Monitoring wildlife parasites for One Health

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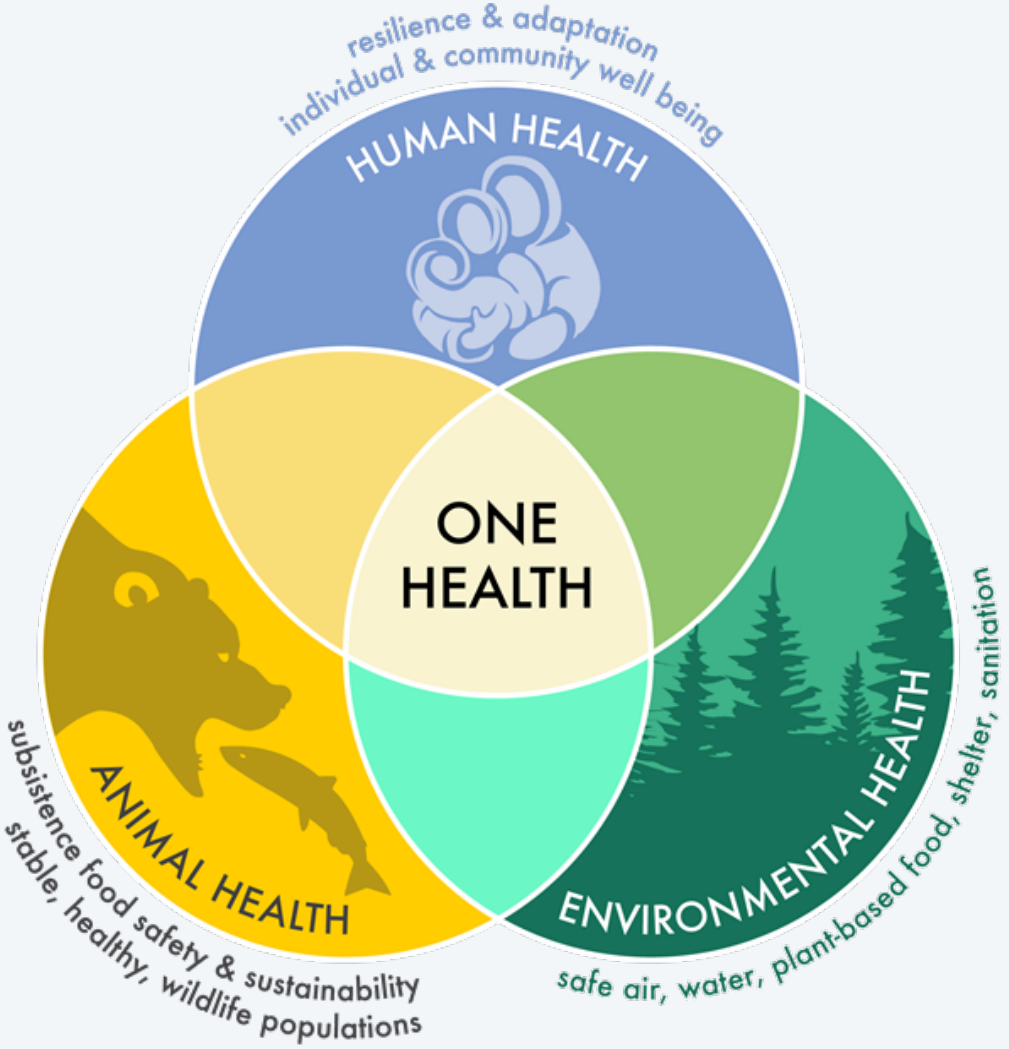
Annual Meeting of the Swiss Society of Tropical Medicine and Parasitology
Mendrisio, 6-7 June 2024

One Health



One Health: integrative approach

Change in perspective:
"us against them" → "shared risk"

Rabinowitz et al., 2008

One Health

“us versus them”

Animals as potential threat

rabies risk from raccoons,
wildlife reservoirs of pathogens

Barrier approach

quarantine, avoidance behaviours,
vector/reservoir population control

change in perspective

“shared risk”

Animals as sentinels

including parasites!

