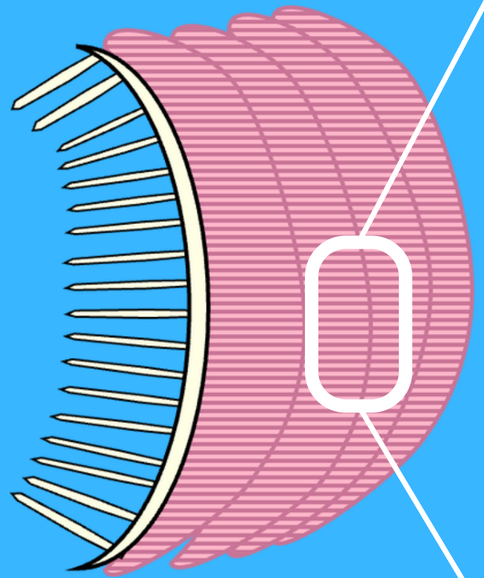
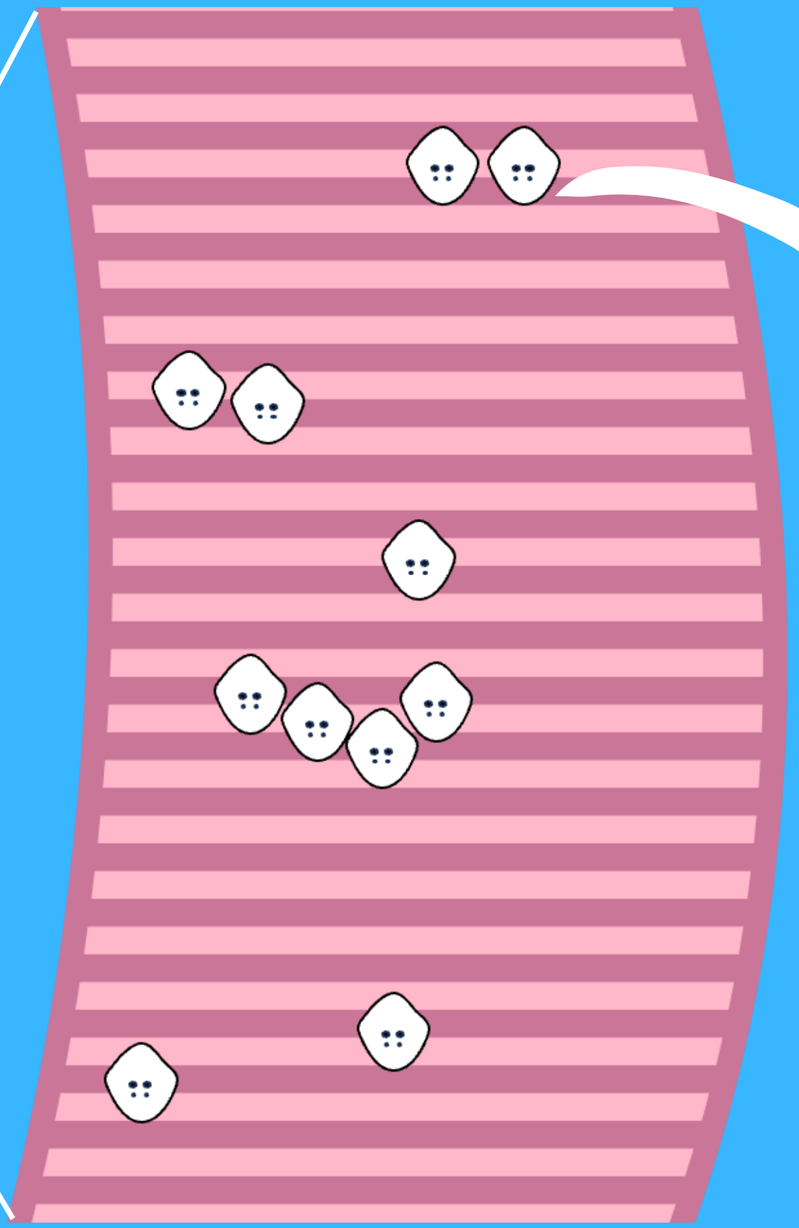
# INVESTIGATING THE GILL-OXYGEN LIMITATION THEORY IN THE CONTEXT OF GILL PARASITE DIVERSIFICATION

Kelly JM Thys, Nikol Kmentová, Maarten PM Vanhove, Maarten Van Steenberge

# WHY RELATE THE GOLT WITH PARASITES?

2D gill surface



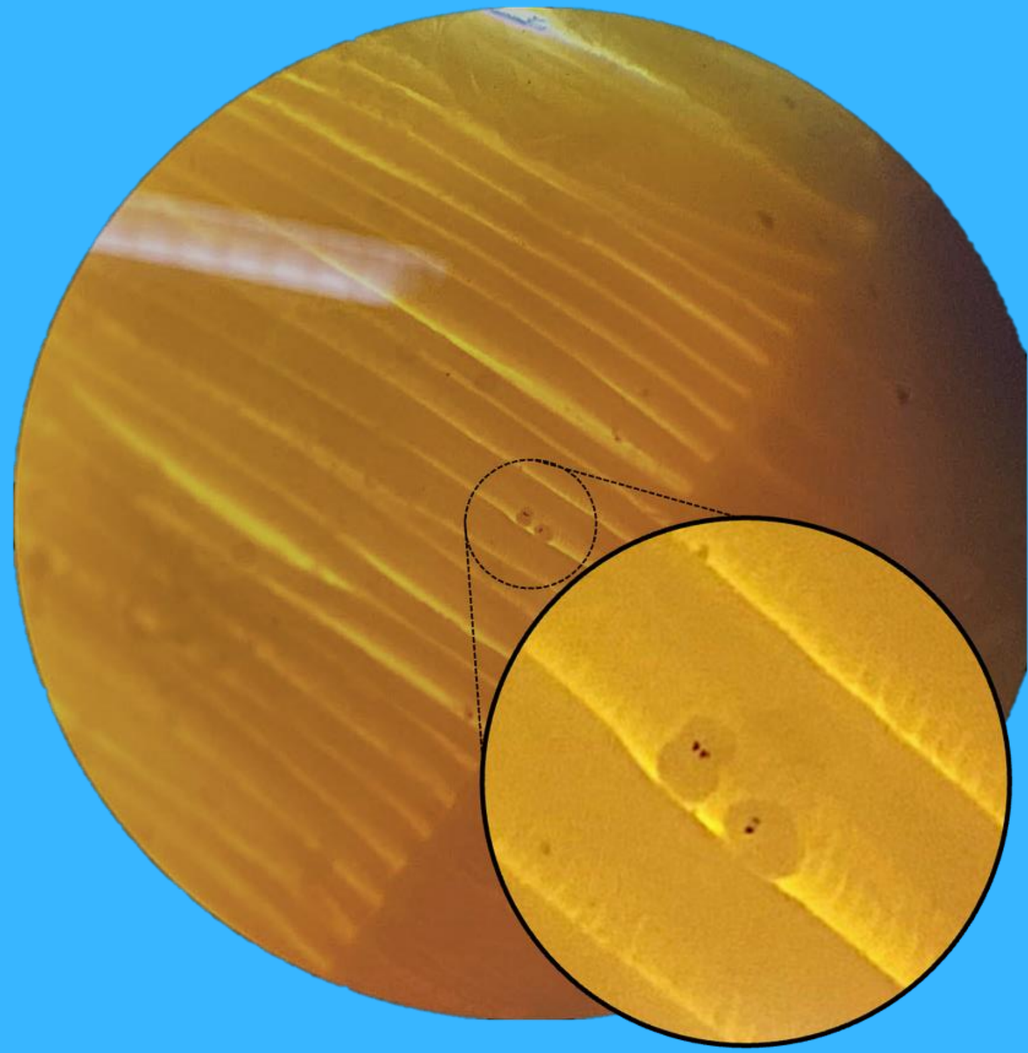


Monogenean gill parasite (fluke)

