

Temporal changes in the flatworm parasite communities of Lake Victoria cichlid fishes in response to ecosystem changes

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Global change

Global change & populations

- Distribution shifts
- Population declines and extinctions
- Few invasions
- in plants
- in animals

free-living

(metazoan) parasites?

Expected to be affected, but direction of change is unclear



Why bother about parasite destiny?

Individual with many parasites → unhealthy

Ecosystem with many parasites → healthy!

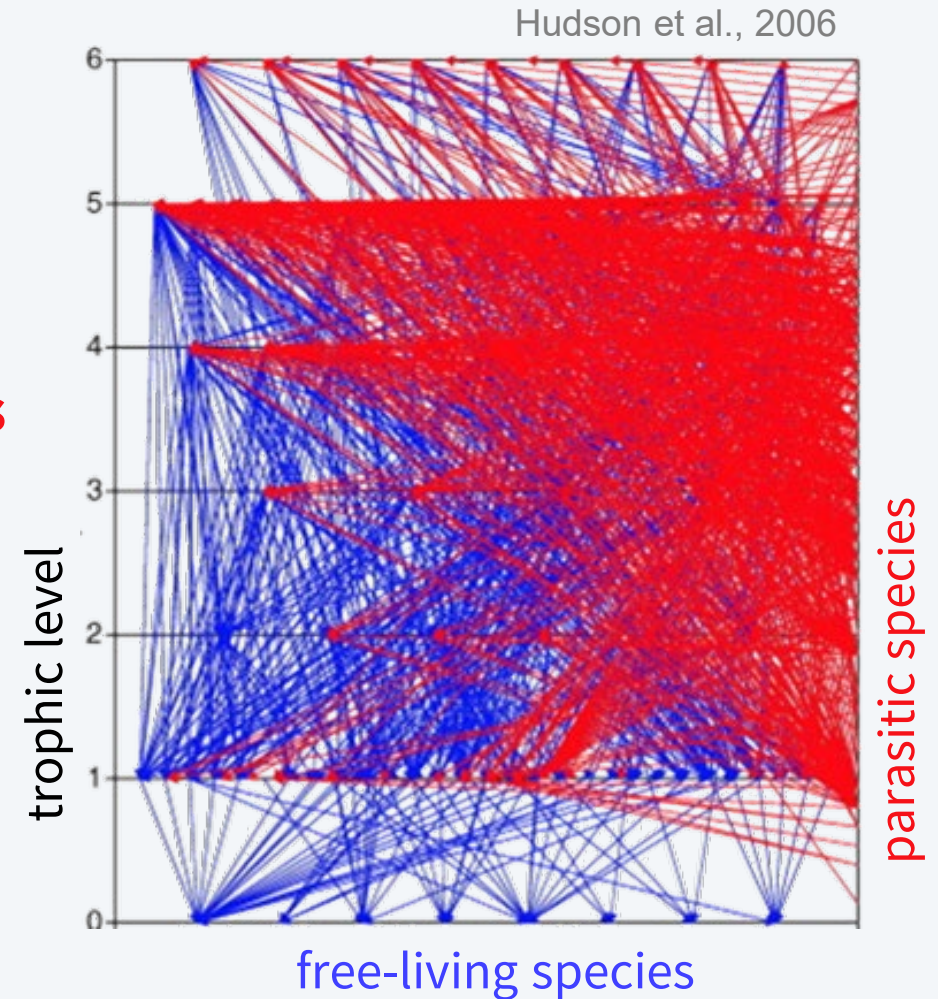
Health ecosystem ← contribution of parasites

Biodiversity (within ecosystem types)

Predictability

Resistance to perturbations

Resilience



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Ecosystem with many parasites → healthy!

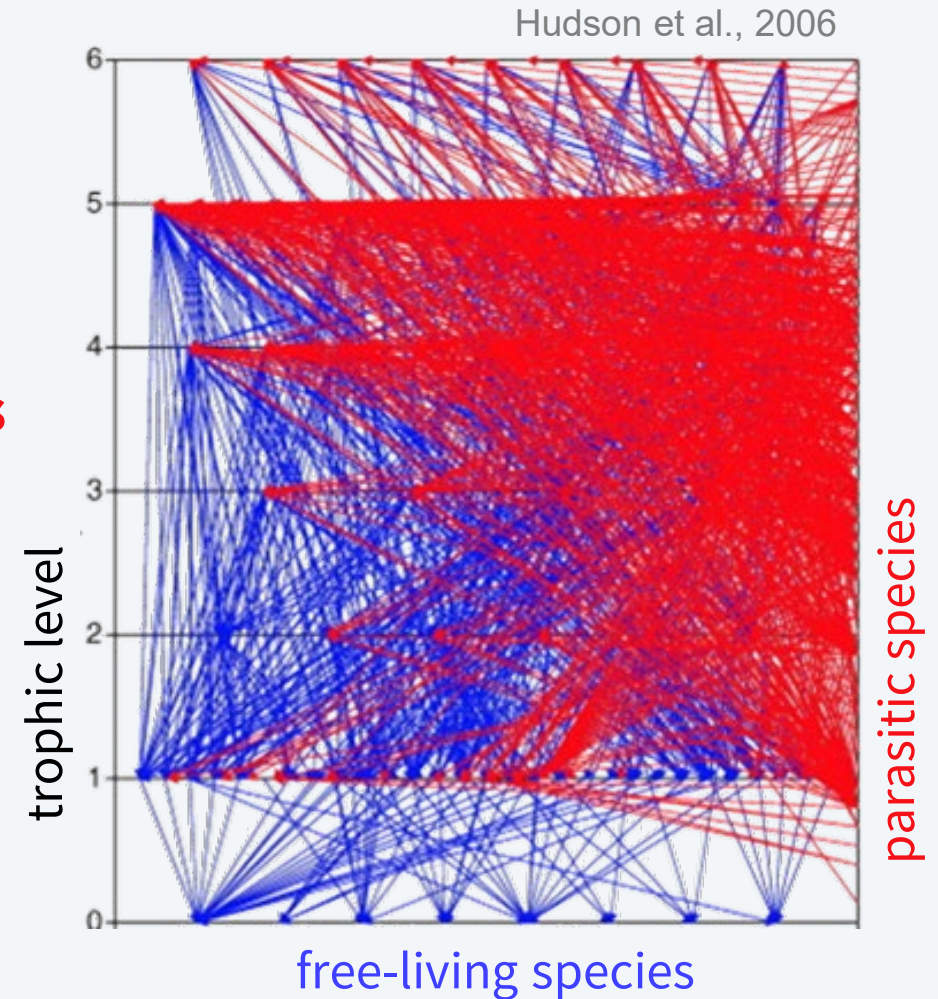
Health ecosystem ← contribution of parasites

Biodiversity (within ecosystem types)

