2022 / 2023

Universität Bern | Universität Zürich
vetsuisse-fakultät

UNIVERSITÄT BERN

Institut für Parasitologie
der Vetsuisse-Fakultät sowie
der Medizinischen Fakultät
der Universität Bern

Co-Direktorinnen:

Prof. Caroline Frey

Prof. Britta Lundström-Stadelmann

SWISS ACCREDITATION sas.admin.ch STS 0678

Nationales Referenzlabor für Toxoplasmose
Nationales Referenzlabor für Trichinellose
Nationales Referenzlabor für Tritrichomonose
Nationales Referenzlabor für Beschälseuche
Nationales Referenzlabor für Neosporose
Nationales Referenzlabor für Besnoitiose

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1. VORWORT DIREKTORINNEN / PREFACE DIRECTORS

Mit viel Freude leiteten wir auch 2022 und 2023 das Institut für Parasitologie (IPA) Bern. In dieser zweiten Berichtsperiode blicken wir zurück auf ein Wiedererwachen der Lehr- und Forschungstätigkeit nach der Pandemie, auf die unvermindert starke Nachfrage nach unseren diagnostischen Dienstleistungen und auf die ersehnte Rückkehr der sozialen Aktivitäten.

Besondere Highlights waren 2022 die durch Prof. Andrew Hemphill und Prof. Britta Lundström-Stadelmann organisierten Konferenzen in Bern: das internationale ApicoWplexa Meeting und die Jahrestagung der Schweizerischen Gesellschaft für Tropenmedizin und Parasitologie (SGTP). An beiden Anlässen stand der kollegiale Wissensaustausch im Zentrum und Kollaborationen wurden initiiert und gestärkt. Im Jahr 2023 durften wir Dr. Natalie Wiedemar begrüssen, die mit ihrem SNF Ambizione Grant eine neue Forschungsgruppe zu *Fasciola hepatica* am IPA aufbaut. Wir freuen uns sehr über diese Erweiterung! Ein weiteres Highlight war 2023 das Sabbatical von Prof. Dr. Robin Gasser der Universität Melbourne, Australien, bei uns am Institut. Aus diesem Aufenthalt resultierte der Robin Gasser Award, ein Nachwuchsförderpreis der SGTP, welcher nun jährlich vergeben wird. Vielen lieben Dank Robin!

In der Berichtsperiode haben sechs neue Doktorinnen und Doktoren und acht Masterstudierende ihre Arbeiten am IPA abgeschlossen. Wir gratulieren allen Nachwuchsforschenden ganz herzlich! Besonders hervorheben möchten wir Dr. Dennis Imhofs Arbeit zur Impfstoffentwicklung gegen Toxoplasmose und Neosporose, die mit dem Young Investigator Award der SGTP ausgezeichnet wurde, und die Masterarbeit von Lea Hiller zur alveolären Echinococcose, die mit dem Alumni Preis der Vetsuisse Bern ausgezeichnet wurde.

Zwei langjährige Mitarbeitende traten 2022 in den wohlverdienten Ruhestand: Prof. Norbert Müller, geschätztes Fakultätsmitglied, Gruppenleiter und ehemaliger Leiter der humanparasitologischen Abteilung, sowie Vreni Balmer, unsere einzigartige Forschungslaborantin. Wir danken für ihren Einsatz, wünschen alles Gute im (Un)Ruhestand und freuen uns über spontane Besuche und Gespräche auch in Zukunft.

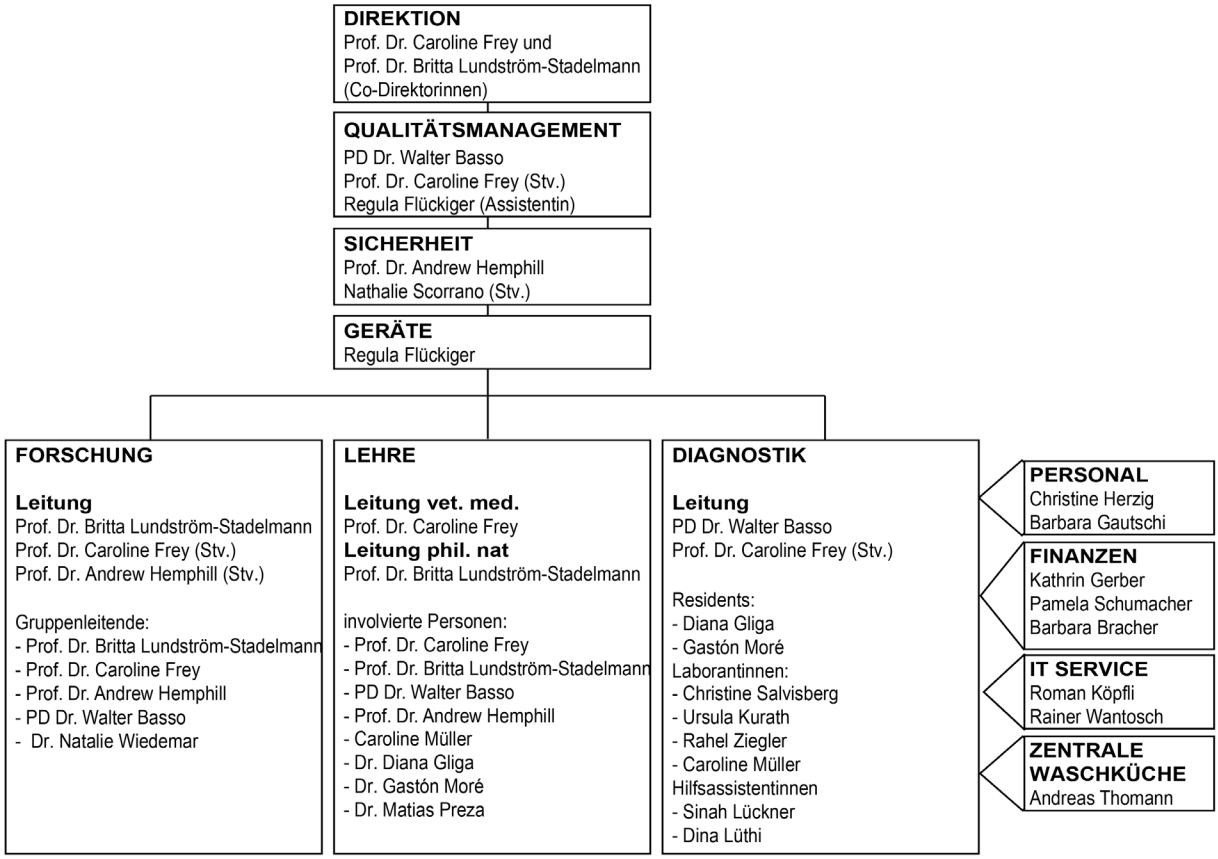
Unser Institut wächst, stösst dabei aber auf limitierte Platzverhältnisse. Als Zwischenlösung hat der Kanton Bern zusätzliche Räumlichkeiten in der Fabrikstrasse zur Verfügung gestellt, doch werden wir uns weiter dafür einsetzen, dass wir langfristig adäquate räumliche Bedingungen auf dem Campus bieten können.

