



Planetary Biodiversity Inventory
(2008–2017):

Tapeworms from Vertebrate Bowels of the Earth

—AN OVERVIEW—

Janine N. Caira, Kirsten Jensen, Boyko B. Georgiev, Roman Kuchta,
D. Timothy J. Littlewood, Jean Mariaux, Tomáš Scholz, Vasyl V. Tkach,
and Andrea Waeschenbach

Project Goals

- (1) To discover and describe **cestode novelty** from
 - as many different countries as possible
 - vertebrate groups not previously examined for cestodes
- (2) To recollect from historically problematic regions and/or host taxa to resolve major **taxonomic issues**
- (3) To **collect specimens** of as many different cestode species across as great a diversity of cestode taxa as possible
- (4) To assess **interrelationships** at multiple levels based on phylogenetic analyses of molecular sequence data from multiple genes informed by morphological data
- (5) To attempt to reconcile cestode **classification** at all levels with a revised understanding of their phylogenetic relationships
- (6) To use historical data and new collections to begin to generate **estimates of total global diversity**



The Team



Bird-hosted cestode team

Jean Mariaux & Boyko Georgiev; Eric Hoberg, Vadim Korniyushin, Pavel Nikolov, & Gergana Vasileva



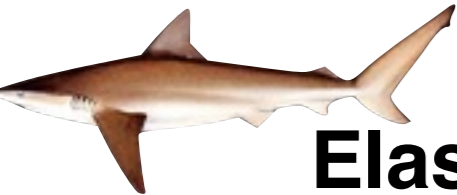
Mammal-hosted cestode team

Vasyl Tkach; Ian Beverage, Voitto Haukisalme, Vadim Korniyushin



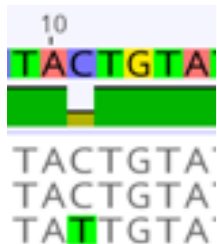
Bony fish-hosted cestode team (+ holocephalans, “herptiles”)

Tomáš Scholz, Roman Kuchta, & Alain de Chambrier; Alicia Gil de Pertierra, Vladimíra Hanzelová, & Mikulas Oros



Elasmobranch-hosted cestode team

Janine Caira & Kirsten Jensen; Ian Beverage, Louis Euzet, Claire Healy, Verónica Ivanov, Masoumeh Malek, Fernando Marques, Lassad Neifar, Harry Palm, Florian Reyda, Tim Ruhnke



Molecular cestode team

Tim Littlewood & Andrea Waeschenbach

The Team

Program assistant

Elizabeth Barbeau



Project website and databases

Yi Zhang, Josh Roy, & Jason Card

***Meet the Suckers* children's book**

Virge Kask & Achim Mohrenberg



Training

Postdoctoral fellows

Jitka Aldhoun (Natural History Museum in London)
Jan Brabec (Czech Academy of Sciences)
Joanna Cielocha (University of Kansas; Rockhurst University)
Caroline Fyler (University of Connecticut; Martha's Vineyard High School)
Voitto Haukisalmi (Finnish Museum of Natural History)
Miloslav Jirků (Czech Academy of Sciences)
Roman Kuchta (Czech Academy of Sciences)
Arseny Makarikov (Russian Academy of Sciences [Siberian Branch])
Adriana Menoret (Universidad de Buenos Aires)
Maria Pickering (University of Connecticut; Meredith College)
Mikulas Oros (Czech Academy of Sciences; Slovak Academy of Sciences)
Martina Orosová (Slovak Academy of Sciences)
Anna Phillips (University of Connecticut; Smithsonian Institution)
Aneta Yoneva (Bulgarian Academy of Sciences)
Andrea Waeschenbach (Natural History Museum in London)

of postdoctoral fellows: **14**
of graduate students: **35**
of undergraduate students: **59**

Graduate students

Philippe Vieira Alves (Univ. Fed. Rural do Rio de Janeiro)
Atabak Aminjan (University of Tehran)
Anirban Ash (Acad. of Sciences of the Czech Republic)
Daniel Barčák (Slovak Academy of Sciences)
James Bernot (University of Connecticut)
Jan Brabec (Academy of Sciences of the Czech Republic)
Mehdi Golestaninasab (University of Tehran)
Stephen Greiman (University of North Dakota)
Rachel Guyer (University of Kansas)
Mohamed Haseli (University of Tehran)
Kaylee Herzog (University of Kansas)
Kendra Koch (University of Kansas)



Collaboration!!

Project meetings

- Geneva (2009)
- Melbourne (2010) (following XIIth ICOPA)
- Lawrence (2011) (following 7th IWCSF)
- Geneva (2012)
- London (2013)
- Brazil (2014) (following 8th IWCSF)



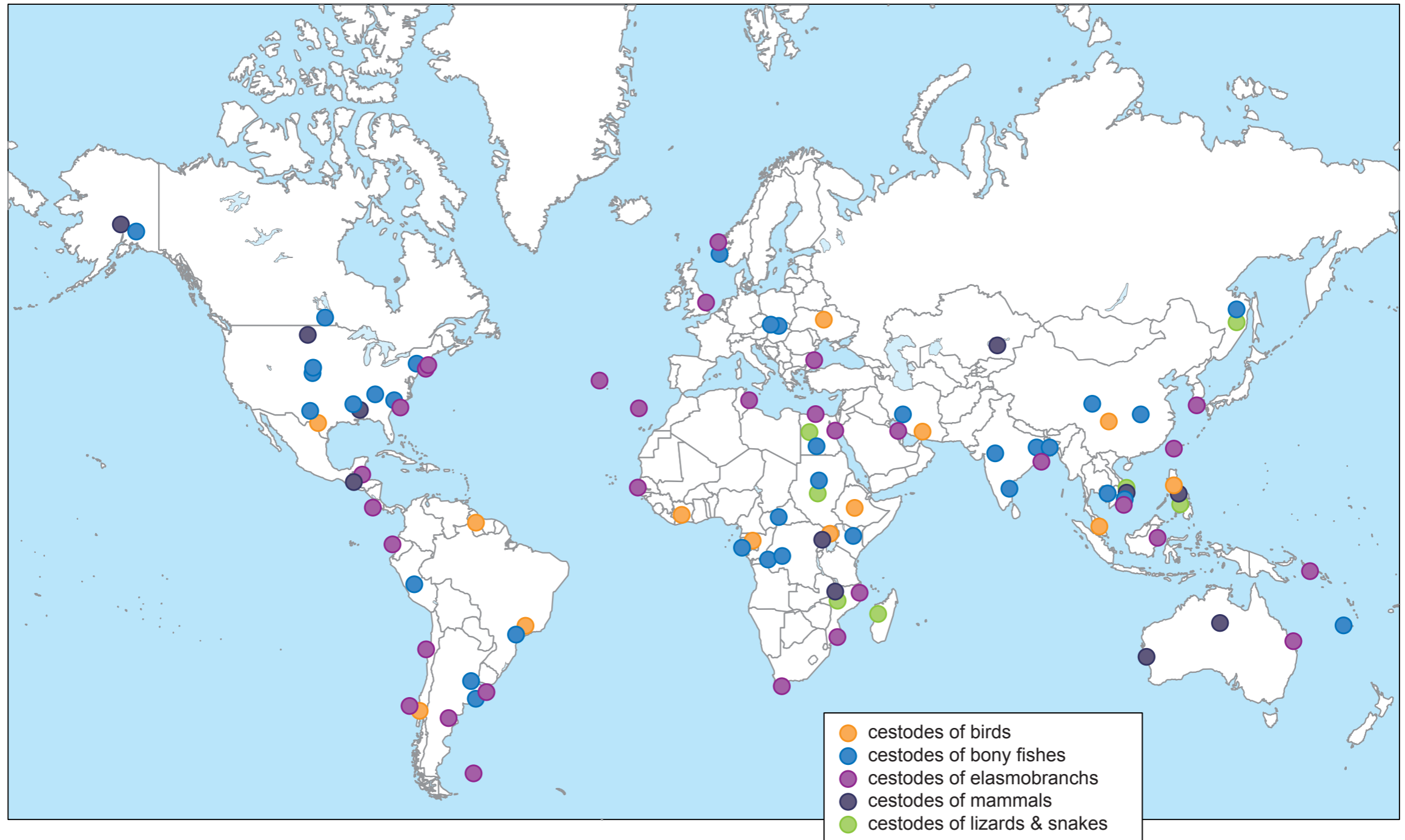
The Team

of participants: >250



Fieldwork

countries visited: 54



In-country collaborators

Mostafa Hossain (**Bangladesh**)

Norlan Lamb & Roy Polonio (**Belize**)

Natalia Da Mata Luchetti, Fernando P. L. Marques, Luis Eduardo Tavares, Marcos Tavares, José Luque, & Ricardo Takemoto (**Brazil**)

Pavel Nikolov (**Bulgaria**)

Touch Bunthang (**Cambodia**)

Manigandan Lejeune Virapin (**Canada**)

Francisco Concha, Günther Försterra, Daniel González-Acuña, & Vreni Häussermann (**Chile**)

Dian Gao, Cai Kuizheng, Pin Nie, Gui Tang Wang, Shan Gong Wu, & Bing Wen Xi (**China**)

Tayler Clarke, Ingo Wehrtmann, & Mario Espinoza (**Costa Rica**)

Oscar Carreno & Gabriela Flores (**Ecuador**)

Mohamed Bosseri & Amal Khalil (**Egypt**)

Eshete Dejen Dresilign, Abebe Getuhun Gubale, & Seyoum Mengistou (**Ethiopia**)

Joost Pompert (**Falkland Islands**)

Bernard Marchand (**France**)

Mathieu Bourgarel & Jean-Paul Gonzales (**Gabon**)

Anirban Ash & Pradip K. Kar (**India**)

Asri Yuinar (**Indonesia**)

Razieh Ghayoumi & Masoumeh Malek (**Iran**)

Andrea Gustinelli (**Italy**)

Inza Kone (**Ivory Coast**)

Steven Goodman, Marie Jeanne Raherilalao, Jeanne Rasamy, & Achille Raselimanana (**Madagascar**)

R. Hashim, Susan Lim (late), & R. Ramli (**Malaysia**)

Samuel Bila (**Mozambique**)

Jean-Lou Justine (**New Caledonia**)

Martin Mortenthaler, Aurora Ramírez Aricara, & Lidia Sánchez (**Peru**)

Rafe Brown (**Philippines**)

Graca Costa & Gui Menezes (**Portugal**)

Vladimir Besprovaznykh, Vladimir Chistyakov, & Alexey Ermolenko (**Russia**)

Rokhaya Sall (**Senegal**)

David Blair, Tingo Leve, & Richard Mounsey (**Solomon Islands**)

Tracey Fairweather & Robert Leslie (**South Africa**)

Ki Hong Kim (**South Korea**)

Zuheir Mahmoud (**Sudan**)

Hsuan-Ching Ho & Hsuan-Wien Chen (**Taiwan**)

Lawan Chanhom (**Thailand**)

Jim Ellis & Andrew Shinn (**UK**)

Olga Lisitsyna & Yuriy Kvach (**Ukraine**)

Michael Barger, Megan Bean, Sara Brant, Isaure de Buron, Anindo Choudhury, Joseph Cook, Stephen Curran, Bryan Frazier,

Andrew Hope, David G. Huffman, John M. Kinsella, Robin Overstreet, Eric Pulis, & Jason Weckstein (**USA**)

Tran T. Binh & Vu Quang Manh (**Vietnam**)

Vietnam (2010)

USA (2013)

UK (2013)

Sudan (2010)

South Africa (2010)

Solomon Isl&s (2012)

Slovakia (2011)

Russia (2011)

Peru (2009)

Norway (2010)

Madagascar (2011)

India (2013)

Gabon (2010)

Ecuador (2014)

China (2010)

Cambodia (2010)

Bulgaria (2010)

Brazil (2011)

Belize (2012)

Bangladesh (2011)

Azores (2012)

Novelty and Diversity

of new species: **215**

of new genera: **64**

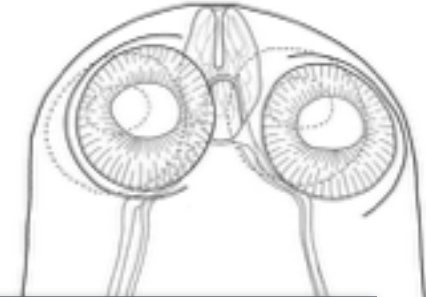
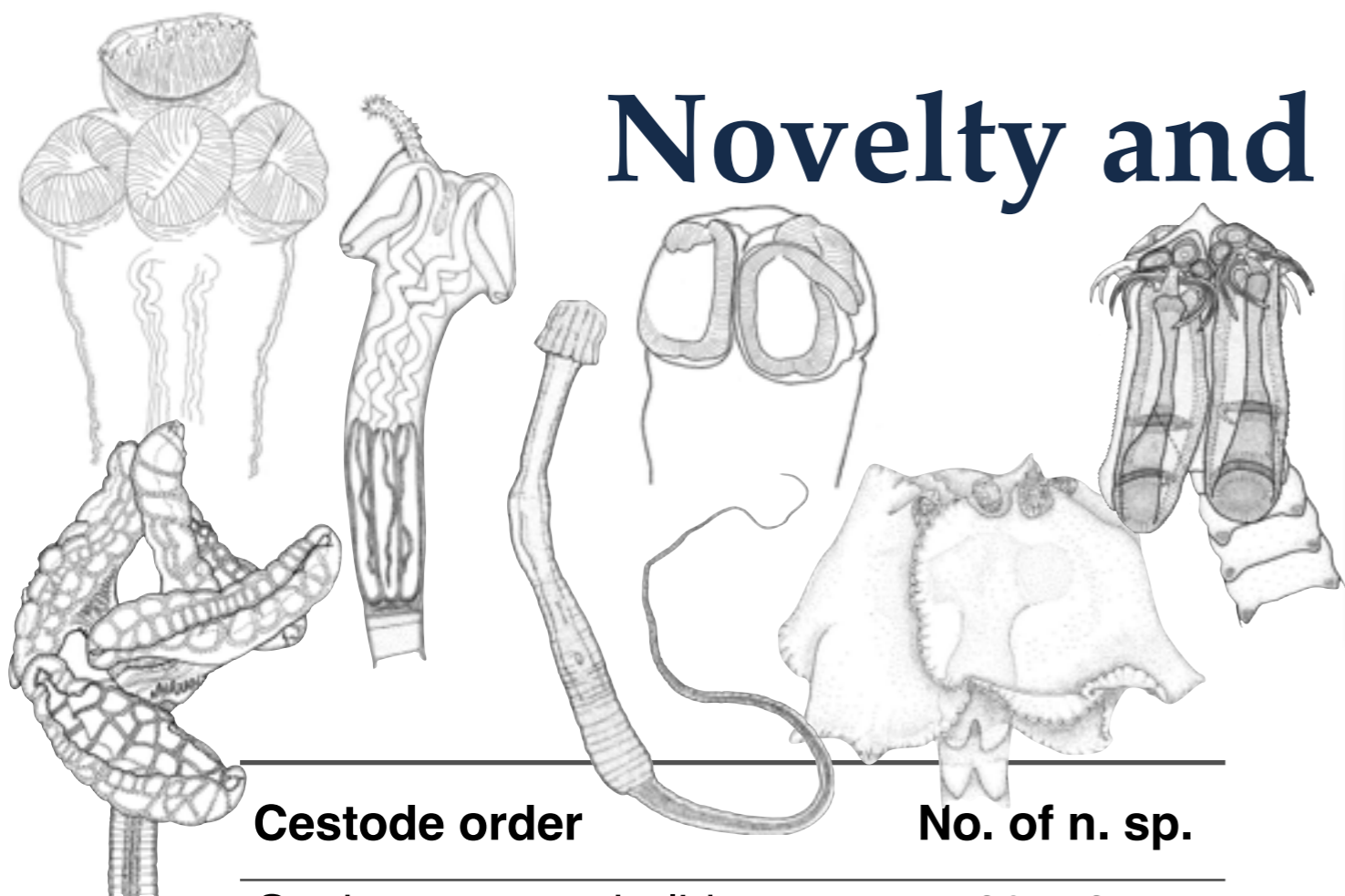
of new combinations: **135**

of species synonymized: **~200**



Novelty and Diversity

of new species: **215**
 # of new genera: **64**
 # of new combinations: **135**
 # of species synonymized: **~200**