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Global change

Anthropogenic changes

- Eutrophication
- Multiple invasions
- Overfishing
- Pollution



Lake Victoria



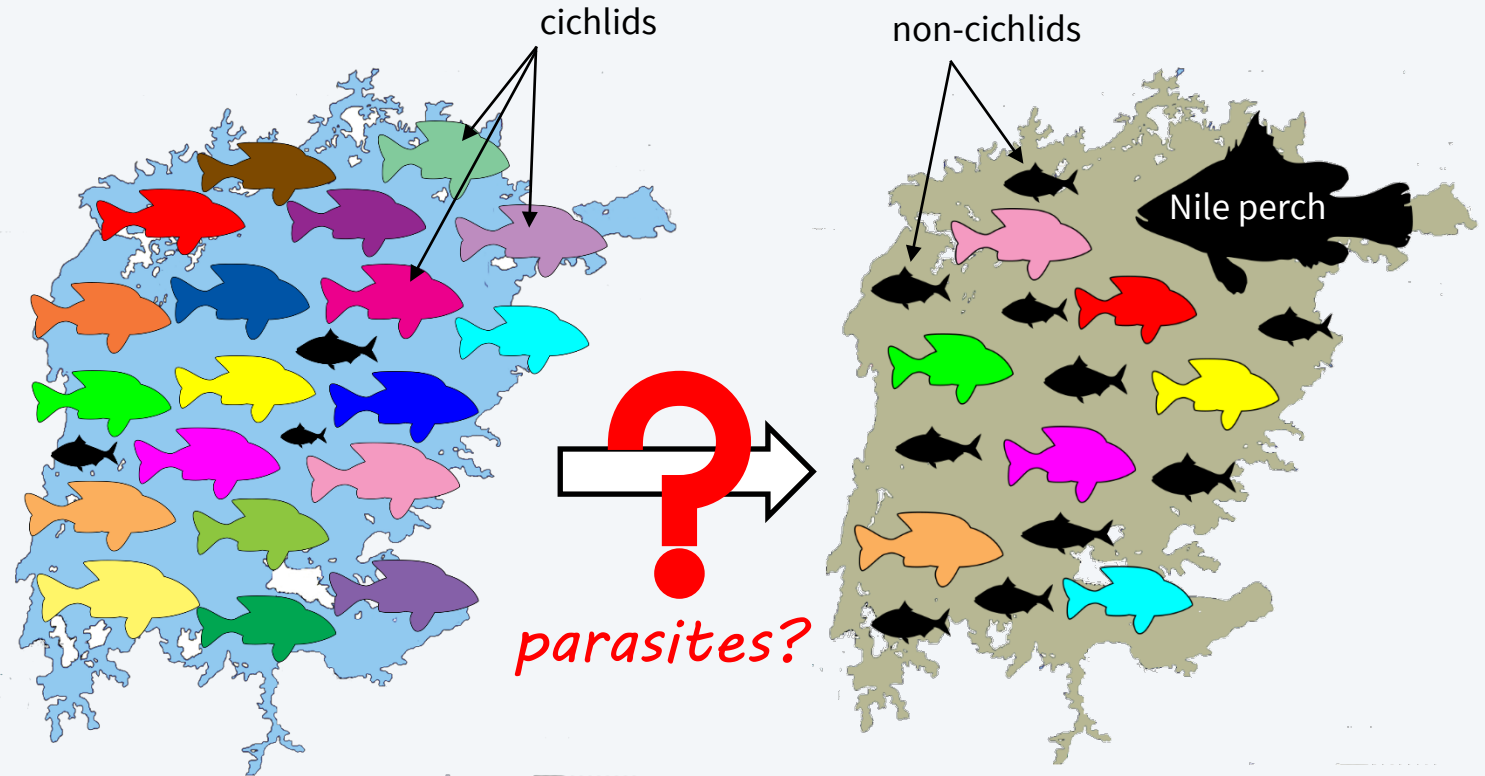
Lake Victoria

- Biodiversity hotspot (especially cichlid fish)
- Drastic anthropogenic changes since 1980s:
 - eutrophication
 - multiple invasions (incl. Nile perch)

Changes in Lake Victoria

Simultaneous
anthropogenic changes

- rapid loss of biodiversity
- loss of complexity
- less stable ecosystem



BEFORE

>500 cichlids
dominated by cichlids
low predation
low water turbidity

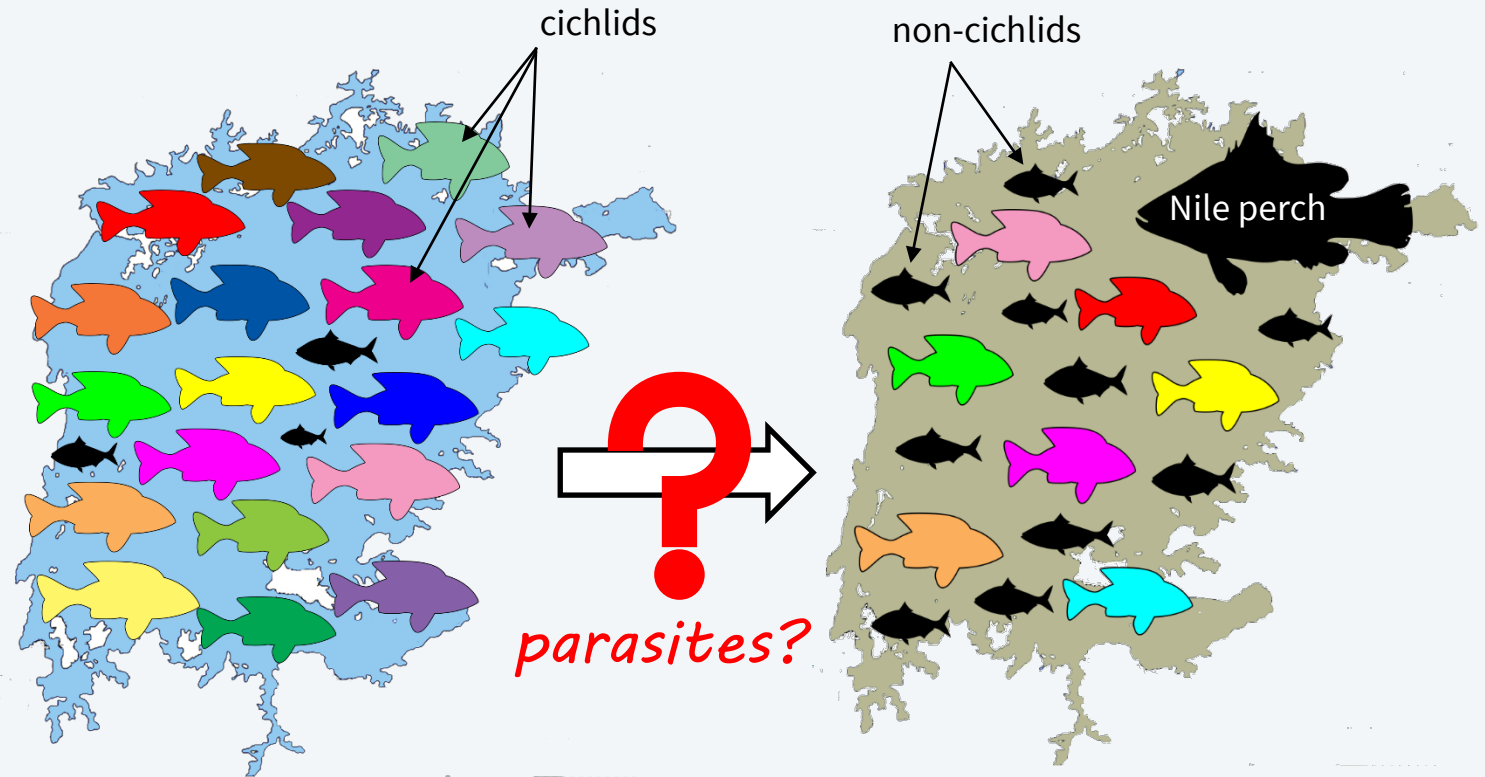
AFTER

250 cichlids
dominated by non-cichlids
high predation (Nile perch)
high water turbidity

Research questions

How parasite communities changed in response to ecosystem perturbations in Lake Victoria?

1. parasite abundance
2. parasite species richness
3. host range of parasites



Study design

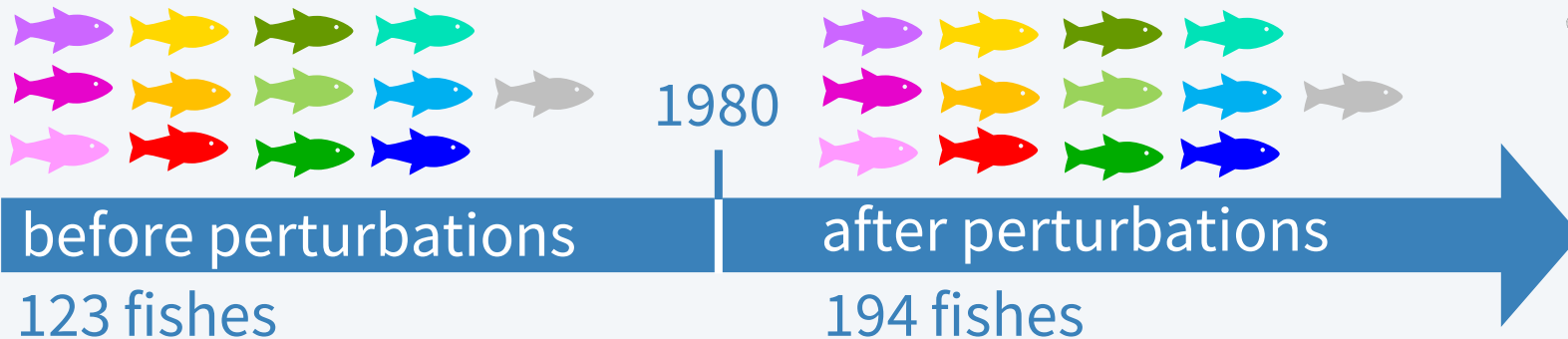
Before-after impact study
using historical and recent collections