**Oxygen as limiting factor for the growth of the 3D bodies of WBEs**

# WHAT ARE MONOGENEANS?

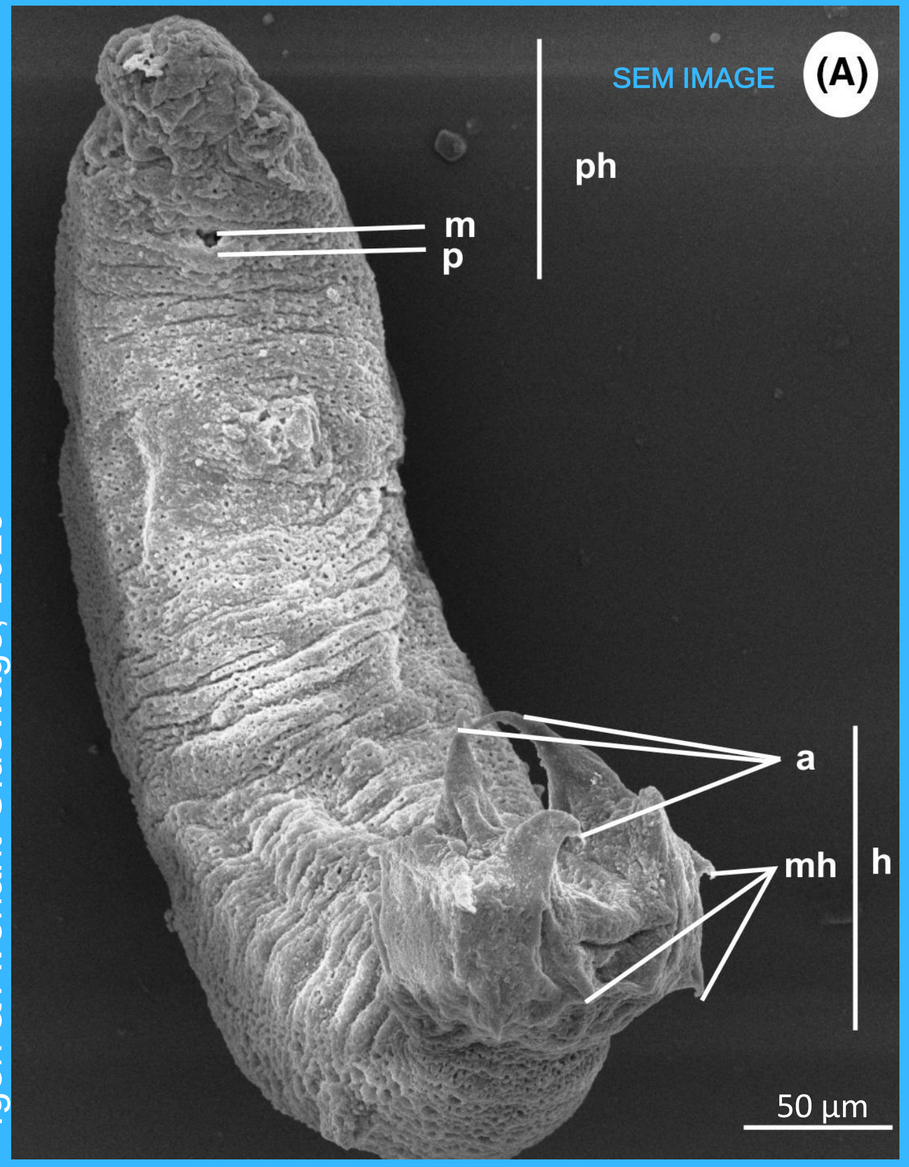
- Flatworm parasites of fish, frogs (WBEs)
- Ectoparasites on skin, gills, fins
- Hermaphroditic
- Direct lifecycle: no intermediate hosts



