



# The Endangered Giant Water Bug

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# Giant Water Bug Taxonomy

**Kingdom:** *Animalia*

**Phylum:** *Arthropoda*

**Subphylum:** *Mandibulata*

**Class:** *Insecta*

**Subclass:** *Dicondylia*

**Infraclass:** *Pterygota* (winged insects)

**Order:** *Hemiptera* (true bugs)

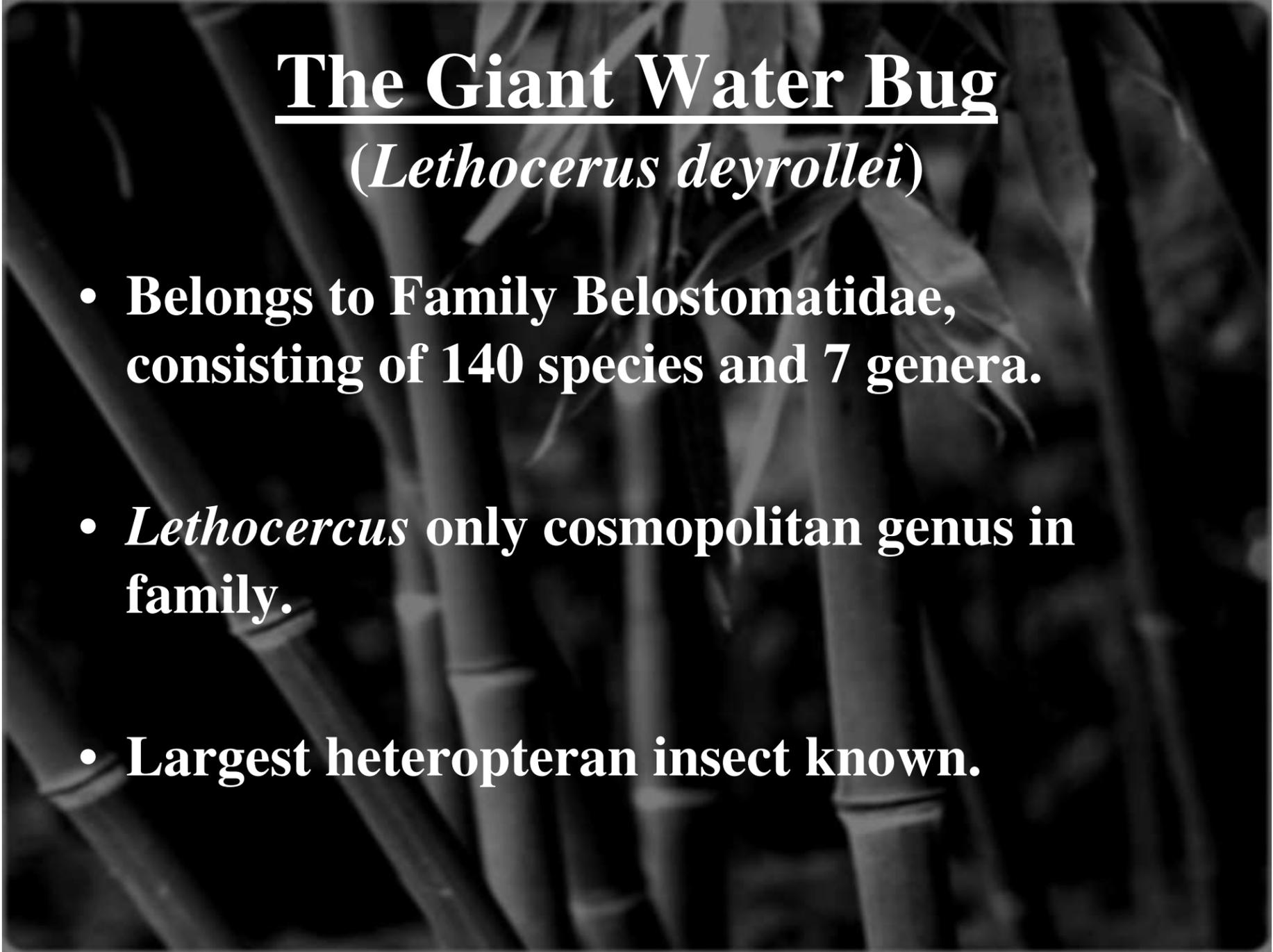
**Superfamily:** *Nepoidea*

**Family:** *Belostomatidae* (giant water bugs)

**Genus:** *Lethocerus*

**Specific name:** *deyrollei*

**Scientific name:** *Lethocerus deyrollei*



## The Giant Water Bug (*Lethocerus deyrollei*)

- **Belongs to Family Belostomatidae, consisting of 140 species and 7 genera.**
- ***Lethocercus* only cosmopolitan genus in family.**
- **Largest heteropteran insect known.**

# Giant Water Bug Interesting Facts

- Popular food in Thailand, considered a delicacy and eaten fresh, cooked and fried.
- They can be found for sale at markets.