Dancing cats provided early warning
on methyl-mercury pollution

Human–animal–environment disease relationships

One Health & Parasites

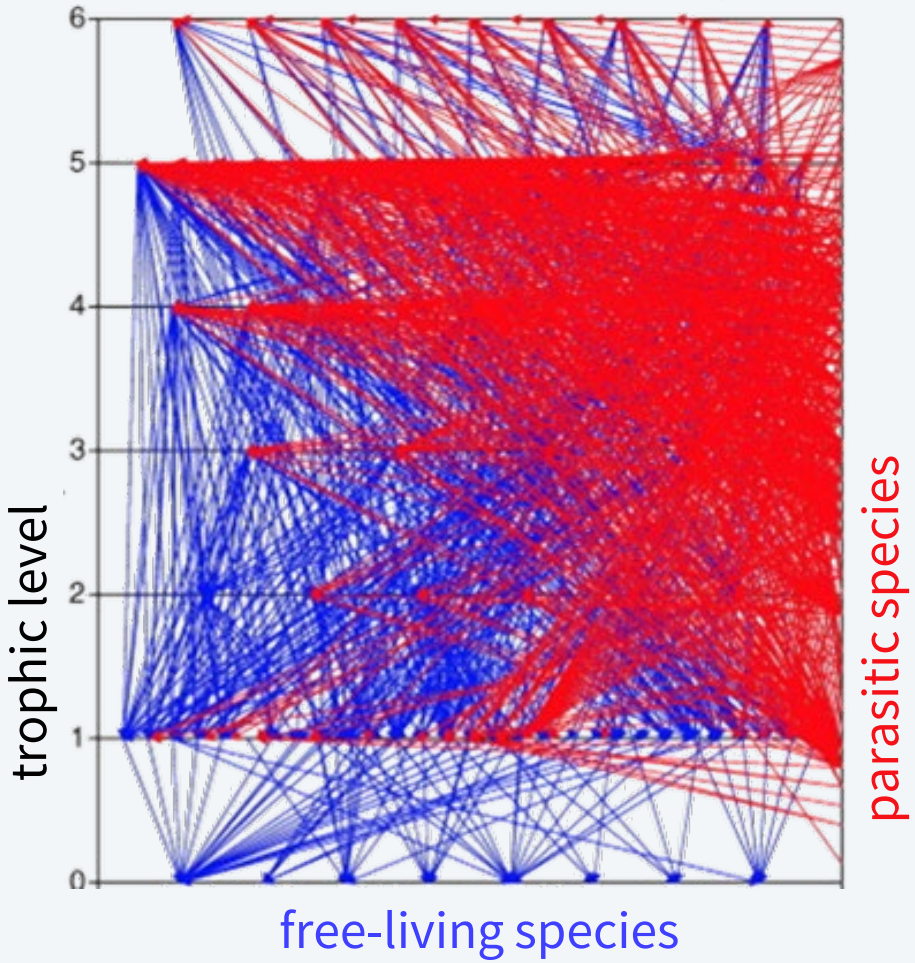
The positive side of parasites

Parasites increase: biodiversity, number of links between species, energy transfer

Parasites regulate host populations

→ Ecosystem robustness and resilience

Hudson et al., 2006



One Health & Parasites

What can we learn from wildlife parasites?

- Status of ecosystem health
  An ecosystem rich in parasites is an healthy ecosystem
- Link between habitat degradation and spillovers
  If an ecosystem changes, then host-parasite interactions change too

  Not only human-nature direct contact, but also human activities
  (main predictor of spillovers: change in land use)

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Links between ecological integrity, emerging infectious diseases originating from wildlife, and other aspects of human health - an overview of the literature

Tom Evans, Sarah Olson, James Watson, Kim Gruetzmacher, Mathieu Pruvot, Stacy Jupiter, Stephanie Wang, Tom Clements and Katie Jung

WCS

Biodiversity and Conservation (2020) 29:3095–3102
https://doi.org/10.1007/s10531-020-02021-6

EDITORIAL

Check for updates

Biodiversity loss, emerging pathogens and human health risks

Kirk S. Schmeller[1] · Franck Courchamp[2] · Gerry Killeen[3]

Journal of Helminthology (1997) **71**, 125–132

Schistosomiasis in the Senegal River Basin: before and after the construction of the dams at Diama, Senegal and Manantali, Mali and future prospects

V.R. Southgate

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

ECOLOGY LETTERS

Ecology Letters, (2018) **21**: 471–483 doi: 10.1111/ele.12904

Pathogen spillover during land conversion

Abstract

Pathogen spillover from wildlife to domestic animals and humans, and the reverse, has caused significant epidemics and pandemics worldwide. Although pathogen emergence has been linked to

ELSEVIER

International Journal for Parasitology 30 (2000) 1395–1405

www.parasitol

Effects of environmental change on emerging parasitic diseases

Jonathan A. Patz[a,*], Thaddeus K. Graczyk[b], Nina Geller[a], Amy Y. Vittor[c]

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INTERFACE

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Research

Check for

Habitat fragmentation, biodiversity loss and the risk of novel infectious disease emergence

David A. Wilkinson[1,2], Jonathan C. Marshall[1], Nigel P. French[1,2] and David T. S. Hayman[1]