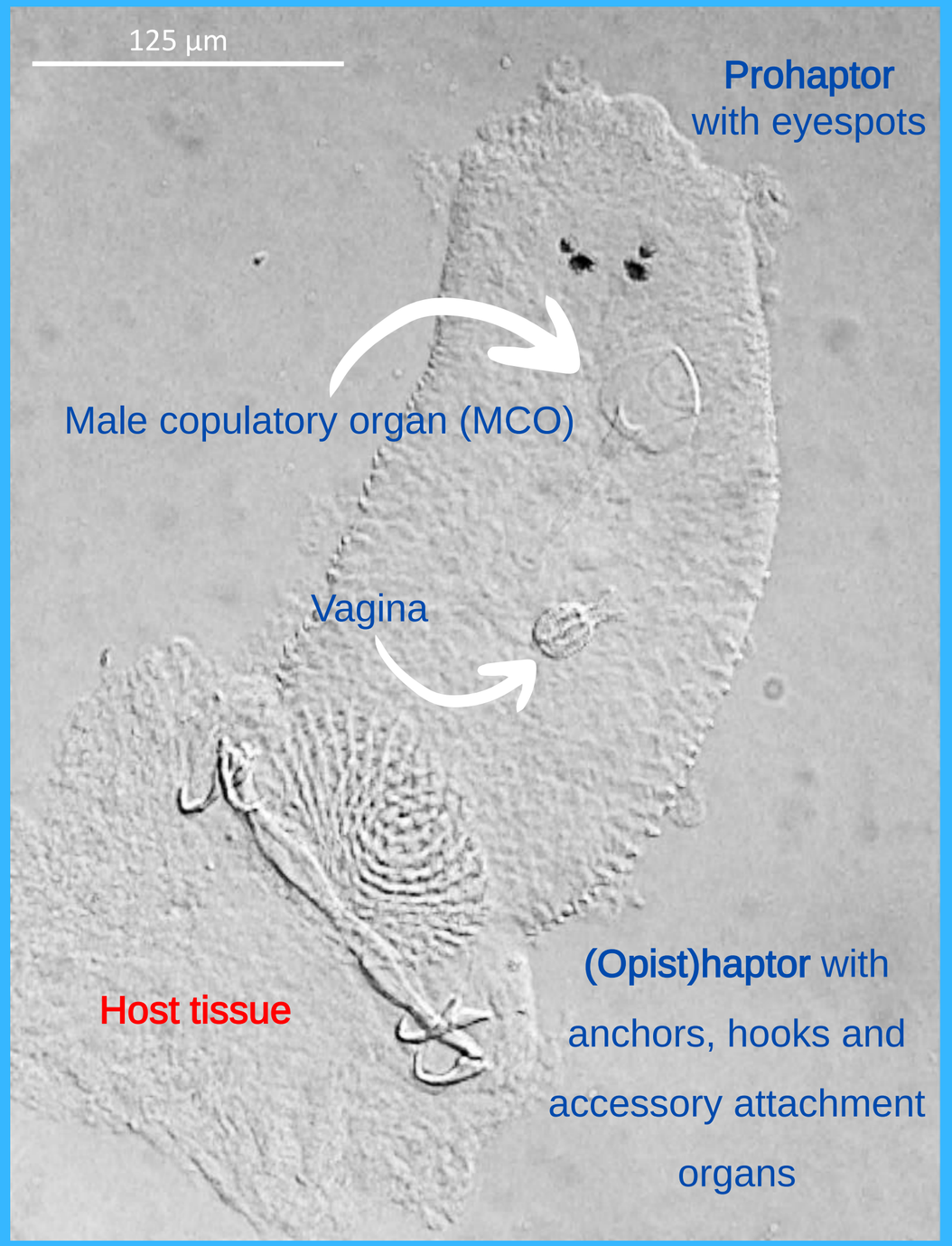
# USING MONOGENEA AS A MAGNIFYING GLASS

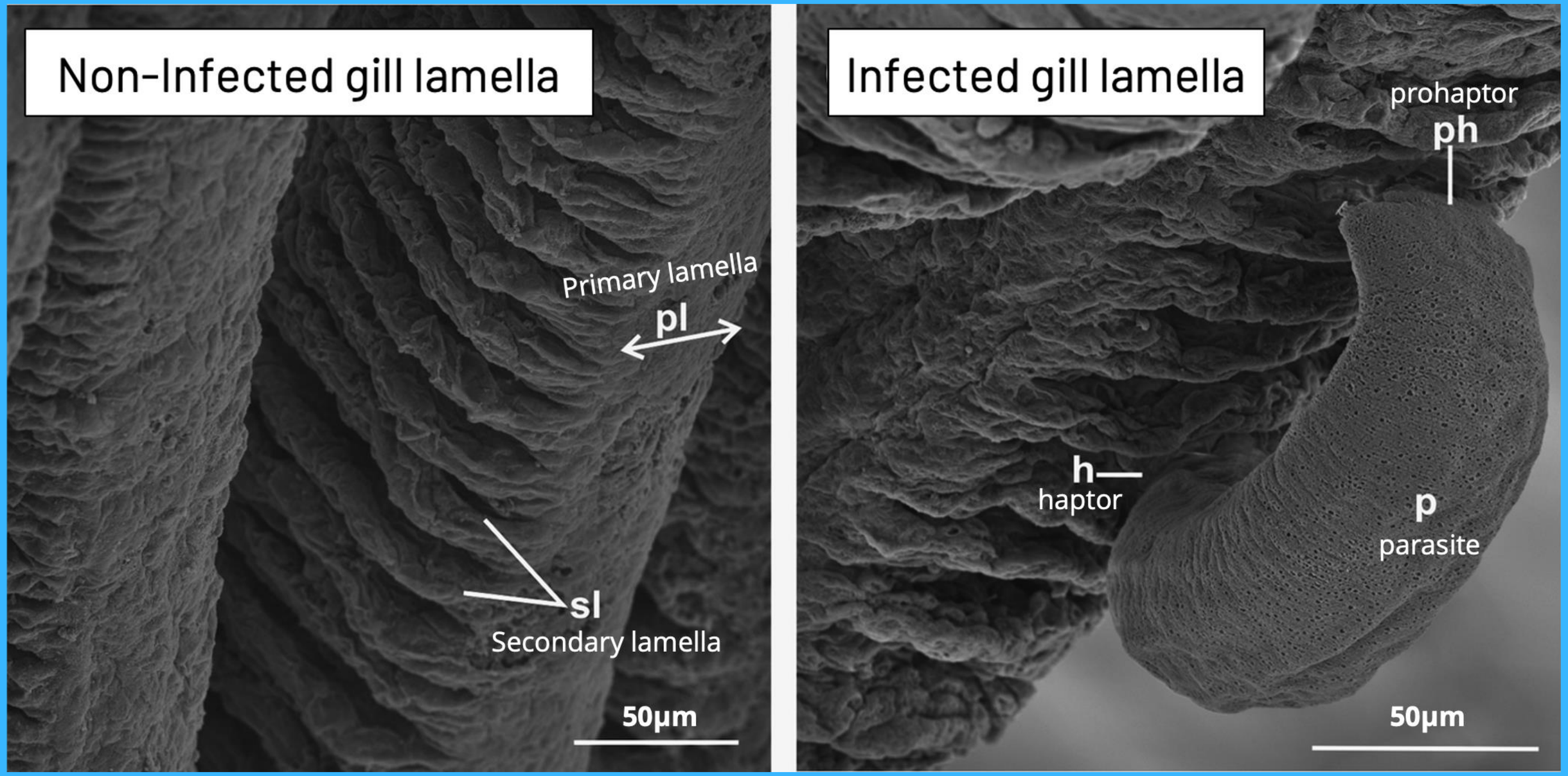
- typically **highly specific** to their host
- **more diverse**
  - smaller Ne
  - shorter generation time (13-20 days) than the host

