9

Somatosensory and electrosensory systems

Ken W. S. Ashwell and Craig D. Hardman

Summary

In both the platypus and echidna, the trigeminal somatosensory pathways are the most behaviourally important sensory system. This is strikingly so in the platypus, where the trigeminal nerve carries electrosensory information from an extensive array of sensory glands on the bill. The platypus bill is a sophisticated electrical and mechanical sensory organ for determining the direction and range of actively motile prey. Although some have argued that the rudimentary electrosensory capability of modern echidnas is due to evolutionary regression, observations of embryonic and post-hatching development of the trigeminal pathways in the modern monotremes is most consistent with each of the modern groups having evolved from an ancestor with limited trigeminal specialisation.

Postcranial somatosensory pathways in both platypus and echidna are structurally and functionally similar to those in therians. The cerebral cortex of both species is reported to include as many as four somatosensory areas (S1, M, R and PV) each with a topographic body map, but this has been questioned (Rowe *et al*. 2004). In the primary somatosensory cortex of the platypus, bimodal neurons responsive to both mechanical and electrical stimuli are believed to underlie the ability of the platypus to calculate the distance to free-swimming prey.

Overview of the monotreme somatosensory system

The 'sixth' sense of monotremes

It has long been recognised that the platypus has a remarkable ability to locate invertebrate prey while submerged. Burrell (1927) speculated on the presence of a sixth sense that the platypus used underwater while its nostrils, eyes and ears are sealed shut. This sense must be so effective as to allow the platypus to catch as much as half its body weight in live prey each night (Burrell 1927). The recognition that the sensory glands of the platypus bill showed morphological