



## INVERTEBRATES

Status: Common, Native Residents

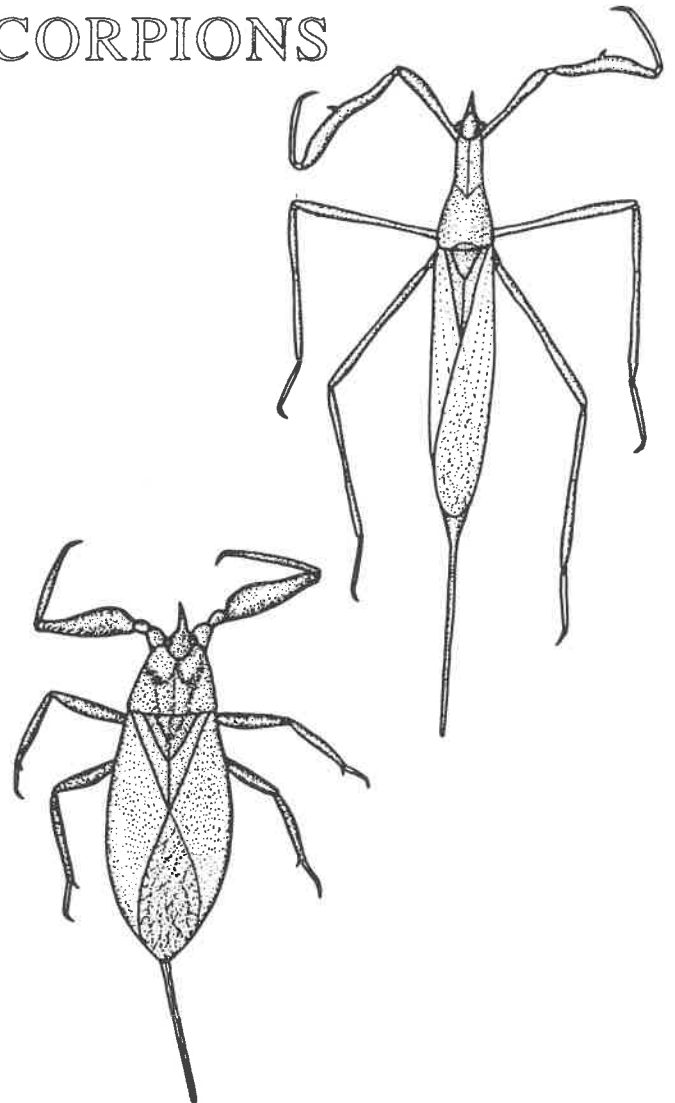
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# WATER SCORPIONS

## Description

Water scorpions are not really scorpions, but insects with only 3 pairs of legs and 2 pairs of wings. Their name comes from their specialized grasping forelimbs, superficially similar to the anterior 'pincers' of scorpions, and an elongate caudal siphon or breathing tube, which conjures up the image of the scorpion's long stinging tail. In both cases, these features are completely different from their scorpion counterparts. The forelegs of a true scorpion have a powerful pincer - similar to that of a crab or lobster - at the tip. The forelegs of the water scorpions are likewise adapted for grasping prey, but lack pincers; instead, they use a jack-knifing design with the outer segments folding into a groove to secure prey. The tail of a scorpion has 6 rounded segments with a terminal venomous spine, and can be folded forward over the animal's back. The tail siphon of the water scorpions is actually two straight filaments pressed against one another; the siphon is not jointed, can pivot only at the base, and does not sting. It is used to obtain air from the water surface, much like a snorkel.

The water scorpions belong to the insect order Hemiptera, or the true bugs. Like all hemipterans the head is a long sucking beak or *rostrum*, which conceals the mouthparts. The head of a water scorpion



**Figure 1. Adults of the two species of water scorpions found in South Dakota: *Ranatra fusca* (above) and *Nepa apiculata* (below).**

is very small and the *rostrum* projects forward. The large eyes project to the side. Within the order Hemiptera, water scorpions belong to the sub-order Heteroptera ('different wings') in which the anterior wings are stiffened to form protective wing cases and conceal the membranous posterior wings that are normally folded beneath. The wings fold at a slant across one another. The overlapping posterior regions remain membranous, with only the anterior part of the forewing being stiffened. The stiffening is brought about by tanning of the wing proteins by chemicals named quinones. Tanning of leather is essentially the same process; tanneries use quinones extracted from tree bark.