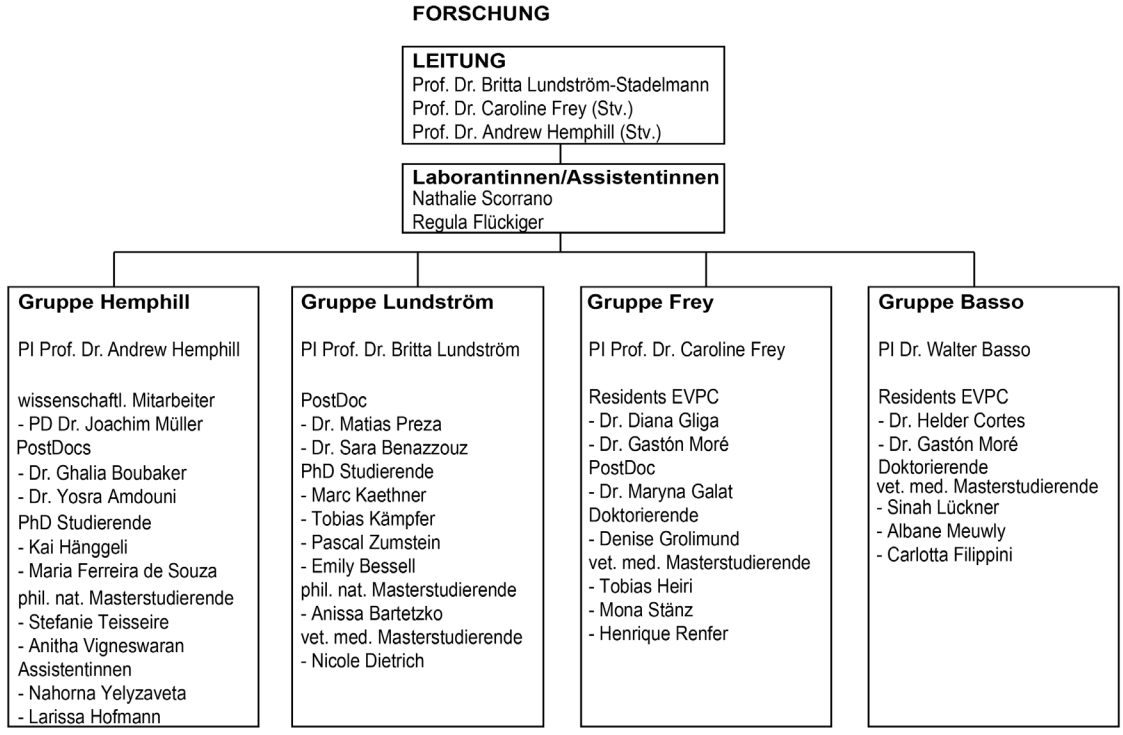
Dank dem Einsatz des gesamten motivierten IPA-Teams waren es zwei weitere erfolgreiche Jahre, in denen rund 70 Publikationen veröffentlicht, über 2'800’000 CHF Drittmittel eingeworben, 250 Lektionen Lehrveranstaltungen gehalten und über 20’000 diagnostische Untersuchungen durchgeführt wurden – und dies alles in einer freudvollen und kooperativen Atmosphäre. Danke an alle Mitarbeitenden!

Caroline Frey & Britta Lundström-Stadelmann, Co-Direktorinnen

Das Team des IPA 2023 mit Profs Lundström-Stadelmann (hellgrüne Jacke) und Caroline Frey (daneben).