Cestode order **No. of n. sp.**

Onchoproteocephalidea	20 + 25
Cyclophyllidea	36
Lecanicephalidea	31
Trypanorhyncha	31
Rhinebothriidea	25
Diphyllidea	18
"Tetraphyllidea" relics	10
Phyllobothriidea	8
Caryophyllidea	6
Bothriocephalidea	3
Litobothriidea	1
Tetrabothriidea	1

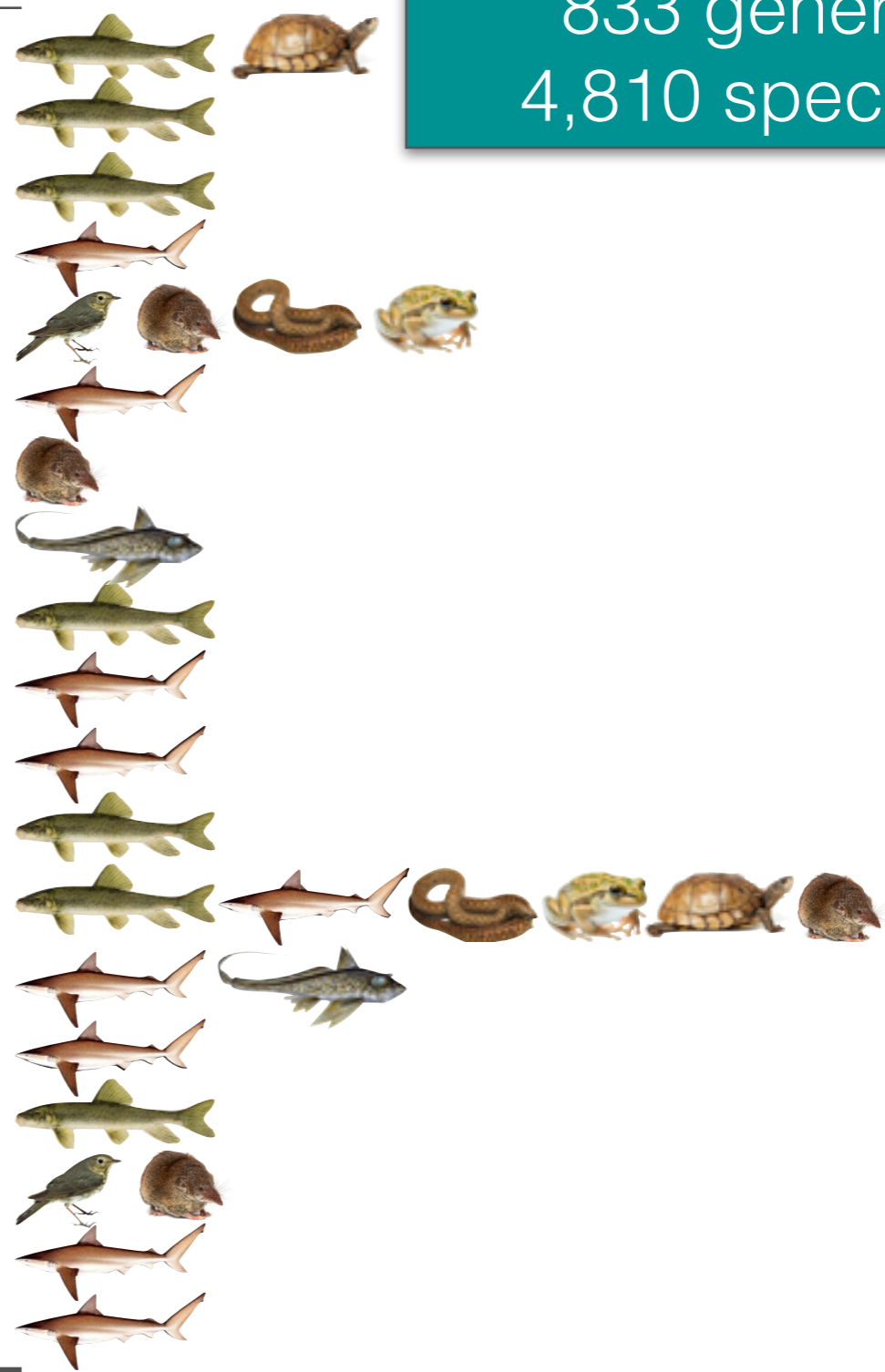
Cestode order **No. of n. gen.**

Cyclophyllidea	20
Lecanicephalidea	9
Onchoproteocephalidea	8 + 1
Trypanorhyncha	8
Bothriocephalidea	5
Rhinebothriidea	5
Diphyllidea	4
Phyllobothriidea	2
Caryophyllidea	1
"Tetraphyllidea" relics	1



Diversity

Cestode order	No. of valid genera	No. of valid species
Amphilinidea	6	8
Bothriocephalidea	48	132
Caryophyllidea	42	122
Cathetocephalidea	3	6
Cyclophyllidea	437	3,034
Diphylloidea	6	59
Diphyllobothriidea	18	70
Gyrocotylidea	1	10
Haplobothriidea	1	2
Lecanicephalidea	29	90
Litobothriidea	1	9
Nippotaeniidea	1	6
Onchoproteocephalidea	79	562
Phyllobothriidea	24	69
Rhinebothriidea	22	136
Spathebothriidea	5	6
Tetrabothriidea	6	70
“Tetraphyllidea” relics	25	104
Trypanorhyncha	81	315



CURRENT STATUS:
 833 genera
 4,810 species

Diversity

Cestode order	No. of genera
Amphilinidea	
Bothriocephalidea	
Caryophyllidea	
Cathetocephalidea	
Cyclophyllidea	
Diphyllidea	
Diphyllobothriidea	
Gyrocotylidea	
Haplobothriidea	
Lecanicephalidea	
Litobothriidea	
Nippotaeniidea	
Onchoproteocephalidea	
Phyllobothriidea	
Rhinebothriidea	
Spathebothriidea	
Tetrabothriidea	
“Tetraphyllidea” relics	
Trypanorhyncha	

Cyclophyllidean family	No. of valid genera	No. of valid species
Acoleidae	2	5
Amabiliidae	10	32
Anoplocephalidae	81	480
Catenotaeniidae	6	36
Davaineidae	37	450
Dilepididae	90	750
Dioicocestidae	5	21
Dipylidiidae	3	15
Gryporhynchidae	16	76
Hymenolepididae	130	923
Mesocestoididae	2	13
Metadilepididae	10	15
Nematotaeniidae	5	19
Paruterinidae	24	125
Progynotaeniidae	6	24
Taeniidae	4	50

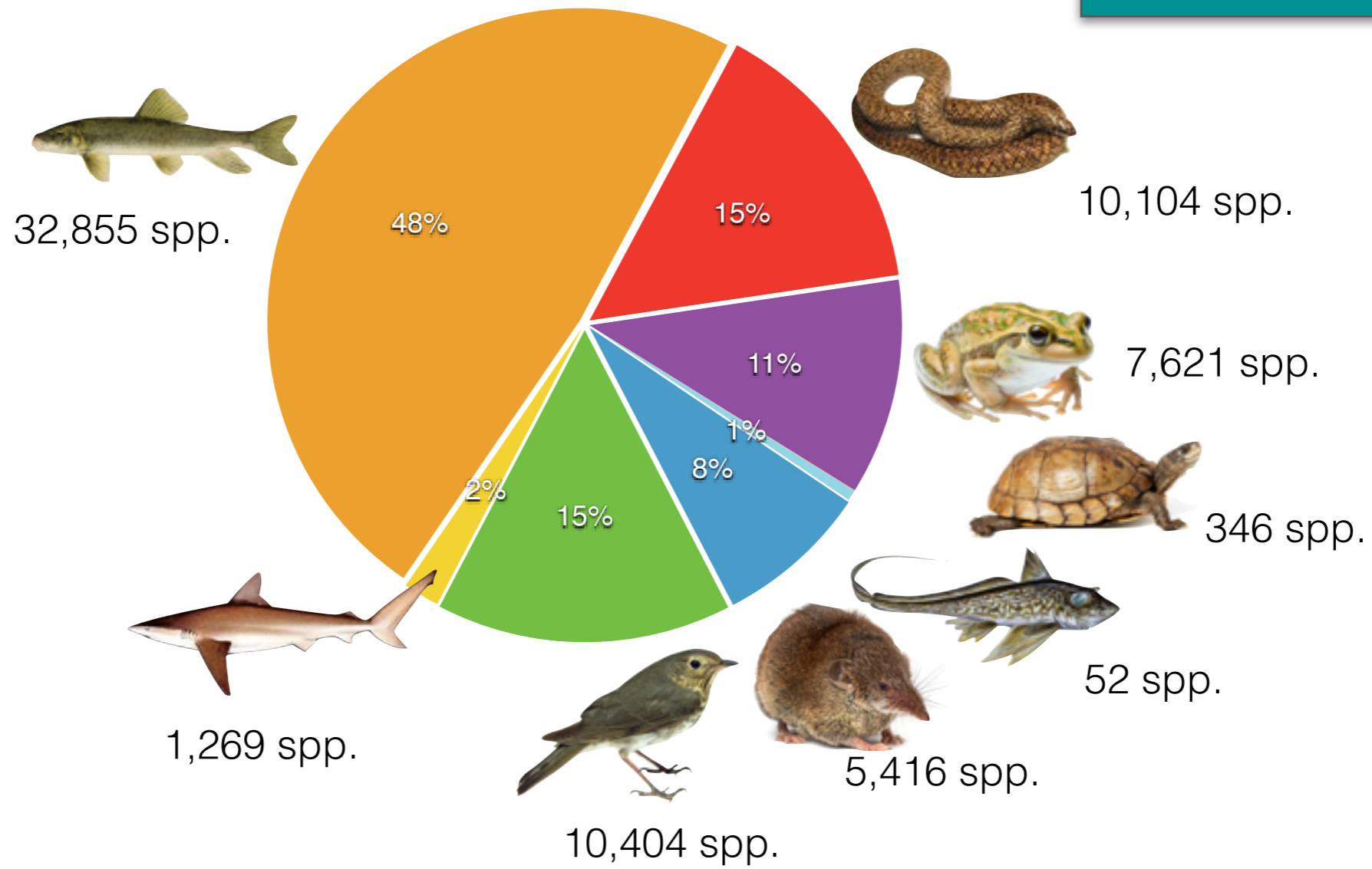
Onchoproteocephalidea (by host group)	No. of valid genera	No. of valid species
I: non-elasmobranch	68	316
II: elasmobranch	11	246

6	70
25	104
81	315

CURRENT STATUS:
 33 genera
 10 species

Host Associations

Vertebrate diversity



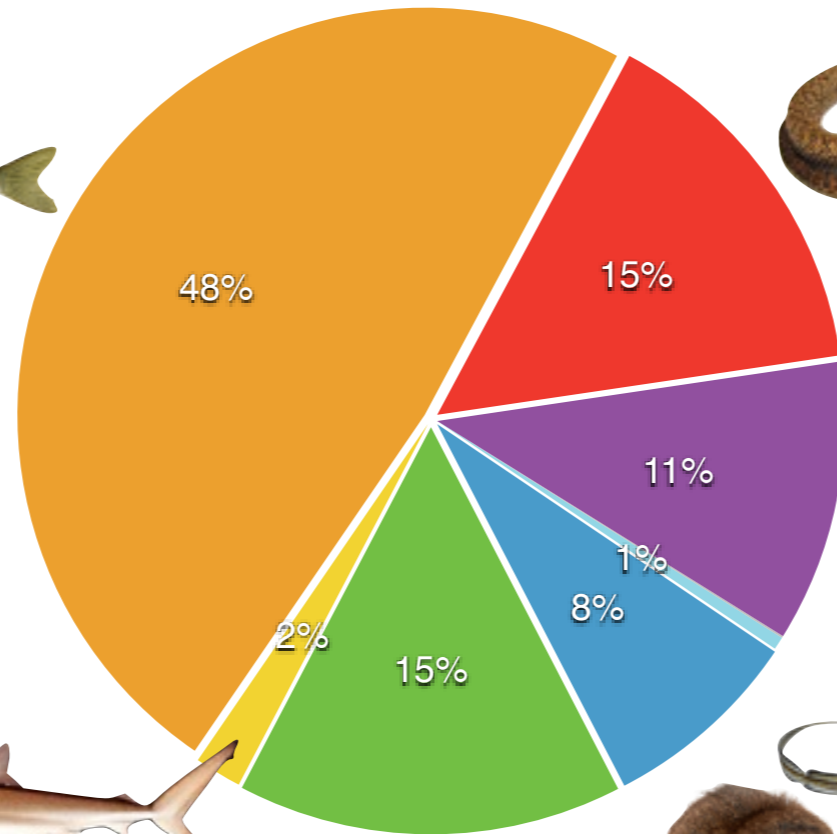
- Birds
- Mammals
- Elasmobranchs
- Bony fishes
- Snakes & lizards
- Amphibians
- Holocephalans
- Turtles



Host Associations

Vertebrate diversity

Amphilinidea
Bothriocephalidea
Caryophyllidea
Haplobothriidea
Nippotaeniidea
Onchoproteocephalidea
Spathebothriidea



