Sperm glorious sperm! Insights from the world of marsupials

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Abstract only

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Abstract: Sexual conflict occurs in many species as males try to maximize paternity whilst females try to select males of superior quality to ensure offspring fitness. After mating, such conflict gives rise to both sperm competition and cryptic female choice. Eutherian and metatherian mammals diverged approximately 130 – 125 million years ago. While both classes of mammals are likely to have been subjected to similar post-copulatory selective forces, marsupials have responded with some unique reproductive adaptations in their ejaculates thought to further male-biased objectives in reproduction. These alternative strategies include semen barriers, efficient sperm transport and sperm co-operation. This paper examines the functional significance of these ejaculate adaptations using a number of promiscuous marsupial examples including the highly seasonal monovular tammar wallaby (Macropus eugenii) from Australia and the non-seasonal polyovular grey short-tailed opossum (Monodelphis domestica) from South America.

Semen Barriers: Semen can act physically or chemically to disable rival sperm or manipulate female reproduction. The tammar, like other macropodids, has a highly elastic copulatory plug thought to act as a physical barrier to fertilization by rival males. We tested this hypothesis by examining seasonal changes in semen quality as well as paternity success following competitive mating in this species. We found that the copulatory plug was significantly more robust during the breeding season when sperm competition is most intense ($P < 0.05$), but no significant first male paternity advantage was observed ($P = 0.112$). Thus, the function of the copulatory plug remains unclear but preliminary evidence suggests it may prevent sperm loss from the female tract in this bipedal species.

Efficient Sperm Transport and Sperm Cooperation: Ejaculation of great numbers of sperm by males is widely regarded as an adaptive strategy that confers success in sperm competition. To determine if promiscuous male marsupials also exhibit superfecundity, we conducted single-mating experiments and assessed sperm dynamics in the female reproductive tract in both the tammar and opossum. In contrast

to the promiscuous rabbit, the tammar and opossum ejaculate 20 and 250-fold less sperm respectively. However, the opossum has extremely efficient sperm transport (1 in 300 ejaculated sperm reach the site of fertilization compared to 1 in 10,000 in the rabbit). This efficiency may be due to the formation of sperm pairs (a form of sperm cooperation) in ejaculates of this and other didelphid marsupials. Indeed, further examination revealed that paired sperm migrate almost exclusively to the isthmus of the oviduct shortly after mating. This is the first in vivo evidence of an adaptive advantage conferred by sperm cooperation in any mammal.

In summary, the tammar, opossum and other marsupials provide important examples of how metatherians have evolved alternative reproductive adaptations in the face of selective pressures.