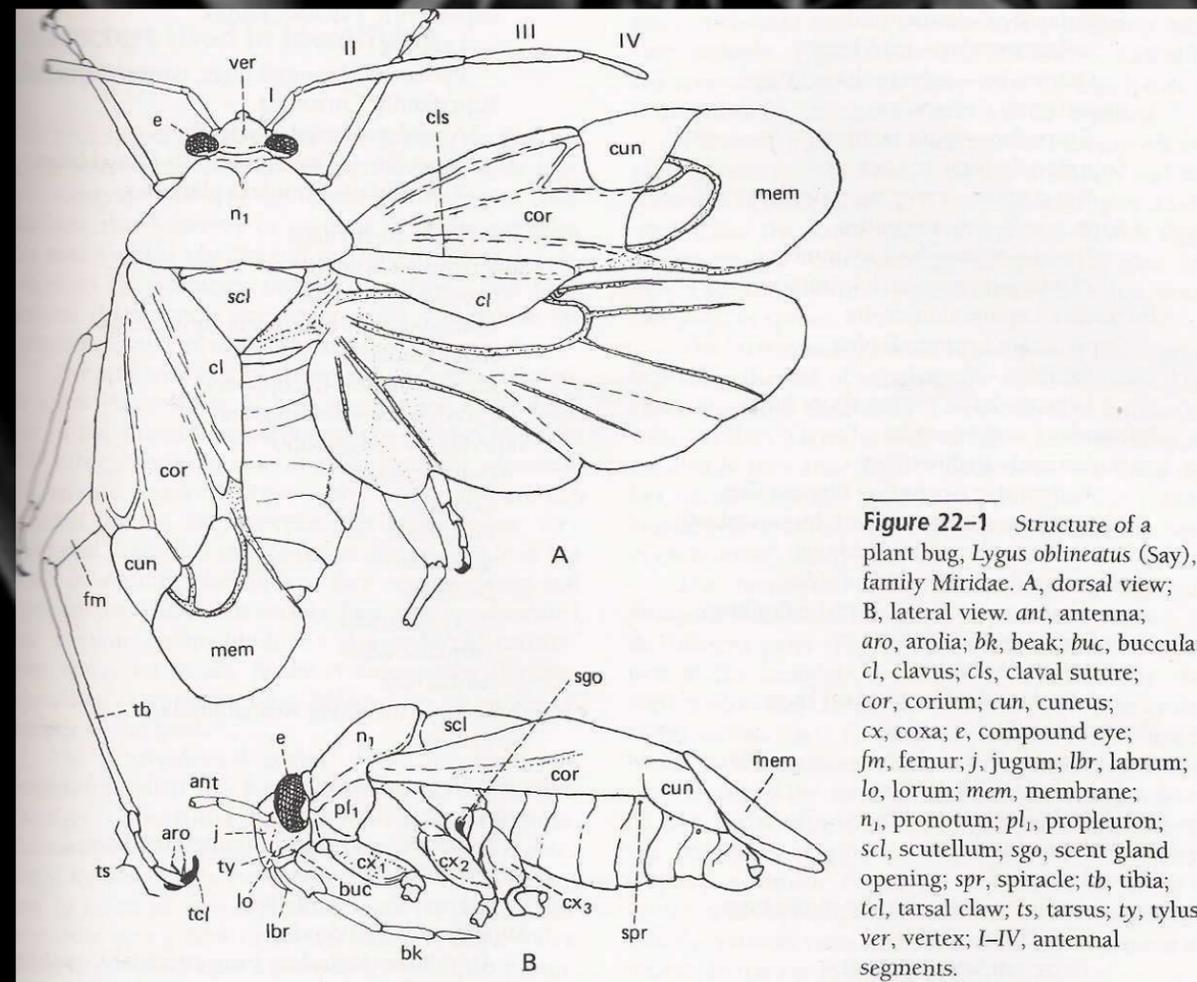


# Giant Water Bug Physiology

- Most species are large (>12cm).
- Suspend below water surface, respiring through two abdominal appendages (acts as siphons).
- Strong beak for injecting prey, directed posteriorly.
- Large raptorial legs with spines.
- Adults cannot breath under water, and periodically surface for air.



# Basic Hemipteran Anatomy



# Giant Water Bug Reproduction

- During mating season, fly from pond to pond.
- Eggs are deposited by the female above water on vegetation.



- Eggs hatch in 1-2 weeks.
- An egg batch can consist of >100 eggs
- Total development time ranges from 1-2 months.

## Giant Water Bug Courtship

- Males attract females with a series of periodic movements near the water surface.
- Prior to ovipositing the eggs, female mates with the male.
- A couple can copulate >30 times before the female oviposits all the egg batch

# Giant Water Bug Behaviour

- Nocturnal predation behaviour
  - Stalk, capture and feed
  - Holds stickle-like forelimbs widely open to grasp prey.
  - <http://www.youtube.com/watch?v=2GdAcw5teVs&NR=1>  
(attempting to catch prey – fish)
  - <http://www.youtube.com/watch?v=1KOMqrbajLQ>  
(successfully catching prey – fish)
- Known to ‘play dead’ and emit a fluid from their anus, when approached by larger predator.