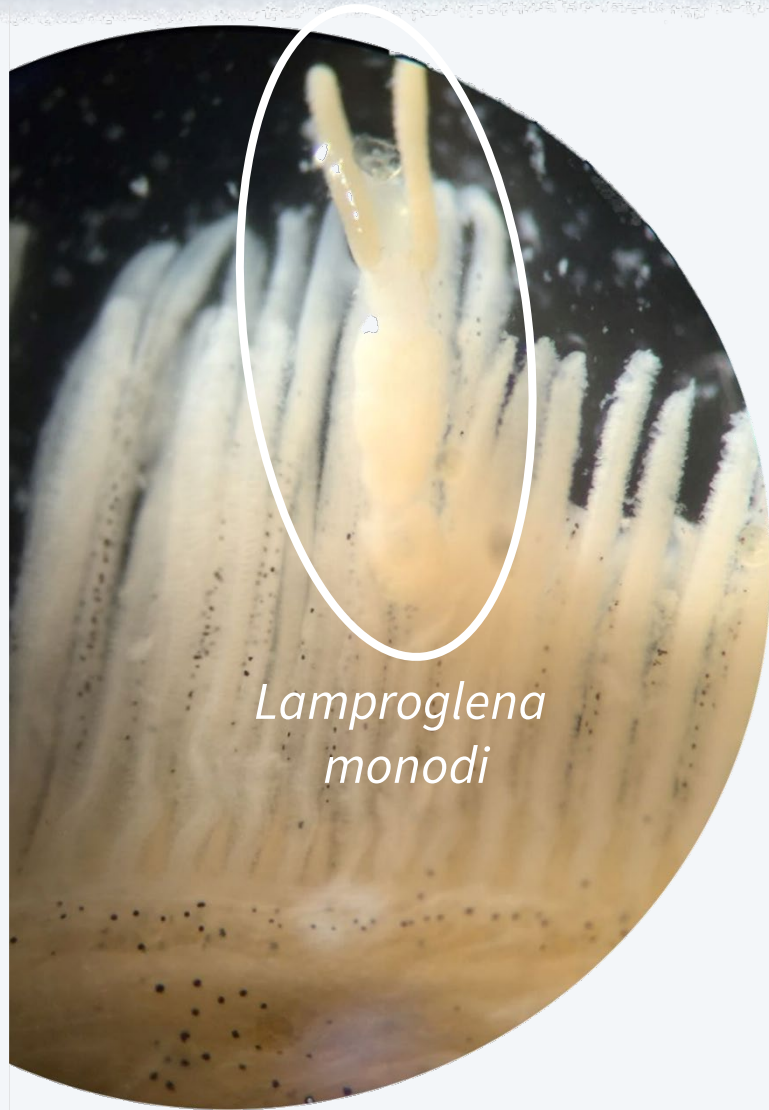
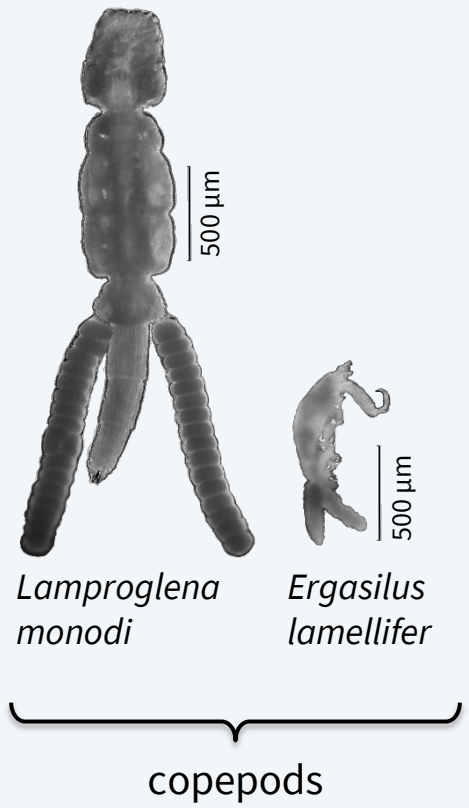
Study design

Before-after impact study
using historical and recent collections

13 cichlid species
7 eco-morphological groups
sampled 1973 – 2014
screened for metazoan gill parasites



Gill parasites

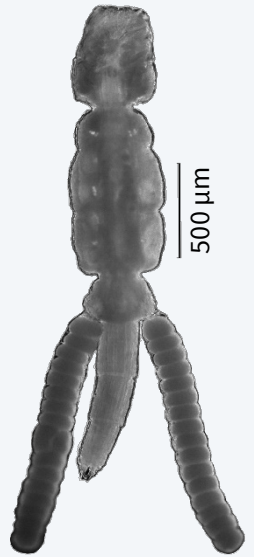


Lamproglana monodi

Gill parasites



6 *Cichlidogyrus* spp.



Lamproglena monodi



Ergasilus lamellifer

copepods



C. nyanza



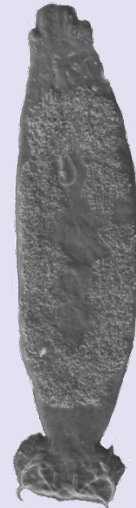
C. pseudodossoui



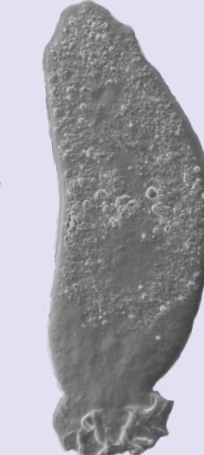
C. furu



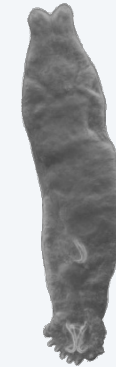
C. vetusmolendarius



C. longipenis



C. bifurcatus



Gyrodactylus sturmbaueri

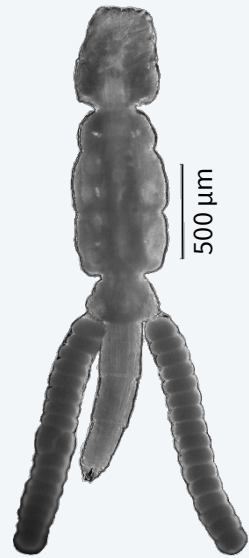
monogeneans (flatworms)



Gill parasites



6 *Cichlidogyrus* spp.
4 species new to science! (Gobbin et al. in prep.)



Lamproglena monodi

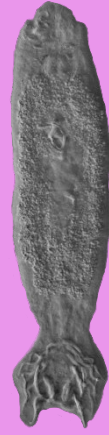


Ergasilus lamellifer

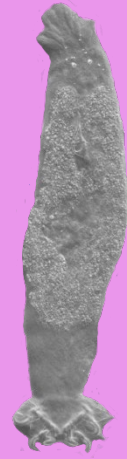
copepods



C. nyanza



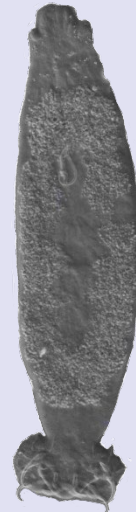
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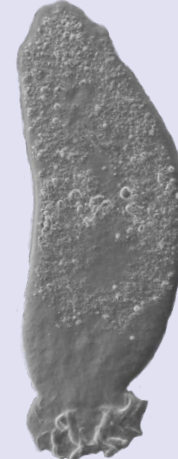
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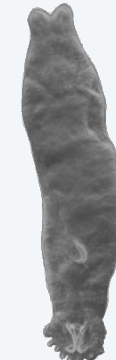
C. vetusmolendarius



C. longipenis



C. bifurcatus

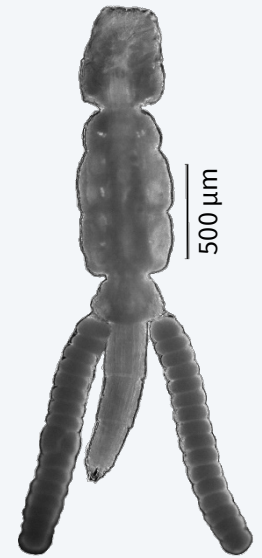


Gyrodactylus sturmbaueri

monogeneans (flatworms)



Gill parasites



Lamproglena monodi



Ergasilus lamellifer

copepods

6 *Cichlidogyrus* spp.