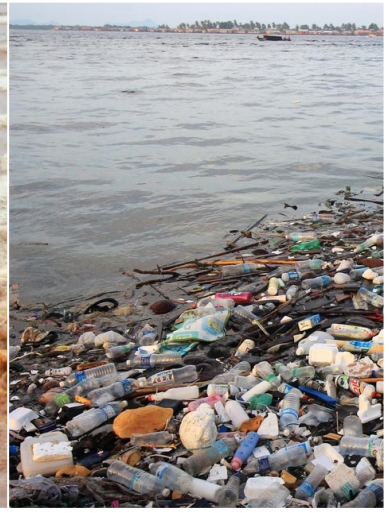
Human-induced ecosystem changes

Many parasitic diseases are linked to water

Anthropogenic changes

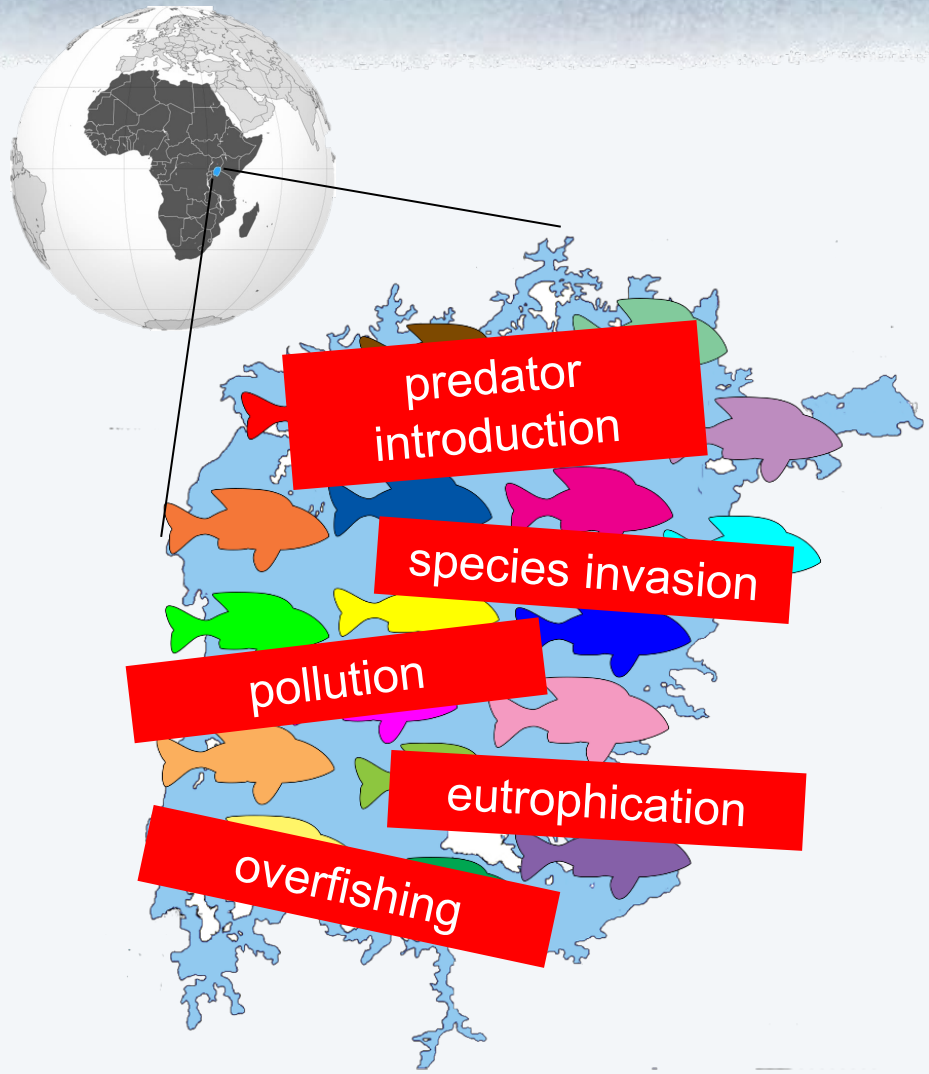
- Water eutrophication
- Species invasions
- Overfishing
- Pollution

Nile perch
(*Lates niloticus*)



