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- **出版社** – 55
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- **論文** – 27,863
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*The Coleopterists Bulletin:* **Vol. 58, No. 1, pp. 37–43.**

## New Open Aquarium System to Breed Larvae of Water Beetles (Coleoptera: Dytiscidae)

**Toshio Inoda,[a] and Shinji Kamimura[a]**

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ABSTRACT

For conservation purposes and to supply rare insects for laboratory use, a system for artificial breeding is crucial. However, in the case of carnivorous freshwater insects such as diving beetles, constant conditions in aquariums are difficult to maintain due to their high rate of food consumption. Furthermore, surface rippling caused by the pumping system for water circulation hinders the respiration of small larvae. We developed a new open aquarium system without water circulation that was successfully applied to the rearing of larvae of diving beetles, *Dytiscus sharpi* (Wehncke) (Coleoptera: Dytiscidae). In comparison to conventional methods, a high proportion of larvae developed into adult insects. The size of reared adults was almost the same as those of field-collected adults. The new method could be applied to the conservation and breeding of other rare species, such as water beetles and water bugs.

Manuscript Received by the Society 2 May 2002
Manuscript Accepted 30 April 2003
Publication date 2 April 2004

The carnivorous larvae of *Dytiscus* species prey on other animals, *e.g.*, insect larvae, amphibian larvae, isopods, or fish fry (Blunck 1923 ; Balduf 1935 ; Wesenberg-Lund 1943 ; Jeffries 1988 ; Johansson and Nilsson 1992 ). They first inject digestive enzymes through the mandibles into the body of the prey then

## Adult Insects

Wild diving beetles (*Dytiscus sharpi*, Fig. 1D) were collected (n = 27) at Boso Peninsula in Chiba, Japan, and were mated under the A般 s.

They were kept outdoors in plastic tanks (74 × 39 × 40 $cm^3$) with 10 cm water depth. They were fed small pieces of dried sardines once a week. De-chlorinated water was automatically supplied every 6h by overflowing the tanks. Japanese parsley (*Oenanthe javanica* (Blume)) was placed in the tanks to provide resting and oviposition substrates. Usually, mating behavior started in November and eggs were found in March after wintering (Inoda 2003 ).

## Juveniles

Thirty newly hatched first instars (Fig. 1A) were collected and kept isolated in each tank of a new open aquarium system (details below). To obtain second instars for the experiments, the remaining first instars were isolated in plastic containers (diameter 4 cm × height 7 cm, 5 cm water depth). They were fed *Asellus hilgendorfi* (Bovalius) (isopods) and/or tadpoles of *Rana ornativentris* (Werner). Fresh de-chlorinated tap water was supplied after feeding. Following development to second instars (Fig. 1B), they were transferred into the tanks of the open aquarium system (n = 94). Some were kept in the same tank partitioned by a 3mm mesh plastic net (Fig. 3). One hundred-150 tadpoles of *R. ornativentris* were supplied to each tank every 7–10 days.

Third instar larvae (Fig. 1C) required no food prior to pupation and were transferred into plastic containers (11 × 8 × 7 $cm^3$) filled with moist soil and kept indoors at 10° to 24°C until emergence. All other stages were kept outdoors (8°–21°C).

## Aquarium System

The open aquarium system used in the present study consisted of three compartments; a water reservoir, a filtering unit and a tank for breeding. A schematic drawing and photographs of the system are shown in Figure 2.

Between the water reservoir (100 liter) and the filtering unit, a submersible pump (EHEIM 1046, 300 liter/h) was placed and run for 20 min every 6h. While the pump was working, the water level in the reservoir tank was kept constant by supplying fresh tap water through a shut-off valve connected to a float. The filtering unit consisted of connected columns of a pre-filter for crude filtering (5µm, Organo, Tokyo) and a carbon filter for de-chlorination (Organo, Tokyo). Our preliminary observation indicated that any residual chlorine caused irreversible damage both to larvae of *D. sharpi* and tadpoles of *R. ornativentris*.

Through a silicon tube (inner diameter 4 mm), de-chlorinated water was then gently introduced into the breeding tanks (30 × 20 × 10 $cm^3$, 7 cm water depth) that were placed in stacks as shown in Figure 2. Water overflowing from the upper tanks supplied the lower ones. Each tank was equipped with outlet tubes of vinyl chloride (inner diameter 13 mm) and rubber gaskets (inner diameter 17.8 mm). When we kept two or three larvae in the same tank, plastic nets were used for partitioning in order to prevent cannibalism (Fig. 3).

## Measurement of Body Size

To investigate whether the present experimental conditions were appropriate for breeding, we compared the sizes of reared adults with those of wild ones. Dorsal aspects of adult insects were photographed with a digital camera (CoolPix 990, Nikon, Tokyo) and the length of body, elytra, pronotum, and maximal body width were determined. Adult insects were also weighted. A non-paired *t*-test was used to test the statistical significance of differences between mean values. P-values less than 0.05 were considered to be statistically significant on both sides.

*sharpi*, which has so far been obscure.


## Acknowledgments

We thank H. Katakura (Department of Life Sciences, University of Hokkaido) and M. Ohara (Systematic Entomology, Hokkaido University Museum) for the critical reading of the manuscript.


