

Procambarus gracilis Grassland crayfish:



The Prairie Crayfish (*Procambarus gracilis*), as Builders of Prairie Soil.

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c. Roger Thoma

P. gracilis Background Info

- Little is known about primary burrowing crayfish
- Found in nearly all remnant patches of prairie in Illinois
- Also found in forest ecotones and heavily disturbed areas such as roadside ditches

P. gracilis Life History

- Classified as a primary burrower
- Females carry young on their abdomen, and deposit them in surface waters in early spring.
- Males are cyclically dimorphic.
- There is generally one individual per burrow.
- Lifespan is 3 – 4 years



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Collections of *P. gracilis*

- Other researchers have found breeding form I males in Illinois from February to May
- Females with young attached were found in March, April, and October.

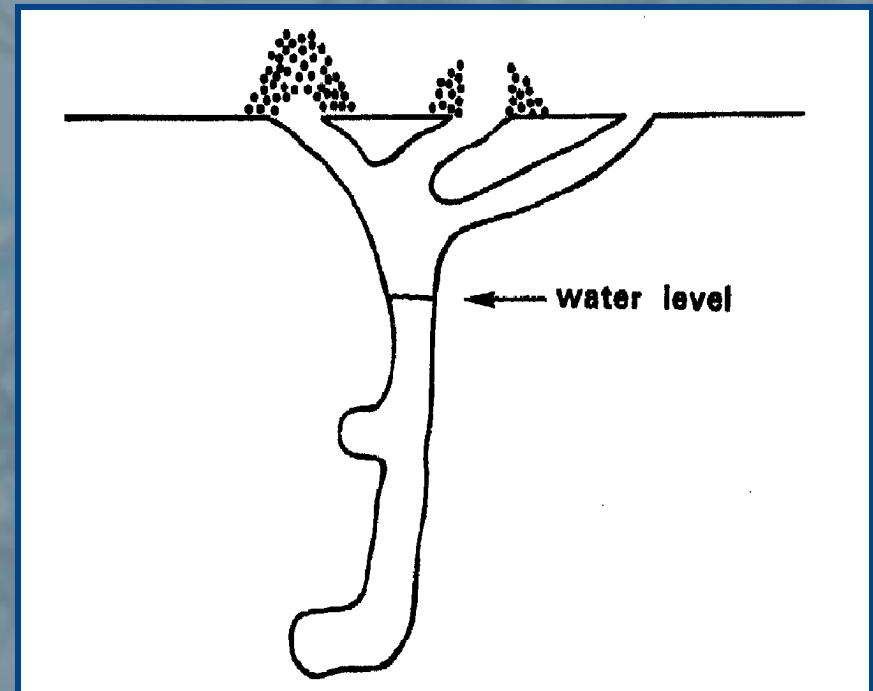
Collections of *P. gracilis* at the Woodworth Prairie

- Crayfish were collected at the surface from April 18 to May 22

	# collected	Average Weight (grams)	Average Carapace Length (cm)
Males	21	8.95 +/- 4.2	3.1 +/- 0.49
Females	8	9.4 +/- 1.3	3.3 +/- 0.24

Burrow Morphology

- From the entrance at the surface a vertical shaft extends down past the water table where it enlarges and terminates in a chamber 1.5 to 2 meters deep



Tarr, 1884

Burrow Entrances at the Surface

- A single burrow may have more than one entrance.
- Burrow entrances are marked by a mound, a mound with a hole, or just a hole.
- We found 19% of open burrow entrances to be connected with one another.



2005 5 1



2005 5 1



2005 5 1

Mound Characteristics

- Average mound height = 6.6 cm +/- 1.7
- Average mound width = 18.1 cm +/- 5.2
- Average diameter of holes = 2.7 cm
- Mounds contained soils from A, B, and C horizons, with clay mounds being most frequent.
- Soil analysis of mounds show that mounds are constructed of silty clay or clay.

Changes occurring at burrow entrances

Three types of changes occur:

- Holes are opened
- Holes are plugged
- Soil is excavated
- The excavated soil at the surface is eroded by weather conditions.