Cyclophyllidea
Anoplocephalidae
Nematotaeniidae
Onchoproteocephalidea



Cyclophyllidea
Nematotaeniidae
Onchoproteocephalidea



Amphilinidea
(Onchoproteocephalidea)

Cathetocephalidea
Diphyllidea
Lecanicephalidea
Litobothriidea
Onchoproteocephalidea
Phyllobothriidea
Rhinebothriidea
"Tetraphyllidea" relics
Trypanorhyncha



Cyclophyllidea
Acoleidae
Amabiliidae
Anoplocephalidae
Davaineidae
Dilepididae
Dioicocestidae
Gryporhynchidae
Hymenolepididae
Mesocestoididae
Metadilepididae
Paruterinidae
Progynotaeniidae
Tetrabothriidea



Cyclophyllidea
Anoplocephalidae
Catenotaeniidae
Davaineidae
Dilepididae
Dipylidiidae
Hymenolepididae
Mesocestodidae
(Paruterinidae)
Taeniidae
Diphyllobothriidea
(Onchoproteocephalidea)
Tetrabothriidea

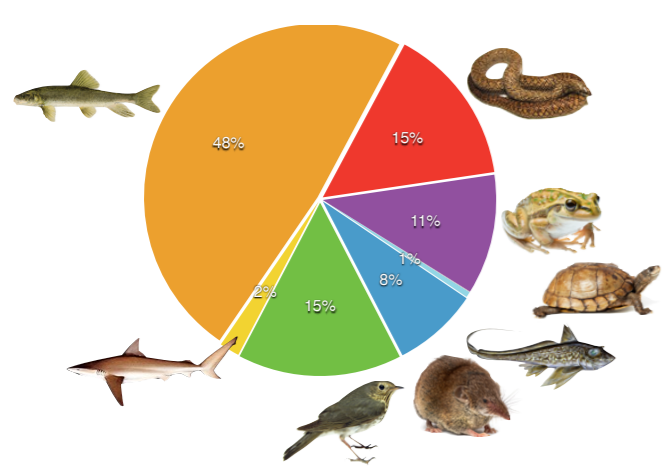


Gyrocotylidea
(Phyllobothriidea)

- Birds
- Mammals
- Elasmobranchs
- Bony fishes
- Snakes & lizards
- Amphibians
- Holocephalans
- Turtles



Host Associations



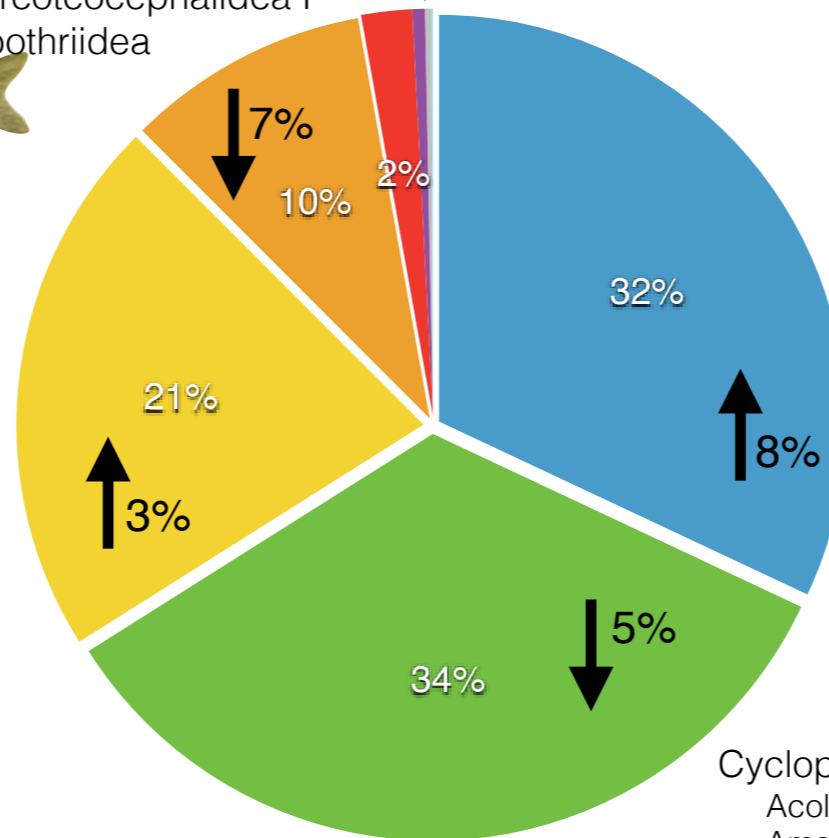
Amphilinidea
Bothriocephalidea
Caryophyllidea
Haplobothriidea
Nippotaeniidea
Onchoproteocephalidea I
Spathebothriidea

Cyclophyllidea
Anoplocephalidae
Nematotaeniidae
Onchoproteocephalidea I

Cyclophyllidea
Nematotaeniidae
Onchoproteocephalidea I
Gyrocotylidea
(Phyllobothriidea)
Amphilinidea
(Onchoproteocephalidea I)

Cathetocephalidea
Diphyllidea
Lecanicephalidea
Litobothriidea
Onchoproteocephalidea II
Phyllobothriidea
Rhinebothriidea
"Tetraphyllidea" relics
Trypanorhyncha

Cyclophyllidea
Anoplocephalidae
Catenotaeniidae
Davaineidae
Dilepididae
Dipylidiidae
Hymenolepididae
Mesocestodidae
(Paruterinidae)
Taeniidae
Diphyllbothriidea
(Onchoproteocephalidea I)
Tetrabothriidea



Cyclophyllidea
Acoleidae
Amabiliidae
Anoplocephalidae
Davaineidae
Dilepididae
Dioicocestidae
Gryporhynchidae
Hymenolepididae
Mesocestoididae
Metadilepididae
Paruterinidae
Progynotaeniidae
Tetrabothriidea

CURRENT STATUS:
4,810 species

Relative cestode diversity
(species) by vertebrate class

- Hosted by birds
- Hosted by mammals
- Hosted by elasmobranchs
- Hosted by bony fishes
- Hosted by snakes & lizards
- Hosted by amphibians
- Hosted by holocephalans
- Hosted by turtles



Host Associations—Poor hosts

Vertebrate groups hosting few or no tapeworms:



Squamata (snakes and lizards)



Chelonii (turtles)



Amphibia (frogs and salamanders)

Artiodactyla (deer, etc.)



Perissodactyla (horses, etc.)



Primata (monkeys, etc.)



Procellariiformes (petrels, etc.)



Sphenisciformes (penguins)



Scombridae (mackerels, tunas, etc.)



Squaliformes (dogfish, etc.)



“Scyliorhinidae” (cat sharks)



Host Associations—Good hosts

Vertebrate groups especially good hosts for tapeworms:



Soricomorpha (shrews, etc.)

Chiroptera (bats)



Lagomorpha (rabbits, etc.)



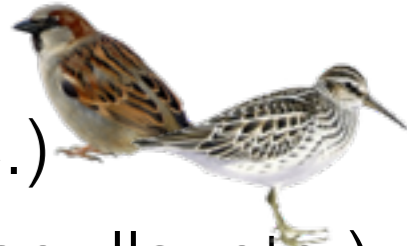
Carnivora (bears, etc.)



Marsupialia (kangaroos, etc.)



Passeriformes (sparrows, etc.)



Charadriiformes (plovers, seagulls, etc.)

Podicipediformes (grebes)



Anseriformes (ducks, geese, etc.)



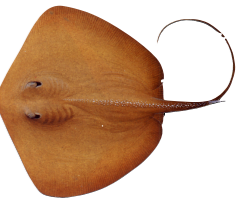
Siluriformes (catfish, etc.)



Cypriniformes (carp, etc.)



Myliobatiformes (stingrays, etc.)



Rhinopristiformes (guitarfish, etc.)



Host Associations—New records



Bothriocephalidea

Bothriocephalus sp. from order Lepisosteiformes

New host family records: Archiridae, Bovichtidae, Platycephalidae, & Serranidae



Diphyllidea

New host family records: Gurgesiellidae & Proscylliidae



Lecanicephalidea

New host family records: Zanobatidae & Urolophidae; + freshwater



Onchoproteocephalidea I

New host family records: Gekkonidae and Dactyloidae; Pangasiidae

New genus from Australian endemic frog



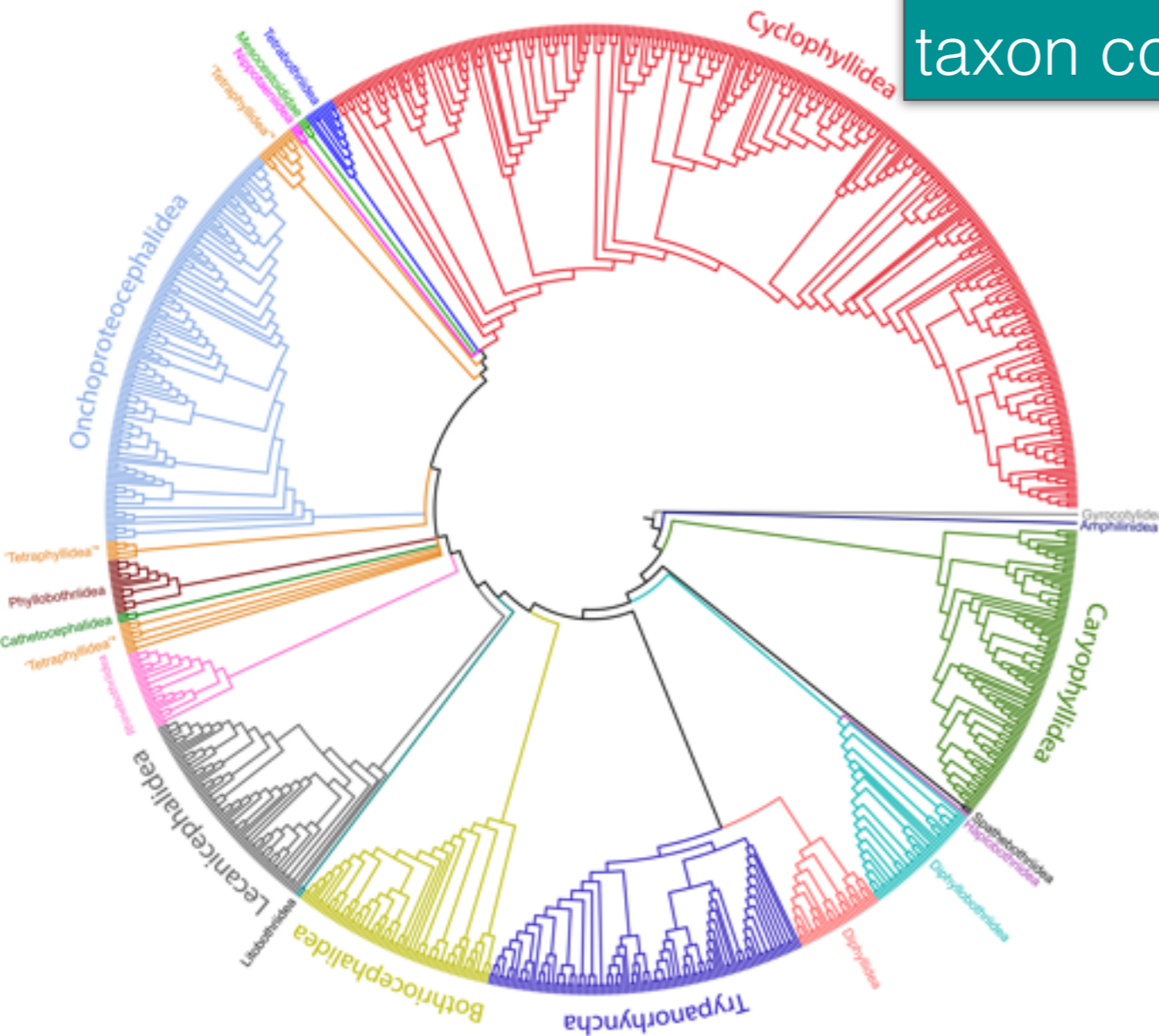
Rhinebothriidea

New host family records: Platyrrhinidae



Phylogenetics and Classification

of specimens sequenced: ~1,000
 # of orders sequenced: 15/19
 loci: 28S rDNA, 18S rDNA, COI, 16S rDNA
 taxon coverage (by order): 10–80%



Bothriocephalida	44%
Caryophyllida	80%
Cathetocephalida	75%
Cyclophyllida (incl. Mesoc.)	10%
Diphyllida	52%
Diphyllobothriida	36%
Lecanicephalida	26%
Litobothriida	55%
Nippotaeniida	57%
Onchoproteocephalida	35%/12%
Phyllobothriida	29%
Rhinebothriida	37%
Tetrabothriida	(few)
“Tetraphyllida” relics	33%
Trypanorhyncha	33%



Phylogenetics

Novel phylogenetic frameworks:

Bothriocephalidea

Caryophyllidea

Cyclophyllidea

Diphyllidea

Diphyllobothriidea

Lecanicephalidea

Litobothriidea

Onchoproteocephalidea

Phyllobothriidea

Rhinebothriidea

“Tetraphyllidea” relics

Trypanorhyncha

Brabec, J., A. Waeschenbach, T. Scholz, D. T. Littlewood, and R. Kuchta. 2015. Molecular phylogeny of the **Bothriocephalidea** (Cestoda): molecular data challenge morphological classification. *International Journal for Parasitology* 45: 761–771.

Brabec, J., T. Scholz, I. Králová-Hromadová, E. Bazsalovicsová, and P. D. Olson. 2012. Substitution saturation and nuclear paralogs of commonly employed phylogenetic markers in the **Caryophyllidea**, an unusual group of non-segmented tapeworms (Platyhelminthes). *International Journal for Parasitology* 42: 259–267.

Hardman, L. M., V. Haukisalmi, and I. Beveridge. 2012. Phylogenetic relationships of the **anoplocephaline** cestodes of Australasian marsupials and resurrection of the genus *Wallabicestus* Schmidt, 1975. *Systematic Parasitology* 82: 49–63.

Haukisalmi, V., L. M. Hardman, E. P. Hoberg, and H. Henttonen. 2014. Phylogenetic relationships and taxonomic revision of *Paranoplocephala* Luhe, 1910 sensu lato (Cestoda, **Cyclophyllidea**, Anoplocephalidae). *Zootaxa* 3873: 371–415.

Haukisalmi, V., L. M. Hardman, V. B. Fedorov, E. P. Hoberg, and H. Henttonen. 2016. Molecular systematics and Holarctic phylogeography of cestodes of the genus *Anoplocephaloides* Baer, 1923 s. s. (**Cyclophyllidea**, Anoplocephalidae) in lemmings (*Lemmus*, *Synaptomys*). *Zoologica Scripta* 45: 88–102.