2. ORGANIGRAMM / ORGANIGRAM (AS OF DEC. 2023)





3. Mitarbeitende / Team Members (Jan. 2022 – Dec. 2023)

Forschung / Research

Gruppenleitende / Principal Investigators

PD Dr. Walter Basso
Prof. Dr. Caroline Frey
Prof. Dr. Andrew Hemphill
Prof. Dr. Britta Lundström-Stadelmann
Prof. Dr. Norbert Müller
Dr. Natalie Wiedemar

Wissenschaftliche Mitarbeitende / Scientific staff

PD Dr. Joachim Müller

Assistierende / Assistants

Yelizaveta Nahorna

Laborantinnen / Technicians

Vreni Balmer
Regula Flückiger
Larissa Hofmann
Nathalie Scorrano

Postdocs

Dr. Yosra Amdouni
Dr. Sara Benazzouz
Dr. Ghalia Boubaker
Dr. Maryna Galat
Dr. Diana Gliga
Dr. Gastón Moré
Dr. Matías Preza

PhD Studierende und Doktorierende / PhD and doctoral students

Jubilee Ajiboye
Emily Bessell
Maria Cristina Ferreira de Sousa
Rebecca Furtado Jost
Denise Grolimund
Kai Hänggeli
Dennis Imhof
Tobias Kämpfer
Marc Kaethner
Miguel Pardo Gil
Patrick Scherrer
Seraina Meister
Pia Cigler
Pascal Zumstein

Masterstudierende / Master students

Anissa Bartetzko
Sheena Chaudry
Nicole Dietrich
Carlotta Filippini
Denise Grolimund
Noé Haudenschild
Tobias Heiri
Lea Hiller
Pauline Liechti
Sinah Lückner
Albane Meuwly
Carmen Luginbühl
Henrique Renfer
Carling Schlange
Anna Schneider
Mona Stänz
Marion Stettler
Stefanie Teysseire
Anitha Vigneswaran
Pascal Zumstein

Bachelorstudierende / Bachelor students

Fabrizio Troia
Anitha Vigneswaran

Adjunct Researchers

Dr. Helder Cortes
University of Evora, Portugal

Prof. Dr. Maria Mar Siles Lucas
Instituto de Recursos Naturales y Agrobiología de Salamanca, Spain

Dr. David Leitsch
Medizinische Universität Wien, Austria

Diagnostik / Diagnostic Unit

Leitung / Head

PD Dr. Walter Basso
Prof. Dr. Caroline Frey (Stv.)
Prof. Dr. Norbert Müller (Stv.)

Laborantinnen / Technicians

Ursula Kurath
Caroline Müller
Christine Salvisberg
Rahel Ziegler

EVPC Residents

Diana Gliga
Dr. Gastón Moré
Dr. Helder Cortes

Assistierende / Assistants

Elena Emmenegger
Sinah Lückner
Dina Lüthi
Ljubo Propadalo

4. GASTFORSCHENDE & PRAKTIKANTINNEN / GUEST RESEARCHERS

- **Claude Schüpbach**, MINT-Praktikum, Gymnasium Lerbermatt, Bern, **Oct. 2023**.
- **Luisa Schiegl,** Research Internship, University of Würzburg, GER, **Oct. 2022 and Oct./Nov. 2023**.
- **Agnė Baranauskaitė,** Research Internship, Nature Research Centre, Vilnius, Lithuania, **Sept. 2023.**
- **Robin Gasser,** Sabbatical, University of Melbourne, Australia, **Aug./Sep. 2023.**
- **Baptiste Colin,** Student Internship, Université Paris, F, **Apr. – Jul. 2023**
- **Charleen Plaisse**, Research Internship, University of Rennes, F, **Mar. 2023**.
- **Kokila Sivabalakrisham,** PhD internship, Department of Zoology, University of Jaffna, Sri Lanka, **Jan. - Mar. 2023**
- **Selene Rubiola,** Research Internship, University of Turin, Italy, **Jan. 2023.**
- **Manuela Semeraro,** Research Internship, University of Parma, Italy, **Oct. 2022, Apr.-Sept.2023.**
- **Lan Anh,** Research Internship, University of Hanoi, Vietnam, **Jul. 2022**.
- **Alice Bernal,** Student internship, Université Paris, F, **Apr. – Aug. 2022**
- **Egger Nicolas,** MINT-Praktikum, Gymnasium Lerbermatt, Bern, **Apr. 2022**.
- **Laura Rico San Roman,** Research Internship, Complutense University Madrid, E, **Mar.-June 2022**.
- **Claudia Tamponi,** Research Internship, University of Sassari, Italy, **Feb./Mar. 2022**.
- **Arthiyan Sivasingham,** PhD internship, Department of Zoology, University of Jaffna, Sri Lanka, **Feb. - Apr. 2022.**

Abschied von Claude Schüpbach (rechts aussen) nach seinem Praktikum 2023.

5. FORSCHUNG / RESEARCH

5.1 GRANTS

Members of IPA as main PI

Swiss National Science Foundation (SNSF) Ambizione Grant

Project title:	"Dissecting resistance mechanisms and identifying new drug targets for the liver fluke *Fasciola hepatica*"
Principal Investigator:	N. Wiedemar
Project Budget:	955'084 CHF
Project Period:	Dez. 2023 – Nov. 2027

UniBe ID Grant

Project Title:	"Role of IL-33 in alveolar echinococcosis"
Principal Investigator:	B. Lundström-Stadelmann and Ph. Krebs
Project Budget:	150'000 CHF
Project Period:	Dec. 2023 – Nov. 2025

Swiss Government Excellence Scholarship

Project Title:	"Drug testing and development for the treatment of cystic echinococcosis"
Principal Investigator:	S. Benazzouz
Project Budget:	42'000 CHF
Project Period:	Sept. 2023 - Aug. 2024

SNSF Scientific Exchanges

Project Title:	"Molecular basis of parasitism – toward new disease interventions"
Principal Investigator:	B. Lundström-Stadelmann and R. Gasser
Project Budget:	6'400 CHF
Project Period:	Aug. 2023 – Oct. 2023

Forschungsstiftung UniBe

Project Title:	"An improved screening method for the discovery of drugs against foodborne flatworms"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	8'123 CHF
Project Period:	Jun. 2023

