
Veliidae: Microvelia

Summary: AMD Pollution Tolerance

- Alum Gulch
 - Higher Mean Tolerance Value
 - MTV higher
 - EPT drop-out



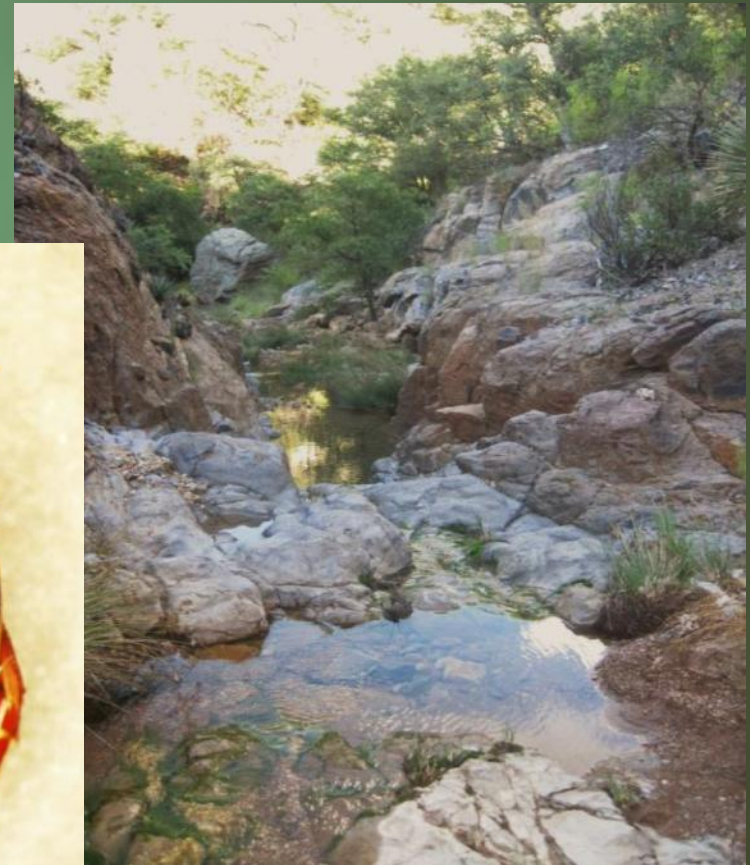
Helicopsychidae: Helicopsyche



Gyrinidae: Gyrinus

Summary: AMD Functional Feeding Groups and Food Webs

- Alum Gulch
 - Predatory/cannibalistic community
 - Loss of lower trophic levels
 - Dytiscidae niche expansion



Questions?

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Gyrinidae: Gyrinus