Individual behaviour models for transmission strategies of transovarial parasites

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The amphipod *Gammarus duebeni* is host to a number of vertically transmitted microsporidian parasites. These parasites are localized in the gonad of the adult host and are transmitted from mother to offspring via the gametes/ova. During embryogenesis parasites are present in most embryonic cells. However, the mechanism by which the parasite infects/reaches the gonad of the developing host is not known. During embryogenesis, parasite burden/load is low and the parasites are unable to move between host cells. We propose that the parasite segregates to target cell lineages (precursors to the gonad) during cell mitosis [1].

At the point of host cell division, the parasites present in a cell may move into either of the two daughter cells. Previous studies [1, 2] have rejected the hypothesis that they do so randomly by comparing the distribution of parasites in cells found experimentally with expected values from a mathematical model of unbiased segregation of daughter cells. In general, the distribution of parasites show a lower number of cells with low numbers of parasites than might be expected, and typically one cells with a large number of parasites. The hypothesis that parasites have a probability above 0.5 of entering one cell lineage was also tested [1]; this was found to fit the empirical data better but in 5 out of 10 cases, the distributions were still significantly different from those predicted by the model.

The possible mechanisms for differential segregation of parasites could be passive, eg an asymmetric spatial distribution in the parent host cell

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or as a result of uneven volumetric host cell cleavage, or active, ie the parasite is able to influence its chance of being transmitted to a particular daughter cell or vary its rate of reproduction according toe the cell lineage.

Using individual behaviour models for the parasites, we are able first to reproduce the results of [1, 2] and further to examine a wide variety of parasite transmission strategies. The use of IBMs is shown to simplify the testing of different strategies. This is compared with emerging new data on parasite distributions which now allows for the identification of cell lineage during amphipod development (see for example [3]).

References

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