Swiss National Science Foundation

Project title:	"Going for unexplored territory: novel drugs and their targets in *Toxoplasma* and *Neospora*."
Principal Investigator:	A. Hemphill
Project Budget:	630'000 CHF
Project Period:	Apr. 2023 – Sept. 2026

Elanco

Project Title:	"Development of novel *in vitro* screening methods"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	19'800 CHF
Project Period:	Apr. 2023 – Jul. 2023

Gottfried and Julia Bangerter-Rhyner-Stiftung

Project Title:	"Novel therapy against the fox tapeworm"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	50'000 CHF
Project Period:	Mar. 2023 – 2027

Uniscientia Foundation

Project Title:	"Novel therapy against the fox tapeworm"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	240'000 CHF
Project Period:	Mar. 2023 – 2027

Bundesamt für Lebensmittelsicherheit und Veterinärwesen

Project Title:	"Literature Review on parasitic protozoans in ready-to-eat food"
Principal Investigator:	C. Frey
Project Budget:	15'000 CHF
Project Period:	Dec. 2022 – Jun. 2023

Swiss National Science Foundation

Project Title:	"Antimicrobial peptides for the treatment of *Toxoplasma* infections"
Principal Investigator:	Y. Amdouni
Project Budget:	255'812 CHF
Project Period:	Oct. 2022 – Sept. 2024

SNSF Scientific Exchanges

Project Title:	"Joint Annual Meeting of SSTMP and SSTTM 2022 in Bern"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	4'400 CHF
Project Period:	Oct. 2022

SNSF Scientific Exchanges

Project Title:	"ApicoWplexa 2022: 6th international meeting on apicomplexan parasites in farm animals"
Principal Investigator:	A. Hemphill
Project Budget:	8'000 CHF
Project Period:	Sept. 2022 – Dec. 2022

Boehringer-Ingelheim

Project Title:	"Endoparasites in cats with an emphasis on *E. multilocularis*"
Principal Investigator:	C. Frey
Project Budget:	87'000 CHF
Project Period:	Mar. 2022 – Dec. 2023

Boehringer-Ingelheim, Zoetis & Biokema

Project Titel:	"Serorurveillance of pasture helminths in dairy cows"
Principal Investigator:	C. Frey
Project Budget:	20'000 CHF
Project Period:	Jan. 2022 – Dec. 2023

Elanco-Bayer Animal Health

Project Title:	"Screening of anti-parasitic drugs"
Principal Investigator:	A. Hemphill
Project Budget:	100'000 CHF
Project Period:	Jan. 2022 – Dec. 2023

Uniscientia Foundation

Project title:	"Ocular toxoplasmosis: studies on drug susceptibility of novel field isolates and development of an animal model"
Principal Investigator:	A. Hemphill
Project Budget:	180'000 CHF
Project Period:	April 2021 – March 2024

Swiss National Science Foundation (SNSF)

Project number:	IZSTZ0_191762
Project title:	"The molecular basis of adaptation of *Aedes* mosquitoes, vectors of viral diseases, to saltwater environments"
Principal Investigator:	A. Hemphill
Project Budget:	132'550 CHF
Project Period:	Oct. 2020 – Sept. 2024

Swiss National Science Foundation (SNSF)

Project number:	310030_192072
Project title:	"Energy-generating pathways of the parasite *Echinococcus multilocularis* and their potential for novel, targeted treatments against alveolar echinococcosis"
Principal Investigator:	B. Lundström-Stadelmann
Project Budget:	700'000 CHF
Project Period:	Apr. 2020 – Mar. 2024

Swiss National Science Foundation (SNSF)

Project title:	"Effects of a double-edged sword: exploiting the interaction between immunity and chemotherapy in murine and ovine models of congenital neosporosis and toxoplasmosis"
Principal Investigator:	A. Hemphill
Project Budget:	846'720 CHF
Project Period:	Apr. 2019 – Mar. 2023

Novartis Research Foundation

Project title:	"Toxoplasmosis: more dangerous than expected? Studies on drug susceptibility of novel parasite isolates"
Principal Investigator:	A. Hemphill
Project Budget:	60'000 CHF
Project Period:	Nov. 2018 – Oct. 2022

IPA as collaborator

National Institutes of Health (NIH)

Project title:	"Optimiziation of lead-BKIs for cryptosporidioisis therapy"
Principal Investigator:	W. Van Voorhis, University of Washington, Seattle, USA.
Collaborator at IPA:	A. Hemphill
Project Budget:	81'000 USD
Project Period:	Mar. 2021 – Feb. 2026

National Institutes of Health (NIH)

Project title:	"Bumped kinase inhibitor drug development for toxoplasmosis"
Principal Investigator:	W. Van Voorhis, University of Washington, Seattle, USA.
Collaborator at IPA:	A. Hemphill
Project Budget:	147'066 USD
Project Period:	Jan. 2021 – Dec. 2025

INSERM International Project

Project title:	"NANOTHERA-ECHINO Project"
Principal Investigator:	S. Dion, University of Rennes, F
Collaborator at IPA:	B. Lundström-Stadelmann
Project Budget:	60'000 EUR
Project Period:	Jan. 2021 – Dec. 2025

Swiss Network for International Studies (SNIS)

Project title:	"ParaSahel – One Health and Citizen Science approaches for contextualized community-led interventions tackling water-borne parasitic diseases in Chad"
Principal Investigator:	H. Greter, Swiss Tropical and Public Health Institute; S. Dürr, Veterinary Public Health Institute, University of Bern
Collaborator at IPA:	C. Frey, B. Lundström-Stadelmann
Project Budget:	280'000 CHF
Project Period:	Nov. 2022 – Nov. 2024