# MONOGENEANS

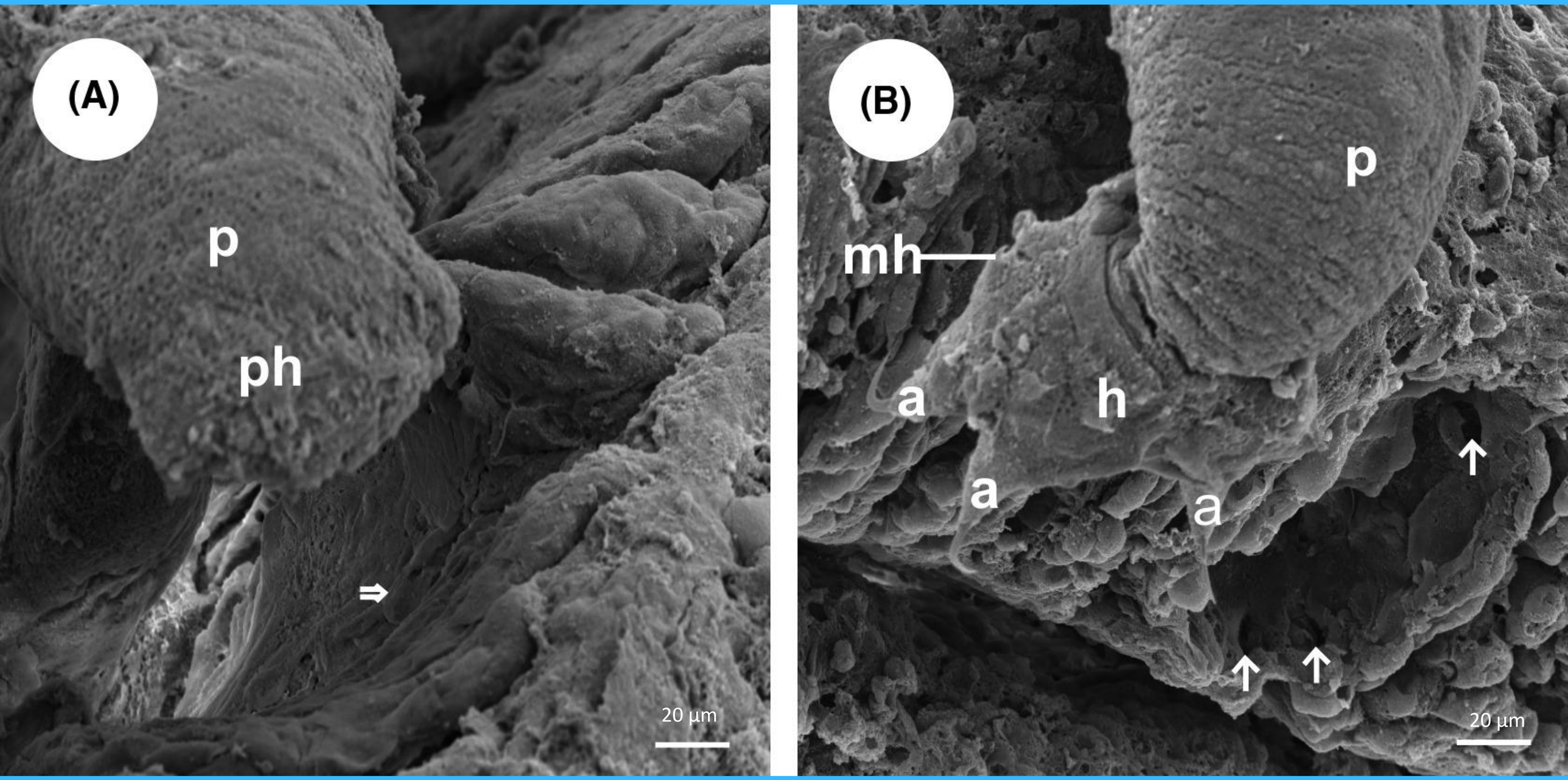



Igeh & Avenant-Oldewage, 2019





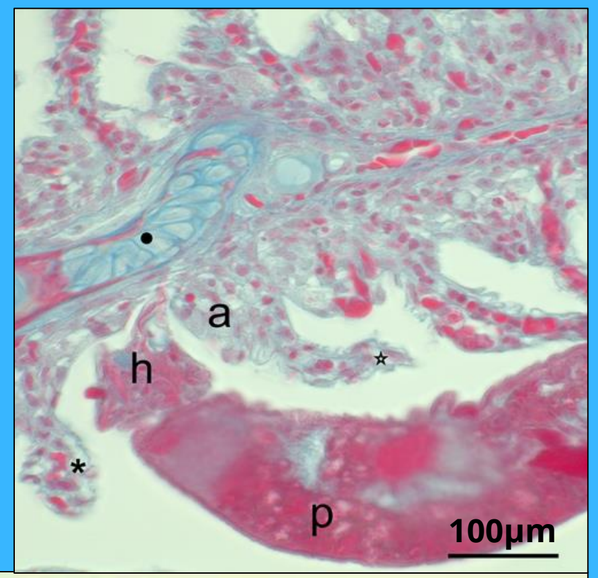

Igeh & Avenant-Oldewage, 2019

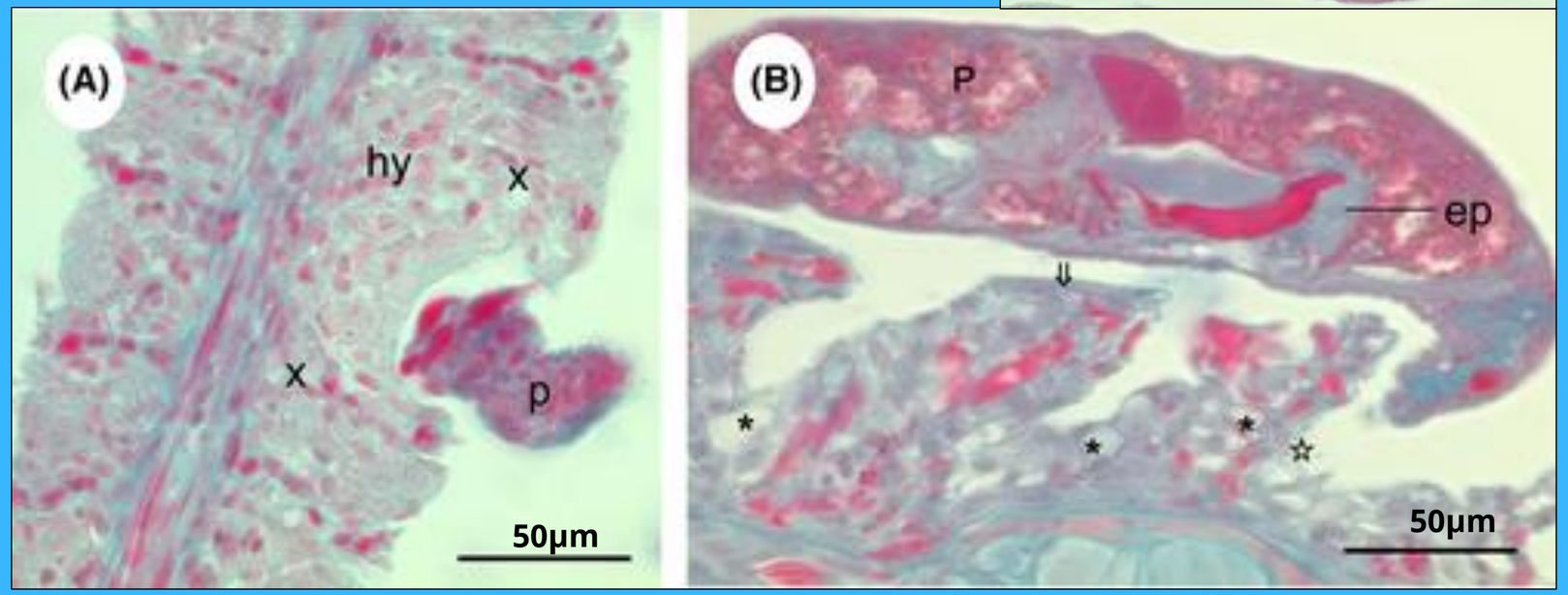



Igeh & Avenant-Oldewage, 2019

# THE INFLUENCE OF MONOGENEANS ON GILL TISSUE

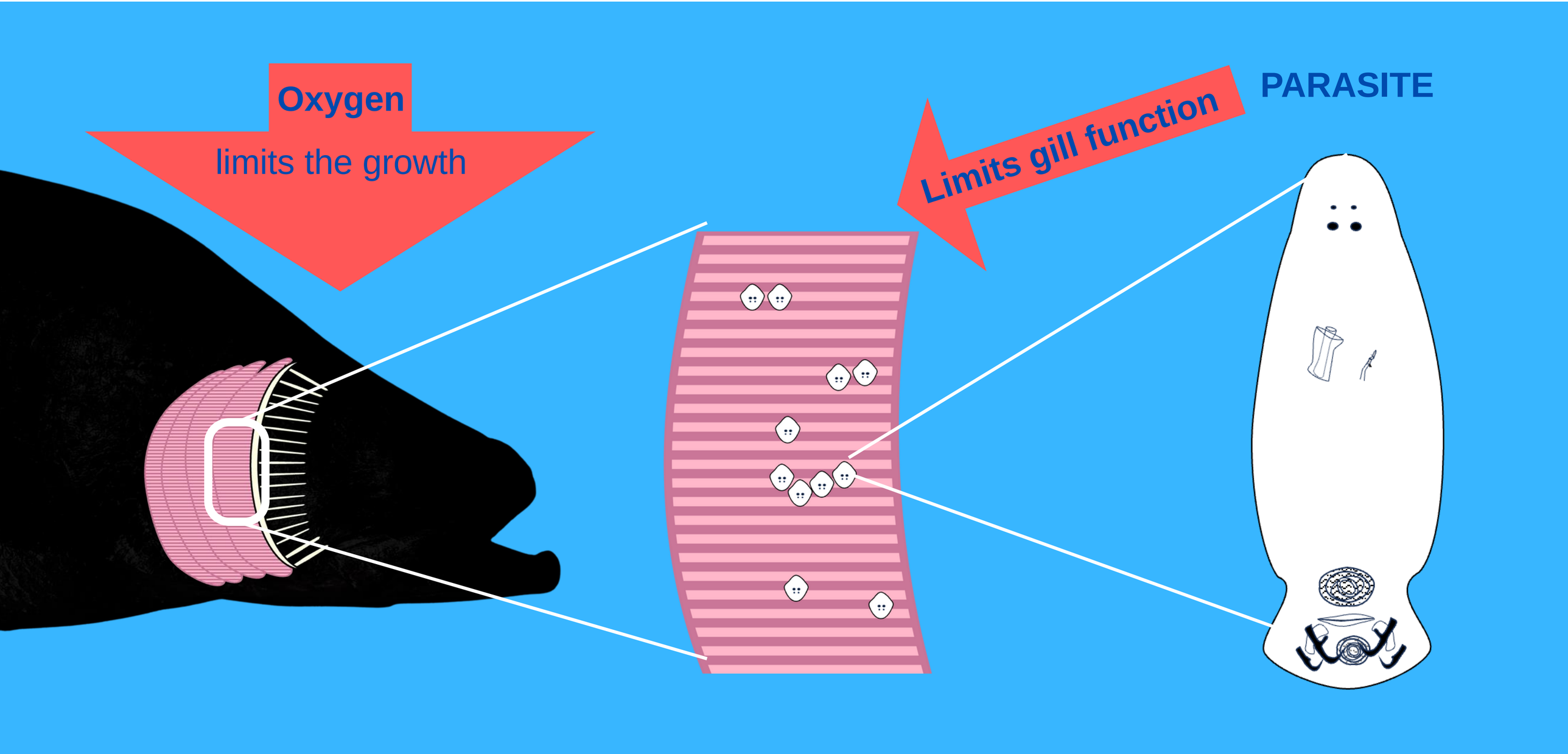