Caira, J. N., F. P. L. Marques, K. Jensen, R. Kuchta, and V. Ivanov. 2013. Phylogenetic analysis and reconfiguration of genera in the cestode order **Diphyllidea**. *International Journal for Parasitology* 43: 621–639.

Waeschenbach, A., J. Brabec, T. Scholz, D. T. J. Littlewood, and R. Kuchta. Accepted. The catholic taste of **broad tapeworms**—multiple routes to human infection. *International Journal for Parasitology*.

Jensen, K., J. N. Caira, J. J. Cielocha, D. T. J. Littlewood, and A. Waeschenbach. 2016. When proglottids and scoleces conflict: Phylogenetic relationships and a family-level classification of the **Lecanicephalidea** (Platyhelminthes: Cestoda). *International Journal for Parasitology* 46: 291–310.

Caira, J. N., K. Jensen, A. Waeschenbach, and D. T. J. Littlewood. 2014. An enigmatic new tapeworm, *Litobothrium aenigmaticum*, sp. nov. (Platyhelminthes: Cestoda: **Litobothriidea**), from the pelagic thresher shark with comments on development of known *Litobothrium* species. *Invertebrate Systematics* 28: 231–243.

de Chambrier, A., A. Waeschenbach, M. Fisseha, T. Scholz, and J. Mariaux. 2015. A large 28S rDNA-based phylogeny confirms the limitations of established morphological characters for classification of **proteocephalidean** tapeworms (Platyhelminthes, Cestoda). *ZooKeys* 500: 25–59.

Ruhnke, T. R., J. N. Caira, and A. Cox. 2015. The cestode order **Rhinebothriidea** no longer family-less: A molecular phylogenetic investigation with erection of two new families and description of eight new species of *Anthocephalum*. *Zootaxa* 3904: 51–81.

Caira, J. N., K. Jensen, and T. R. Ruhnke. 2017. “**Tetraphyllidea**” van Beneden, 1850 relics. In *Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth*. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 371–400.

Olson, P. D., J. N. Caira, K. Jensen, R. M. Overstreet, H. W. Palm, and I. Beveridge. 2010. Evolution of the **trypanorhynch** tapeworms: Parasite phylogeny supports independent lineages of sharks and rays. *International Journal for Parasitology* 40: 223–242.



Phylogenetics and Classification


Author's personal copy

Molecular Phylogenetics and Evolution 63 (2012) 834–847

Contents lists available at ScienceDirect

Molecular Phylogenetics and Evolution

journal homepage: www.elsevier.com/locate/ympev




Adding resolution to ordinal level relationships of tapeworms (Platyhelminthes: Cestoda) with large fragments of mtDNA

Andrea Woeschenbach, B.L. Webster, D.T.J. Littlewood*

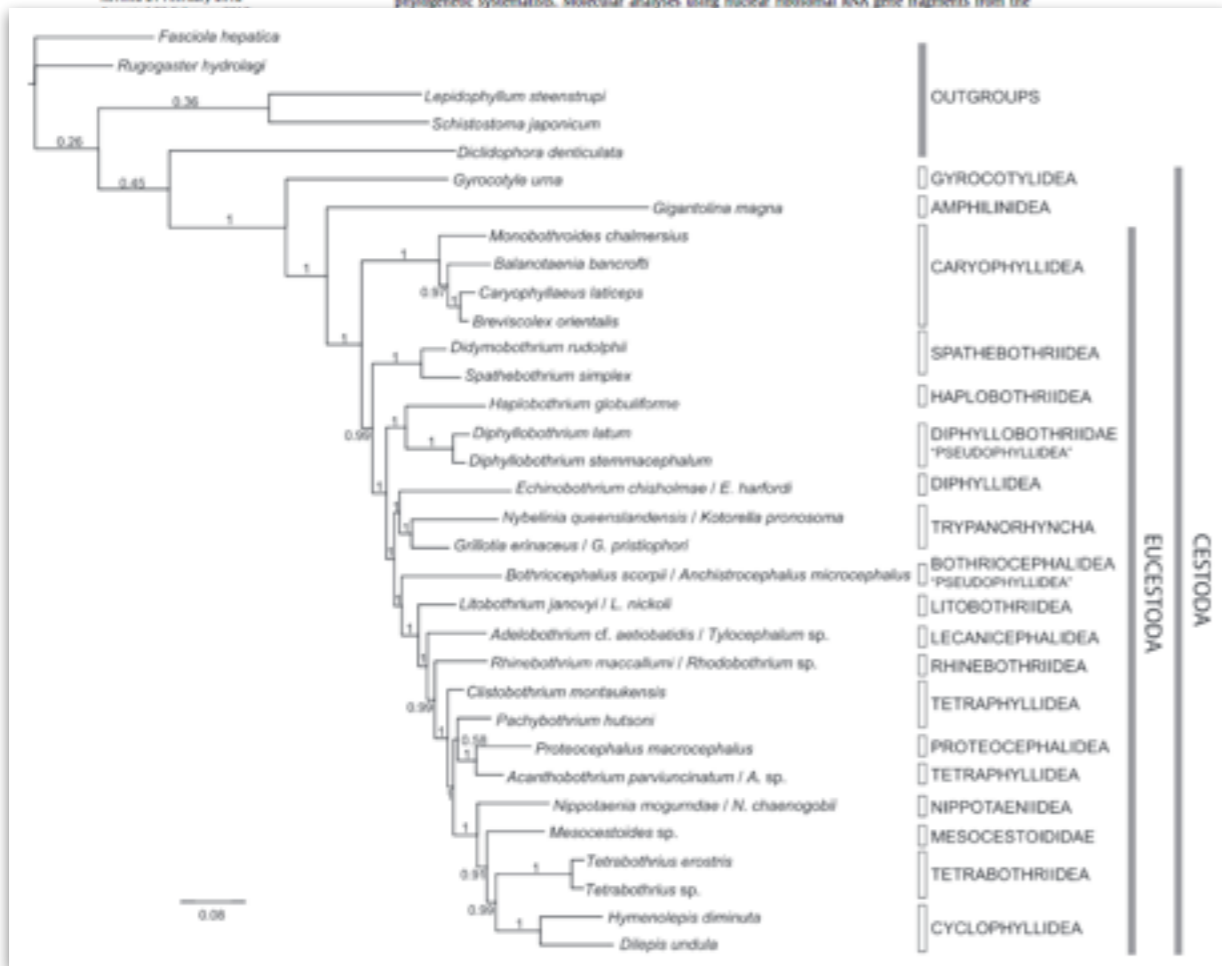
Department of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD, UK

ARTICLE INFO

Article history:
Received 9 December 2011
Revised 21 February 2012

ABSTRACT

The construction of a stable phylogeny for the Cestoda, indicating the interrelationships of recognised orders and other major lineages, has proceeded iteratively since the group first received attention from phylogenetic systematists. Molecular analyses using nuclear ribosomal RNA gene fragments from the



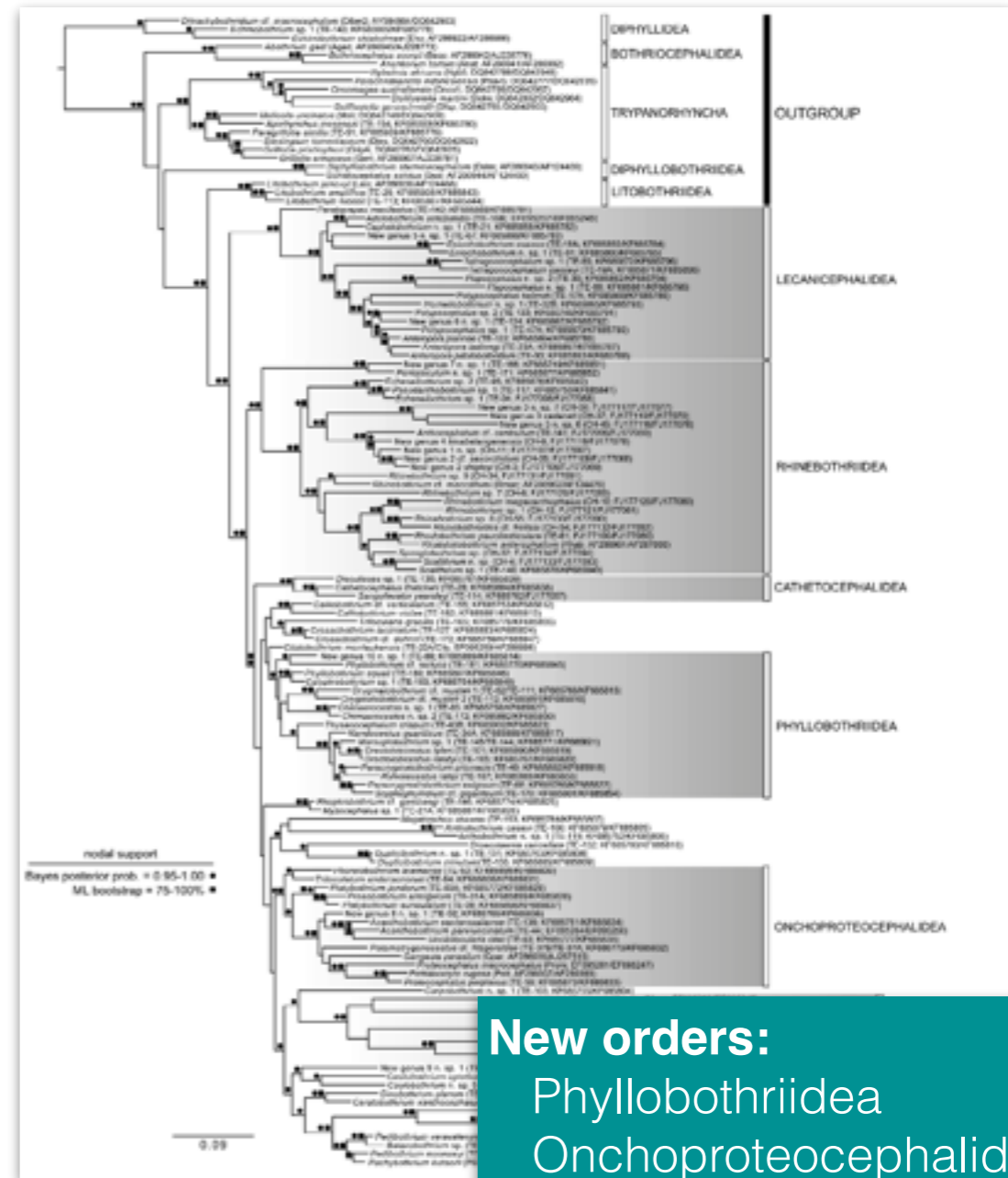
International Journal for Parasitology 44 (2014) 55–73

Contents lists available at ScienceDirect

International Journal for Parasitology

journal homepage: www.elsevier.com/locate/ijpara





Classification

Trypanorhyncha

Rhinebothriidea Lecanicephalidea

Onchoproteocephalidea



New family-level classification

New family-level classification

New family:
Rhinebothriidae

New suborders:
Trypanobatoidea
Trypanoselaoidea

New families:
Anthocephaliidae
Escherbothriidae

New families:
Aberrapecidae
Eniochobothriidae
Paraberrapecidae
Zanobatocestidae



Dissemination

Parasitology > University of Conn: x

tapeworms.uconn.edu

UCONN Parasitology

A Survey of the Tapeworms (Cestoda: Platyhelminthes) from Vertebrate Bowels of the Earth

HOME PARTICIPANTS ACTIVITIES PRODUCTS RESOURCE

DBs best viewed in Firefox

Host Databases

Global Cestode Database

Citation Database

ABOUT THE TAPEWORM ORDERS

DIPHYLLIDEA CYCLOPHYLLIDEA
TRYPANORHYNCHA GYROCOTYLIDEA NIPPOTAENIIDEA
TETRABOTHRIZIDEA SPATHEBOTHRIZIDEA
RHINEBOTHRIZIDEA CATHETOCEPHALIDEA
CARYOPHYLLIDEA PROTOCEPHALIDEA
LECANICEPHALIDEA TETRAPHYLLIDEA
BOTHRIOCEPHALIDEA DIPHYLLOBOTHRIZIDEA
LITOBOTHRIZIDEA HAPLOBOTHRIZIDEA AMPHILINIDEA

ABOUT TAPEWORMS:
Tapeworms (or cestodes) are a Class of platyhelminths that as adults are obligate parasites in the gut of vertebrates. They themselves lack a digestive system and are unique in their possession of elaborations called microtriches throughout their outer surface; among other functions, these structures appear to aid in absorption of nutrients. The life cycles of tapeworms are complex often involving a series of 3 or more hosts; they transfer between these hosts when one host consumes another. The ~6,000 tapeworm species comprise 18 Orders that differ most conspicuously in the form of their attachment structure, the scolex.

ABOUT THE PROJECT:
This NSF funded project is a collaborative effort among cestode experts from 21 countries around the world. Its primary goal is to expand knowledge of tapeworms globally. Thus, in addition to discovering novelty through examination of vertebrate hosts and geographic regions that have not previously been explored for tapeworms, it aims to compile and synthesize existing taxonomic information on cestodes so as to make it easily and publicly available. Furthermore, it aims to provide a database system for effectively tracking host/parasite data.

NSF PBI Award Nos. 0818696 & 0818823

EEB KU THE UNIVERSITY OF KANSAS



Dissemination

Parasitology > University of Conn: <http://tapeworms.uconn.edu/finalpub.html>

UConn

Planetary Biodiversity Invento: <https://hdl.handle.net/1808/24421>

myKU Email Enroll & Pay KU Directory

HOME PARTICIP

DBs best viewed in Firef

Host Databases

Global Cestode Database

Citation Databas

KU ScholarWorks

Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth

No Thumbnail

View/Open
[PBI_Special_Publication25.pdf](#)
(16.29Mb)

URI
<http://hdl.handle.net/1808/24421>

Collections
Special Publication [1]

Citation
Caira, J. N. and K. Jensen (eds.). 2017. Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, 463 pp.

Issue Date
2017-07-20

Author
Caira, Janine N.
Jensen, Kirsten

Publisher
Natural History Museum, University of Kansas

Search

Search KU ScholarWorks
This Collection

BROWSE

All of KU ScholarWorks
Communities & Collections
This Collection

MY ACCOUNT

Login
Register

STATISTICS

View Usage Statistics



Dissemination

Parasitology > University of Conn: x

tapeworms.uconn.edu

UCONN Parasitology

A Survey of the Tapeworms (Cestoda: Platyhelminthes) from Vertebrate Bowels of the Earth

HOME PARTICIPANTS ACTIVITIES PRODUCTS RESOURCES

DBs best viewed in [Firefox](#)

Host Databases

Global Cestode Database

Citation Database

ABOUT THE TAPEWORM ORDERS

ABOUT TAPEWORMS:
Tapeworms (or cestodes) are a Class of platyhelminths that as adults are obligate parasites in the gut of vertebrates. They themselves lack a digestive system and are unique in their possession of elaborations called microtriches throughout their outer surface; among other functions, these structures appear to aid in absorption of nutrients. The life cycles of tapeworms are complex often involving a series of 3 or more hosts; they transfer between these hosts when one host consumes another. The ~6,000 tapeworm species comprise 18 Orders that differ most conspicuously in the form of their attachment structure, the scolex.