IISD – Experimental Lakes Area ELA

Lake Victoria

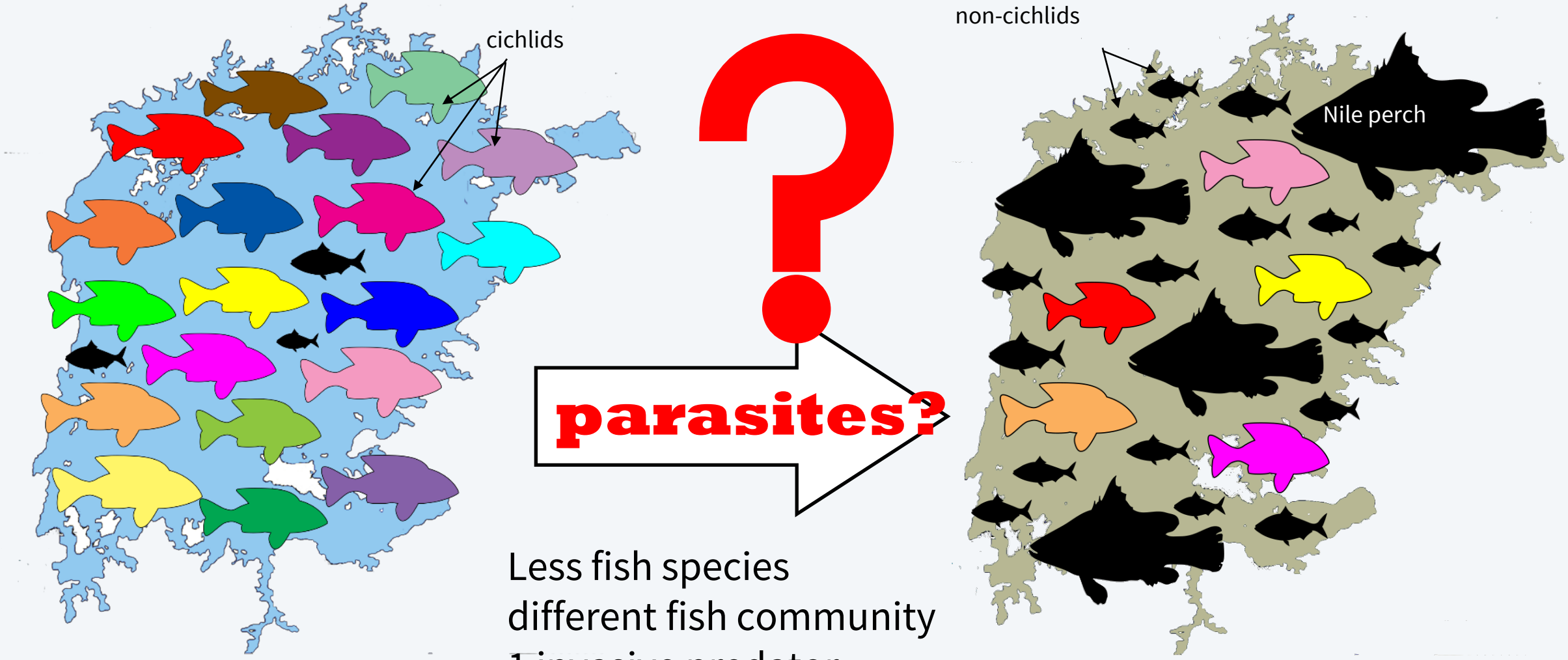


Lake Victoria

- African Great Lake (~60’000 km^2)
- Well studied system (especially fishes)
- Good model for anthropogenic impact on wetlands:

