## Killer Shrimp - Dikerogammarus villosus

An amphipod native to the Ponto-Caspian region, *Dikerogammarus villosus* has recently invaded and spread throughout western Europe. Its populations have caused in significant ecological disruption, including reduced biodiversity and local species extinction. Although not yet known from North America, there is major concern about the potential environmental impact of this amphipod should it be introduced.

#### **Taxonomy**

Phylum - Arthropoda
Class - Crustacea
Order - Amphipoda
Family - Gammaridae

#### **General Biology**

#### Morphology

- Bodies are laterally compressed (e.g., flattened from side to side), curled, and semi-transparent (Fig. 1)
- Body length of up to 30 mm, which is relatively large for a freshwater amphipod
- Body consists of head, thorax, and abdomen (Fig. 1)
- Prominent features on head are two pairs of antennae, one pair of eyes, and mouthparts (Fig. 1)
- Mandibles (a type of mouthpart) of *D. villosus* are relatively large and powerful, thus giving it a very effective mechanism for predation
- Thorax consists of seven segments (Fig. 1)
  - Each thoracic segment contains a pair of walking legs
  - First two pairs of walking legs are modified to assist with grasping of food
  - First four pairs of walking legs extend downwards and forwards
  - Last three pairs of walking legs extend downwards and backwards
  - Females have extra branches located on the walking legs which create a space used to shelter and incubate eggs
- Abdomen consists of six segments (Fig. 1)
  - Abdominal section is divided into two parts, each containing three segments
  - First set of abdominal segments contains three pairs of brush-like limbs called pleopods
  - Second set of abdominal segments contain three pairs of shorter and immobile, rod-like limbs called uropods

#### **Behavior**

- Kills its prey by biting and shredding them
- Much more deadly predator than native amphipods (partially due to its much larger and more powerful mouthparts)
- Attacks and eliminates other gammarid species
- Colonizes a wide variety of substrates, is capable of adapting to a wide range of habitats, and is able to survive fluctuations in temperature, salinity, and oxygen levels

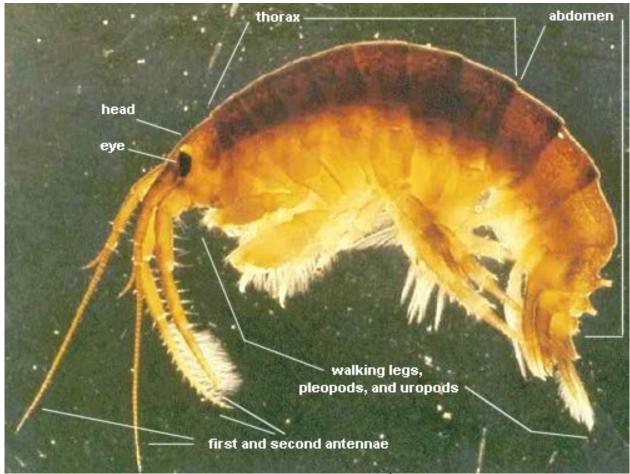


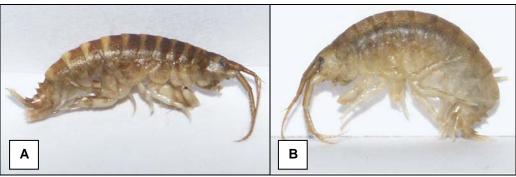
Fig. 1 Dikerogammarus villosus.1

## **Identification**

**Distinguishing Characteristics** 

- Total body length of up to 30 mm (relatively large for a freshwater amphipod)
- May appear striped or uniform in coloration pattern (Fig. 2)
- Mandibles are relatively large
- Behavior is particularly vicious and destructive, killing and maiming unselectively

<sup>&</sup>lt;sup>1</sup> http://wabau.kww.bauing.tu-darmstadt.de/forschu/projekte/Elbe/Faunistische\_Highlights.html



**Fig. 2** Polymorphic coloration pattern of *D. villosus*: striped (A) and uniform (B) exoskeleton patterns<sup>2</sup>.

## **Life Cycle**

Juveniles • Newly released young resembling adults, but microscopic in size

As with other arthropods, develop an exoskeleton, molting several times as

they increase in size

Adults • Sexual maturity reached at 6 mm in length

Populations are predominantly female

• Exceptionally high growth rates (e.g., 1.3–2.9 mm per month during the

winter and 2.0–2.6 mm over a two week period in spring)

**Reproduction** • Reproduce sexually, high fecundity

Reproduction occurs year round

During mating, male carries smaller female on his back (i.e., amplexus)

• Female can carry approximately 50 fertilized eggs and releases them into the ventral brood chamber, where they are incubated and develop

## **Habitat Characteristics**

Preferred Environment • Fresh and brackish waters

Lakes, rivers, and canals

Able to colonize all types of fastened banks, sheet-pile walls, and

especially mats of algae near or on the water surface

• Following invasion of the River Rhine, *D. villosus* became the dominant species on stone substrates where it out-competed other species including *Gammarus tigrinus* (a strongly competitive species native to

North American waters)

**Temperature** • Eurythermic (i.e., tolerant to wide range of temperature changes)

Optimal metabolic temperatures are between 20-23°C

Upper thermal limits between 30-35°C

Oxygen • Tolerant of low dissolved oxygen

Highest oxygen consumption occurred at 20°C

Salinity • Prefers fresh and brackish waters (0%-10% salinities)

Able to adapt to salinities of 20‰

Intolerant of salinities >24‰

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<sup>&</sup>lt;sup>2</sup> Simon Devin, Université de Metz, France

# **Distribution**

Native Range • Danube and its tributaries in central-eastern Europe

North American Distribution • Has never been recorded

Probable Means of Introduction • Invasion predicted via ballast tanks from European ships

#### **Diet**

Voracious predator of macroinvertebrates, including other gammarids

Dikerogammarus villosus video.mpg

Video 1 Predation of aquatic sowbug by D. villosus.3

#### **Impacts**

Negative

- Interactions between D. villosus and native gammarid species can result in displacement or local extinction of native species, thereby reducing biodiversity
- D. villosus has been observed attacking small fish, which raises concern over whether vulnerable life stages (eggs, larvae, and juveniles) of vertebrates may also be at risk
- May be an intermediate host of acanthocephalan worms (a parasite of birds and fish)

## **Management**

**Prevention Techniques** 

- Mandatory ballast control
- Shoreside treatment plants, where ship ballast water could be unloaded, treated, and safely released, are being considered, but this could be an expensive option
- Filtration systems and chemical use for ship ballast are also options being considered

## <u>Literature</u>

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<sup>&</sup>lt;sup>3</sup> Dirk Platvoet, Zoological Museum, Amsterdam, The Netherlands and Jaimie Dick, Queen's University of Belfast, Northern Ireland

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#### **Web Sites**

http://www.geocities.com/fadjar z/Jones/jones7.htm

Selective Pollination - Donald Forsha Jones (1928) Chapter 7

http://www.guardian.co.uk/uk news/story/0,3604,417246,00.html

Guardian Unlimited - Pink Peril threatens native species in Britain's rivers

http://www.glerl.noaa.gov

NOAA, Great Lakes Environmental Research Laboratory

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