C. nyanza



C. pseudodossoui



C. furu



C. vetusmolendarius



C. longipenis



C. bifurcatus

monogeneans (flatworms)

1 individual only
(after perturbations)



Gyrodactylus sturmbaueri

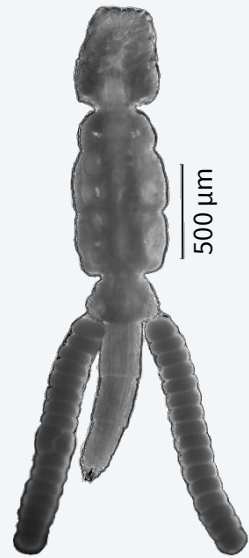


Cichlidogyrus

Gill parasites



6 *Cichlidogyrus* spp.



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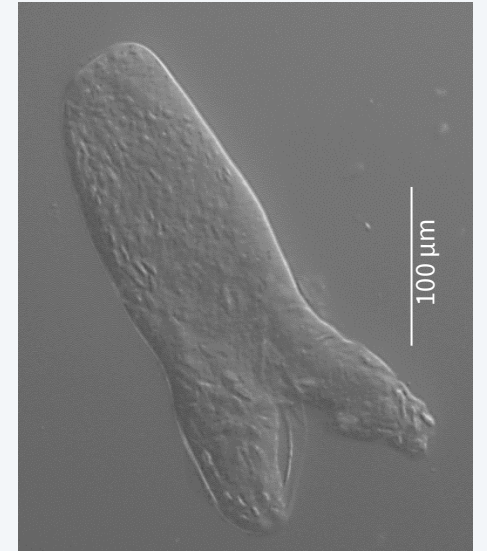
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Gyrodactylus sturmbaueri

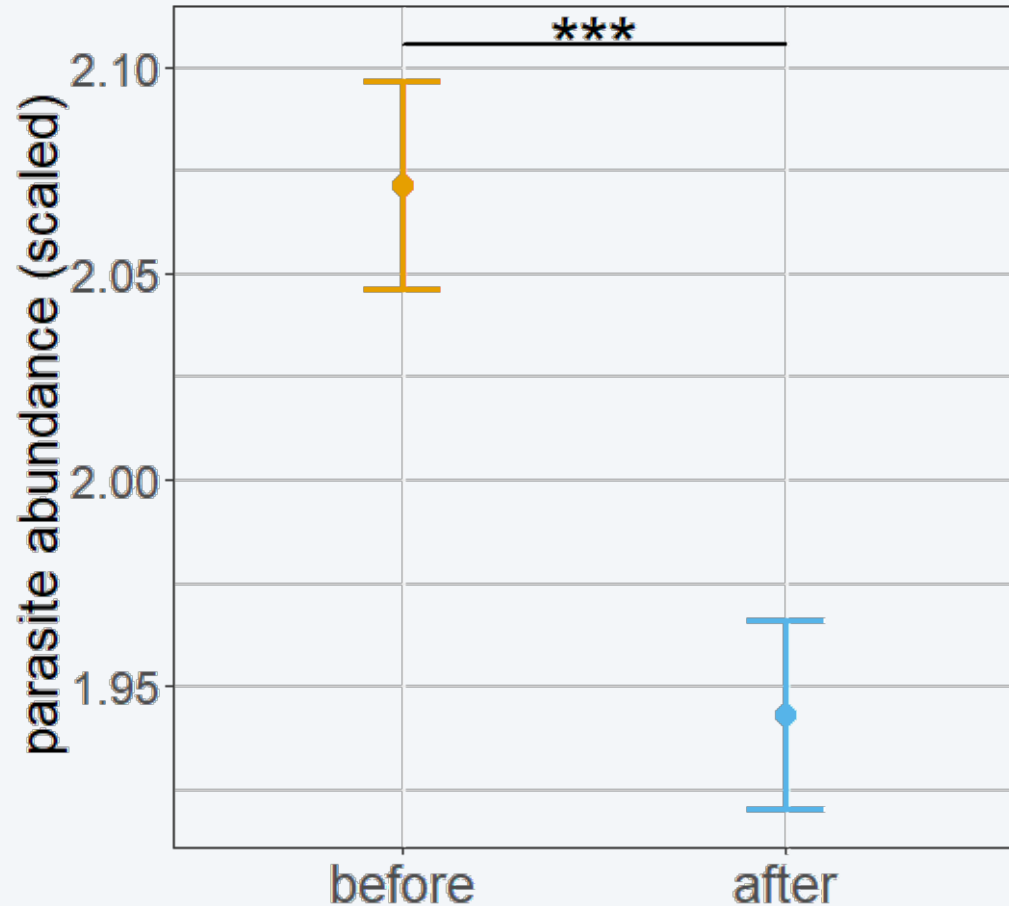


Unidentified parasite taxon
(before perturbations)
→ taxon 1

copepods

monogeneans (flatworms)

