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.

- *Lethocerus* 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

Figure 22-1. Structure of a plant bug, Lygaeus oblitatus (Say), family Miridae. A, dorsal view; B, lateral view: ant, antenna; ano, anole; bk, beak; tbc, buccula; cl, clavus; clv, claval suture; cor, corium; cun, cuneus; ex, coxa; e, compound eye; fmr, femur; j, jugum; lb, labium; la, larva; mem, membrane; n, pronotum; pl., pleuroton; scl, scutellum; sgo, scent gland opening; spr, spiracle; tb, tibia; tcp, dorsal claw; t, tarsus; ty, tylus; vri, verex; I-IV, abdominal segments.
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.
  – [Link](http://www.youtube.com/watch?v=2GdAcw5teVs&NR=1) (attempting to catch prey – fish)
  – [Link](http://www.youtube.com/watch?v=lKOMqrbajLQ) (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*

Black-Spotted frog – *Rana nigromaculata*

Cricket Frog – *Rana limnocharis*

*Rhacophorus schlegelii*
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)
• 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
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*.

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