# Giant Water Bug Habitat



- Occupies
  - Aquatic habitats
  - Rice fields
  - Densely vegetated ponds and rivers in Japan
  - Freshwater streams and ponds.

## Giant Water Bug Diet

- Carnivorous insect
- Primary diet: frogs and fishes
- Use powerful digestive saliva injected into prey to kill and suck out juices.
- The longer the bug is allowed to inject its saliva, the worse the resulting bite.



## Giant Water Bug Diet (cont.)

- *R. nigromaculata* (Black-Spotted Frog)
  - Adults are infrequently exploited by Giant Water Bugs due to difficulty of handle (too large).
  - True frog species, distributed:
    - East Asia
    - Eastern and Northeastern China
    - Amur River valley in Russia
    - Korean Peninsula
    - Most of Japan (excl. Hokkaido)



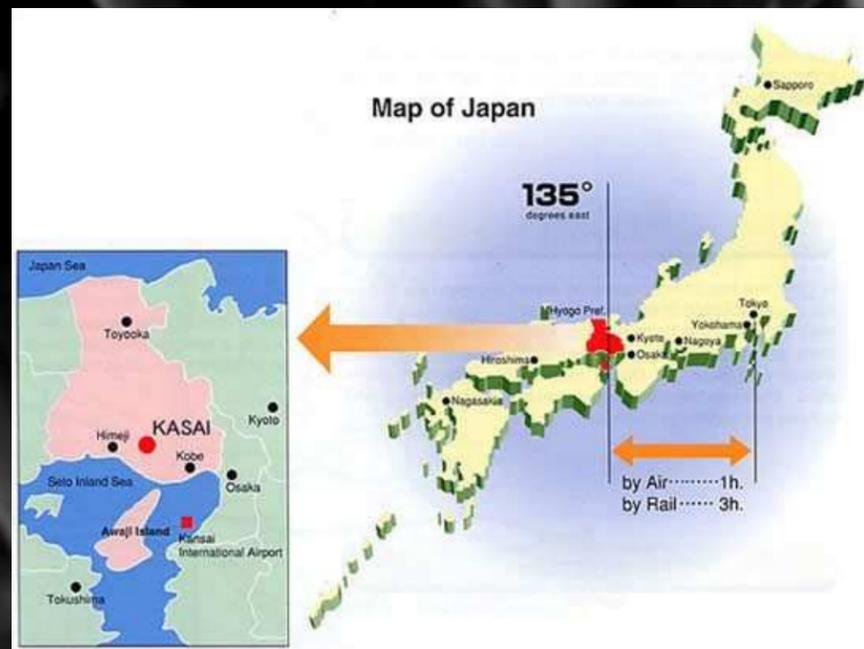
## Giant Water Bug Diet (cont.)

- *H.japonica* (Japanese Tree Frog)
  - Breeding adults are major choice for Giant Water Bug food source.
  - This species is distributed:
    - from Hokkaido to Yakushima in Japan
    - from Korea along the Ussuri River to Northeastern China

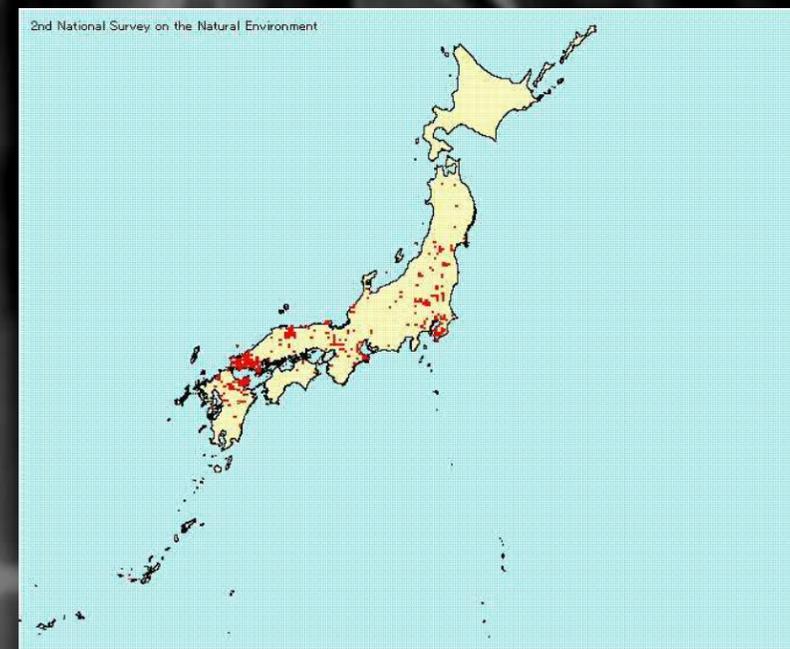


# Giant Water Bug Distribution

- Distributed in tropical and temperate regions (excluding Northern Palaearctic region).



Sayo, Hyogo Prefecture Study Site



Japan Distribution

# Giant Water Bug Endangerment Status

- Local decline in central Japan.
- Possible contributions to decline:
  - Loss of appropriate aquatic habitats
  - Pesticide dispersal
  - Water pollution within habitats
  - Decrease in number of prey (fishes and frogs).