- Distortion of the extracellular cartilaginous matrix (●)
- Rupturing of epithelial tissue (☆)
- Lamellar fusion (x)
- **Hyperplasia (hy)**
- **Compression (⇒)**
- **More mucous cells (*)**



# HYPOTHESIS:

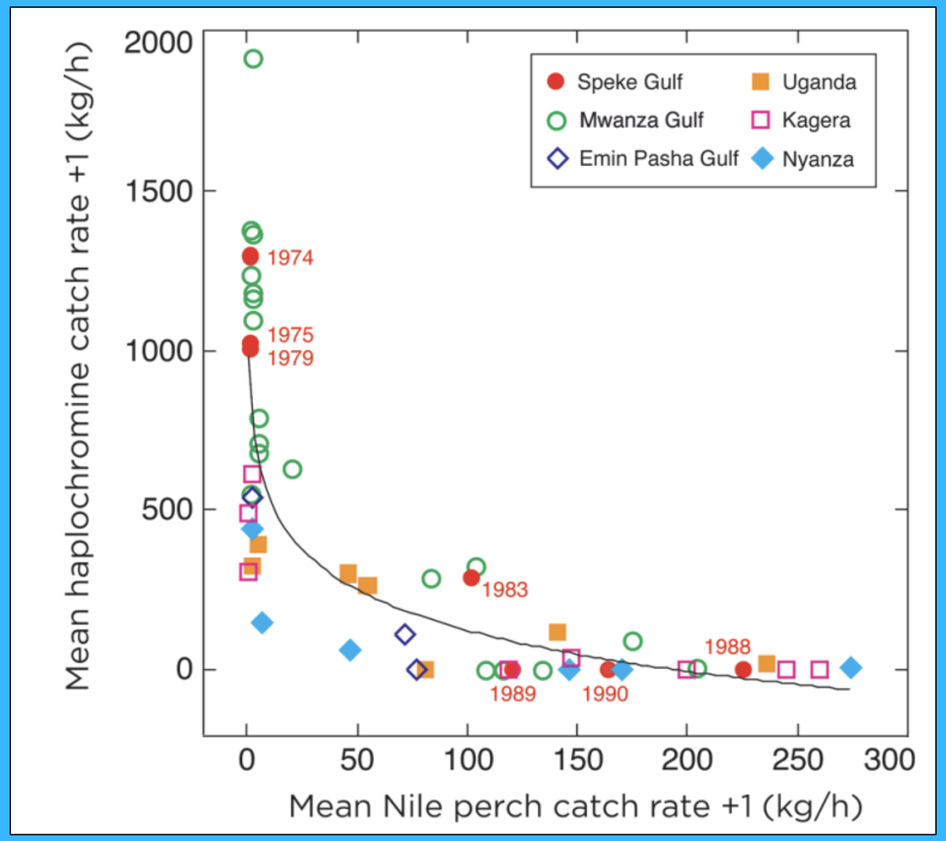
Parasite infection on the gills will reduce gill functioning and thereby impair the growth of the WBE