2004 Crayfish Activity

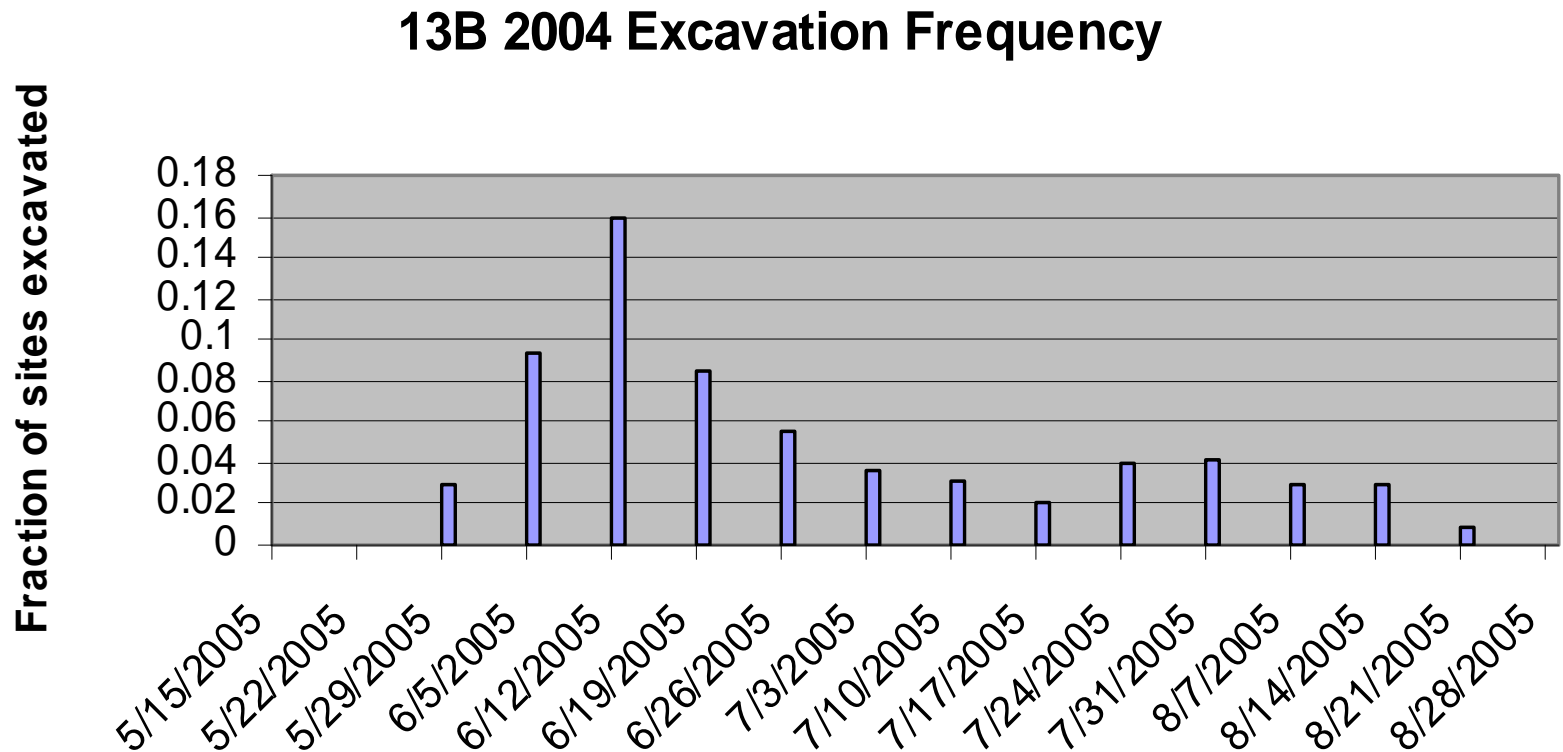
Two 100 square meter sites were inventoried	13B 100 m ²	16E 100 m ²
Total Sites	97	40
New sites	58	8
Active Sites	78	27
Mound Building Sites	61	23
Inactive Sites	19	13

2005 Crayfish Activity

	13B	16E
Same two plots -different years		
Total Sites	131	48
New sites	41	10
Active Sites	114	40
Mound Building Sites	60	23
Inactive Sites	17	8