# Giant Water Bug Endangerment Status (cont.)

- Listed “vulnerable” on Red Data Book of Japan.
  - IUCN and Red Data Book threatened scale:



- Extinct
- Extinct in Wild
- Critically Endangered
- Endangered
- **Vulnerable**
- Lower Risk
- Near Threatened
- Data Deficient
- Least Concern

## Endangerment Status of Giant Water Bug Prey

- *R.nigromaculata* (Black-Spotted Frog)
  - Listed “Near-Threatened to Vulnerable” from the 2007 IUCN Red List
  - Increasingly threatened by hunting and water pollution.
- *H.japonica* (Japanese Tree Frog)
  - Listed “Least Concern” from the 2007 IUCN Red List



**Anuran-dependent predation by  
the giant water bug, *Lethocerus deyrollei*  
(Hemiptera: Belostomatidae),  
in rice fields of Japan**

## Study Objectives



- Study *L. deyrollei* dietary patterns with reference to rice-field anuran fauna.
- Increase *L. deyrollei* species in rice fields.
- Maintain *L. deyrollei* primary food sources.

## Hypothesis

- A decrease in prey animals, such as newly metamorphosed juvenile *Rana nigromaculata* (black-spotted frog) and breeding adult *Hyla japonica* (Japanese tree frog) results in the widespread disappearance of *L. deyrollei*.



## Study Justification



- The Giant Water Bug underwent shift in major food source.
  - From Japanese Tree Frog (in spring) to Black-Spotted Frog (in summer).
- The Giant Water Bug deemed ‘vulnerable’ according to the Red List in Japan, and needs exploration into conservation and maintenance.
- Insufficient published works on the ecology of the Giant Water Bug.

# Study Methodology

- Field work in rice field of Sayo, Hyogo Prefecture in central Japan.



- Duration: 27 April – 2 October 2000
- Examined diet of giant water bug (*L.deyrollei*):
  - *Rana nigromaculata* (Black-spotted Frog)
  - *Hyla japonica* (Japanese Tree Frog)
  - *Rhacophorus schlegelii*
  - *Rana limnocharis* (cricket frog)

# The Rice Fields

- Located on hillsides of Soya, Hyogo Prefecture
- Reformed into well-drained consolidated fields
- Irrigated in early May, 'ponded up' until end of June
- Water drained again in early July
- Fields remained unflooded till ground-surface hardened to enable combine harvester
- Irrigated again until late August



# Data Collection

- Giant Water Bug
  - Appeared after irrigation in early May
  - Reproduced till August
  - Adults emerged July – September
  - Each measured for body length and painted for identification
  - When found feeding, prey identified according to taxonomic level and age class (juvenile or adult)



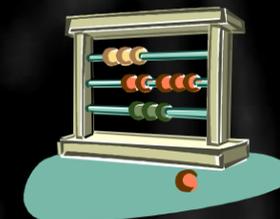
## Data Collection (cont.)

- Frogs
  - Encountered frogs were captured for lab analysis from study site and recorded:
    - Species
    - Age class (juvenile or adult)
    - Snout length (SVL)
  - All were returned when measurements completed.



# Experimental Measures

- Food Availability (for Giant Water Bug) determined by:
  - The # of individual frogs captured in 1 hour period (between 2000hrs – 2100hrs) in a 1ha area where Giant Water Bugs were abundant.
- Seasonal fluctuations in anuran availability determined by:
  - Weekly census taken from 27 April – 2 October 2000
- Data were separated into 2 different seasons:
  - May and June (spring)
  - July and September (summer)



# Results



Japanese Tree Frog – *Hyla japonica*



*Rhacophorus schlegelii*



Black-Spotted frog – *Rana nigromaculata*



Cricket Frog – *Rana limnocharis*

## Diet Composition Observed

- 4 species of anurans were exploited
  - *Hyla japonica* (adult and juvenile)
  - *Rhacophorus schlegelii* (adult)
  - *Rana nigromaculatai* (adult and juvenile)
  - *Rana limnocharis* (juvenile)



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- A black and white photograph of bamboo stalks and leaves, serving as a background for the text. The stalks are vertical and segmented, with some leaves visible at the top.
- The major prey items of *L. deyrollei* varied dramatically from spring to summer
  - 4th instar nymphs and 5th instar nymphs
    - fed predominantly on juvenile *R. nigromaculata*

# Food Availability of Anurans

- Frogs captured in rice fields
  - 11 May after irrigation
  - 25 September after harvest