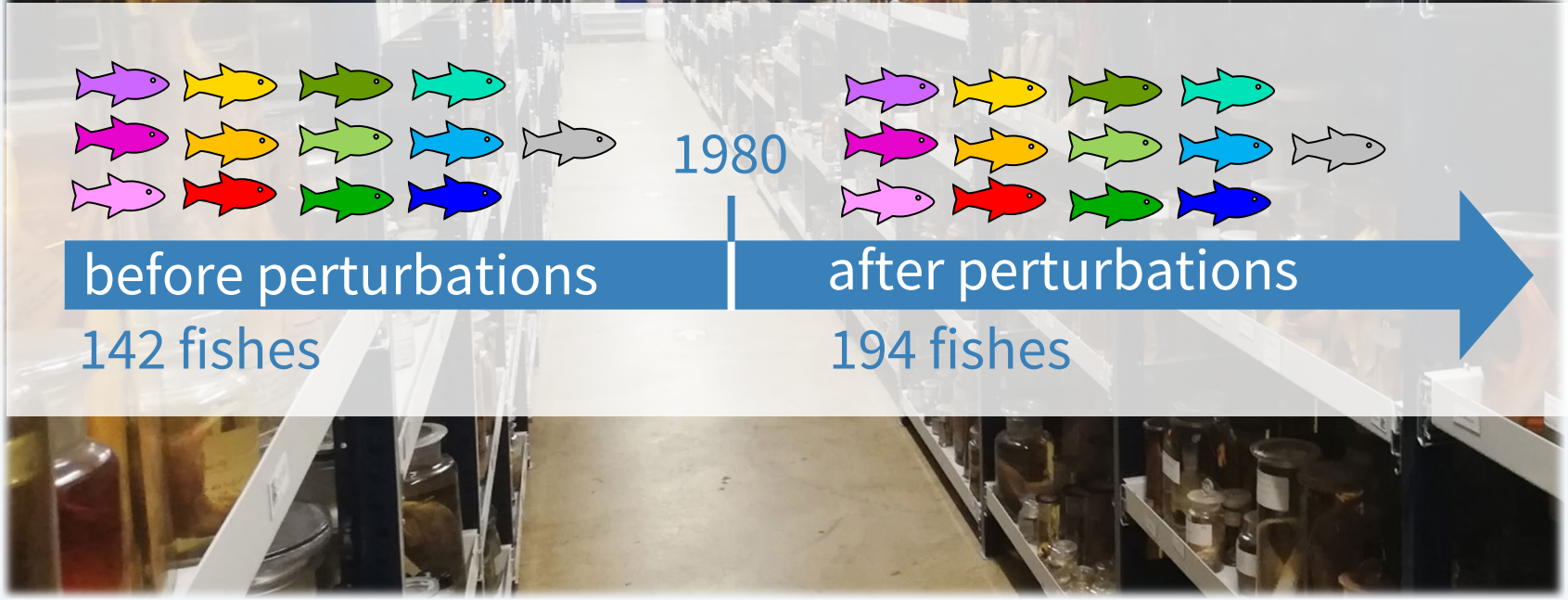
  human perturbations since 1980s

Lake Victoria



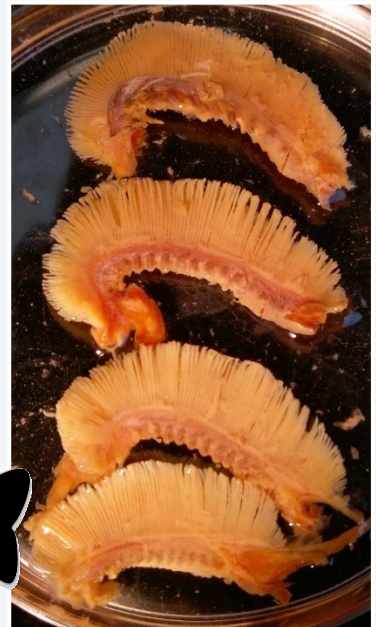
Less fish species
different fish community
1 invasive predator

Study design

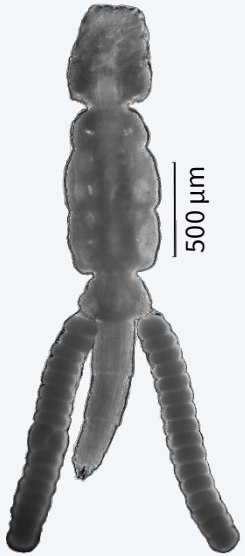


Before-after impact study, using historical and recent collections

13 cichlid fish species screened for gill macroparasites



Gill parasites

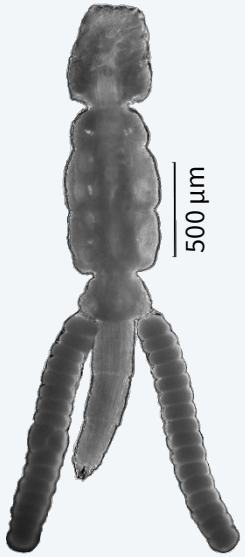


Lamproglena monodi

Ergasilus lamellifer

copepods
(crustaceans)

Gill parasites



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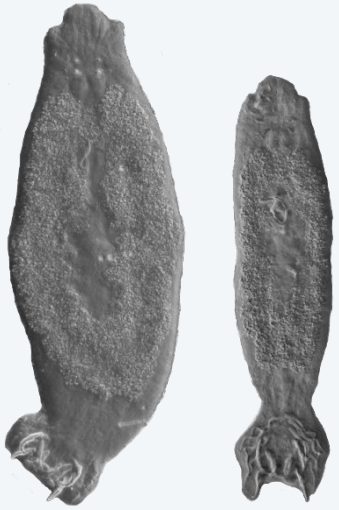