[Illustrated Glossary](#)

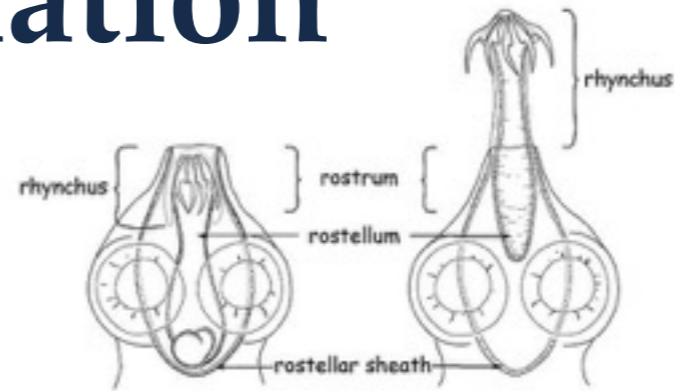
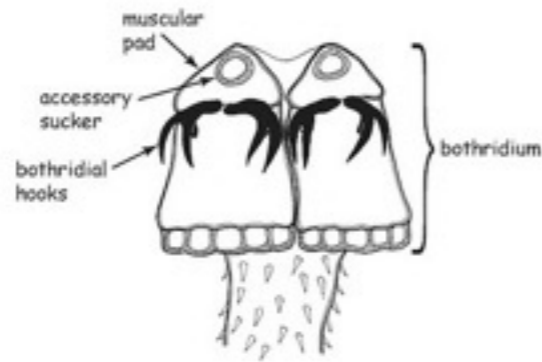
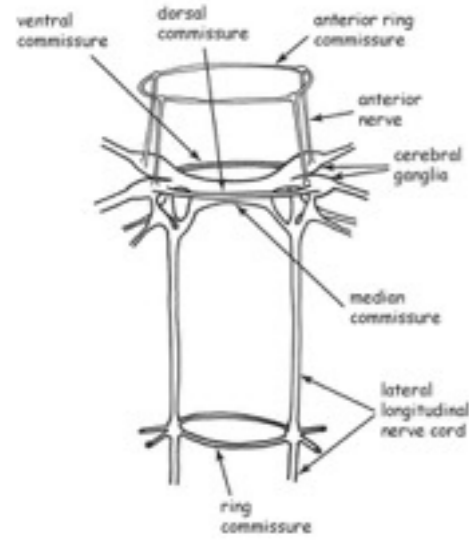
ABOUT THE PROJECT:
This NSF funded project is a collaborative effort among cestode experts from 21 countries around the world. Its primary goal is to expand knowledge of tapeworms globally. Thus, in addition to discovering novelty through examination of vertebrate hosts and geographic regions that have not previously been explored for tapeworms, it aims to compile and synthesize existing taxonomic information on cestodes so as to make it easily and publicly available. Furthermore, it aims to provide a database system for effectively tracking host/parasite data.

NSF PBI Award
Nos. 0818696 & 0818823

EEB KU THE UNIVERSITY OF KANSAS



Dissemination

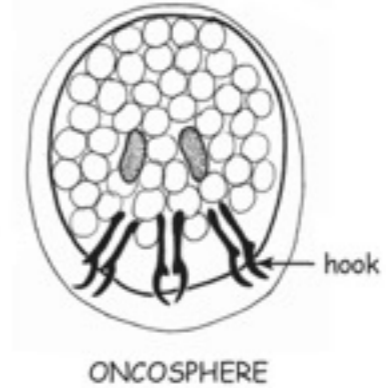
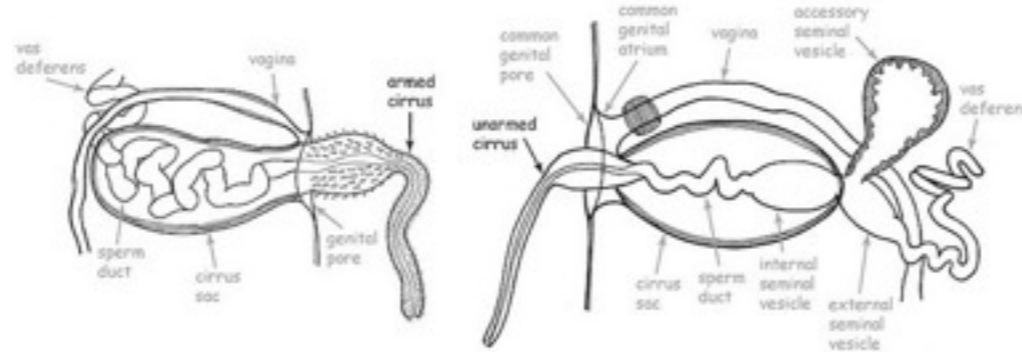
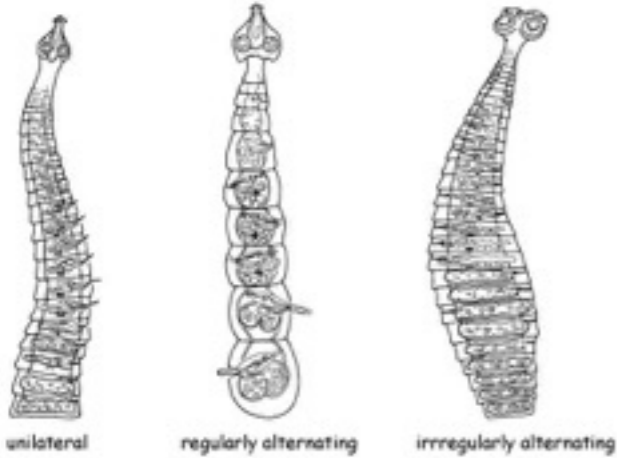


SCOLEX WITH RETRACTILE ROSTELLUM

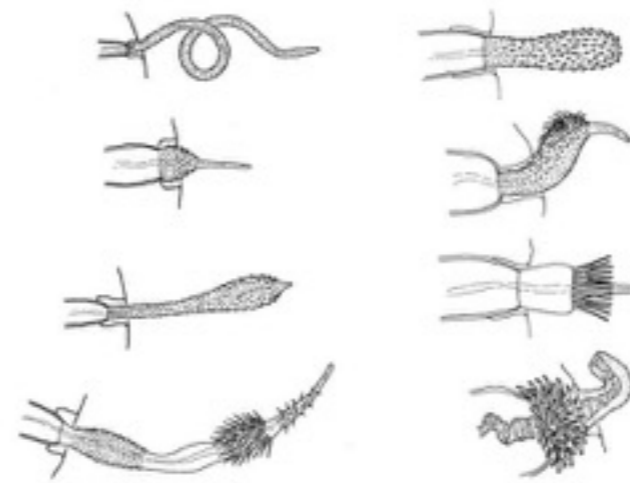
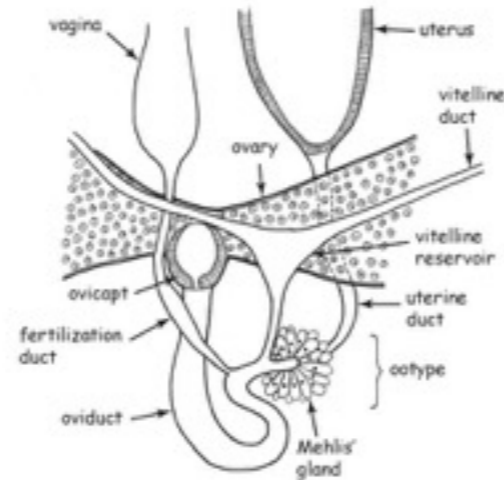
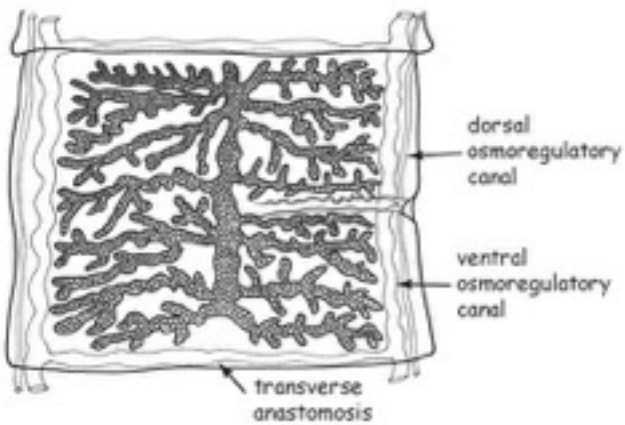
Illustrated Glossary

- LIST OF ILLUSTRATIONS**
- apical organ
 - apical organ (invaginated)
 - body regions
 - bothrial hooks
 - bothridium
 - bothrium
 - cirrus
 - cirrus (armed)
 - cirrus (evaginated)
 - coracidium

GENITAL PORES



ONCOSPHERE



EVAGINATED CIRRUS

- genital pores (separate)
- hermaphroditic sac
- lappet
- lateral diverticula
- loculi
- male ducts
- metascolex
- microtriches
- monozoic
- nerves
- onchosphere
- ootype
- paruterine capsule
- paruterine organ
- pedicel
- proglottid
- proglottid maturity
- protonephridia
- reproductive organs (1 set)
- reproductive organs (2 sets)
- rostellar apparatus (invaginable)
- rostellar apparatus (retractile)
- rostellum
- rostellum (retracted)
- scolex (monobothriate)
- stalk



Dissemination

Parasitology > University of Conn: x

tapeworms.uconn.edu

UCONN Parasitology

A Survey of the Tapeworms (Cestoda: Platyhelminthes) from Vertebrate Bowels of the Earth

HOME PARTICIPANTS ACTIVITIES PRODUCTS RESOURCES

DBs best viewed in [Firefox](#)

Host Databases

Global Cestode Database

Citation Database

ABOUT THE TAPEWORM ORDERS

ABOUT TAPEWORMS:
Tapeworms (or cestodes) are a Class of platyhelminths that as adults are obligate parasites in the gut of vertebrates. They themselves lack a digestive system and are unique in their possession of elaborations called microtriches throughout their outer surface; among other functions, these structures appear to aid in absorption of nutrients. The life cycles of tapeworms are complex often involving a series of 3 or more hosts; they transfer between these hosts when one host consumes another. The ~6,000 tapeworm species comprise 18 Orders that differ most conspicuously in the form of their attachment structure, the scolex.

[Illustrated Glossary](#)

ABOUT THE PROJECT:
This NSF funded project is a collaborative effort among cestode experts from 21 countries around the world. Its primary goal is to expand knowledge of tapeworms globally. Thus, in addition to discovering novelty through examination of vertebrate hosts and geographic regions that have not previously been explored for tapeworms, it aims to compile and synthesize existing taxonomic information on cestodes so as to make it easily and publicly available. Furthermore, it aims to provide a database system for effectively tracking host/parasite data.

NSF PBI Award
Nos. 0818696 & 0818823

EEB KU THE UNIVERSITY OF KANSAS



Global Cestode Database

of records: 12,274
 # of valid genera: 592
 # of valid species: 3,143

TAPEWORM SPECIES DETAILS
Arostrelepis intermedia Makarikov & Kontrimavichus, 2011 (Cyclophyllidae: Hymenolepididae)

Cestode Scientific Name	Type Host	Type Locality
Species ID: 9960	Host Class: Rodentia	Country: Russia
Order: Cyclophyllida	Host Order: Criconidae	Body of Water: Sakhalin Island
Family: Hymenolepididae	Type Host (Literal): Genus: <i>Myodes</i>	City/Region: Poronayskiy Reserve
Subfamily:	Species: <i>rufocanus</i>	Coordinates: 49°16'N, 143°58'E
Genus: <i>Arostrelepis</i>	Subspecies:	Additional Localities: Bauntovskiy Rayon, Bol'shoy Amalot River, Republic of Buryatia, Russia; Gorniy Rayon, Sredne-Kolym'skiy Rayon, Yakutia; Amgun' River, Khabarovskiy Kray
Species: <i>intermedia</i>	Type Host (Valid): Genus: <i>Myodes</i>	Locality Notes:
Authority: Makarikov & Kontrimavichus, 2011	Species: <i>rufocanus</i>	
Taxonomic Status: Valid name	Subspecies:	
Valid Name:	Additional Host(s): <i>Myodes rufocanus</i>	
Synonyms:	Site in Host: small intestine	
Genus Record: No	Host Notes:	
Type Species: No		
Type of Genus: no		
Verified: Yes		
Verified By: A. Makarikov		
Citation(s): Makarikov, A. A. and V. L. Kontrimavichus, 2011. A redescription of <i>Arostrelepis beringensis</i> (Kontrimavichus et Smirnova, 1991) and descriptions of two new species from Palearctic micropine rodents, <i>Arostrelepis intermedia</i> sp. n. and <i>A. janickii</i> sp. n. (Cestoda: Hymenolepididae). <i>Folia Parasitologica</i> 58(4): 289-301. [2014] Download PDF		
Redescription:		
Scientific Name Notes:		

Record Data		
Date (mm/dd/yyyy)	Action	User Name
10/12/2012	Created	A. Makarikov
08/29/2014	Modified	
06/01/2016	Modified	B. Barber

TAPEWORM SPECIES DETAILS
Arostrelepis intermedia Makarikov & Kontrimavichus, 2011 (Cyclophyllidae: Hymenolepididae)

Unique Taxon Code: *Arostinter*

Original Description

Original Figures

Line Drawing 1

Line Drawing 2

Photo Micrograph

Scanning Electron Micrograph

Fig. 1. *Arostrelepis intermedia* sp. n. A - dorso-ventral view of scolex (No. 18.28.5.13); B - sublateral view of scolex (No. 18.28.5.13); C - holotype, male mature proglottides; D - holotype, hermaphr... More

Fig. 2. *Arostrelepis intermedia* sp. n. A - cirrus; B - egg; C - holotype, copulatory part of vagina; D - holotype, gravid proglottis. Scale bars: A, B - 20 µm; C - 100 µm; D - 500 µm

Redescription

Redescription Figures

New Combination



Dissemination

Parasitology > University of Conn: x

tapeworms.uconn.edu

UCONN Parasitology

A Survey of the Tapeworms (Cestoda: Platyhelminthes) from Vertebrate Bowels of the Earth

HOME PARTICIPANTS ACTIVITIES PRODUCTS RESOURCES

DBs best viewed in [Firefox](#)

Host Databases

Global Cestode Database

Citation Database

ABOUT THE TAPEWORM ORDERS

ABOUT TAPEWORMS:
Tapeworms (or cestodes) are a Class of platyhelminths that as adults are obligate parasites in the gut of vertebrates. They themselves lack a digestive system and are unique in their possession of elaborations called microtriches throughout their outer surface; among other functions, these structures appear to aid in absorption of nutrients. The life cycles of tapeworms are complex often involving a series of 3 or more hosts; they transfer between these hosts when one host consumes another. The ~6,000 tapeworm species comprise 18 Orders that differ most conspicuously in the form of their attachment structure, the scolex.