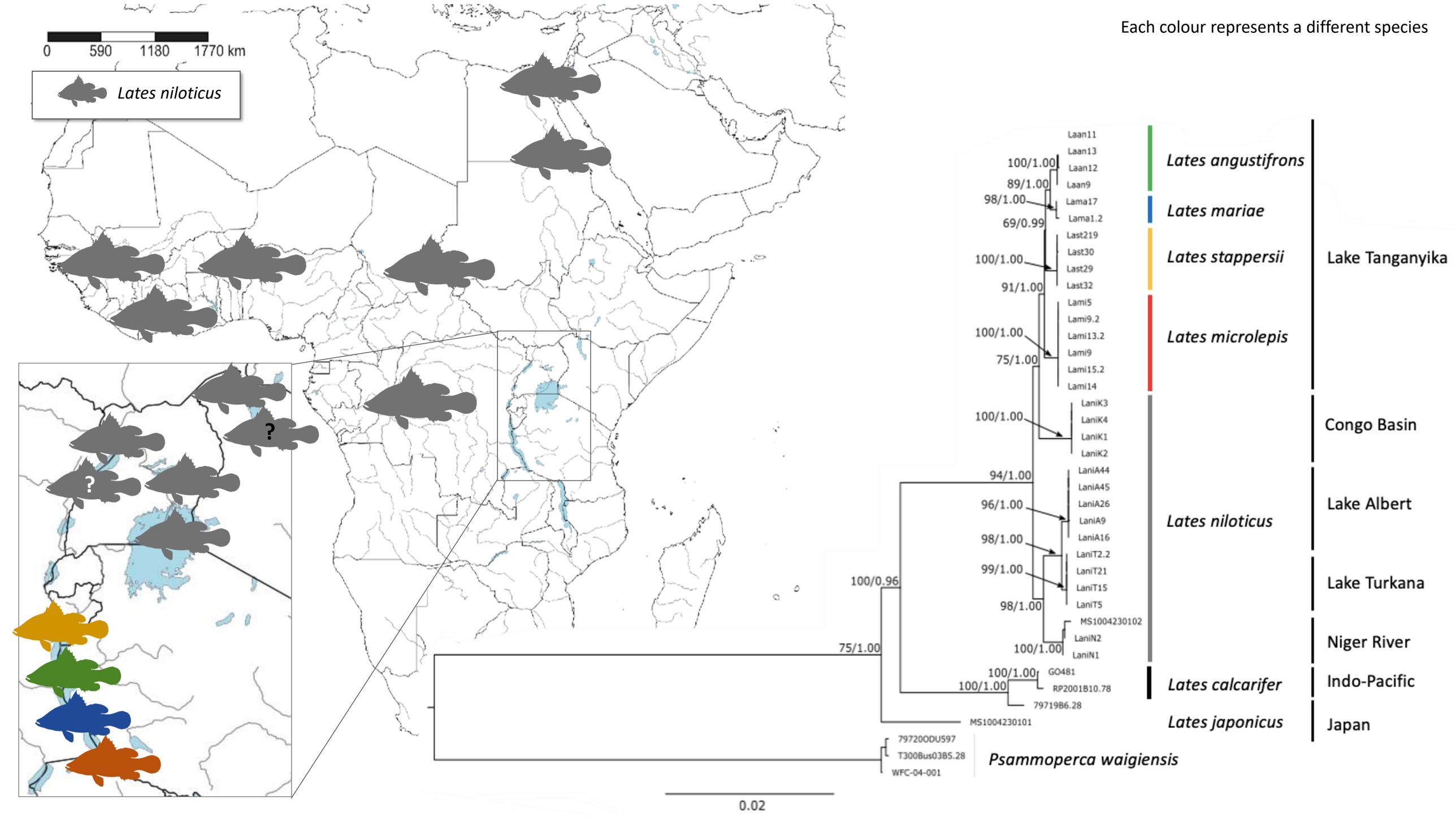


# OUR MODEL SYSTEM

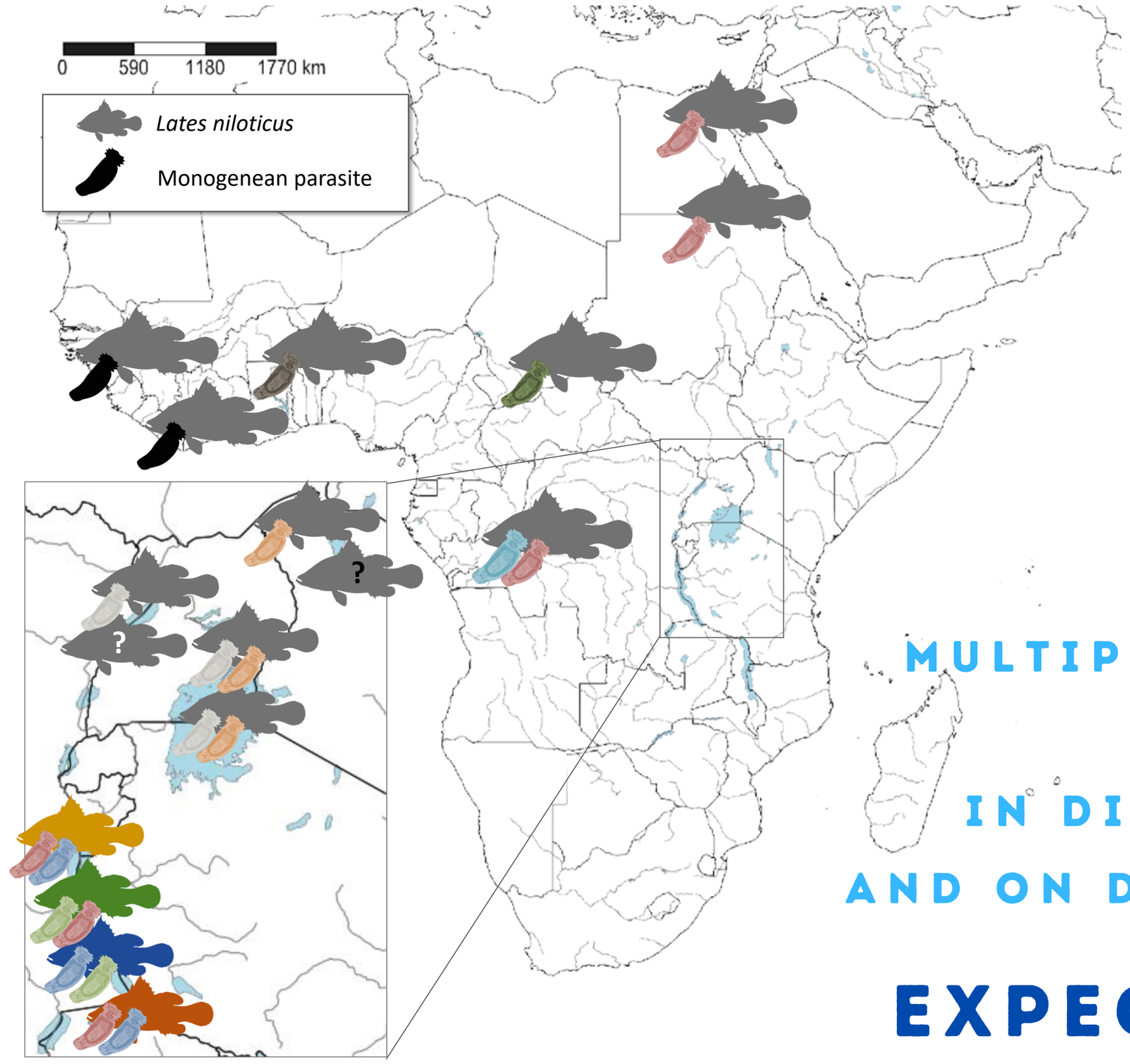
Tijs Goldschmidt
Darwin's Dreampond Drama in Lake Victoria

The Nile perch (*Lates niloticus*)





Each colour represents a different species
0
590
1180
1770 km
Lates niloticus
?
?
Laan11
Laan13
Laan12
Laan9
Lama17
Lama1.2
Last219
Last30
Last29
Last32
Lami5
Lami9.2
Lami13.2
Lami9
Lami15.2
Lami14
LaniK3
LaniK4
LaniK1
LaniK2
LaniA44
LaniA45
LaniA26
LaniA9
LaniA16
LaniT2.2
LaniT21
LaniT15
LaniT5
MS1004230102
LaniN2
LaniN1
GO481
RP2001B10.78
79719B6.28
MS1004230101
79720ODU597
T300Bus03B5.28
WFC-04-001
100/1.00
89/1.00
98/1.00
69/0.99
100/1.00
91/1.00
100/1.00
75/1.00
100/1.00
94/1.00
96/1.00
98/1.00
99/1.00
98/1.00
100/1.00
100/1.00
100/1.00
100/0.96
75/1.00
Lates angustifrons
Lates mariae
Lates stappersii
Lates microlepis
Lates niloticus
Lates calcarifer
Lates japonicus
Psammoperca waigiensis
Lake Tanganyika
Congo Basin
Lake Albert
Lake Turkana
Niger River
Indo-Pacific
Japan
0.02