C. nyanza

C. pseudodossoui

C. furu

C. vetusmolendarius

C. longipenis

C. bifurcatus

Gyrodactylus sturmbaueri

Cichlidogyrus

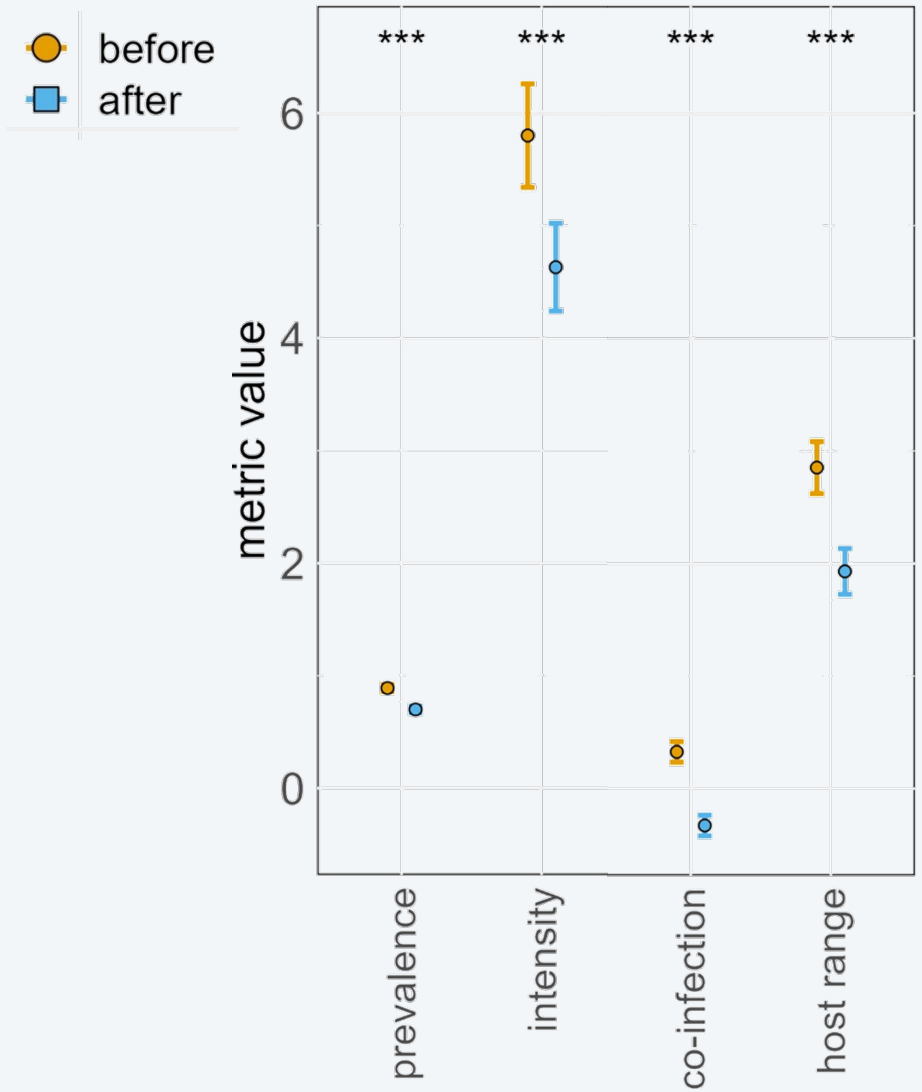
monogeneans (flatworms)

One Health & gill parasites

Advantages of One Health research on gill parasites

- Direct life cycle → no confounding effects
- High host specificity → spillovers are meaningful
- Ethics → not a threat to humans
- Infection parameters → intensity, zero counts, prevalence, co-infections, H-P network
- Collection-based research → cheap, large datasets, 1 host individual = 1 parasite community