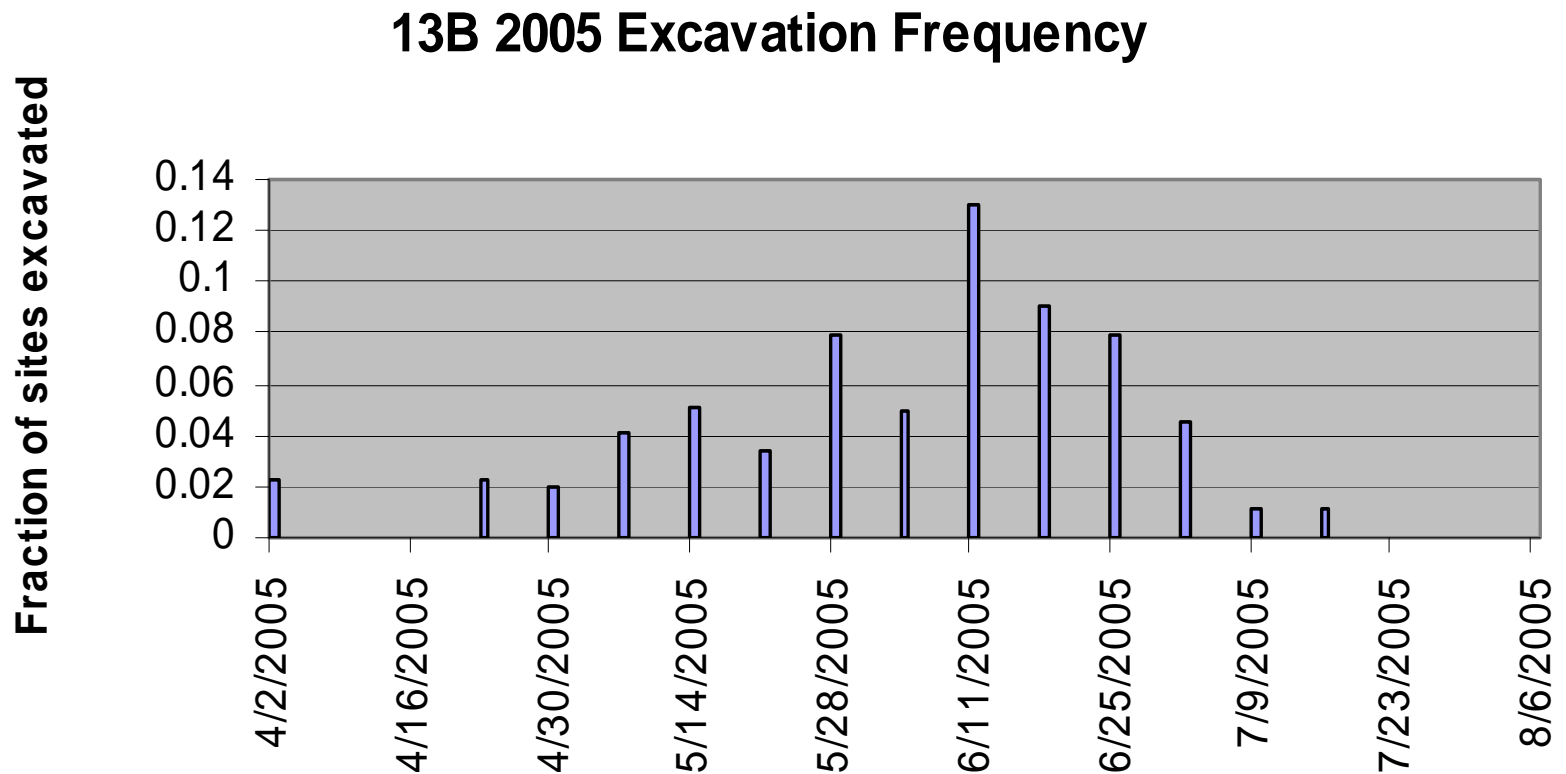
Temporal Patterns of Soil Movement

- 33 sites excavated out of 41 active sites.