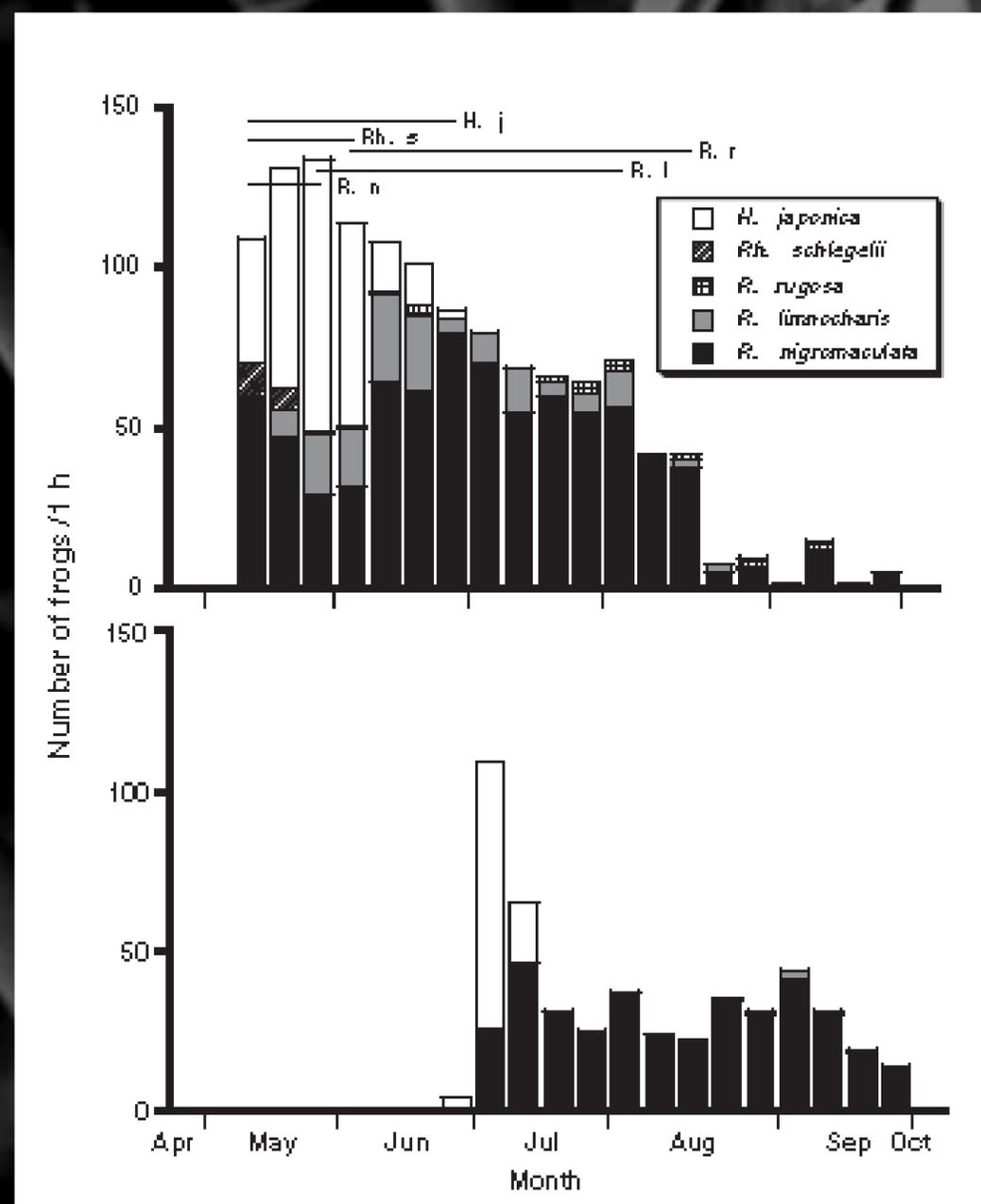
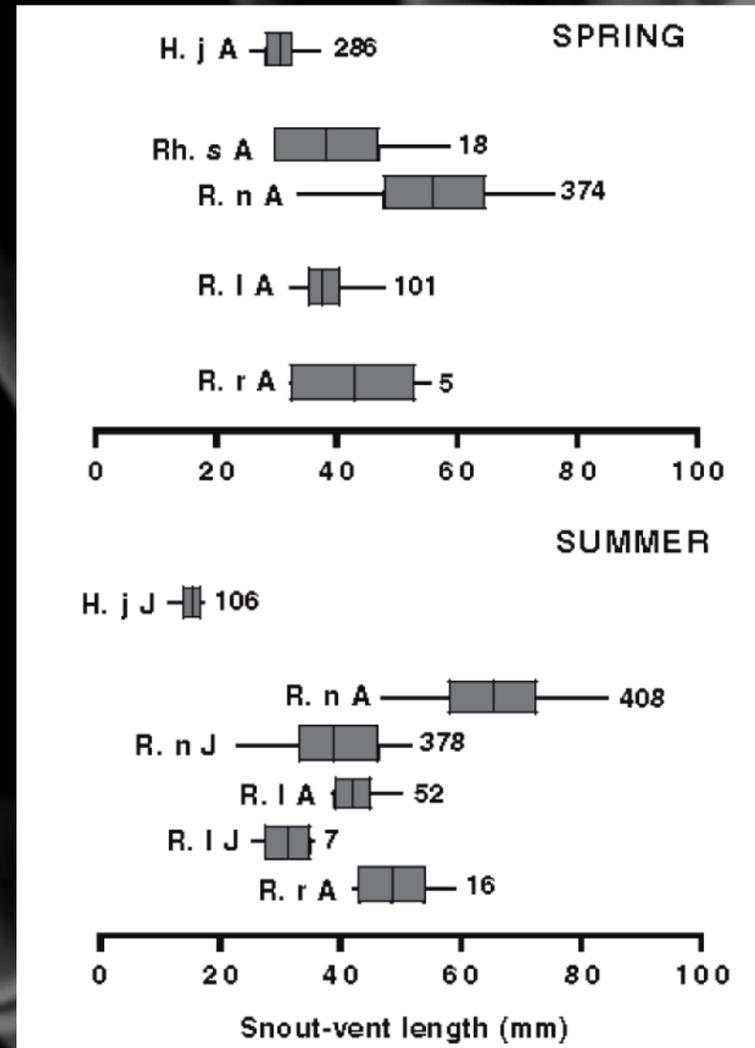


