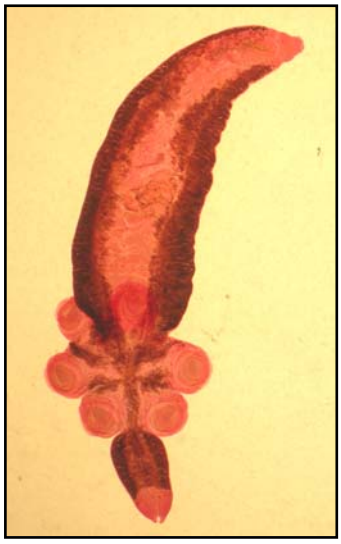
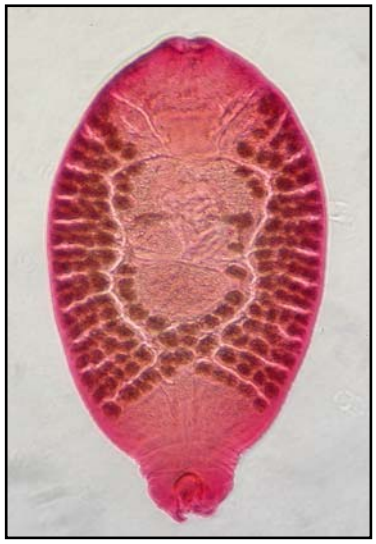
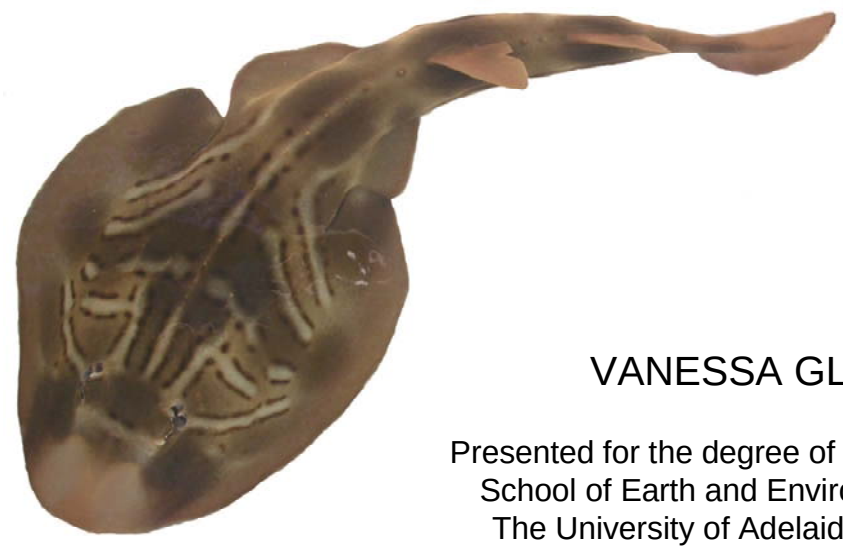
MONOGENEANS OF THE SOUTHERN FIDDLER RAY, *TRYGONORRHINA FASCIATA* (RHINOBATIDAE) IN SOUTH AUSTRALIA: AN EXCEPTIONAL MODEL TO COMPARE PARASITE LIFE HISTORY TRAITS, INVASION STRATEGIES AND HOST SPECIFICITY

VANESSA GLENNON

Presented for the degree of Doctor of Philosophy
School of Earth and Environmental Sciences
The University of Adelaide, South Australia

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Vanessa Glennon
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Title page images. Top (left to right): *Branchotenthes octohamatus* (Hexabothriidae); *Pseudoleptobothrium aptychotremae* (Microbothriidae); *Calicotyle australis* (Monocotylidae). Bottom: *Trygonorrhina fasciata* (Rhinobatidae)
Photos: V. Glennon

DEDICATION

To my beloved parents Rose and Bryan Glennon

As a child you showed me the world, encouraged my dreams, quelled my fears and taught me to reach. Every achievement of mine is an achievement of yours.

PUBLICATIONS ARISING FROM THIS PhD

Glennon, V., Chisholm, L.A. and Whittington, I.D., 2005. *Branchotenthes octohamatus* sp. n. (Monogenea: Hexabothriidae) from the gills of the southern fiddler ray, *Trygonorrhina fasciata* (Rhinobatidae) in South Australia: description of adult and larva. *Folia Parasitologica* 52: 223–230.

Glennon, V., Chisholm, L.A. and Whittington, I.D., 2006. A redescription of *Calicotyle australis* Johnston, 1934 (Monogenea: Monocotylidae) from the type host *Trygonorrhina fasciata* (Rhinobatidae) off Adelaide, South Australia, including descriptions of live and silver stained larvae. *Systematic Parasitology* 63: 29–40.