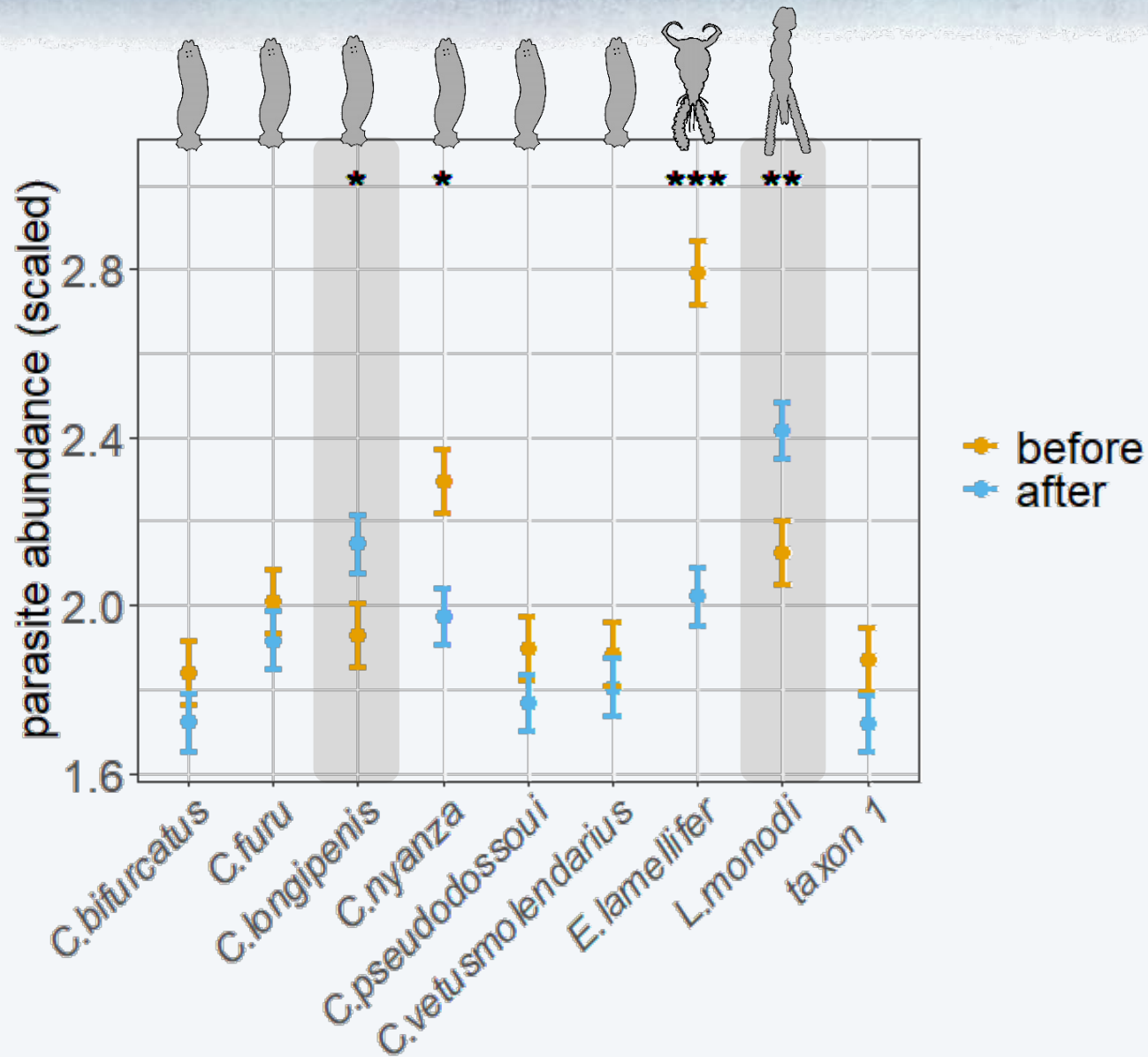
Changes in parasite abundance



Overall, parasite **abundance** decreased after perturbations in Lake Victoria

GLM, controlled for fish size

Changes in parasite abundance



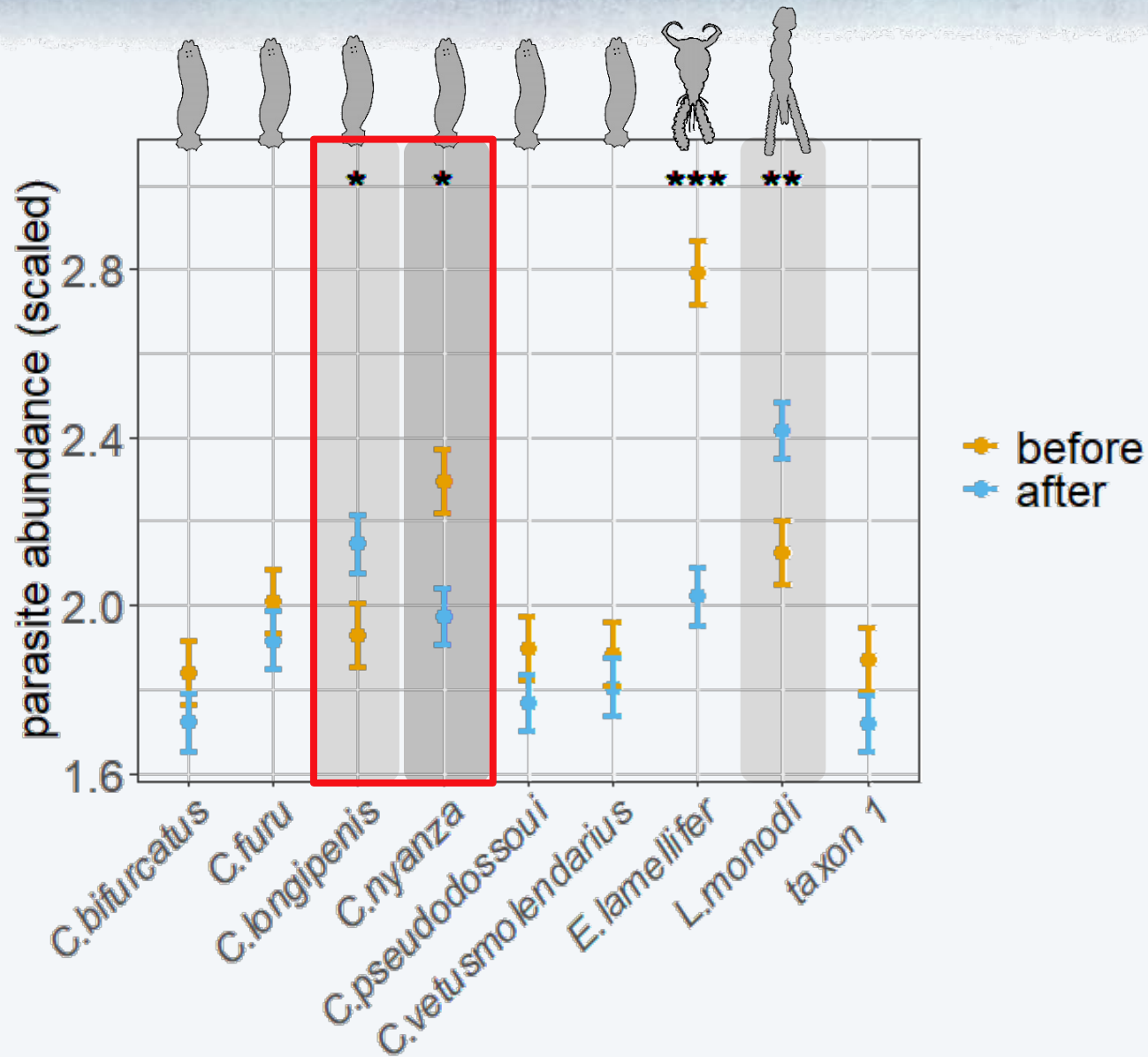
This trend holds for most parasite species

Two parasite species increased in abundance

GLM, controlled for fish size & Tukey posthoc test

Few winners, many losers

Changes in parasite abundance

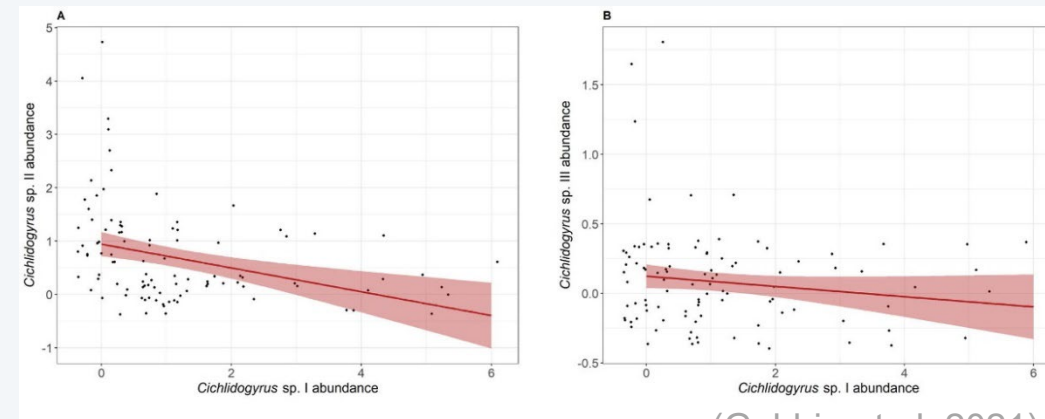


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Two parasite species increased in abundance

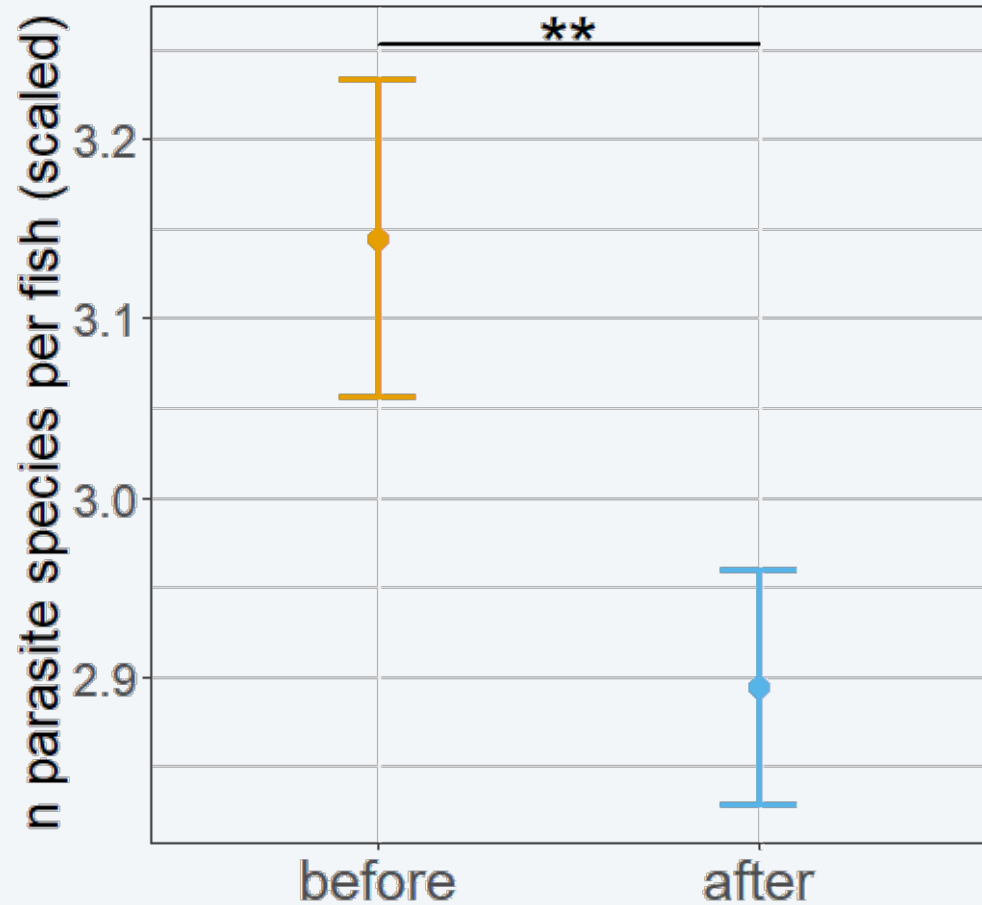
GLM, controlled for fish size & Tukey posthoc test