Figure 1

Anuran fauna changed dramatically in early July because post-breeding migration and metamorphosed juvenile recruitment

Juvenile recruitment took place for a short period around early July, and the majority of larval *H. japonica* and *R. nigromaculata* metamorphosed together at this time

Adult *R. nigromaculata* were consistently abundant in the rice fields but were less frequently exploited by *L. deyrollei*



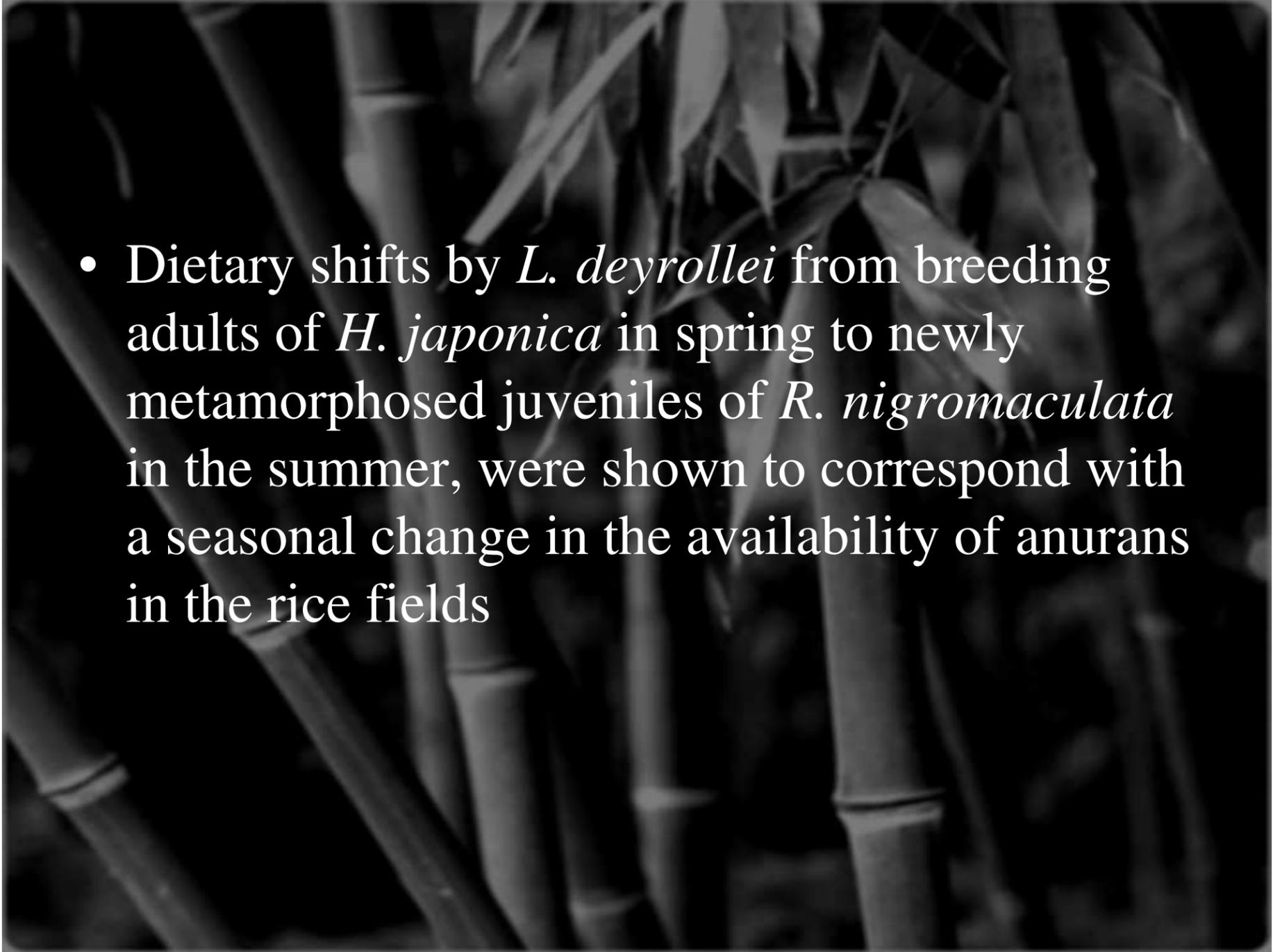
SVL measurements  
*R. nigromaculata*  
 overall are larger than *H.*  
*japonica*