Results

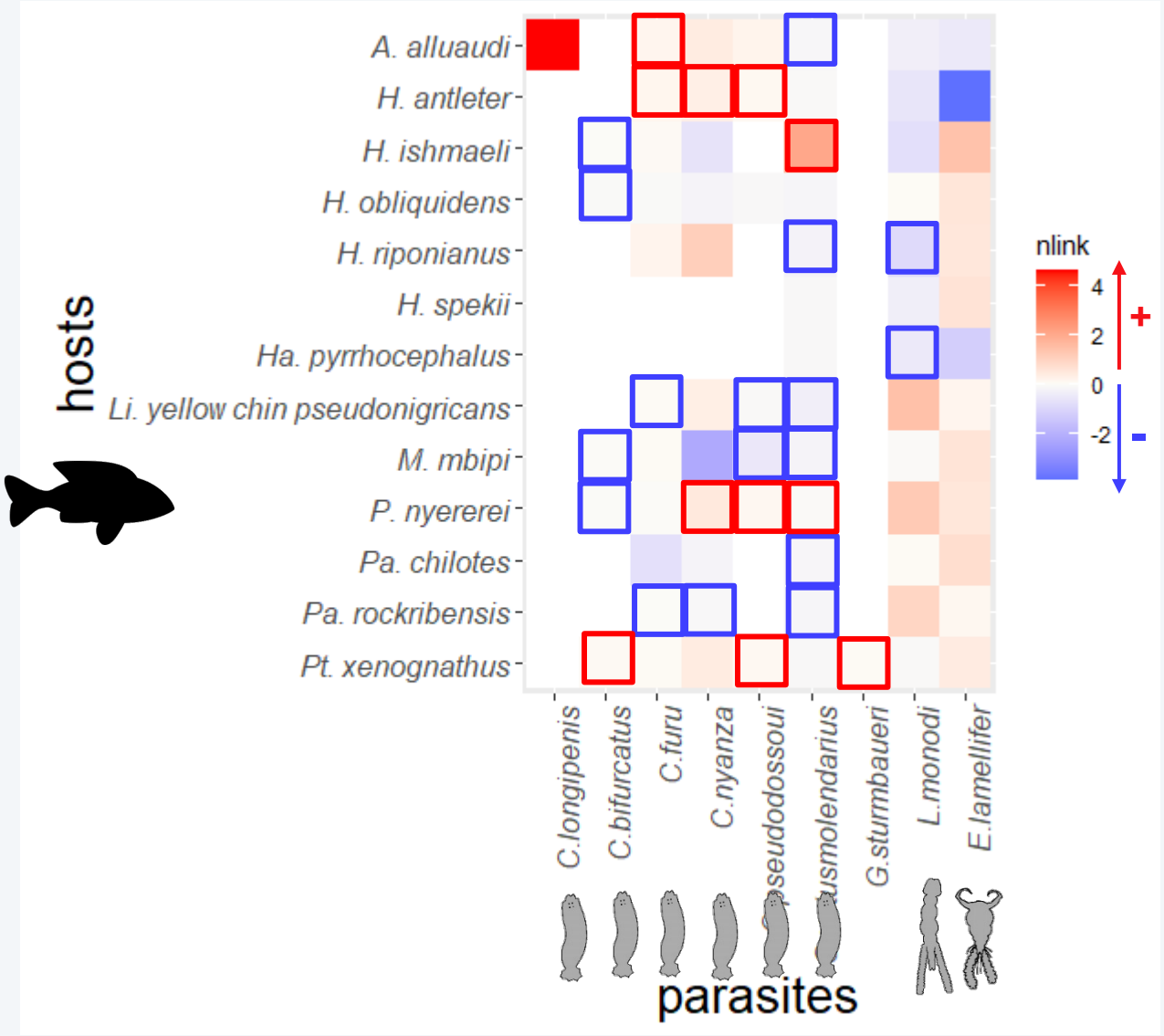


After ecosystem perturbations in Lake Victoria:

- Fewer fish were infected
  (prevalence decreased)
- Fish were infected by a lower number of parasites
  (intensity decreased)
- Co-infections became less frequent
  (decreased occurrence of ≥2 parasite species on the same host individual)
- Parasite species infected less host species
  (host range decreased)

Hurdle model, GLM

Results



Spillovers

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

Perturbations may favor spillovers (network rearrangement)

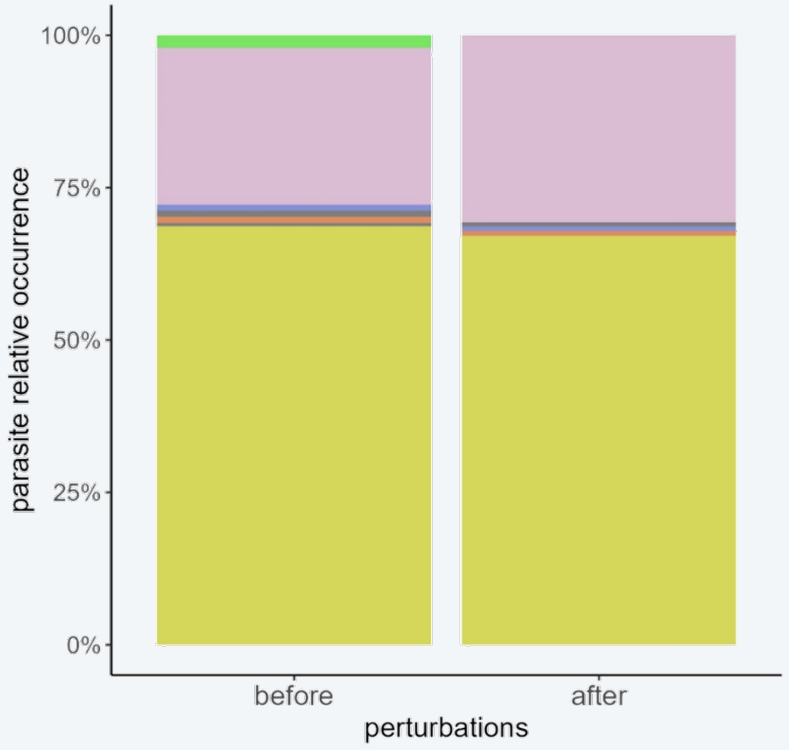
Results

Are these changes in parasite infections really due to human perturbations? **Yes!**