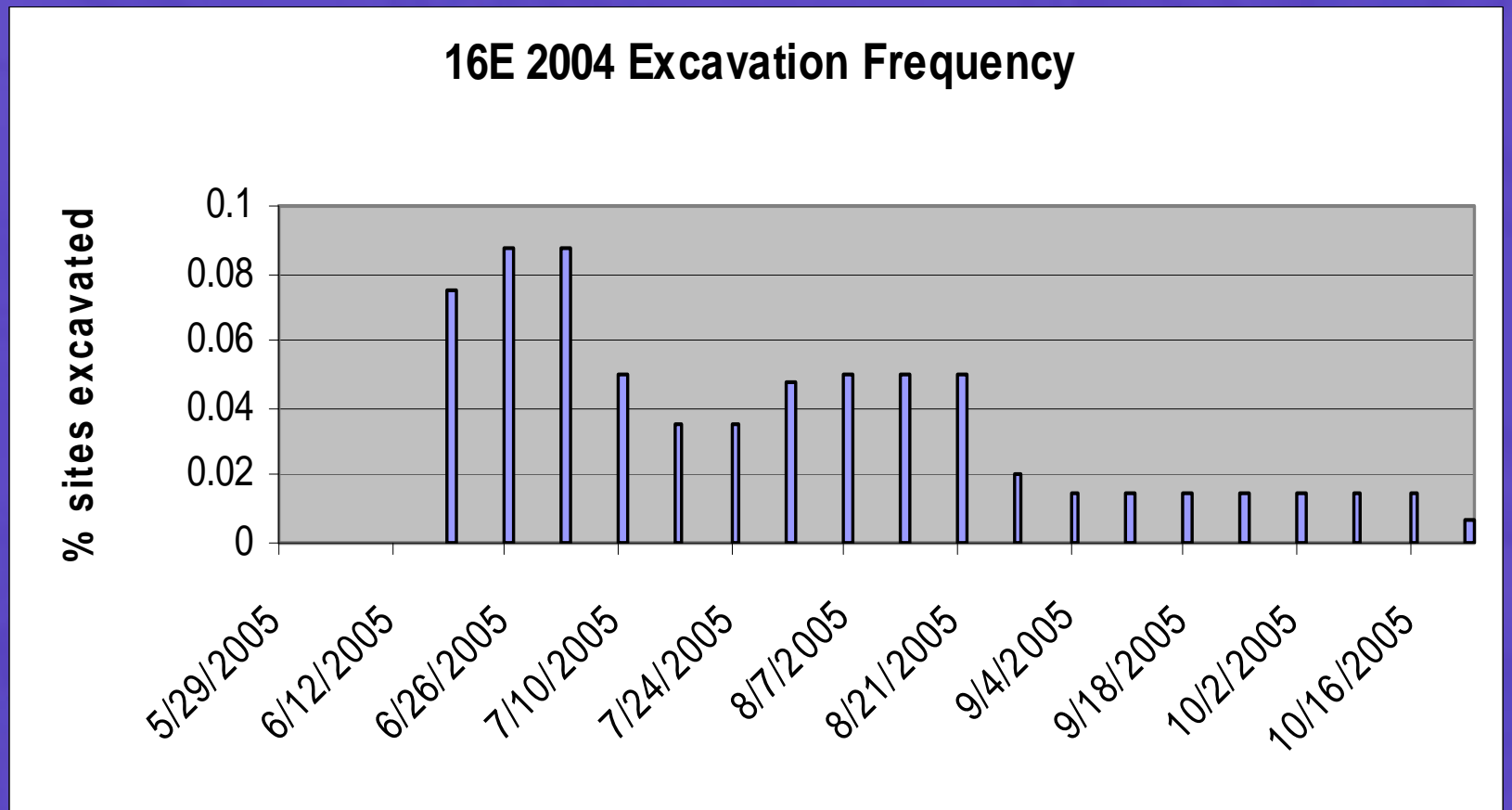
Temporal Patterns of Soil Movement

- 32 sites excavated out of 89 active sites



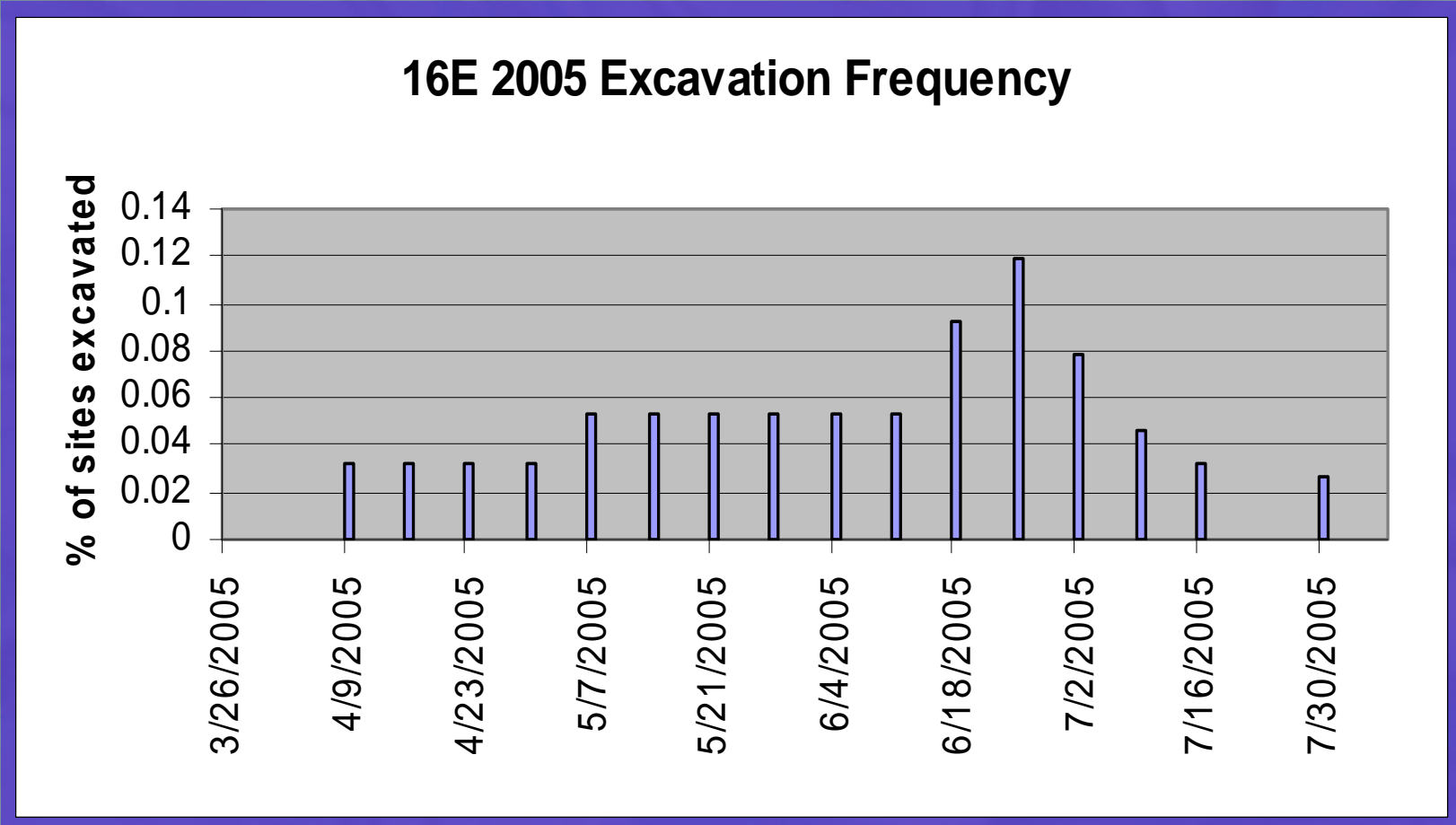
Temporal Patterns of Soil Movement

- 15 sites excavated out of 40 active sites



Temporal Patterns of Soil Movement

- 15 sites excavated out of 38 active sites



Spatial Patterns of Excavation

- Random survey of 47 1m² plots on July 12
- Crayfish prefer to build mounds in the wet undisturbed areas of prairie.
- On a fine scale I suspected that crayfish activity is of a slightly clumped distribution, due to the lifespan of a burrow and the possibility of multiple entrances to one burrow.

Amount of Soil Excavated by the Crayfish

- From random survey of 47 1m² plots
- 27 mounds were found on the total 47 m², giving 0.6 mounds m⁻²
- The average mound weight was 339 grams
- This is equal to about 200 g m⁻²
- This figure is an underestimate of soil moved per year, because it does not take erosion into account.

Rate of Mound Erosion

- Used measurement data from newly formed mounds to calculate erosion rate
- Subtracted mound volume at October 1st from mound volume at date of last recorded excavation, and divided by number of days in interval.
- The average rate of erosion is approximately 1 gram day⁻¹

Total Amount of Soil Moved per Year

- The average start date of excavation is May 27
- This is 46 days of erosion until July 12
- Equaling about $220 \text{ g m}^{-2} \text{ yr}^{-1}$ of soil brought to the surface by crayfish
- Or $2200 \text{ kg ha}^{-1} \text{ yr}^{-1}$

Amount of Soil Moved by Other Prairie Animals

- Rodents excavate from 44,927 kg ha⁻¹ to 89,854 kg ha⁻¹ yr⁻¹
- A single ant species may excavate around 1000 kg ha⁻¹ yr⁻¹
- Earthworms also move a significant amount of material.
- Estimated that these three groups of animals turn over the top 0.6m of the prairie every 100 years.