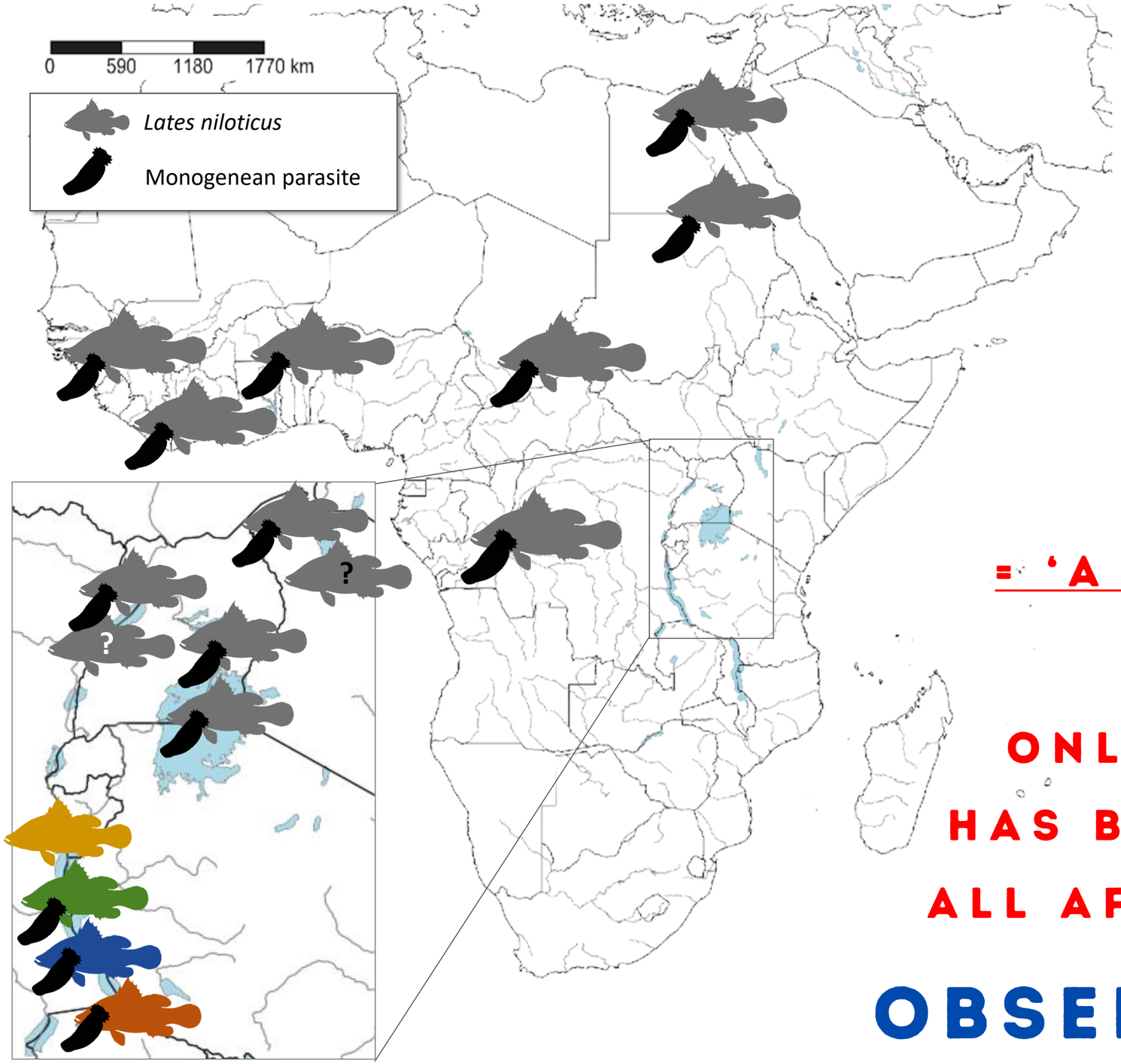
Each colour represents a different species




MULTIPLE SPECIES INFECTING
LATES PERCHES
IN DIFFERENT LOCALITIES
AND ON DIFFERENT HOST SPECIES

# EXPECTED DIVERSITY

Each colour represents a different species




= 'A FAILURE TO DIVERGE'

ONLY A SINGLE SPECIES HAS BEEN FOUND TO INFECT ALL AFRICAN LATES PERCHES

# OBSERVED DIVERSITY

# OUR MODEL SYSTEM

## FAILURE TO DIVERGE

Freshwaters

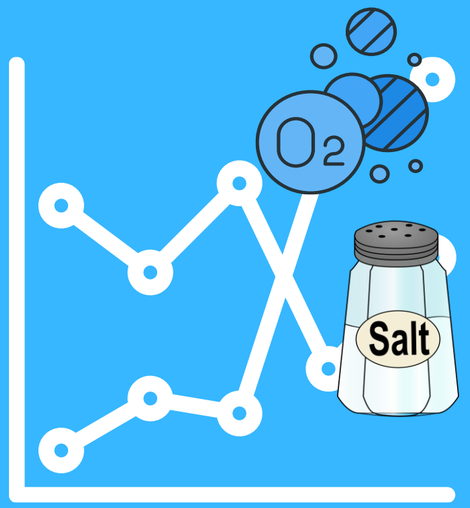
## DIVERSIFICATION

Marine and estuarine

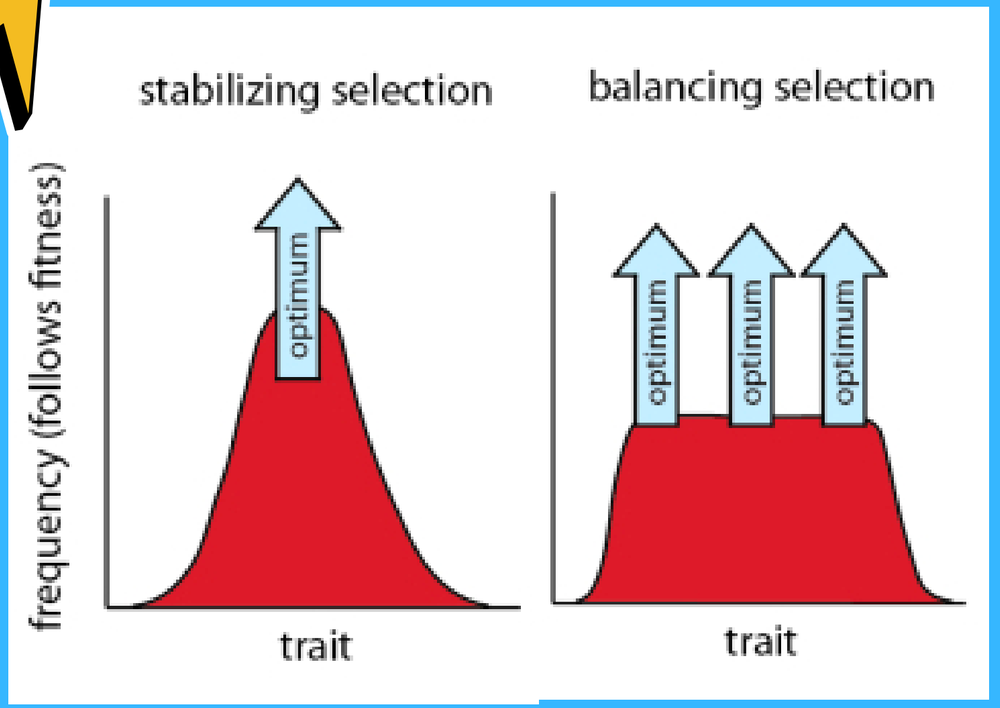
| Latid host | Diplectanid gill parasite |
|---|---|
| *Lates calcarifer* | *Dolicirroplectanum lacustre* |
| *Lates niloticus* | *Dolicirroplectanum penangi* |
| *Lates longispinis* | *Diplectanum setosum* |
| *Lates macrophthalmus* | *Diplectanum narimeen* |
| *Lates angustifrons* | *Laticola latesi* |
| *Lates mariae* | *Laticola paralatesi* |
| *Lates microlepis* | *Laticola seabassi* |
| *Lates stappersii* | |