The Hemiptera are insects that grow through a series of molts but lack a distinct metamorphosis. The juvenile stages, or *nymphs*, resemble small versions of the adult.

Like all insects, water scorpions possess antennae (feelers), but they are tiny and lie concealed at the base of the eyes. Two genera may be found in South Dakota; both are widely distributed in North America. *Nepa apiculata*, the only North American species in the genus, is a dark brown, strongly flattened water scorpion closely resembling a dead leaf. Adults are fully winged, but apparently flightless. *Nymphs* are paler, are shorter bodied, and lack the long caudal siphon. Adults range from 0.6 to 0.8 inches (16-20 mm) long with a 0.3 to 0.4 inch (8-10 mm) 'tail.'

*Ranatra* spp. are long water scorpions or water stick insects. Nine species are found in North America, but they are difficult to identify. The most common species in our region is the pale buff *Ranatra fusca*. *Ranatra* spp. are longer and much more slender than *Nepa*, with a long, tapering thorax and almost cylindrical *abdomen*. The outer 'jack-knifing' portion of the forelegs is shorter than in *Nepa* (see Figure 1). *Ranatra* are pale buff in color. Adults will fly on warm days, lifting the wings to reveal a red-topped abdomen. These slender insects are fairly common and widespread in slow-flowing

waters with dense vegetation. Adults are 1.2 to 1.4 inches (30-35 mm) long with a 0.4 to 0.6 inch (10-15 mm) 'tail.'

## Distribution

Both genera occur in the state, but *Nepa apiculata* has an eastern distribution in North America and is quite scarce in the Great Plains region. *Ranatra fusca* appears to be widespread in the state, though seldom abundant. There is little information available on other species. Both genera are quite tolerant of polluted and deoxygenated waters, but are usually associated with dense vegetation. *Nymphs* occur in the summer months, but adults may be found throughout the year.

## Natural History

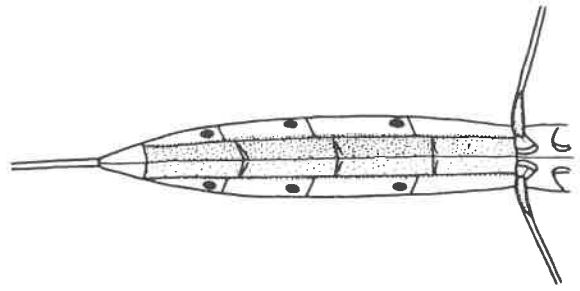
Water scorpions usually lurk motionless close to the surface, head down, clinging to twigs or pond weeds. Periodically, they back up to the water surface to replenish air. Like the majority of insects, water scorpions are air-breathers. They carry a submerged air bubble that serves as a renewable air supply. Air is trapped by tiny water-repellent hairs on the under surface of the forewings and the underlying *abdomen*. The trapped air bubble connects with the surface through a series of hairs between the two tail filaments of the breathing tube. When this breaks the surface, *diffusion* renews the oxygen content of the air bubble. When under water, the animal's oxygen supply is gradually depleted as metabolism occurs. Oxygen and nitrogen also dissolve out of the bubble into the surrounding water. If the water is deoxygenated, the rate of oxygen loss from the bubble will be high and the animal will need to surface every few minutes. But in more typical habitats, with abundant living plants close to the water's surface, very little will be lost from the air bubble to the surrounding water. In fact, as the oxygen content of the bubble is depleted by the animal, oxygen from the surrounding water will start to *diffuse into* the bubble, partly offsetting the metabolic consumption. In this way, the water scorpions are able to survive when trapped beneath ice. during the

winter. Under these conditions, the very low temperatures lower metabolism to a level where dissolved oxygen levels provide for adequate gas exchange.

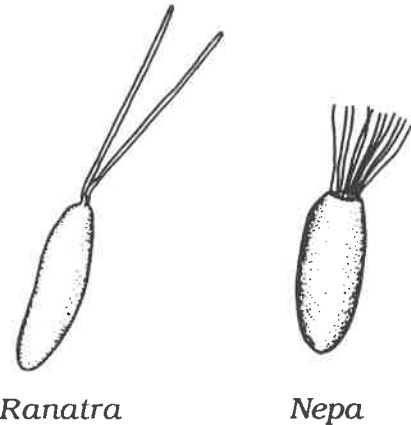
In the summer months, because of their dependence on the surface for air, water scorpions do not want to stray into deeper waters. To ensure against this, they possess three pairs of pressure sensors called false spiracles on the underside of the *abdomen*. These are visible as dark, oval discs (see Figure 2). Underneath these discs are air sacs of the insect's internal respiratory system. These are compressed as the animal ventures deeper. Nerve endings attached to the walls of the air sacs register the degree of deformation and thereby inform the water scorpion of the depth. Upward displacement of air in the sacs also informs the animal of its posture in the water.