Figure 2

## Discussion

- This study revealed that *L. deyrollei* fed predominantly on anurans inhabiting the rice fields
- Unknown how much they depend on anurans
- Giant Water Bugs in Japanese rice fields fed on anurans much more frequently than any other species previously studied

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- Frogs are first choice for food as it is a bigger meal and less energy spent hunting and catching smaller invertebrates
    - Frogs are the more satisfactory meal

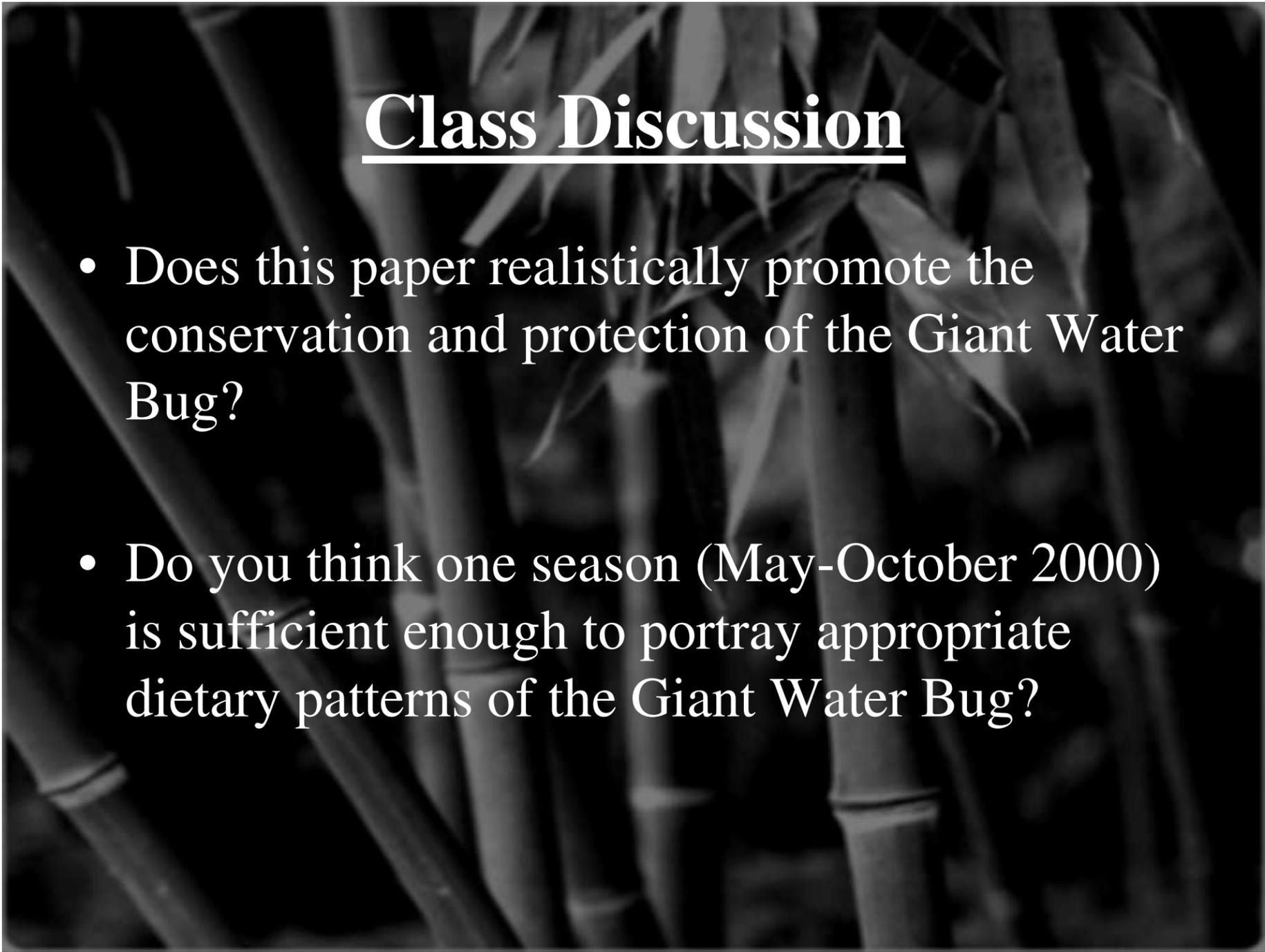
- 
- Dietary shifts by *L. deyrollei* from breeding adults of *H. japonica* in spring to newly metamorphosed juveniles of *R. nigromaculata* in the summer, were shown to correspond with a seasonal change in the availability of anurans in the rice fields

## Final Conclusions

- Anuran dependent predation:
  - Decline in anurans → decline in Giant Water Bugs
- The decline of these predators suggest that conservation of frog populations is substantially important for maintaining biodiversity within the rice field ecosystem

A black and white photograph of bamboo stalks and leaves, serving as a background for the text. The bamboo stalks are vertical and segmented, with some leaves visible at the top. The lighting is dramatic, highlighting the texture of the bamboo.