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Results of: Search in every Kingdom for all exactly for 'Oenanthe javanica'

***Oenanthe javanica*** **(Blume) DC.**
Taxonomic Serial No.: 506796

## Taxonomy and Nomenclature

| | |
|---|---|
| Kingdom: | Plantae |
| Taxonomic Rank: | Species |
| Synonym(s): | |
| Common Name(s): | Java waterdropwort |

**Taxonomic Status:**

| | |
|---|---|
| Current Standing: | accepted |

**Data Quality Indicators:**

| | |
|---|---|
| Record Credibility Rating: | verified - standards met |

## Taxonomic Hierarchy

| | |
|---|---|
| Kingdom | Plantae -- Planta, plantes, plants, Vegetal |
| Subkingdom | Tracheobionta -- vascular plants |
| Division | Magnoliophyta -- angiospermes, angiosperms, flowering plants, phanérogames, plantes à fleurs, plantes à fruits |
| Class | Magnoliopsida -- dicots, dicotylédones, dicotyledons |
| Subclass | Rosidae |
| Order | Apiales |
| Family | Apiaceae |
| Genus | Oenanthe L. -- waterdropwort |
| Species | Oenanthe javanica (Blume) DC. -- Java waterdropwort |

**Direct Children:**

| | |
|---|---|
| Subspecies | Oenanthe javanica ssp. javanica (Blume) DC. -- Java waterdropwort |
| Subspecies | Oenanthe javanica ssp. stolonifera (Wallich ex DC.) Murata -- stolon waterdropwort |

## References

**Expert(s):**

| | |
|---|---|
| Expert: | Mark W. Skinner |

## Tables Return to TOC

**Table 1.** Comparison of body size between reared and wild adult insects

| Sex | | Body length (mm) | Elytral length (mm) | Pronotum length (mm) | Body width (mm) | Weight (g) |
|---|---|---|---|---|---|---|
| Male | Wild (n = 13) | 31 ± 1.7 | 24 ± 1.2 | 5.2 ± 0.4 | 16 ± 0.8 | 1.8 ± 0.2 |
| | Bred (n = 38) | 31 ± 1.2 | 23 ± 1.2 | 5.1 ± 0.4 | 16 ± 0.7 | 1.9 ± 0.3 |
| Female | Wild (n = 14) | 30 ± 1.9 | 22 ± 0.9 | 4.6 ± 0.6 | 15 ± 0.5 | 1.6 ± 0.1 |
| | Bred (n = 29) | 30 ± 1.5 | 22 ± 1.0 | 4.8 ± 0.5 | 15 ± 0.9 | 1.7 ± 0.2 |

Mean values ± SD.

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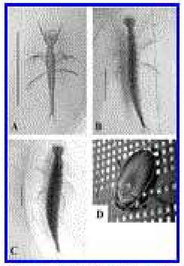

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**Fig. 1.** Photographs showing each stage of larvae of *D. sharpi* kept in the open aquarium system. **A)** First instar larva 5 days after hatching; **B)** second instar larva 10 days after hatching; **C)** third instar larva 32 days after hatching. **D)** a reared adult. Bars indicate 10 mm.

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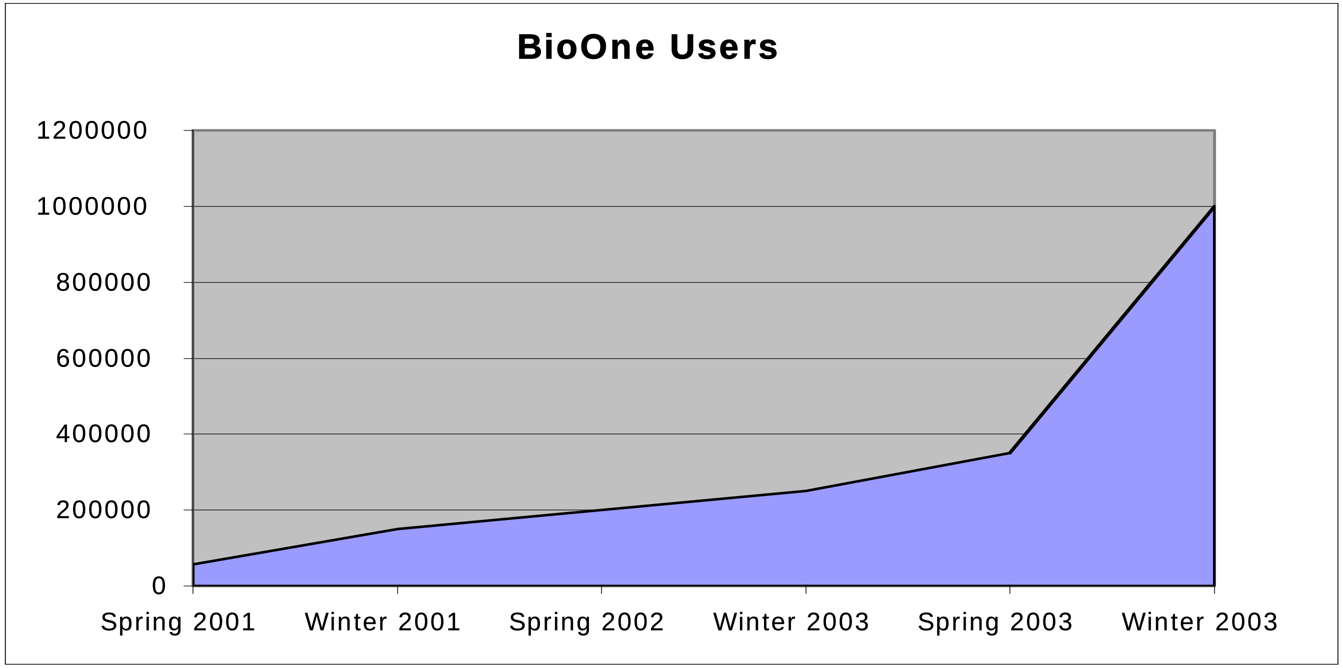

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