[Illustrated Glossary](#)

ABOUT THE PROJECT:
This NSF funded project is a collaborative effort among cestode experts from 21 countries around the world. Its primary goal is to expand knowledge of tapeworms globally. Thus, in addition to discovering novelty through examination of vertebrate hosts and geographic regions that have not previously been explored for tapeworms, it aims to compile and synthesize existing taxonomic information on cestodes so as to make it easily and publicly available. Furthermore, it aims to provide a database system for effectively tracking host/parasite data.

NSF PBI Award
Nos. 0818696 & 0818823

E.E.B. KU THE UNIVERSITY OF KANSAS



Dissemination

of citations: 3,887

The screenshot displays the Global Cestode Database interface. The main content area shows the citation details for a 2017 paper by Caira, J. N., C. J. Healy, F. P. L. Marques, and K. Jensen. The citation is titled "Three new genera of rhinebothriidean cestodes from stingrays in Southeast Asia" and is published in *Folia Parasitologica*, volume 64, pages 008 (18 pp.). The citation type is a journal article. The page also lists associated tapeworm records, including *Barbeaencestus* and *Divaricobothrium* species. A PDF of the paper is available for download (11.37 Mb).

Citation			
Author(s)	Caira, J. N., C. J. Healy, F. P. L. Marques, and K. Jensen	Complete Citation	Caira, J. N., C. J. Healy, F. P. L. Marques, and K. Jensen. 2017. Three new genera of rhinebothriidean cestodes from stingrays in Southeast Asia. <i>Folia Parasitologica</i> 64: 008 (18 pp.).
Year	2017		
Title	Three new genera of rhinebothriidean cestodes from stingrays in Southeast Asia	Notes	Associated Tapeworm Records (13826) <i>Barbeaencestus</i> (13829) <i>Barbeaencestus jockuschae</i> (13830) <i>Barbeaencestus calickiae</i> (13831) <i>Barbeaencestus sexorchidus</i> (13832) <i>Barbeaencestus shinleyi</i> (13827) <i>Divaricobothrium</i> (13833) <i>Divaricobothrium tribelium</i> (13834) <i>Divaricobothrium trifidum</i> (13828) <i>Synsaccestus</i> (13835) <i>Synsaccestus kinabatanganensis</i>
Citation Type	Journal Article		
Journal	<i>Folia Parasitologica</i>		
Book Title		PDF	Cairaetal(2017).pdf 11.37Mb Download
Editor(s)			
Publisher			
Volume(Issue)	64		
Page Numbers	008 (18 pp.)		
City			
Citation ID	7003		



Dissemination

Parasitology > University of Conn: x

tapeworms.uconn.edu

UCONN Parasitology

A Survey of the Tapeworms (Cestoda: Platyhelminthes) from Vertebrate Bowels of the Earth

HOME PARTICIPANTS ACTIVITIES PRODUCTS RESOURCES

DBs best viewed in Firefox

Host Databases

Global Cestode Database

Citation Database

ABOUT THE TAPEWORM ORDERS

DIPHYLLIDEA CYCLOPHYLLEIDA
TRYPANORHYNCHA GYROCOTYLIDEA NIPPOTAENIIDEA
TETRABOTHRIZIDEA SPATHEBOTHRIZIDEA
RHINEBOTHRIZIDEA CATHETOCEPHALIDEA
CARYOPHYLLIDEA PROTOCEPHALIDEA
LECANICEPHALIDEA TETRAPHYLLEIDA
BOTHRIOCEPHALIDEA DIPHYLLOBOTHRIZIDEA
LITOBOTHRIZIDEA HAPLOBOTHRIZIDEA AMPHILINIDEA

ABOUT TAPEWORMS:
Tapeworms (or cestodes) are a Class of platyhelminths that as adults are obligate parasites in the gut of vertebrates. They themselves lack a digestive system and are unique in their possession of elaborations called microtriches throughout their outer surface; among other functions, these structures appear to aid in absorption of nutrients. The life cycles of tapeworms are complex often involving a series of 3 or more hosts; they transfer between these hosts when one host consumes another. The ~6,000 tapeworm species comprise 18 Orders that differ most conspicuously in the form of their attachment structure, the scolex.

ABOUT THE PROJECT:
This NSF funded project is a collaborative effort among cestode experts from 21 countries around the world. Its primary goal is to expand knowledge of tapeworms globally. Thus, in addition to discovering novelty through examination of vertebrate hosts and geographic regions that have not previously been explored for tapeworms, it aims to compile and synthesize existing taxonomic information on cestodes so as to make it easily and publicly available. Furthermore, it aims to provide a database system for effectively tracking host/parasite data.

NSF PBI Award
Nos. 0818696 & 0818823

E.E.B. KU THE UNIVERSITY OF KANSAS



Dissemination

Global Cestode Database

tapewormdb.uconn.edu/index.php/hosts/specim

Global Cestode Database

ELASMOBRANCH SPECIM

ID		Sex
Collection Code	<input type="text"/>	
Collection No.	<input type="text"/>	
Genus	<input type="text"/>	
Species	<input type="text"/>	
ID Verified	<input type="checkbox"/> Yes <input type="checkbox"/> No	
ID Verified By	<input type="text"/>	
Order	<input type="text"/>	
Family	<input type="text"/>	
ID Notes	<input type="text"/>	

RECORD DATA	
Created By	<input type="text"/>
Date Created (MM/DD/YYYY)	<input type="text"/>
Modified By	<input type="text"/>
Date Modified (MM/DD/YYYY)	<input type="text"/>

Host Notes

Search Strict Loose

Best viewed in Firefox

Global Cestode Database

Elasmobranchs Specimens

+ Add + CSV Control Panel

ELASMOBRANCH SPECIMEN DETAILS


BO - 400 *Maculabatis macrura*

New Search Edit Record

ID	Host Specimen Attributes	Locality	Associated Parasites
Species ID No. 1284	Sex male	Collection Date (mm/dd/yyyy) 4/19/2004	Parasites 10% NBF 95% EtOH 10% NBF Picked
Collection Code BO	Maturity immature	Collected By J. N. Caira	Valve Yes
Collection No. 400	Freshness specimen pithed	Source of Specimen	Sift
Genus <i>Maculabatis</i>	PCL (cm)	Collection Method trawling	Worms Yes (NBF) Yes n/a
Species <i>macrura</i>	Disk Length (cm) 43	Collection Depth (m)	Parasite Specimens (8)
Common Name (was <i>Himantura cf. gerrardi</i>)	Disk Width (cm) 49.5	Country Malaysia	Parasite Notes valve at KU; 1 vial Rhinebothridea in 70% EtOH to Tim R.
ID Verified Yes	Total Length (cm) 162.5	Ocean Pacific Ocean	
ID Verified By H. Ralicki, J. Caira & K. Jensen	Host Specimen Necropsied	Body of Water/River South China Sea	
Class Elasmobranchii	Host Specimen Deposition Saved No	River Basin	
Order Myliobatiformes	Accession No.	Island(s) Borneo	
Family Dasyatidae	DNA Samples Saved Yes	State/Province Sarawak	
ID Notes full spot: K. K. Manchong, Kuching Fisheries, Haul No. 1; -live -immature -3 blood smears taken -stomach lesions fixed in formalin -nose bulbs and 5 right gill arches tshaken in seawater then fixed in formalin -gnathids taken from gills -pericardium, body cavity and cloaca checked, no parasites seen. Included in Naylor et al. (2011); valve at KU	DNA Samples Deposition - G. Naylor at Florida State- J. Caira at UConn- P. Last at CSIRO	City	
	ND2 Data Generated Yes	Coordinates 02°00'00.00"N, 110°37'60.00"E	
	GN No. 3612	Decimal Degree Latitude	
	ND2 Sequence Data	Decimal Degree Longitude	
	Genbank No.		
	Cophylogeny Specimen Yes		
	Host Notes		

Record Data		
Date (MM/DD/YYYY)	Action	User Name
01/26/2009	Created	
02/22/2012	Modified	
08/31/2015	Modified	J. Caira
08/06/2016	Modified	J. Caira