# Class Discussion

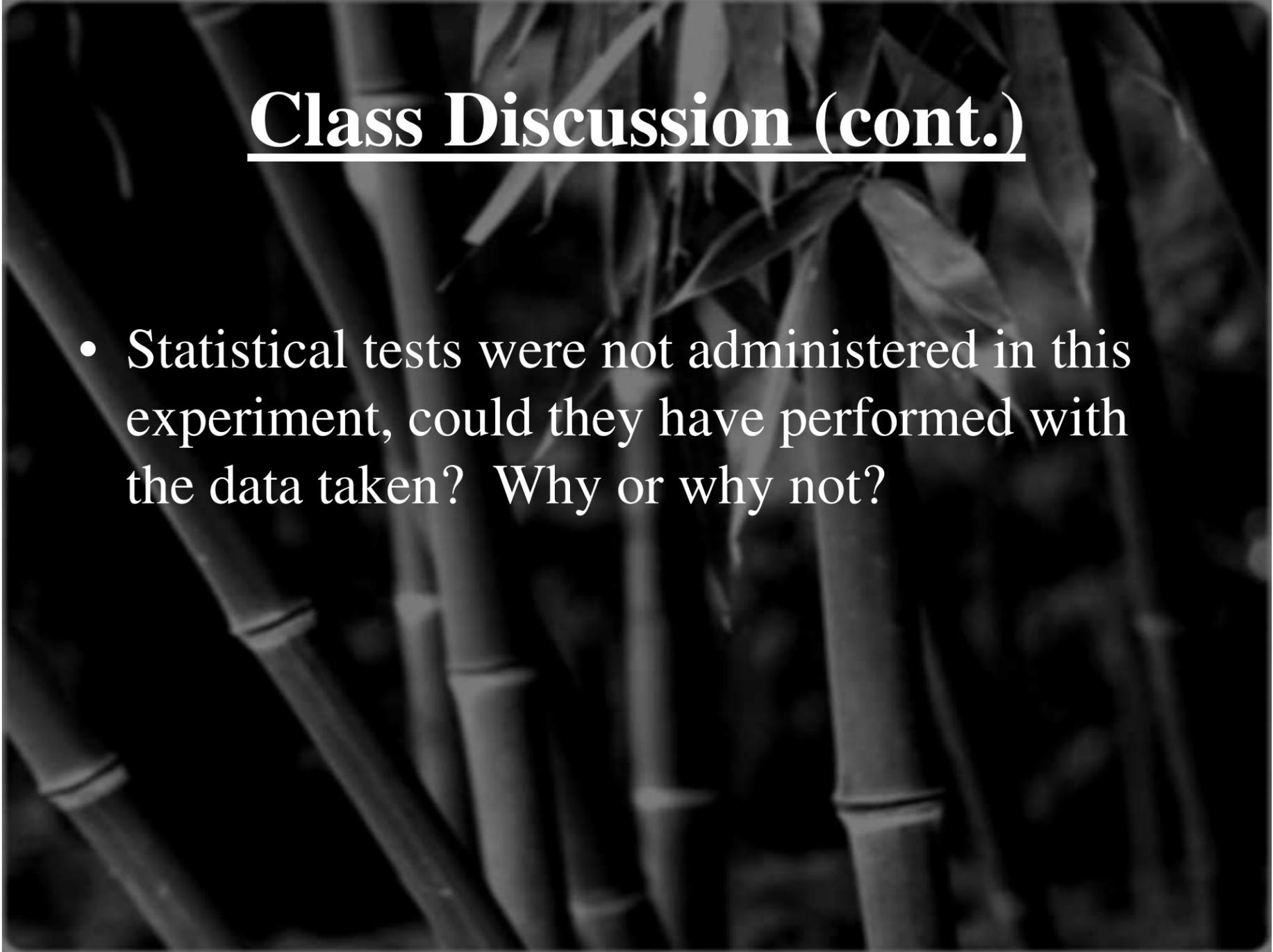


## Class Discussion

- Does this paper realistically promote the conservation and protection of the Giant Water Bug?
- Do you think one season (May-October 2000) is sufficient enough to portray appropriate dietary patterns of the Giant Water Bug?

## Class Discussion (cont.)

- How justifiable is the statement “anuran-dependent predation,” when the Giant Water Bug is non-specifically choosing its food source?
- What physiological characteristics of the Giant Water Bug would constitute the dietary shift pattern between food sources?

A black and white photograph of bamboo stalks and leaves, serving as a background for the text. The stalks are vertical and segmented, with some leaves visible at the top.

## Class Discussion (cont.)

- Statistical tests were not administered in this experiment, could they have performed with the data taken? Why or why not?



- <http://www.youtube.com/watch?v=2GdAcw5teVs&NR=1>  
(attempting to catch prey – fish)
- <http://www.youtube.com/watch?v=lKOMqrbajLQ>  
(successfully catching prey – fish)