Glennon, V., Chisholm, L.A. and Whittington, I.D., 2006. *Pseudoleptobothrium aptychotremae* Young, 1967 (Monogenea, Microbothriidae) redescribed from a new host, *Trygonorrhina fasciata* (Rhinobatidae) in South Australia with a description of the larva and post-larval development. *Acta Parasitologica* 51: 40–46.

Glennon, V., Chisholm, L.A. and Whittington, I.D., 2006. Three unrelated species, 3 sites, same host - monogenean parasites of the southern fiddler ray, *Trygonorrhina fasciata*, in South Australia: egg hatching strategies and larval behaviour. *Parasitology* 133: 55–66.

Glennon, V., Chisholm, L.A. and Whittington, I.D., 2007. Experimental infections, using a fluorescent marker, of two elasmobranch species by unciliated larvae of *Branchotenthes octohamatus* (Monogenea: Hexabothriidae): invasion route, host specificity and post-larval development. *Parasitology* 134: 1243–1252.

Glennon, V., Perkins, E.M., Chisholm, L.A. and Whittington, I.D. Comparative phylogeography reveals host generalists, specialists and cryptic diversity: hexabothriid, microbothriid and monocotylid Monogenea from Rhinobatidae in southern Australia. *International Journal for Parasitology* (in press).

TABLE OF CONTENTS

ABSTRACT

Trygonorrhina fasciata (Rhinobatidae) specimens naturally infected by three monogenean species were captured and maintained in marine aquaria to promote a continuous parasite load. Monogenean eggs recovered from aquaria provided larvae for descriptions and life history experiments. I describe the adult, larva and post-larval development of a new species of hexabothriid, *Branchotenthes octohamatus*, from the gills. This is the first monogenean larva described with only eight hooklets. This character may be useful to help resolve problematic relationships within the Hexabothriidae and offers insight into more general hypotheses about relationships within the Monogenea. I also redescribe the adult of *Calicotyle australis* (Monocotylidae) from the cloaca and describe the larva. The number and arrangement of larval ciliated epidermal cells and sensilla was revealed using silver nitrate. I redescribe *Pseudoleptobothrium aptychotremae* (Microbothriidae) adults from the skin of *T. fasciata*, representing a new host and locality record. Larval anatomy and post-larval development are also documented. The presence of six needle-like spicules in the larval haptor is confirmed, supporting an earlier theory that spicules are ancestral vestiges.

My studies revealed three different egg hatching, host finding strategies and larval 'types'. *Branchotenthes octohamatus* has a 'sit-and-wait' strategy, entirely dependent on mechanical disturbance to stimulate eggs to hatch. Larvae are unciliated, cannot swim, lack pigmented eyespots and show no photo-response but may survive for more than two days after hatching at 22 ºC. In contrast, eggs of *C. australis* hatch spontaneously with a strong diurnal rhythm in the first few hours of daylight when exposed to a LD12:12 illumination regime. Larvae are ciliated and can swim, have pigmented eyespots, are photo-positive and can remain active and survive for up to 24 h after hatching at 22 ºC. Eggs of *P. aptychotremae* may have a 'bet-hedging' strategy. Some eggs hatch spontaneously and rhythmically in an LD12:12 regime during the last few hours of daylight but their low hatching success rate suggests that other eggs may require a different cue provided by the host. Larvae are ciliated, can swim, lack pigmented eyespots, show no photo-response and remain active for only a few hours at 22 ºC.

Experiments using the fluorescent dye, 5(6)-carboxyfluorescein diacetate *N*-succinimidyl ester (CFSE) revealed *B. octohamatus* on gills of *T. fasciata* within 30 min of exposure to the host. This provides strong evidence that larvae invade the gills directly via the host's inhalant respiratory current and do not migrate after initial attachment elsewhere.

Five rhinobatid species (*Aptychotrema vincentiana, T. fasciata, Trygonorrhina* sp. A, *A. rostrata* and *Rhinobatos typus*), with overlapping distributions spanning west, south and east Australian coastal waters were surveyed for monogeneans at four locations between Fremantle, Western Australia and Stradbroke Island, Queensland. Genetic homogeneity, using the mitochrondrial gene Cytochrome b (cytb) and the nuclear marker, Elongation factor-1 alpha (EF1a), was observed for all *Branchotenthes* and *Calicotyle* specimens irrespective of collection locality or rhinobatid species. Genetic homogeneity was observed for *Pseudoleptobothrium* specimens collected in western and southern Australia. However, local genetic heterogeneity was apparent among *Pseudoleptobothrium* specimens collected from two sympatric host species in New South Wales. Analyses revealed a highly divergent clade, indicating a morphologically cryptic, ancestral species.

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Chapters III – VII are published papers and Chapter VIII is now in press. Acknowledgements specific to these chapters are as follows:

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