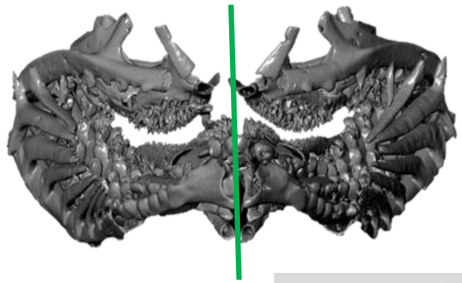
## HYPOTHESIS:

Parasite infection on the gills (**biotic stress**) will reduce gill functioning and thereby impair the growth of the WBE but combined with the variability of the tropical freshwater environments (**abiotic stress**) in Africa, this also impairs the **diversification** of both the host and the parasite

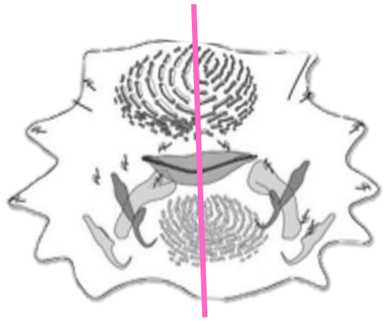



- **Stabilizing selection** due to functional constraints in the gill environment (GOLT)
- **Balancing selection** because of the variability of the tropical freshwater environments





AQUATIC ENVIRONMENT



GILL PARASITE

**Fluctuating asymmetry gills**

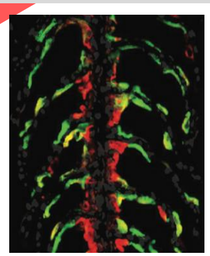
*Lifetime*

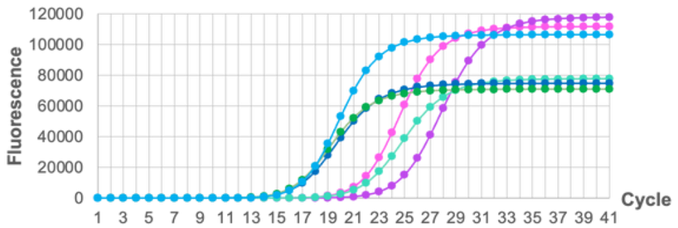
**Fluctuating asymmetry haptor**

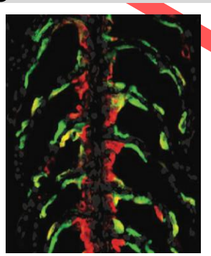
**Quantify mtDNA/nuclearDNA**

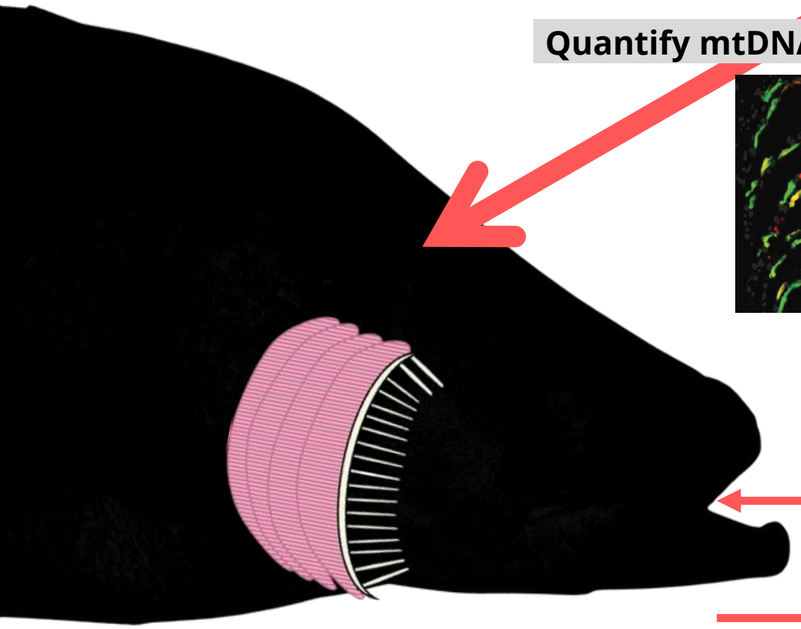
*Ontogeny*

**Quantify mtDNA/nuclearDNA**





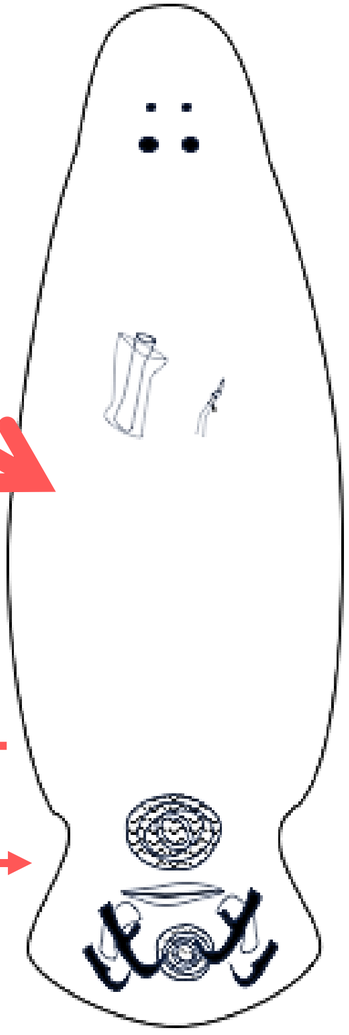


**Lesions from infection**

**Gill histopathology + SEM**

**Immune response**

**Immunity gene expression**



# GROWTH AND DIVERSIFICATION IMPAIRED

# THOUGHTS, COMMENTS, QUESTIONS, SUGGESTIONS?

KELLY.THYS@UHASSELT.BE

natural sciences .be

UHASSELT
KNOWLEDGE IN ACTION