Their slow movements and excellent camouflage make water scorpions inconspicuous to potential prey species. These include smaller insects such as the *nymphs* of mayflies, stoneflies, and water beetles, crustaceans such as freshwater shrimp and hog lice (Isopoda), and small segmented worms. Water scorpions are ambush predators and cling to plants with the second and third pairs of legs. The forelimbs are held out at the front. When prey approaches, the hindlimbs straighten, swinging the water scorpion forward, and the victim is grasped by one of the forelimbs. Firmly held in the jackknifing grip, it is then pierced by the *rostrum* and injected with digestive enzymes. Partially digested tissues are then sucked up. The *rostrum* of several water bugs, including the water boatmen and huge belostomatid bugs, can deliver an excruciating bite. However, despite allegations in many texts, water scorpions are docile and are quite safe to handle.

Water scorpions can swim for short distances but seldom do so unless disturbed. When swimming, they use alternating oar-like movements of the second and third legs to propel themselves in a somewhat jerky fashion.



**Figure 2. Ventral Abdomen of *Ranatra* With Dark False Spiracles.**



**Figure 3. Eggs of Water Scorpions Showing Respiratory Horns.**

In our area, the Nepidae produce only one brood per year; further south many species will have two broods. Both of our genera breed in the spring. Males attract females by a quiet chirping, rather in the manner of a cricket. The sound is produced by rubbing a roughened surface at the base of the forelegs against a tiny file on the front edge of the thorax, which also serves as a *resonator*. After mating, the female lays several eggs, which are attached to aquatic vegetation. The eggs possess two anterior horns, or spiracles, that serve the same function as the breathing siphon of the adults (see Figure 3). By penetrating the water surface, these provide an air supply to the egg. Frequently, the eggs are inserted into the stems of emergent plants such as cattails, with the respiratory horns projecting. If they are submerged, the eggs are able to respire by means of a thin air film that remains trapped within the intricate

lattice of the egg shell. This structure serves as a kind of permanent gill into which oxygen *diffuses* from the surrounding water and from which carbon dioxide can *diffuse* out. The advantage of this arrangement is that oxygen and carbon dioxide diffuse some 10,000 times more rapidly in air than in water, and gas exchange across the egg shell is thereby facilitated. Eggs hatch in early summer into nymphs. These pass through five molts before maturation.

## Collecting And Keeping Water Scorpions

*Nepa apiculata* can be searched for in shallow waters at pond and river edges and collected by hand or by using a small net. *Ranatra* spp. typically inhabit deeper waters and are best collected by sweeping a dip net slowly through dense vegetation near the water surface. When captured, they usually lie motionless with the limbs extended anteriorly and posteri-

only and are easily overlooked as twigs or dead leaves. They are easy animals to maintain in an indoor aquarium. Use a gravel bed and freshly collected rainwater or pond water with plenty of submerged vegetation (*Elodea*, *Callitriche*, *Myriophyllum*, *Ceratophyllum* or *Potamogeton* are ideal). Plants can be secured beneath a few large stones. Make sure that some vegetation reaches to within 0.8 inches (20 mm) of the water surface allowing the water scorpions to breathe. Small *nymphs* and crustaceans provide ideal prey items. Use a well-lit location to promote plant growth but avoid direct sunlight. A few freshwater snails are useful to prevent the accumulation of algae on the glass.

## Conservation Measures

There are no restrictions concerning the collecting and keeping of aquatic insects. For this reason, and because they are so easy to keep, they make ideal creatures for classroom study.

## Glossary

**Abdomen** - the hindmost of the three major divisions of an insect's body: head, thorax, and abdomen. The abdomen comprises twelve segments.

**Caudal** - posterior; of or pertaining to a tail.

**Diffusion** - the random movement of molecules due to their kinetic energy. It increases with increased temperature.

**Nymph** - the immature life-stage of an insect that goes through incomplete metamorphosis.

**Resonator** - something that increases or intensifies sound by sympathetic vibration.

**Rostrum** - modified mouthparts, characteristic of the insect order Hemiptera, which are used for sucking juices from plants and prey animals.

**Venomous** - poisonous.

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