Swisslos Aarau & Solothurn

Project title:	"Trypanosomen – Gefährden Blutparasiten die Nachzucht von Alpenseglern?"
Principal Investigator:	S. Keller, P. Cigler, I. Adrian-Kalchhauser (all FIWI)
Collaborator at IPA:	G. Moré, W. Basso, C. Frey
Project budget:	83'000 CHF
Project Period:	Aug. 2022 – Dec. 2025

KORA-Raubtierökologie und Wildtiermanagement

Project title:	"*Toxoplasma gondii* infections in Eurasian wolves in Switzerland: occurrence and impact on behaviour"
Principal Investigator:	P. Scherrer, N. Gerber (KORA), I. Marti (FIWI)
Collaborator at IPA:	W. Basso, C. Frey
Project Budget:	4'000 CHF
Project Period:	Mar. 2022 – Dec. 2024

5.2 Projektzusammenfassungen / Projects and Summaries of Main Projects

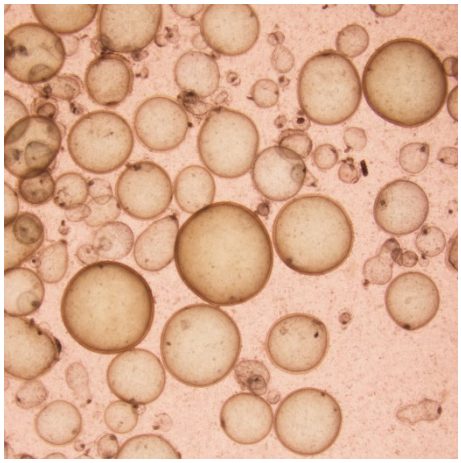
Echinococcus multilocularis – der Fuchsbandwurm / the Fox Tapeworm

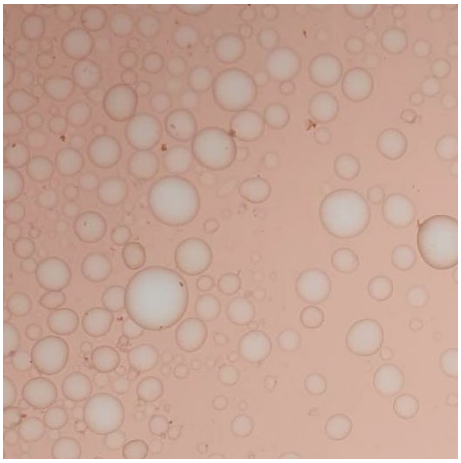
Researchers at IPA (PI, then in alphabetical order)**:**
Prof. Dr. Britta Lundström-Stadelmann, Anissa Bartetzko, Dr. Sara Benazzouz, Nicole Dietrich, Prof. Dr. Andrew Hemphill, Lea Hiller, Marc Kaethner, Tobias Kämpfer, Roman Memedovski, Dr. Joachim Müller, Dr. Matías Preza, Dr. Reto Rufener, Nathalie Scorrano, Pascal Zumstein, Raphael Zurbriggen.

External collaborators (only PIs are listed, alphabetical order):
Prof. Dr. Guido Beldi (University of Bern), Dr. Klaus Brehm (University of Würzburg, D), Dr. Solange Bresson-Hadni (French National Reference Center for Echinococcosis, Besançon, F; Geneva University Hospital), Dr. Sarah Dion (Institut de Recherche en Santé (IRSET), University of Rennes, F), Prof. Dr. Stone Dogget (Oregon Health and Science University, Portland, OR, USA), Prof. Dr. Manfred Heller (University of Bern), Prof. Dr. Carlo Largiadèr (University of Bern), Prof. Dr. Martin Lochner (University of Bern), Prof. Dr. Marcus Vinicius Nora de Souza (Fundação Oswaldo Cruz, BR), Prof. Dr. Alex Odermatt (University of Basel), Dr. Clément Regnault (Glasgow Polyomics, UK), Prof. Dr. Martin Schlitzer (University of Marburg), Prof. Dr. Stefan Schürch (University of Bern), Prof. Dr. Antonio Varcasia (University of Sassari, I).

Project background
The metacestode (larval stage) of the helminth *Echinococcus multilocularis* is the causative agent of alveolar echinococcosis (AE), a severe and in many cases incurable disease in humans and animals. Radical curative surgery is not possible in many AE patients, and therapy based on the benzimidazoles albendazole or mebendazole is presently the only approved drug treatment option for a stabilizing, but non-curative, treatment. Thanks to markedly improved *in vitro* culture techniques for *E. multilocularis* metacestodes and stem cells we implemented, we developed novel medium-throughput drug-screening assays. This allowed us to establish objective and quantifiable read-outs.

Project description
A whole-organism-based screening cascade was so far only available for *E. multilocularis* and **we applied and validated this screening cascade to *E. granulosus sensu stricto (s.s.)***. On a global scale, *E. multilocularis* and *E. granulosus sensu lato* are the third and second most important food-borne parasites, respectively. AE and cystic echinococcosis cause global burdens of 688,000 and 184,000 Disability Adjusted Life Years (DALY) and are responsible for at least 18,500 and 188,000 new human cases per year. Thus, clearly, there was need to have respective methods in place for *E. granulosus*. For this (and future) study we needed large amounts of metacestode vesicles and germinal layer cells of *E. granulosus s.s.*, which we could generate with the adaptation of *in vitro* cultivation methods from *E. multilocularis* to *E. granulosus* in collaboration with Prof. Varcasia, University of Sassari, and Prof. Brehm, University of Würzburg.

