Macrobrachium as shown for instance in [11] for *M. australiense*. Our preliminary experiments on the behaviour of paired male *M. rosenbergii* indicate that the same is valid for this prawn. Similar properties were ascribed to the tail lengths of the lizard *Uta stansburiana* [7] and the widowbird *Euplectes progne* [12] or the horn length of the red deer *Cervas elaphus* [9]. In all these cases the male does not give up his dominance voluntarily, though he may lose it accidentally or by committing autotomy for defensive purpose such as in the case of the aforementioned lizard. In our case of *Macrobrachium rosenbergii*, the male appears to give up its dominance "of its own volition" by moulting off its chelae once their length in relation to the body length reaches a predetermined limit. The abdicated male can regain its dominance by a highly accelerated regenration of the chelae to the appropriate length. In our study we observed individuals during the life of which this cycle of programmed autotomy followed by speeded up regrowth occurred three times.

Macrobrachium rosenbergii does not have a limited mating season, and like many other tropical species can readily mate all through the year. Thus, it may perhaps be suggested that the above-mentioned phenomenon of cyclic dominance enables a rotation in the position of the dominant male. The fact that the dominant status of the male is not permanent may allow other males of lower hierarchical status to participate in the mating effort, thereby increasing genetic variability of the populations' gene pool.

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Warm and Cold Receptors in the Nose of the Vampire Bat *Desmodus rotundus*

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The vampire bat *Desmodus rotundus* (Phyllostomatidae; Chiroptera) has been shown to be capable of detecting temperature differences. In behavioral experiments animals responded to infrared radiation as low as 5×10^{-5} W cm^{-2}. They were capable of detecting the radiation of human skin at a distance of 13 cm [1]. Blocking experiments using a surface anaesthetic had led to the suggestion that thermal receptors may be concentrated in the nose pits of the vampires [2]. Therefore, single-fiber recordings have been carried out to investigate the location of the peripheral receptors in the nose. The animals were anesthetized by intraperitoneal injection of hexobarbitone sodium (0.065 mg/g body weight) and subsequent doses during the experiment. A canula was inserted into the trachea and the animal's head was fixed in a head holder. The infraorbital nerve was exposed rostral of the foramen infraorbitale. Fine filaments of the nerve were dissected under mineral oil until neuronal activity of a single functioning fiber could be recorded on a platinum electrode. A mineral oil pool of sufficient size was provided by walling the wound with a ring of Xantopren®.

We found in total 77 specific thermal receptors, 55 of them being cold and 22 being warm receptors. Receptive fields have been established by a small thermode with a tip diameter of 0.2 mm. 74 of the receptors were situated in the central nose leaf or the rostral part of the upper lip [3]. One receptor was found on the lateral pad, one on the apical pad and one on the edge of the lateral pit. No thermal receptors could be located within the nose pits. The previous hypothesis has thus to be modified.

43 of the receptors (27 cold and 16 warm) could be tested over a temperature range from 10 to 40 °C [4]. The average static discharge frequency and the maximal dynamic response of the cold and the warm receptors is shown in Fig. 1. Cold receptors exhibit a static discharge at constant temperatures be-

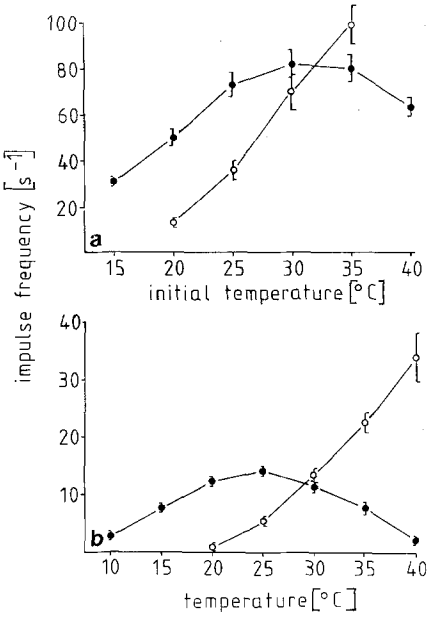

Fig. 1. Average static discharge frequency (b) and maximal dynamic response (a) of cold receptors (●, $n=27$) and warm receptors (○, $n=16$) in the nose of the vampire bat *Desmodus rotundus*. The temperature step was +5 °C in warm receptors and −5 °C in cold receptors. Vertical bars: standard error of the mean (SEM)