Competition within species of *Cichlidogyrus* may play a role



(Gobbin et al. 2021)

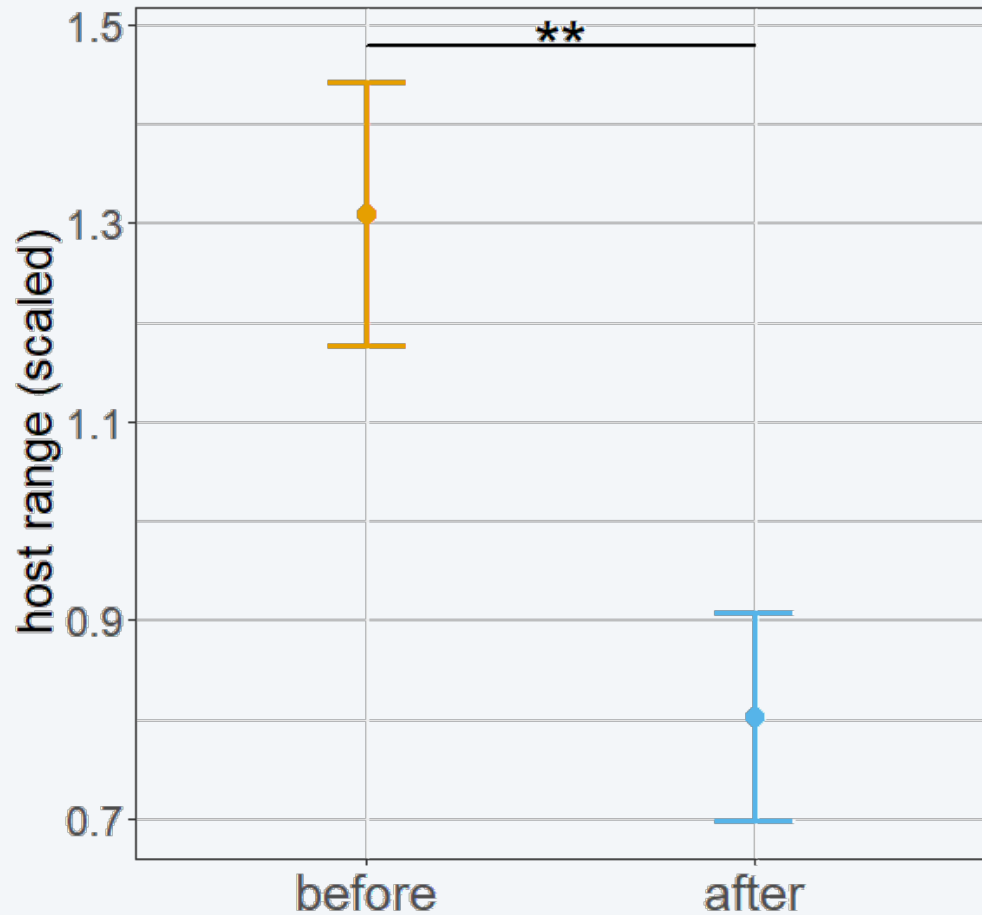
Changes in parasite species richness



After perturbations in Lake Victoria, host individuals are infected by fewer **parasite** species.

GLM, controlled for fish size

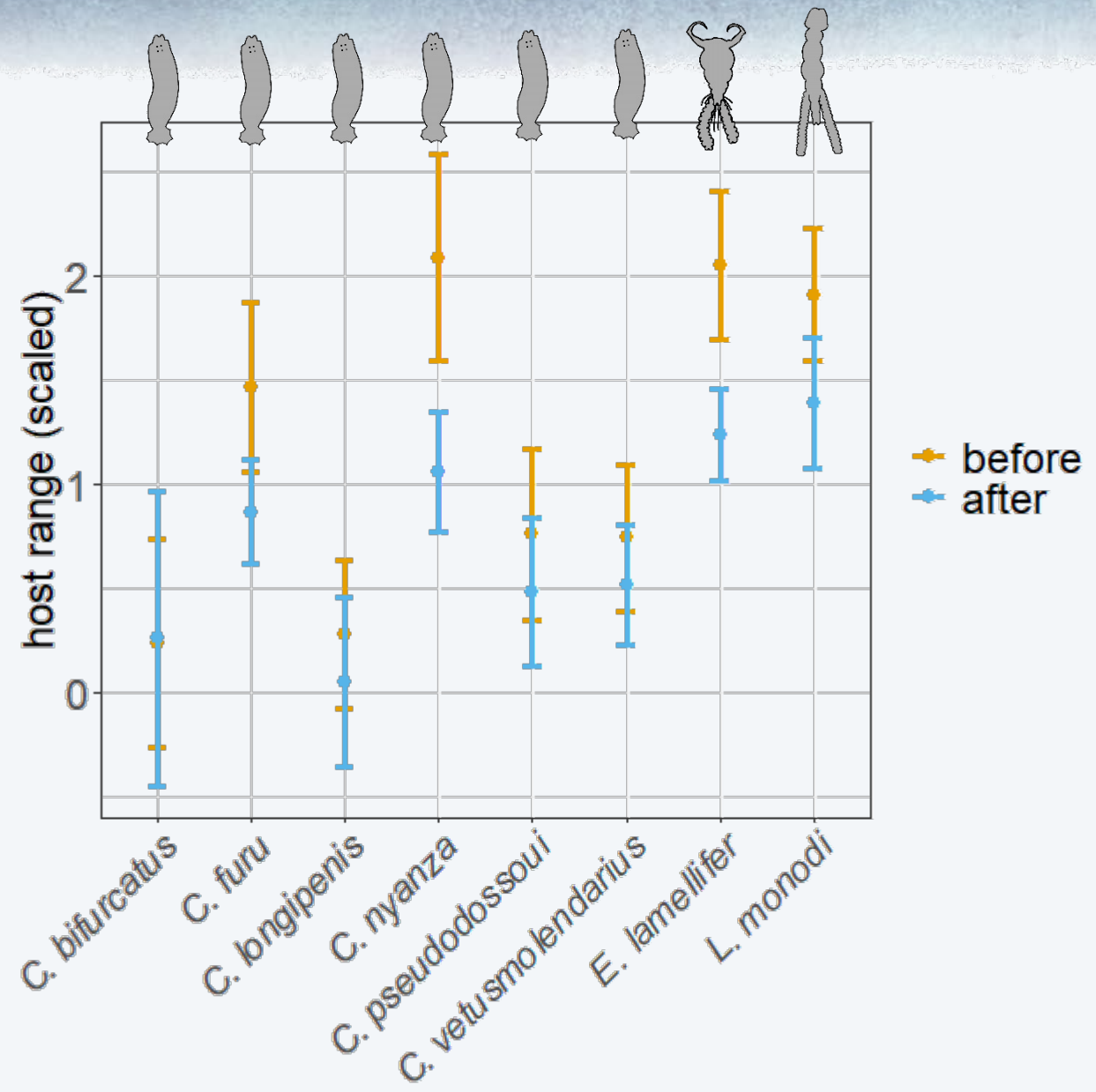
Changes in host range



After perturbations in Lake Victoria, parasite species infected fewer **host** species.