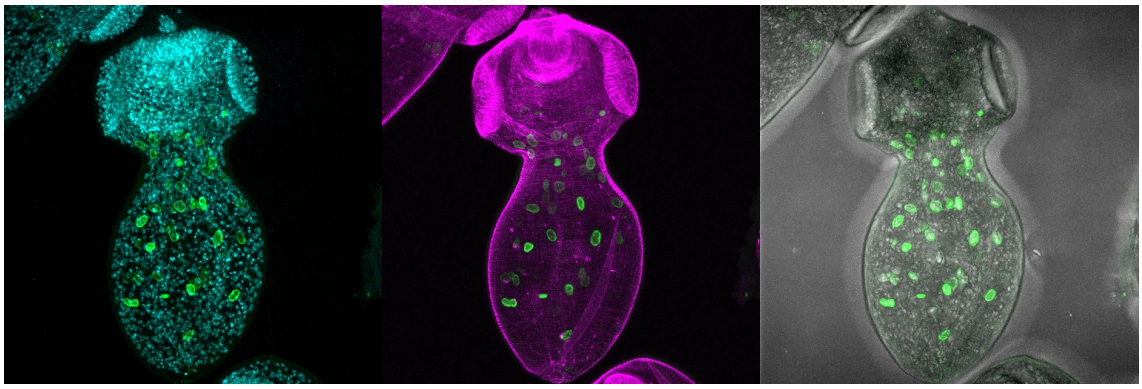




***E. granulosus* (Hundebandwurm) und *E. multilocularis* (Fuchsbandwurm) Metazestodenkultur *in vitro*.**

We confirmed that isolated *E. granulosus s.s.* germinal layer cells could form novel metacestode vesicles. This had never been shown before for germinal layer cells that were isolated from *in vitro* generated metacestode vesicles. We also showed that *in vitro* generated *E. granulosus s.s.* metacestode vesicles and germinal layer cells, as well as *ex vivo* isolated protoscoleces could be successfully adapted to an established *in vitro* drug screening cascade. **The results of this project have the potential to boost drug screening against *E. granulosus* and they have set the foundation for comparative analyses of *E. multilocularis* and *E. granulosus* in a defined *in vitro* setting.**

A **better knowledge of the proteome of our parasite, including sub-fractions of the vesicle fluid, the vesicle tissue, and secreted fractions, is incremental for a better understanding of the metabolism**. For this reason, we conducted a proteomic analysis in collaboration with M. Heller, proteomics core facility of the UniBe. In vesicle fluid, vesicle tissue and culture medium of *E. multilocularis* metacestode vesicles we could identify ~3,000 parasite proteins. Interestingly, the protein composition of vesicle fluid and culture medium was dominated by a distinct pattern of antigen B (AgB) subunits. This pattern was conserved in metacestode fluid from infected mice. By immunofluorescence we localized AgB subunits to calcareous corpuscles. HA-tagged synthetic AgB polypeptides were shown to be taken up from culture medium into vesicle fluid of metacestode vesicles *in vitro* within hours, **thus a potential lipid-uptake via this route, that was so far postulated within the field, might be feasible**. **Concluding, our *in vitro* model allowed detailed assessments of both protein patterns and proteome dynamics of *E. multilocularis*.**



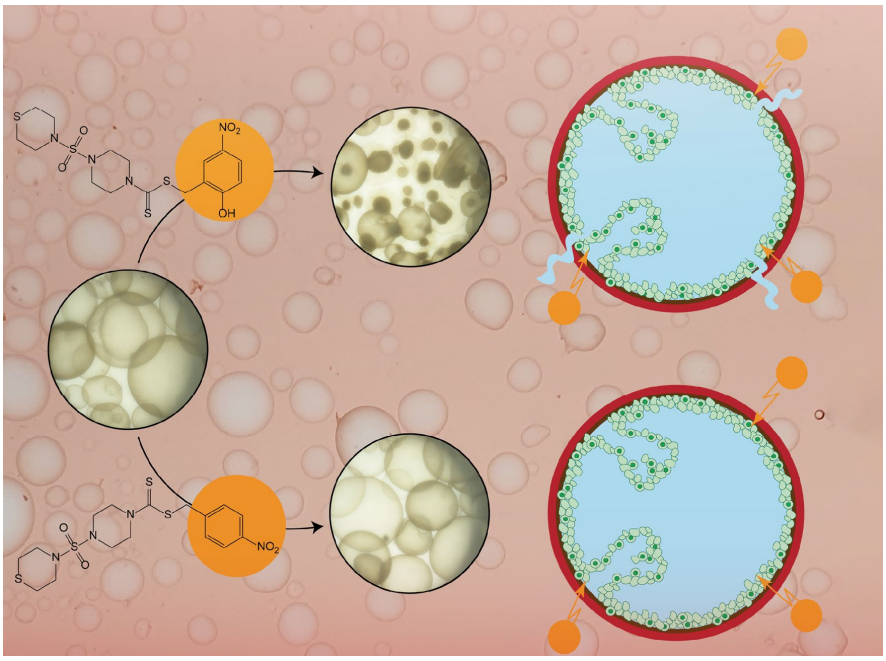
Protoscoleces des Fuchsbandwurms, gefärbt in blau (Zellkerne), pink (Muskeln) und grün (Antigene).