Image

Caption dorsal view ventral view head (dorsal view) mouth mid-dorsal denticles

New Search Back to Search Results

Best viewed in Firefox

NSF PBI AWARD Nos. 0818606 & 0818823

University of Connecticut

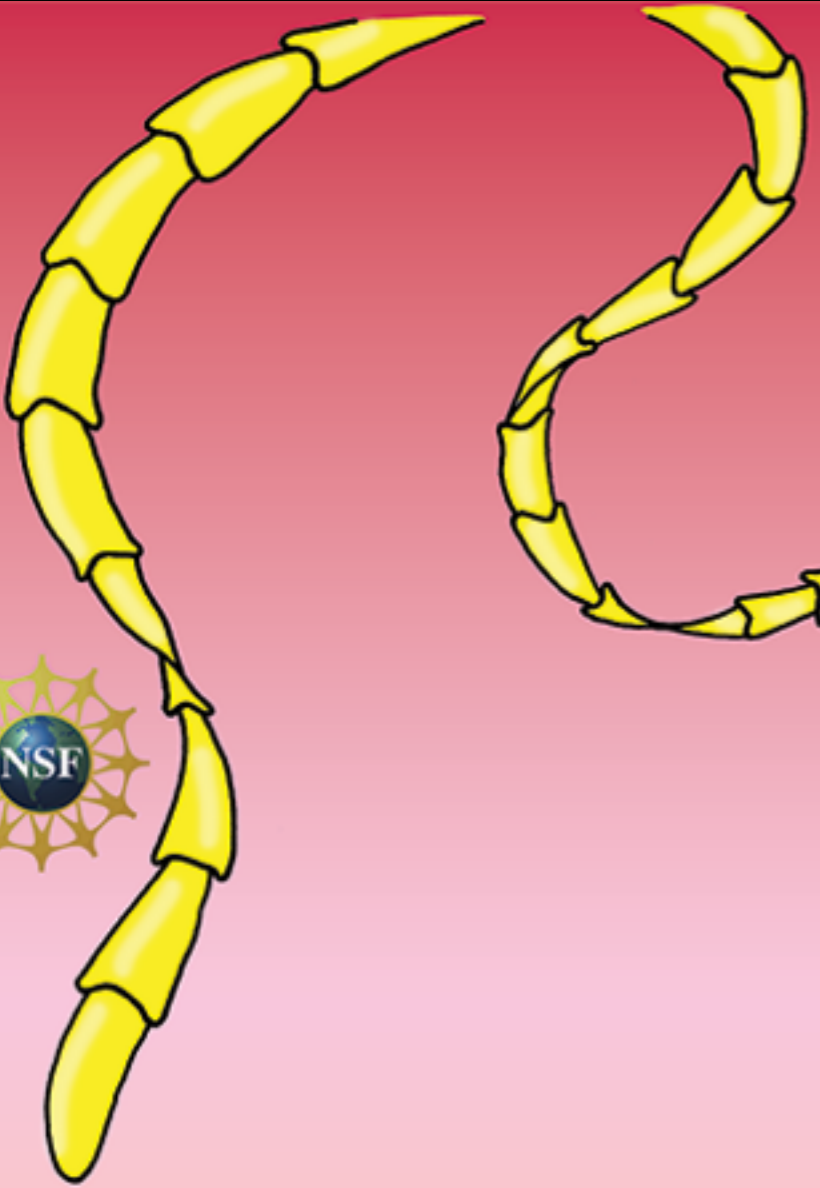
KU KANSAS



Outreach

University of Kansas,
Natural History Museum





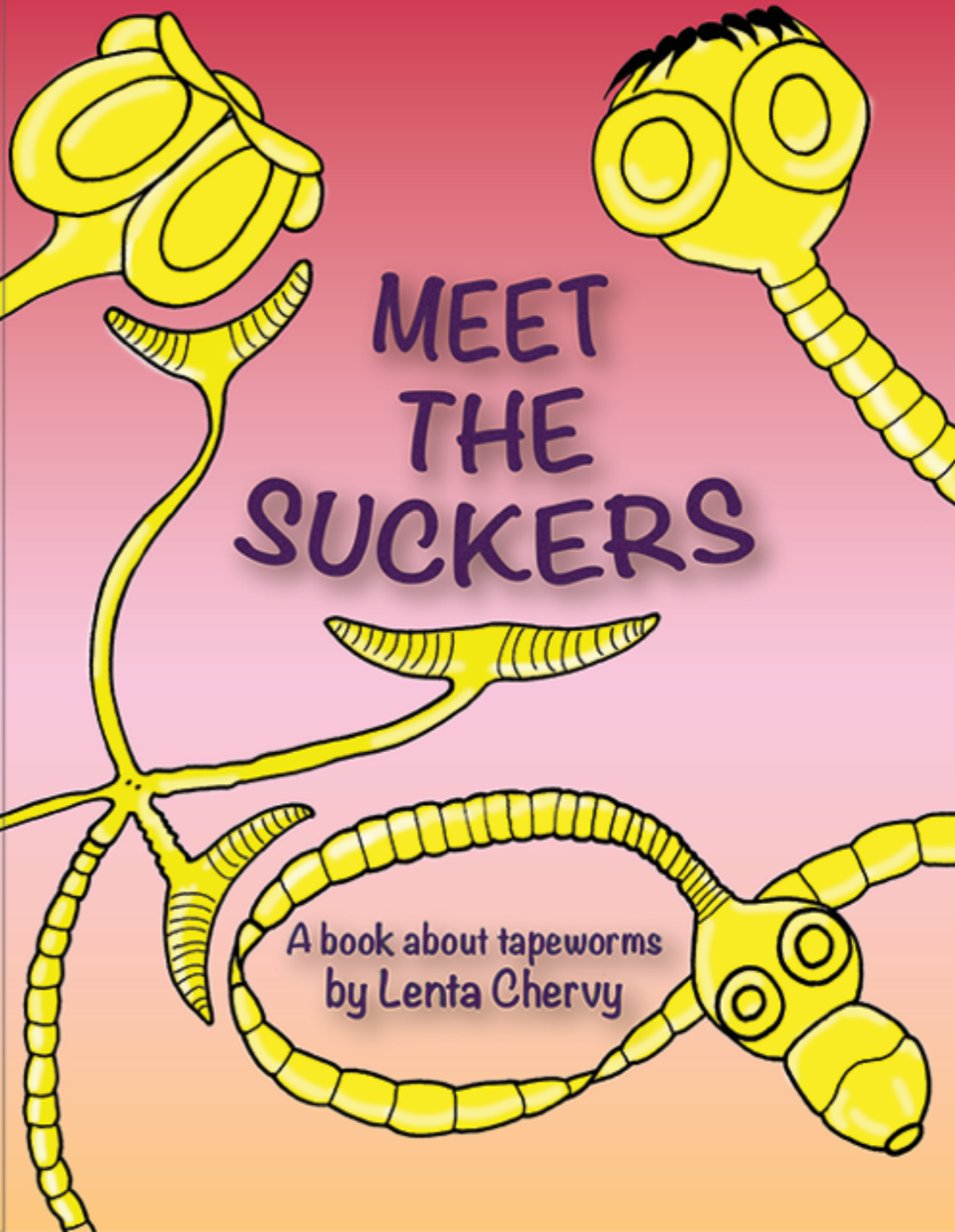
Chervy

MEET THE SUCKERS



MEET THE SUCKERS

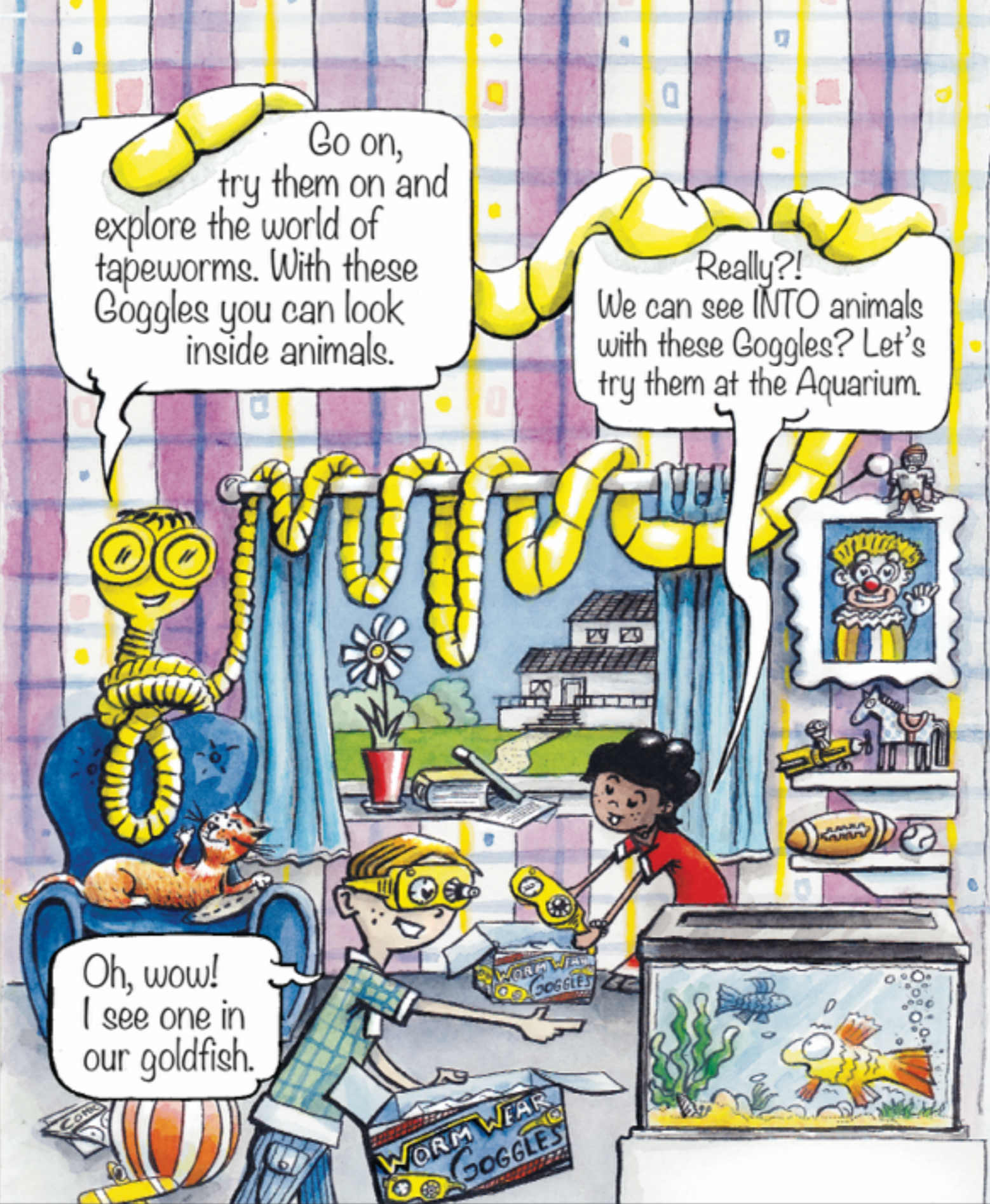
A book about tapeworms
by Lenta Chervy



Go on,
try them on and
explore the world of
tapeworms. With these
Goggles you can look
inside animals.

Really?!
We can see INTO animals
with these Goggles? Let's
try them at the Aquarium.

Oh, wow!
I see one in
our goldfish.



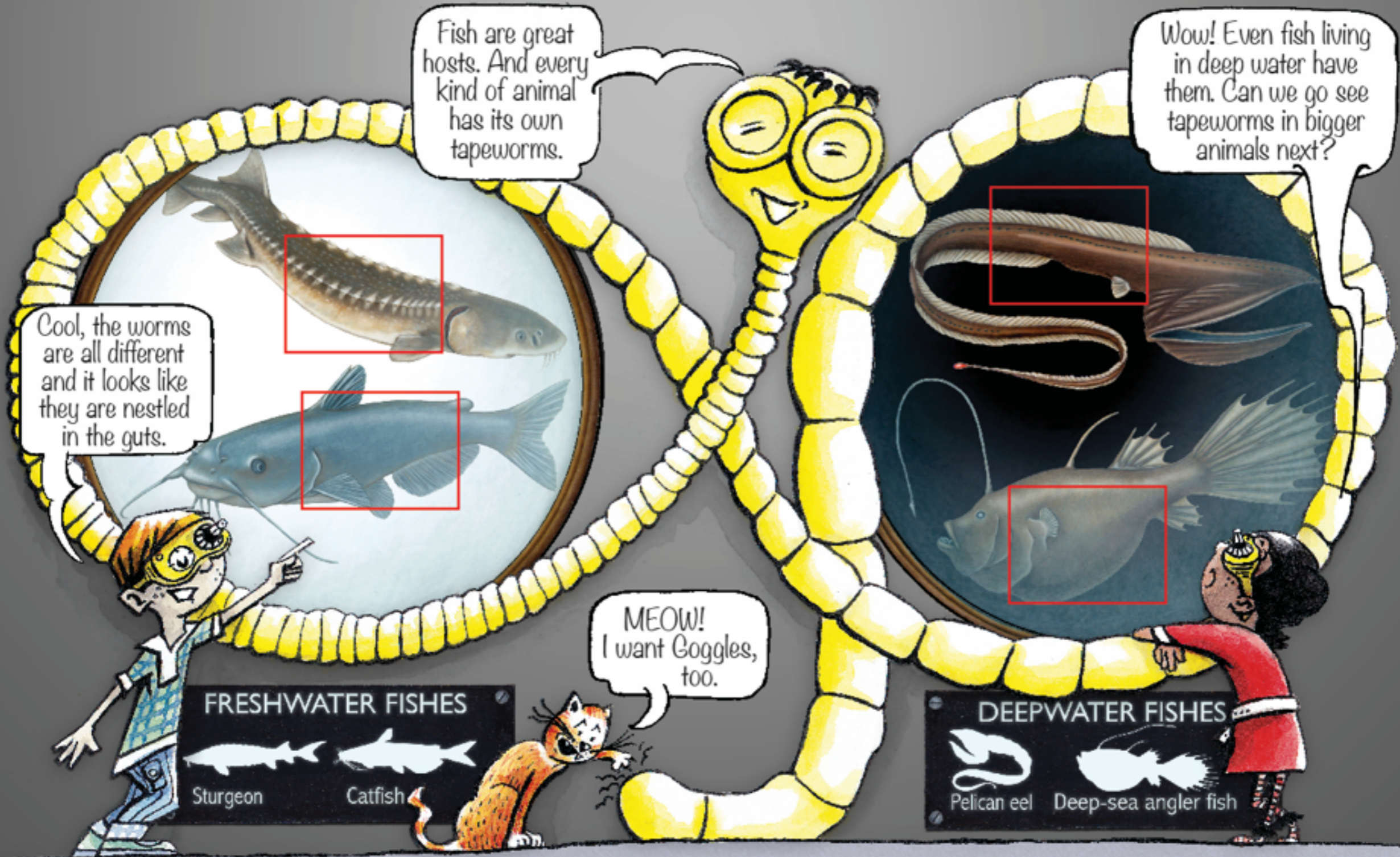
Cyri, the spokesworm, arrives with Worm Wear Goggles for Briar and Jacob and opens up for them a whole new exciting world that had been hidden to them until now.

Fish are great hosts. And every kind of animal has its own tapeworms.

Wow! Even fish living in deep water have them. Can we go see tapeworms in bigger animals next?

Cool, the worms are all different and it looks like they are nestled in the guts.

MEOW!
I want Goggles, too.



FRESHWATER FISHES



Sturgeon

Catfish

DEEPWATER FISHES

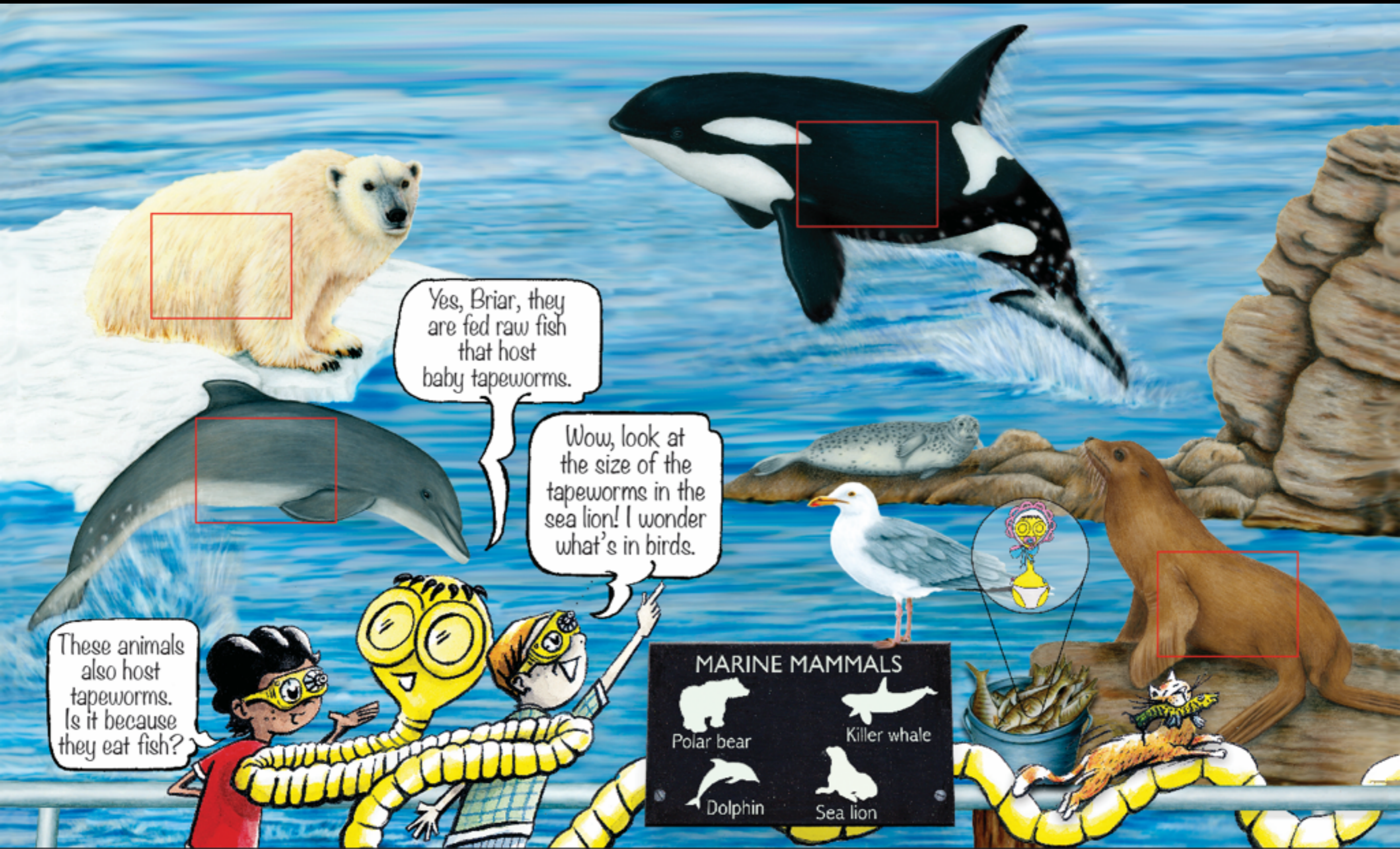


Pelican eel

Deep-sea angler fish

At the Aquarium, with Cyri and their Worm Waer Goggles, the kids begin to see that most animals have tapeworms that live inside of them. Different kinds of tapeworms,...

...live in different kinds of animals. In their hosts, tapeworms are snuggled into the surface of their host's gut. Except for Cyri, tapeworms cannot live outside their hosts.



Yes, Briar, they are fed raw fish that host baby tapeworms.