GLM, controlled for fish sampling effort

Changes in host range

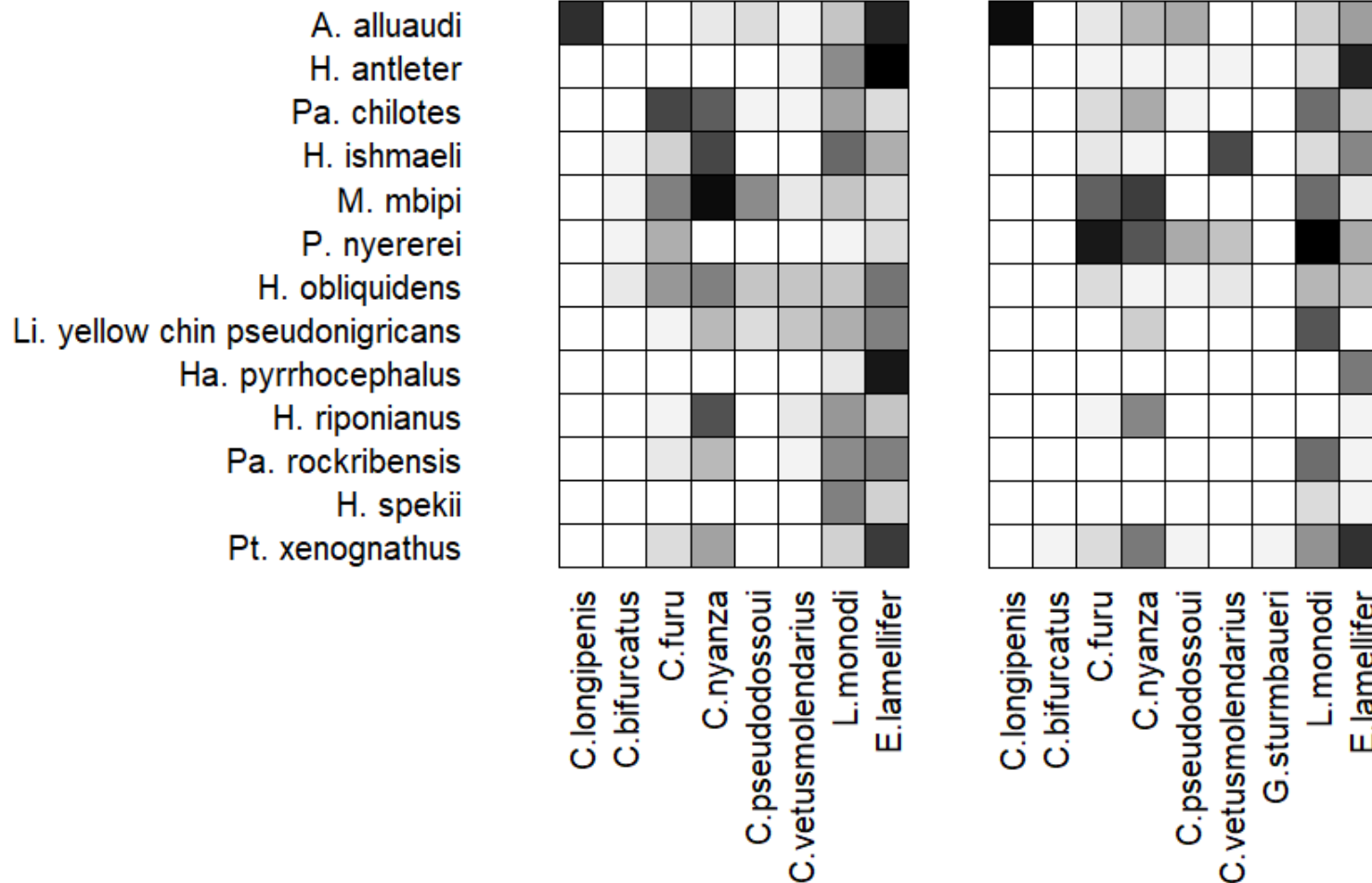


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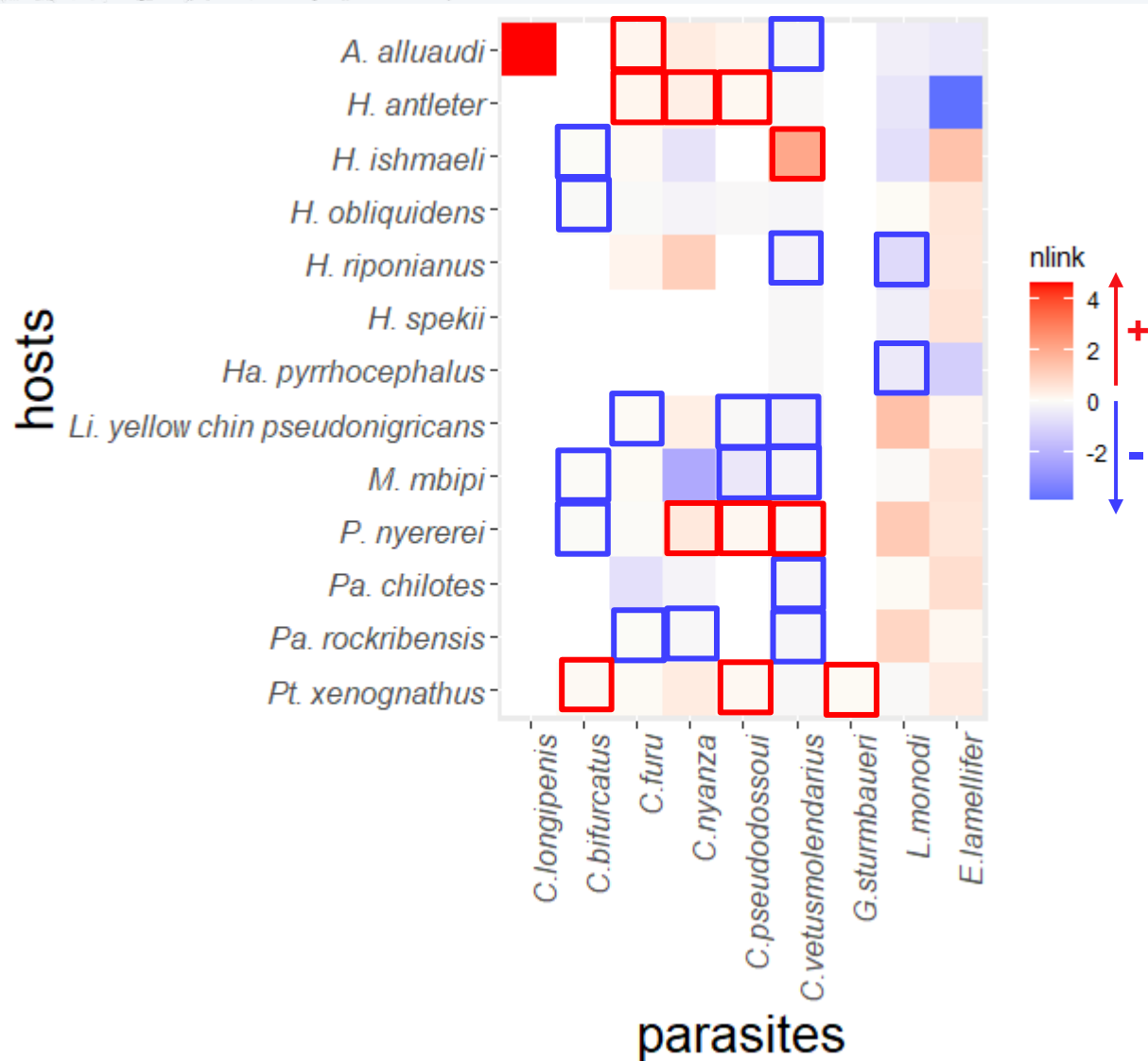
Changes in host-parasite combinations

before
ecosystem changes after



Number of host-parasite links

Changes in host-parasite combinations



- some parasites disappeared from some host species, and
- colonized few new host species that they did not infect before.