Due to the fact that pharmaceutical companies are reluctant to engage in preclinical drug development for AE, we have largely focused on **repurposing** of already existing drugs or compound classes that are on the market or being developed for other indications. With whole organism screening we hereby focus on **anti-cancer compounds, natural compounds and anti-infective compounds**. We perform **pharmacodynamic studies** *in vitro* and *in vivo*, investigate the **mode of action** of active compounds, as well as the **structure activity relationship**. In 2022 and 2023, our main studies covered (a) the anti-malarial mefloquine, (b) dithiocarbamates, and (c) endochin-like quinolones.

a) We had previously demonstrated the activity of **mefloquine** in AE mouse models, with plasma levels that are achievable in human patients by a malaria-prophylactic dose. For this reason, mefloquine was considered for salvage treatment of AE. We assessed several mefloquine derivatives that were not more active than mefloquine, but allowed structure activity relationship analyses. Differential affinity chromatography - proteomics in collaboration with M. Heller, Proteomics Core Facility UniBe, identified 216 proteins that bind exclusively to mefloquine and MEF-3 (an active derivative). Identified proteins covered energy metabolism, cellular transport and

structure, as well as stress response and nucleic acid binding, **confirming the pleiotropic effects induced by mefloquine, and in particular, its effects on the energy metabolism**.

b) We tested if disulfiram and **dithiocarbamate derivatives** were active against *E. multilocularis* metacestode vesicles *in vitro*. We applied an *in vitro* drug screening cascade for the identification of novel compounds against *E. multilocularis* metacestode vesicles with disulfiram and 51 dithiocarbamate derivatives, synthetized by our collaborator Prof. Schlitzer from the University of Marburg. Five compounds showed activity against *E. multilocularis* metacestode vesicles after five days of drug-incubation in a damage marker release assay. Structure-activity relationship analyses revealed that a *S*-2-hydroxy-5-nitro benzyl moiety was necessary for anti-echinococcal activity, as derivatives without this group had no effect on *E. multilocularis* metacestode vesicles. The five active compounds were further tested for potential cytotoxicity on mammalian cells. Of the two compounds with low toxicity (Schl-32.315 and Schl-33.652), none were highly active on isolated germinal layer cells, but against metacestode vesicles. **Schl-33.652 showed a low IC_{50} and should be followed up in the future for its activity against AE and its mode of action, in particular regarding energy generating pathways.**



Ausschnitt aus der "Cover story" im Journal Tropical Medicine and Infectious Disease Vol. 8, Issue 12, 2023.

c) We screened 13 **endochin-like quinolones** (ELQs), synthetized by our collaborator Prof. Dogget, Oregon Health and Science University) *in vitro* for their activities against two isolates of *E. multilocularis* metacestodes and isolated germinal layer. For the five most active, EC_{50} values against metacestodes were assessed. Further, the gene sequence of the proposed target, the mitochondrial cytochrome b, was analyzed. Oxygen consumption assays showed that ELQ-400 inhibits the *E. multilocularis* cytochrome bc_1 complex under normoxic conditions, thus clearly, **ELQ-400 is an inhibitor of energy generating pathway in the parasite**. When tested under anaerobic conditions, ELQ-400 was hardly active against *E. multilocularis* metacestodes, as also confirmed by transmission electron microscopy. ELQ-400 treatment increased levels of parasite-released succinate, the final electron acceptor of the MD. This suggests that the parasite switched to MD for energy generation. Therefore, MD was inhibited with quinazoline, which did not induce damage to metacestodes under anaerobic conditions. **The combination treatment with quinazoline strongly**

improved the activity of the bc_1 inhibitor ELQ-400 against *E. multilocularis* metacestodes under anaerobic conditions.

Based on these screening-based studies we have developed more target-based approaches for further treatment of echinococcosis: Possible targets that are studied are the **energy metabolism** (see above), and **metabolic footprint** and requirements of the parasite. We had previously shown that *E. multilocularis* metacestode vesicles scavenge large amounts of L-threonine from the culture medium that was neither stored nor overused for protein synthesis. This motivated us **to study the effect of L-threonine on the parasite and how it is metabolized and if it could offer a novel molecular target for treatment**. This study is now under submission.

In one collaborative study with Prof. Odermatt (University of Basel) and Prof. Beldi (Inselspital Bern), we explored an involvement of unfolded protein response (UPR) and endoplasmic reticulum-stress (ERS) during *E. multilocularis* infection in mice. AE caused chronic inflammation, UPR activation and ERS in mice. The *E. multilocularis*-induced inflammation and consecutive ERS was ameliorated by the standard drug in use, albendazole, and αPD-L1 treatment, indicating their effectiveness to inhibit parasite proliferation and downregulate its activity status. Neither albendazole nor αPD-L1 themselves affected UPR in control mice.

THE ROLE OF IL-33 IN ALVEOLAR ECHINOCOCCOSIS

Researchers at IPA: Prof. Dr. Britta Lundström-Stadelmann, Prof. Dr. Bruno Gottstein.

External collaborators: Dr. Brice Autier (IRSET Rennes, F), Dr. Sarah Dion (IRSET Rennes, F), Prof. Dr. Philippe Krebs (University of Bern).

Project background: During the course of alveolar echinococcosis (AE), the larval stage of *E. multilocularis* develops in the liver, where an initial Th1/Th17 immune response may allow its elimination in resistant individuals. In patients susceptible to infection and disease, the Th2 response initiates later, inducing tolerance to the parasite. The role of interleukin 33 (IL-33), an alarmin released during necrosis and known to drive a Th2 immune response, has not yet been described during AE.