Uniqueness of Crayfish Excavations

- Both ants and earthworms incorporate plant material into their excavations, giving excavations a low C:N ratio.
- Crayfish excavations come from deeper in the soil profile than excavations of other excavators.
- Crayfish mounds would be expected to have a different chemical composition than the surrounding topsoil.

Nutrient Leaching in Soils

- Water percolates through the soil carrying with it nutrients.
- This water gets trapped in clay particles.
- Crayfish move this clay to the surface.

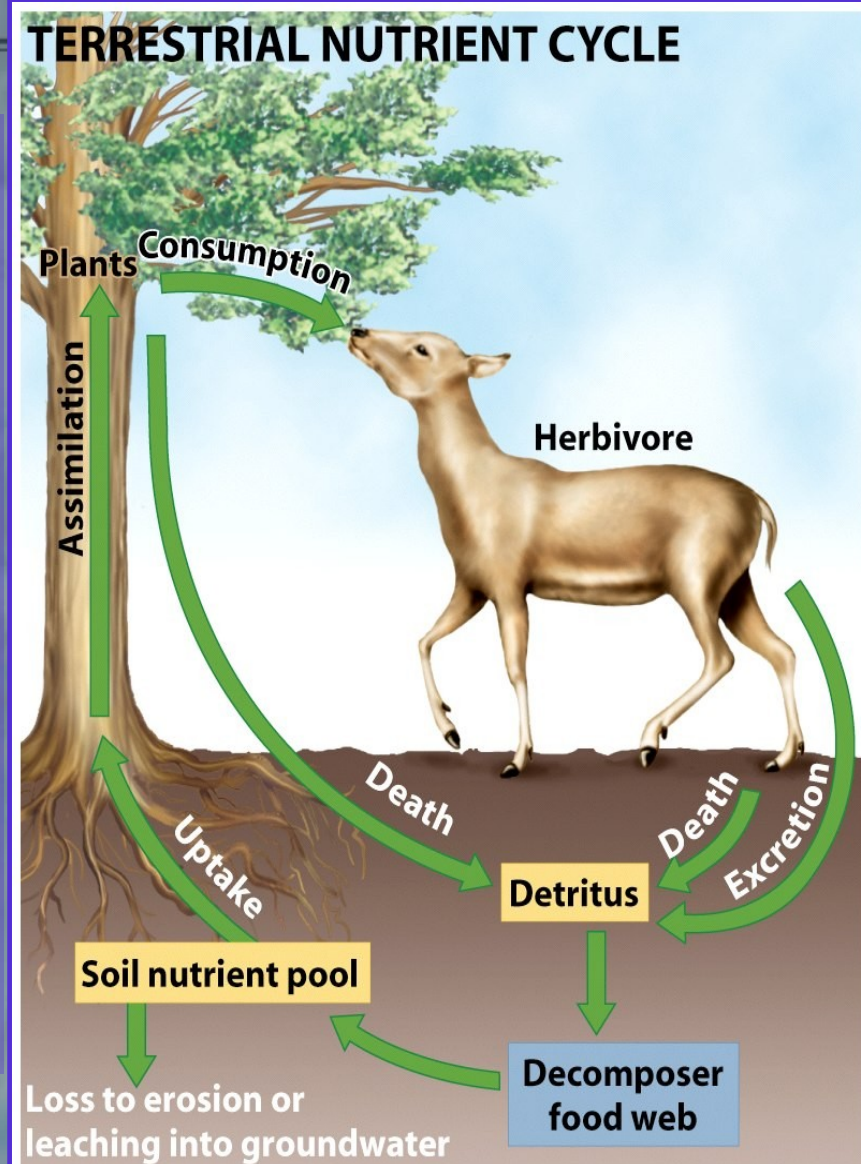


Figure 54-13 Biological Science, 2/e
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Mounds as Ecological Disturbances

- Estimated that approximately 2% of the surface per year is disturbed by crayfish mounds.
- Brewer showed significant mortality of seedlings of *Drosera capillaris* caused by crayfish mounds.
- Study showing that mounds near coast have high salinity and disrupt plant communities.

CONCLUSIONS

- Crayfish move significant amounts of material to the surface
 - $200 \text{ g m}^{-2} \text{ yr}^{-1}$ is equivalent to 0.2 mm yr^{-1} or 20 cm in 1000 years
 - Unlike the burrowing of rodents, ants and worms which churns the topsoil, crayfish bring material to the surface from deep soil layers.
- Crayfish are most active in mound building in mid June.