Perturbations may favor host switching

Conclusions

After perturbations in Lake Victoria:

- parasites decreased in abundance
only two parasite species became more abundant: few winners, many losers
- fewer parasite species infected host individuals
- parasites infected fewer and different host species
→ ecosystem perturbations may favor host switching

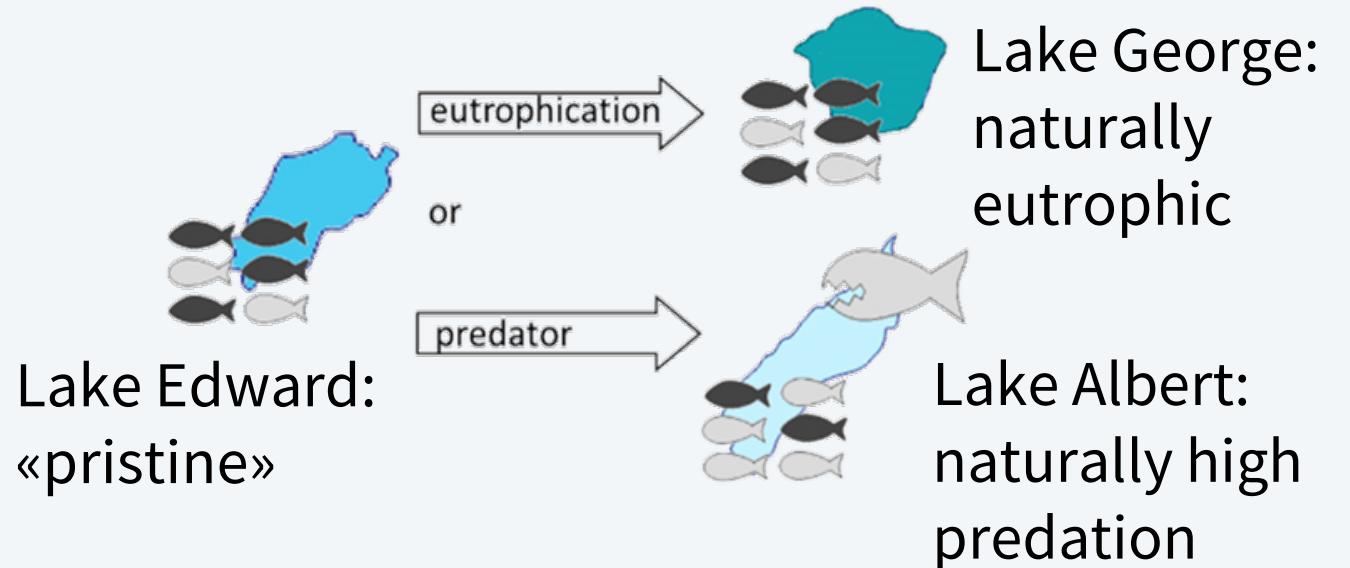
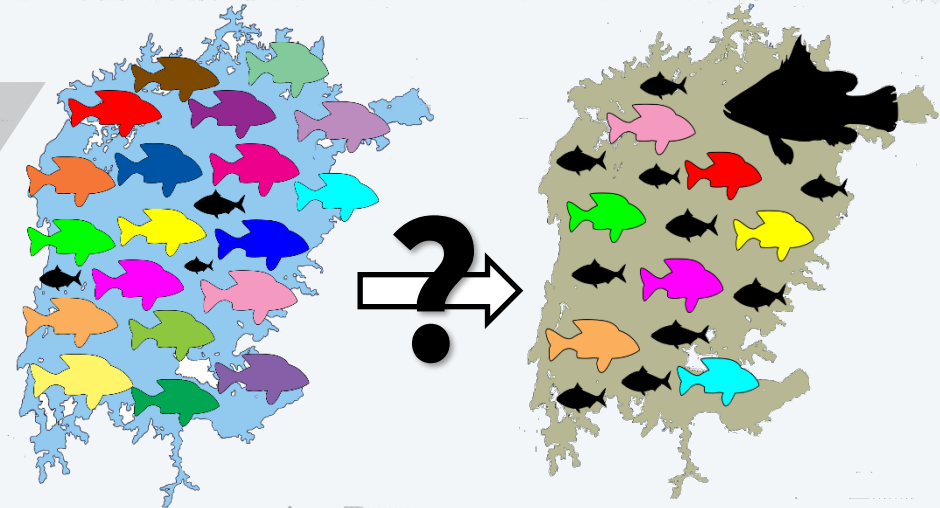
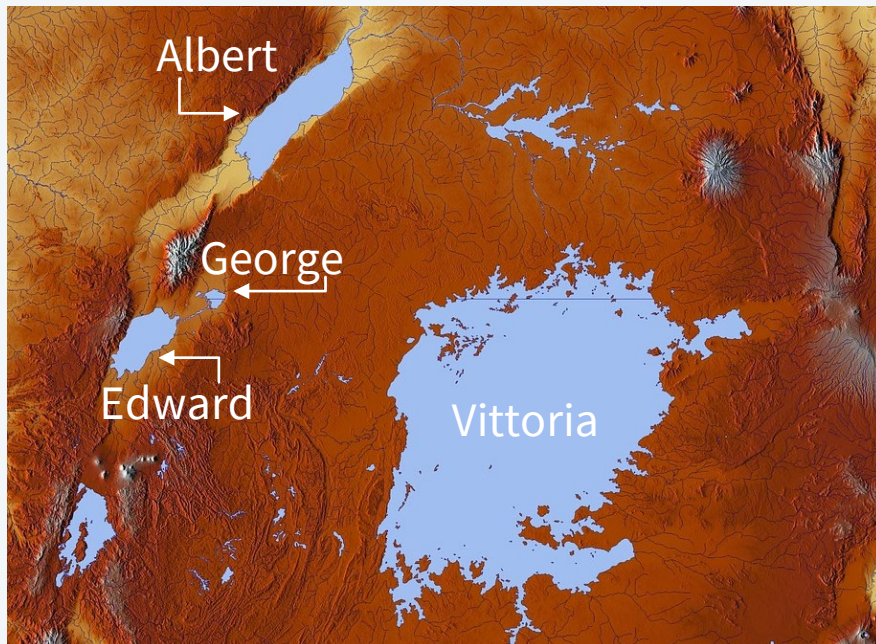
Parasites as sentinel for ecosystem health,
which might contribute to better strategies for linking conservation and
ecosystem health.

Next step

Disentagling the causes

What caused these changes in Lake Victoria parasites?

Space-for-time approach





Thank you



Koninklijk Museum voor Midden-Afrika, Tervuren (B)
Institut Royal des Sciences naturelles de Belgique, Bruxelles (B)
Naturalis Biodiversity Center, Leiden (NL)

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- ✦ **TP Gobbin**, MPM Vanhove, O Seehausen, ME Maan, and A Pariselle (*subm.*), **Four new species of *Cichlidogyrus* (Platyhelminthes, Monogenea, Dactylogyridae) from Lake Victoria haplochromine cichlid fishes, with the redescription of *C. bifurcatus* and *C. longipenis***. Submitted to *Parasite*. Preprint available on bioRxiv doi: 10.1101/2021.01.29.428376.
- ✦ **TP Gobbin**, MPM Vanhove, R Veenstra, ME Maan, and O Seehausen (2023). **Variation in parasite infection between replicates of speciation in Lake Victoria cichlid fish**. *Evolution* 77(7), 1682-1690. doi:10.1093/evolut/qpad080
- ✦ **TP Gobbin**, MPM Vanhove, A Pariselle, ME Maan, and O Seehausen (2020). **Temporally consistent species differences in parasite infection but no evidence for rapid parasite-mediated speciation in Lake Victoria cichlid fish**. *Journal of Evolutionary Biology* 33(5): 556. doi:10.1111/jeb.13615
- ✦ **TP Gobbin**, MPM Vanhove, O Seehausen, and ME Maan (2020). **Microhabitat distributions and species interactions of ectoparasites on the gills of cichlid fish in Lake Victoria, Tanzania**. *International Journal for Parasitology* 51(2-3), 201-204. doi:10.1016/j.ijpara.2020.09.001
- ✦ **TP Gobbin**, R Tiemersma, G Leone, O Seehausen, and ME Maan (2020), **Patterns of ectoparasite infection in wild-caught and laboratory-bred cichlid fish, and their hybrids, implicate extrinsic rather than intrinsic causes of species differences in infection**, *Hydrobiologia* 848(16), 3817-3831. doi:10.1007/s10750-020-04423-7.