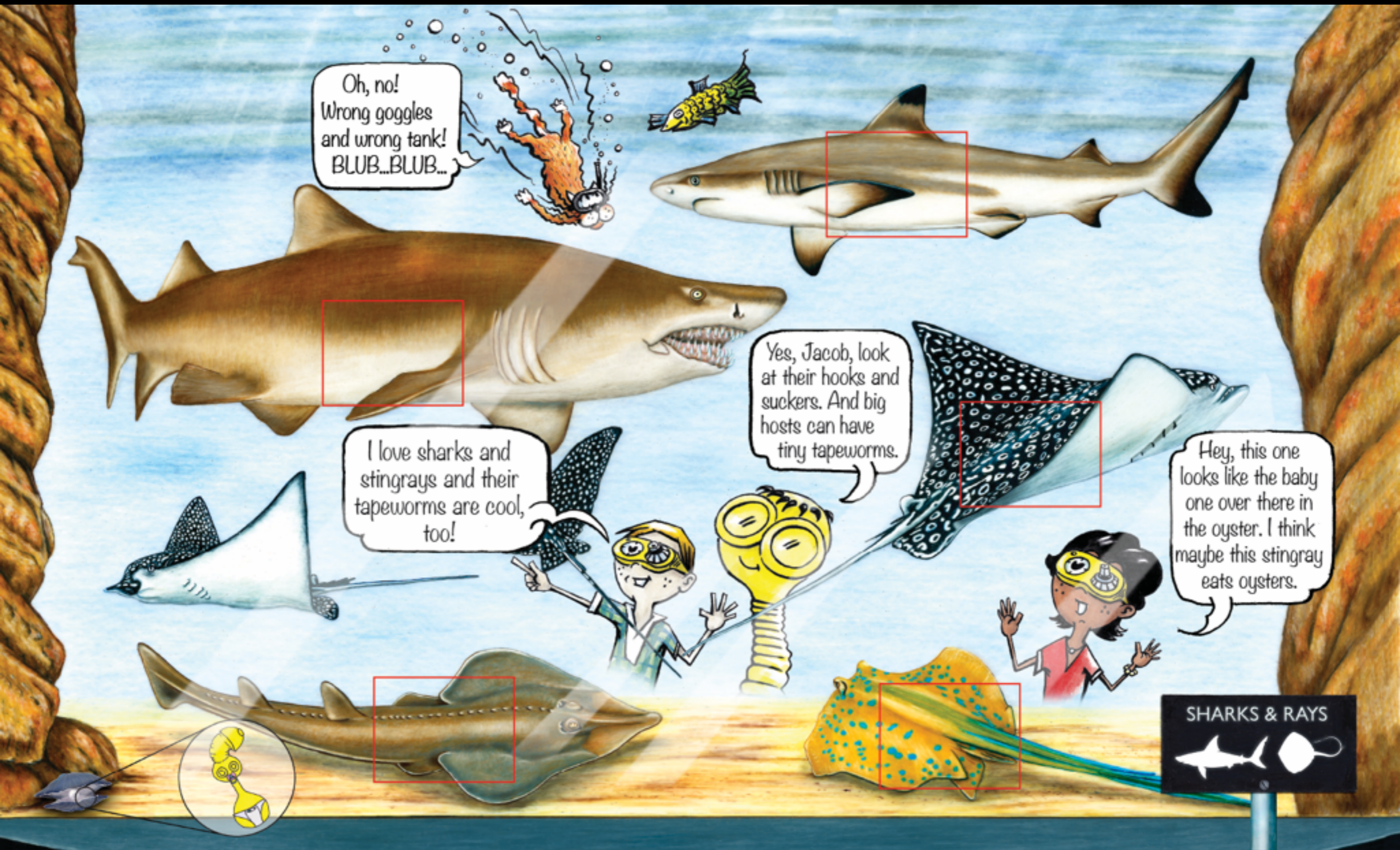
Wow, look at the size of the tapeworms in the sea lion! I wonder what's in birds.

These animals also host tapeworms. Is it because they eat fish?

MARINE MAMMALS
Polar bear
Killer whale
Dolphin
Sea lion

In the marine mammal exhibit, Briar and Jacob see their second baby tapeworm and learn that hosts get their tapeworms from food, such as raw fish.

They see one of the biggest tapeworms there inside of a killer whale. They also see that animals that live in ice, like polar bears, can have tapeworms.



Oh, no!
Wrong goggles
and wrong tank!
BLUB...BLUB...

Yes, Jacob, look
at their hooks and
suckers. And big
hosts can have
tiny tapeworms.

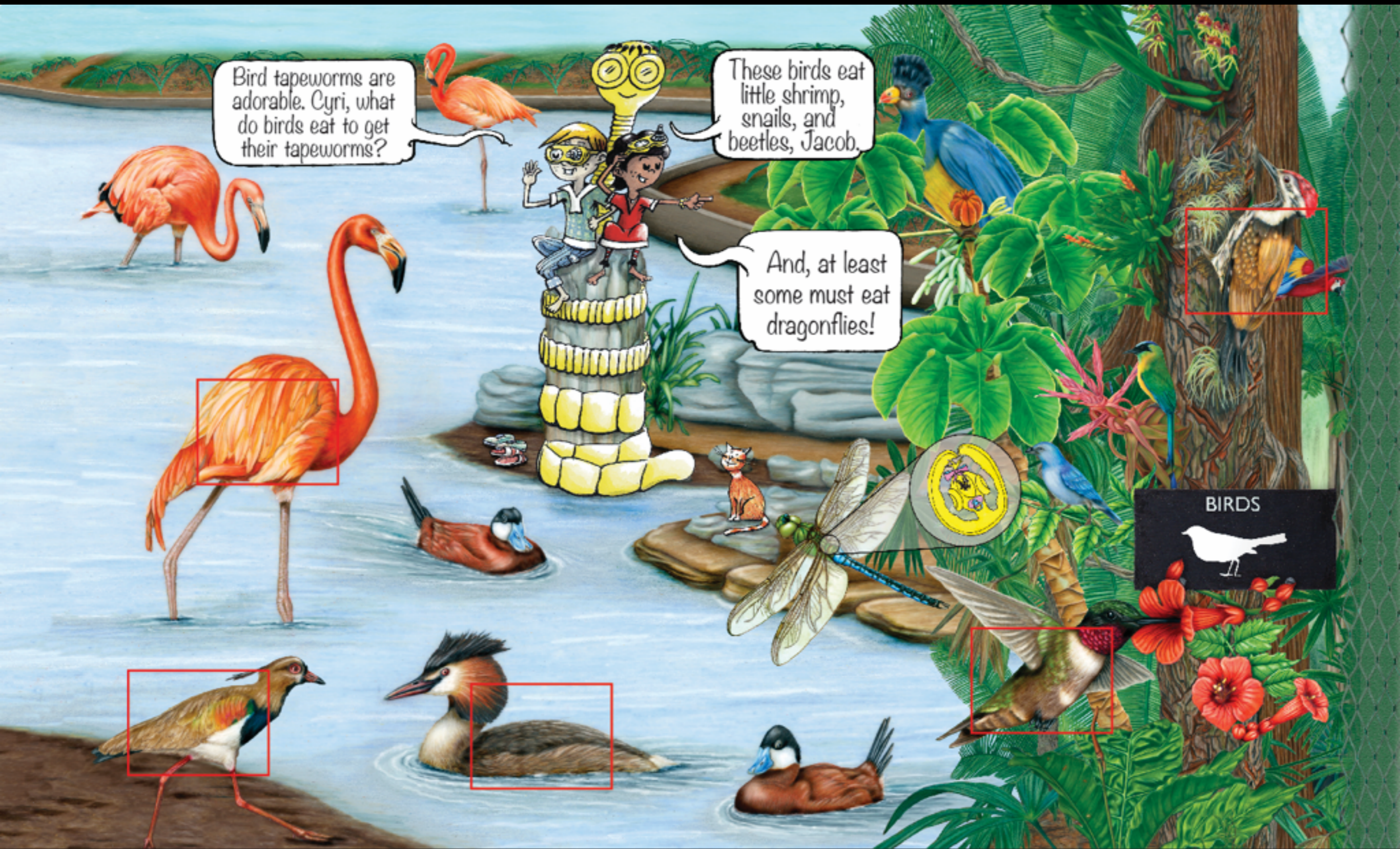
I love sharks and
stingrays and their
tapeworms are cool,
too!

Hey, this one
looks like the baby
one over there in
the oyster. I think
maybe this stingray
eats oysters.

SHARKS & RAYS

In the shark and stingray tanks, Briar and Jacob see all sorts of beautiful tapeworms. Some sharks and stingrays even host more than one kind of tapeworm.

They see that each type of tapeworm attaches to the gut in its own unique way. Living in a scallop on the floor of the tank they also see their first baby tapeworm.



Bird tapeworms are adorable. Cyri, what do birds eat to get their tapeworms?

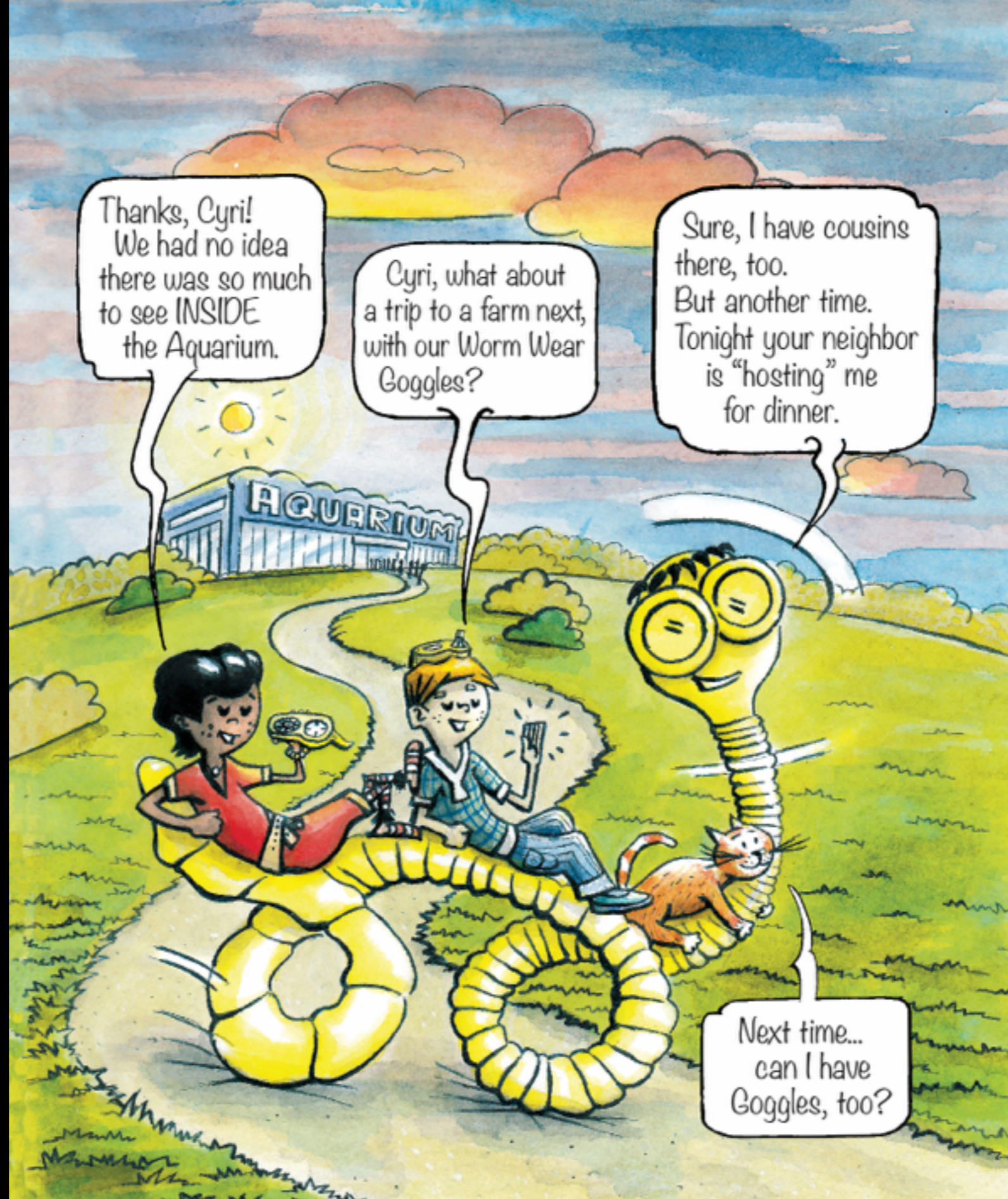
These birds eat little shrimp, snails, and beetles, Jacob.

And, at least some must eat dragonflies!

BIRDS


It turns out that all sorts of birds also host tapeworms—wading birds, ducks, flamingos, woodpeckers, and even hummingbirds.

Many of the tapeworms of birds are funny little creatures. The tapeworms of wading birds are so small that as babies they live in dragonflies.



Thanks, Cyri!
We had no idea
there was so much
to see **INSIDE**
the Aquarium.

Cyri, what about
a trip to a farm next,
with our Worm Wear
Goggles?

Sure, I have cousins
there, too.
But another time.
Tonight your neighbor
is "hosting" me
for dinner.

Next time...
can I have
Goggles, too?

Watch out for the next adventure of Briar and Jacob and their spokesworm Cyri when they "meet the suckers" of farm animals.

Publications

2017

of publications: 220+

- Alves, P. V., A. de Chambrier, J. L. Luque, and T. Scholz. 2017. Untangling convoluted taxonomy of *Chambrieria* (Proteocephalidae), with erection of *Riggenbachiella* n. g. and the description of a new species from pimelodid. *Parasitology* **94**: 367–389.
- Beveridge, I., M. Haseli, V. A. Ivanov, A. Menoret, and B. J. Schaeffner. 2017. Trypanorhyncha Diesing, 1863. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 401–429.
- Bueno, V. M.† and J. N. Caira. 2017. Redescription and molecular assessment of relationships among three species of *Echeneibothrium* (Rhinebothriidae: Echeneibothriidae) parasitizing the yellownose skate, *Dipturus chilensis*, in Chile. *Journal of Parasitology* **103**: 268–284.
- Caira, J. N., V. M. Bueno†, and K. Jensen. 2017. Cathetocephalidea Schmidt & Beveridge, 1990. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 65–76.
- Caira, J. N., K. Gallagher†, and K. Jensen. 2017. Litobothriidea Dailey, 1969. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 231–241.
- Caira, J. N., C. J. Healy, F. P. L. Marques, and K. Jensen. 2017. Three new genera of rhinebothriidean cestodes from stingrays from Southeast Asia. *Folia Parasitologica* **64**: 008 (18 pp.).
- Caira, J. N., V. Ivanov, K. Jensen, and F. P. L. Marques. 2017. Diphyllidea van Beneden in Carus, 1863. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 149–166.
- Caira, J. N. and K. Jensen (eds.). 2017. Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, 463 pp.
- Caira, J. N., K. Jensen, B. B. Georgiev, R. Kuchta, D. T. J. Littlewood, J. Mariaux, T. Scholz, V. V. Tkach, and A. Waeschenbach. 2017. An overview of tapeworms from vertebrate bowels of the earth. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 1–20.
- Caira, J. N., K. Jensen, and V. A. Ivanov. 2017. Onchoproteocephalidea II Caira, Jensen, Waeschenbach, Olson & Littlewood, 2014. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 279–304.
- Caira, J. N., K. Jensen, and T. R. Ruhnke. 2017. “Tetraphyllidea” van Beneden, 1850 relics. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 371–400.

de Chambrier, A., T. Scholz, J. Mariaux, and R. Kuchta. 2017. Onchoproteocephalidea I Caira, Jensen, Waeschenbach, Olson & Littlewood, 2014. *In* Planetary Biodiversity Inventory (2008–2017): Tapeworms from Vertebrate Bowels of the Earth. J. N. Caira and K. Jensen (eds.). University of Kansas, Natural History Museum, Special Publication No. 25, Lawrence, KS, USA, pp. 1–20.