tween 10 and 40 °C. 20 of the 27 receptors had the maximal static activity at 25 °C (20 °C: 2; 30 °C: 4; 35 °C: 1); the frequencies at these peak temperatures ranged in the different neurons from 7.9 to 24.2 impulses/s. The maximal dynamic responses [5] were found at the temperature step from 30 to 25 °C in 14 fibres (25–20 °C: 4; 20–15 °C: 1; 35–30 °C: 7; 40–35 °C: 1), with peak frequencies between 34 and 160 imp./s.

During the dynamic response a discharge in periodic groups of impulses was apparent in 13 cold fibers; in one fiber this pattern could be recorded additionally at a constant temperature. This so-called burst discharge has been previously described for various other species including man [6] and seems to be a common feature of cold fibers.

Warm receptors exhibit a static discharge at constant temperatures between 20 and 40 °C ($n=11$) respectively 25 to 40 °C ($n=5$). Maximal static activity was recorded at 40 °C in 13 receptors (35 °C: 2; 30 °C: 1) with frequencies ranging from 19.1 to 66 imp./s. Some fibers were tested at 45 °C and showed an irregular discharge for some seconds before the discharge ceased. 11 receptors had their maximal dynamic response at the temperature step from 35 to 40 °C (30–35 °C: 4; 25–30 °C: 1), with peak frequencies between 62 and 156 imp./s.

A burst discharge was apparent in 5 warm fibers either during the dynamic response or at constant temperatures. Burst discharges and irregular activity have been observed already in warm fibers of other mammalian species [7], but were never subject of closer investigation. However, analysis of burst discharges in reptilian warm receptors indicate that temperature dependence and underlying mechanisms of this discharge pattern in both warm and cold receptors are the same [8].

The range of warm receptor activity in vampire bats seems to be shifted to lower temperatures compared to other mammals. Receptors with a static discharge below 28 °C have not been observed at all in mammals, but can be found in snakes of different families [9]. Even single cold and warm receptors respond to the radiant heat of a human finger held 2 mm apart from the surface of the central nose leaf with a dynamic decrease (resp. increase) of frequency and a significant change of static discharge. The great number of thermal receptors concentrated in the central nose leaf gives strong evidence for the suggestion that this area of the face is responsible for the thermoperceptive performance of the vampire bats.

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2-Methyl-3-butene-2-ol, a Major Component of the Alarm Pheromone of the Hornet *Vespa crabro*

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Vespine wasps of the genera *Vespula*, *Dolichovespula* and *Provespa*, [1–3] produce alarm substances in their venom glands. During an investigation of the defense behavior of the European hornet, *Vespa crabro*, we developed a bioassay which led to the identification of a major volatile venom sac compound releasing alarm behavior.

A colony was kept in the laboratory and allowed to forage outside. A honey container was placed 5 cm in front of the colony entrance, thus enabling constant observation of a certain number of workers. Small strips of filter paper which were deposited near the entrance and impregnated with venom sprayed from workers or from squashed venom sacs, provoked typical alarm behavior among the hornets, consisting of wing buzzing, approaching, running out of the nest, biting the filter paper and taking off. The defense flight was performed around the nest entrance. The workers hovered in front of dark objects in the surronding area, sometimes touching them. For our bioassay we used buzzing, defense flight and running out of the nest entrance.

For the extraction of the volatile compounds, the content of the venom sacs was distilled at 20 °C under low pressure (10^{-5} mbar) into a container cooled by liquid nitrogen. This resulted in a solvent-free fraction of venom compounds. The volatile products were analyzed by GC-MS (gaschromatograph Varian 3700 equipped with a 25 m glass capillary column, SE 54, column temperature programmed from 40 °C, 10 °C/min). The gaschromatograph was coupled to a Finnigan MAT 212 mass spectrometer which was connected to a Varian MAT SS 100 data system.

In the distilled extracts from the ven-

