An examination of the morphological diversity within a new genus of tapeworm from stingrays (Class: Cestoda)

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INTRODUCTION

Despite their unfortunate reputation, parasites are vital members of any biological community. Nearly every free-living species on the planet is known to play host to one, if not several, parasite species (Price 1980). In part because of this ubiquity, parasites can be used to facilitate investigations ranging from elucidating community food web patterns to acting as indicators of ecosystem health (Marcogliese 2005). In a recent international effort to expand our understanding of marine biodiversity, researchers have been working cooperatively with the goal of identifying new species of elasmobranchs (i.e., sharks, skates and stingrays) and their parasites. The majority of these elasmobranch parasites have been discovered to be tapeworms (Eyring et al. 2012).

Tapeworms, or cestodes, make up one of the more common parasite subgroups, with more than 5,000 described species, over 1,400 of which are exclusively marine (Caira & Reyda 2005). As new elasmobranchs are identified, it is becoming evident that their associated tapeworm populations are highly diverse and mostly consist of undescribed species (Reyda & Caira 2006). These tapeworm specimens are so radically different from previously described species that entirely new taxonomic classifications are needed in order to describe them (e.g., Healy et al. 2009). These new tapeworm specimens must be correctly identified and formally described before trends such as host specificity can be examined (Caira & Jensen 2001). Formal species descriptions are thus a stepping-stone towards the ultimate goal of understanding ecological interactions within this parasite-host community.

This study highlights a portion of the larger, ongoing international effort and assesses a newly-established group of tapeworm species, i.e., a genus, temporarily referred to as Rhinebothriinae New Genus 3 (as referred to by Healy et al. 2009). Our goal is to produce a comprehensive organization of the morphological diversity that exists within this new genus using both traditional light microscopy and scanning electron microscopy (SEM). Assessment of diversity will include examination of the bothridial and proglottid characteristics of multiple individuals within the genus, as combinations of these features have in the past aided in recognizing several potential morpho-types or species. In this report, we provide observations of the scolex, a prominent feature of the tapeworm anatomy. The scolex (see Figure 1) is the structure a tapeworm uses to attach to the intestinal wall of its vertebrate host. In the tapeworms studied here, the scolex consists of four cup-like organs called bothridia (Figure 1) that are structurally modified for attachment to the intestinal walls of stingrays.

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Figure 1. An image of scolex features in Rhinebothriinae New Genus 3 (line drawing by Danielle Willsey).

MATERIALS AND METHODS

Elasmobranch specimens were collected by collaborators from the University of Connecticut and elsewhere, and a subset of the collected tapeworm specimens were sent to the Reyda lab at the main lab of the Biological Field Station for morphological analyses. Specimens were preserved in 70% ethanol (following fixation in the field with 4% neutral-buffering formalin) and organized according to host stingray species. Examined specimens also included permanently-mounted slides on loan from the Royal Museum of Ontario (voucher numbers available upon request).

Specimens to be studied with light microscopy were permanently mounted on glass slides in Canada balsam using conventional methods (see Reyda & Olson 2003). Slides were examined using a Leica DM2500 compound light microscope (Leica Microsystems, Wetzlar, Germany) at 100x, 200x, 400x, 630x and 1,000x magnifications. Associated Leica microscope software was used for obtaining and recording specific measurements. In addition, a representative bothridium of the scolex (Figure 1) of each potential species was drawn with the aid of a drawing tube on the Leica microscope.

Scolex features (Figure 1) that were examined included length and width of the bothridia;
whether the bothridia was constantly constricted; whether the anterior loculus did or did not overhang the remainder of the bothridium; number of complete transverse septa in the anterior region; presence or absence of incomplete transverse septa (septa that do not connect completely from one edge of the bothridium to the other) in the anterior region; presence or absence of complete longitudinal septa in the posterior region; and presence or absence of lateral posterior subloculi (Figure 1). Proglottid features that were examined included the presence or absence of an external seminal vesicle; a thick- or thin-walled cirrus sac (the male tapeworm organ); overall cirrus sac size in relation to the proglottid (segment of the tapeworm body); presence or absence of a seminal receptacle; and a vagina that did or did not recurve anteriorly to the cirrus sac.

A subset of the preserved specimens was also prepared for SEM examination using conventional methods (see Healy et al. 2009). The images obtained from SEM were then analyzed for the same bothridial characteristics as were light microscope slides. After analysis, specimens were separated into preliminary categories based on combinations of their morphological features and each grouping was considered in the context of host locality and host specificity using collection data from the Global Cestode Database (Caira & Jensen 2013).

RESULTS
Following analysis, eight categories were erected to organize the diversity within Rhinebothriinae New Genus 3, with each grouping representing a potential species or morphotype. Groupings were organized into a dichotomous key (Figure 2) in which bothridial features were used to distinguish each group and illustrate the diversity within the genus.

DISCUSSION
It is clear that a high degree of morphological diversity exists within Rhinebothriinae New Genus 3, a conclusion that aligns with previous taxonomic assessments of these marine tapeworms (Healy et al. 2009). Figure 2 illustrates this diversity in terms of the ~eight morphological species that were encountered. This demonstrates that several distinct species exist within this genus that remain undescribed at this time. Preliminary organizations of tapeworm genera, such as the one produced from this study, can provide support to future species description efforts. They also have the potential to serve as useful tools in examinations of coevolution and host specificity (e.g. Caira & Jensen 2001), both of which are vital components to understanding trophic relationships within this marine system. Concrete species descriptions are necessary to obtain a true understanding of parasite-host relationships within this community. Hence, for the next step in this process, we will formally describe one of these species from within this diverse genus.
Figure 2. A Dichotomous key representation of the morphological diversity that exists within Rhinebothriidea New Genus 3 (Class: Cestoda) using line drawings of individual bothridia and SEM images of scoleces to represent individual species or morpho-types.

CONCLUSION

This study demonstrates that a great amount of morphological species diversity awaits discovery in the world. The eight new species illustrated here are just one small component of the biological diversity represented by tapeworms and other parasites. Efforts must continue to document this biodiversity.

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REFERENCES


