

# Making a meal of mother

SIR — All spiders provide some form of maternal care, from weaving protective silk around the eggs to guarding and feeding spiderlings<sup>1</sup>. An unusual and extreme form of care is matrophagy, where the spiderlings consume their mother. Although widely reported<sup>1-3</sup>, the significance of this behaviour has not been explored. Here we describe a novel form of maternal care that includes matrophagy in the Australian social spider *Diaea ergandros* Evans (Thomisidae).

Mothers store food in unviable trophic eggs that are never laid. The nutrients stored in these eggs appear to be converted to haemolymph which is consumed by 'nursing' spiderlings. Later, the partially depleted eggs are consumed directly when the offspring eat their mother's entire body. Mothers that store more food support longer periods of matrophagal feeding, thereby reducing sibling cannibalism.

Maternal care is more extensive among social than other spiders<sup>4-6</sup>. *D. ergandros* mothers build a large, protective nest with eucalyptus leaves, and capture large insect prey to feed their brood. The survival of spiderling *D. ergandros* depends on the mother's presence until they reach their fourth instar, after which they are capable of foraging and nest construction<sup>7,8</sup>.

We examined the ovaries of female *D. ergandros* at different reproductive stages (Fig. 1). Gravid females had elongated ovaries containing many small oocytes. Female *D. ergandros* lay only a single clutch, unlike other thomisids<sup>5</sup>, and after oviposition their ovaries become shrivelled, with no oocytes. However, mothers regain weight after oviposition and have unusual ovaries that contain significantly fewer ( $t = 4.22$ ,  $P < 0.01$ ) and larger ( $t = 20.15$ ,  $P < 0.001$ ) oocytes than those of gravid mothers. Histological examination revealed that the oocytes in the redeveloped

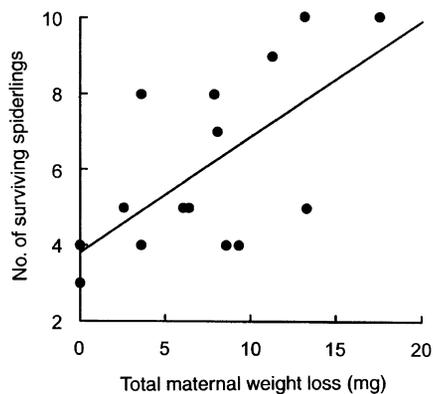


FIG. 2 The number of juveniles surviving the starvation period was positively correlated with the weight lost by mothers ( $r = 0.65$ ,  $F_{1,15} = 9.60$ ,  $P < 0.01$ ,  $n = 16$ ), but not total spiderling weight ( $r = 0.281$ ,  $F_{1,15} = 1.119$ ; not significant).

ovaries were distorted and appeared to be nonviable; yolky granules filled the cytoplasm and no nuclear material had been stained.

Spiderlings do not obtain the nutrients contained in these oocytes by simply eating them because, unlike trophic eggs<sup>9</sup>, the oocytes are larger than the oviducts and cannot be laid. Instead, the fourth-instar spiderlings acquire these nutrients when they slowly cannibalize their mother. Initially, they imbibe small quantities of haemolymph from the leg joints of the living, unresisting mother. As matrophagy continues, the mother loses mobility and her opisthosoma shrinks, presumably as the trophic eggs are transformed into haemolymph. After several weeks, she is decrepit, unable to move, and the offspring eat her entirely.

The growth and survival of mothers and spiderlings was examined for 6 weeks. The brood gained weight ( $6.5 \pm 2.8$  mg,  $n = 16$ ) during the first 3 weeks of the

starvation period, which corresponded with the weight lost by their mothers ( $8.0 \pm 1.7$  mg,  $n = 16$ ). The weight lost by the mother during the starvation period affected the duration of matrophagy and hence juvenile survival. Lighter mothers were entirely consumed earlier in the experiment than heavier mothers, and thus cannibalism among the spiderlings of these lighter, deceased mothers occurred earlier. Consequently, the number of surviving offspring at the end of the experiment was positively correlated with the weight lost by the mothers over the starvation period (Fig. 2).

Extreme forms of parental care, such as matrophagy, may be most likely among spiders that typically produce single clutches. Additionally, matrophagy may facilitate the evolution of social behaviour<sup>9</sup> by reducing cannibalism among groups of siblings<sup>10,11</sup>, as occurs in *D. ergandros*<sup>7</sup> and other social species<sup>6,11</sup>.

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## Opening up Ca<sup>2+</sup> stores with InsP<sub>3</sub>

SIR — Hirose and Iino<sup>1</sup> introduced the low-affinity Ca<sup>2+</sup>-sensitive dye Fura2 into intracellular Ca<sup>2+</sup> stores of vascular smooth-muscle cells and measured the kinetics of inositol trisphosphate (InsP<sub>3</sub>)-induced Ca<sup>2+</sup> release. This novel technique of incubating intact cells with Ca<sup>2+</sup> buffers like Fura2/AM (ref. 1) or Fura-2/AM (refs 2-5) to load them in the intracellular stores, followed by permeabilization of the plasma membrane, allows fast measurements of the luminal Ca<sup>2+</sup> concentration ([Ca<sup>2+</sup>]<sub>l</sub>) in the presence of a constant cytosolic [Ca<sup>2+</sup>]. As luminal Ca<sup>2+</sup> can control InsP<sub>3</sub>-induced Ca<sup>2+</sup> release<sup>6</sup>, we investigated in

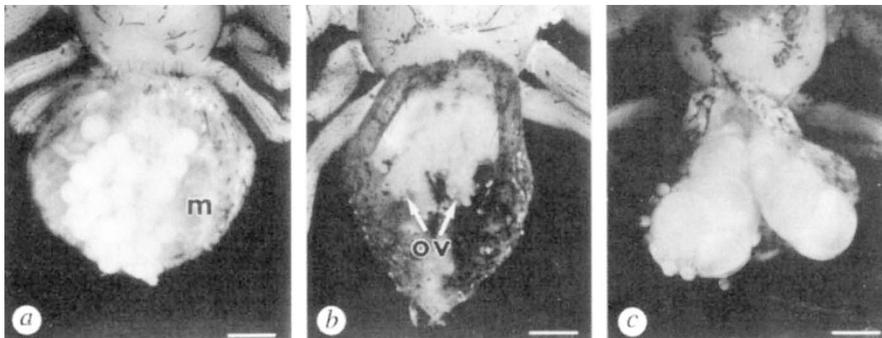


FIG. 1 a, A gravid female ( $44.54 \pm 2.05$  mg,  $n = 22$ ), with the left ovary exposed, surrounded by midgut diverticula (m). Ovaries contained  $41 \pm 6.02$  oocytes ( $n = 8$ )  $0.26 \pm 0.01$  mm in diameter. b, A female one week after oviposition ( $22.50 \pm 0.54$  mg,  $n = 22$ ) with a completely eviscerated opisthosoma; ovaries (ov) extremely small, without oocytes ( $n = 7$ ). c, A mother one month after oviposition ( $47.13 \pm 1.69$  mg,  $n = 22$ ) with enlarged, irregular ovaries. Ovaries contained  $13 \pm 1.51$  oocytes ( $n = 8$ )  $0.77 \pm 0.03$  mm in diameter. Scale bars, 1 mm.