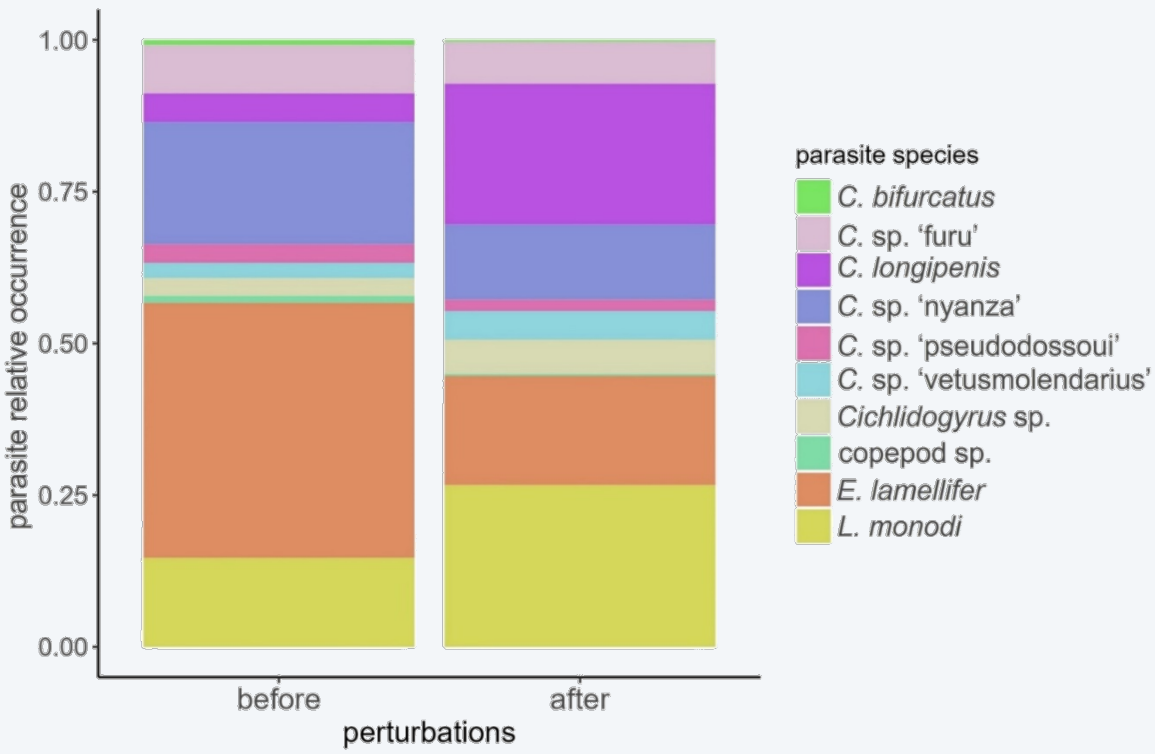
The relative occurrence of parasites changed in Lake Victoria,
but not in a pristine nearby lake

→ observed changes actually result from anthropogenic perturbations

Lake Edward (pristine)



Lake Victoria (human perturbations)



Conclusions

- Parasites intensity, prevalence, and co-infections decreased after perturbations in Lake Victoria
- Ecosystem perturbations can favor spillovers: parasites infected fewer and different host species

Parasites as sentinels:

- to provide an early warning for host switches
- to monitor ecosystem health

IUCN SSC
PARASITE
Specialist Group

Conclusion

Parasites are useful tools for One Health

Need of baseline data → monitor parasite diversity and population changes

IUCN Parasite Specialist Group

Red List to assess conservation status of species
(50% of animal species are parasites)

Raise awareness, contribute to action plans

IUCN = International Union for Conservation of Nature

IUCN SSC PARASITE Specialist Group

Excluding parasites of humans and of domestic animals !

Swiss National Science Foundation

UHASSELT

IUCN SSC PARASITE Specialist Group

fwo

natural sciences .be

Thank you

Ichthyo-parasitological team @ Hasselt University (B)

Royal Museum for Central Africa (B)
Royal Belgian Institute of Natural Sciences (B)
Naturalis Biodiversity Center (NL)
EAWAG, Swiss Federal Institute of Aquatic Science and Technology (CH)

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- **TP Gobbin**, M Van Steenberge, N Vranken, MPM Vanhove (2024) **Worms of change: anthropogenic disturbance changes the ectoparasite community structure of Lake Victoria cichlids**. Preprint available on bioRxiv doi: 10.1101/2024.04.14.589059

- **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.