Project description: Wild-type (WT) and IL-$33^{-/-}$ C57BL/6J mice were infected by peritoneal inoculation with *E. multilocularis* metacestodes and euthanized 4 months later, and their immune response were analyzed. Immunofluorescence staining and IL-33 enzyme-linked immunosorbent assay (ELISA) were also performed on liver samples from human patients with AE. Overall, metacestode lesions were smaller in IL-$33^{-/-}$ mice than in WT mice. IL-33 was detected in periparasitic tissues, but not in mouse or human serum. In infected mice, endogenous IL-33 modified peritoneal macrophage polarization and cytokine profiles. Th2 cytokine concentrations were positively correlated with parasite mass in WT mice, but not in IL-$33^{-/-}$ mice. In human AE patients, IL-33 concentrations were higher in parasitic tissues than in distant liver parenchyma. The main sources of IL-33 were $CD31^+$ endothelial cells of the neovasculature, present within lymphoid periparasitic infiltrates together with $FOXP3^+$ T_{reg}s. In the murine model, periparasitic IL-33 correlated with accelerated parasite growth putatively through the polarization of M2-like macrophages and release of immunosuppressive cytokines IL-10 and transforming growth factor β1 (TGF-β1). We concluded that IL-33 is a key alarmin in AE that contributes to the tolerogenic effect of systemic Th2 cytokines. **This suggests that targeting IL-33 could be of interest for the management of patients with AE, and that IL-33 polymorphisms could be responsible for increased susceptibility to AE.**

DRUGS AGAINST ADULT TAPEWORMS: PRAZIQUANTEL AND ITS MODE OF ACTION

Researchers at IPA: Prof. Dr. Britta Lundström-Stadelmann, Marc Kaethner.

External collaborators: Dr. David Maillard (Merck), Prof. Dr. Jonathan Marchant (Medical College Wisonsin, WI), Dr. Thomas Spangenberg (Merck), Dr. Daniel Sprague (Medical College Wisonsin, WI).

Project background: The anthelmintic drug praziquantel remains a key clinical therapy for treating various diseases caused by parasitic flatworms. The parasite target of praziquantel has remained undefined despite longstanding usage in the clinic, although a candidate ion channel target, named $TRPM_{PZQ}$, has recently been identified. Intriguingly, certain praziquantel derivatives show different activities against different parasites.

Project description: In this project led by project partners Marchant and Sprague, we interrogate whether the different activities of praziquantel analogs against different parasites are also reflected by unique structure–activity relationships at the $TRPM_{PZQ}$ channels found in these different organisms. To do this, several praziquantel analogs were synthesized and functionally profiled against schistosome and cestode $TRPM_{PZQ}$ channels. **Data demonstrate that structure–activity relationships are closely mirrored between parasites and their $TRPM_{PZQ}$ orthologs, providing further support for $TRPM_{PZQ}$ as the therapeutically relevant target of praziquantel.**

ENDOPARASITES IN CATS WITH AN EMPHASIS ON *ECHINOCOCCUS MULTILOCULARIS*

Researchers at IPA: Prof. Dr. Caroline Frey, PD Dr. Walter Basso, Dr. Gastón Moré, Prof. Dr. Norbert Müller, Rebecca Furtado Jost.

External colllaborators: Dr. Loïc Antoine (Boehringer-Ingelheim), Dr. Nelson Marreros (HAFL, Zollikofen).

Project background

The role of the domestic cat as definitive host for *Echinococcus multilocularis* and thus in environmental contamination with eggs has not yet been entirely resolved. This study aimed to assess the prevalence of *E. multilocularis* and other gastrointestinal parasites in Swiss domestic cats and to compare the diagnostic sensitivity of different methods for the detection of intestinal taeniid infection.

Project description

Fecal samples from cats were obtained either naturally voided, or by necropsy. In the latter case, the intestines were screened for parasites by the intestinal scraping and sedimentation technique. Faecal samples were analysed by coproscopy and by copro-quantitative PCRs. We found various intestinal parasites, namely *Hydatigera (syn. Taenia) taeniaeformis*, *Toxocara cati*, *Capillaria* sp., hookworms, *Mesocestoides litteratus*, *Giardia* sp., *Cystoisospora rivolta*, *Cystoisospora felis*, *Toxoplasma gondii*, *Hammondia hammondi* and *Strongyloides* sp. Necropsy revealed adult *H. taeniaeformis* in 12 animals, of which eight faecal samples were positive by the copro-qPCR (sensitivity = 67%) and six samples by the sedimentation/flotation technique (sensitivity = 50%). No *E. multilocularis* infection was detected in the sampled cats.

There was no evidence of *E. multilocularis* infection among the 146 cats examined, suggesting that the prevalence of this parasite is low (< 1%) in the Swiss domestic cat population. Nonetheless, some of the sampled cats were infected by parasites that have rodents as intermediate hosts, demonstrating successful predation by these cats, and some were infected with zoonotic parasites. Cats therefore should not be disregarded as potential hosts for *E. multilocularis* and other zoonotic parasites.

PREVENTIVE AND THERAPEUTIC TARGETS FOR THE CONTROL OF NEOSPOROSIS, TOXOPLASMOSIS AND DISEASES CAUSED BY OTHER APICOMPLEXANS

Researchers at IPA: Prof. Dr. Andrew Hemphill, Dr. Yosra Amdouni, Alice Bernal, Dr. Ghalia Boubaker, Kai Hänggeli, Noé Haudenschild, Larissa Hofmann, PD Dr. Joachim Müller, Carling Schlange, Maria Cristina Ferreira de Sousa, Yelyzaveta Nahorna.

External collaborators: Prof. Dr. Stone Doggett, Prof. Dr. Julien Furrer, Prof. Dr. Gilles Gasser, Prof. Dr. Richard K. Haynes, Prof. Dr. Adrian Hehl, Prof. Dr. Manfred Heller, Prof. Dr. Alexandre Leitao, Prof. Dr. Nadia Mercader-Huber, Prof. Dr. Luis-Miguel Ortega-Mora, Prof. Dr. Wes Van Voorhis.

Project background

Apicomplexan parasites cause serious diseases in animals and man. Among these are species that are exlusively of veterinary importance such as *Neospora caninum* and *Besnoitia besnoiti*, and others exhibit a high zoonotic importance, incuding *Toxoplasma gondii* and *Cryptosporidium parvum*. For most apicomplexans there are no efficacious vaccines on the market, and the current drug treatments are often hampered by adverse side effects and and low efficacy.

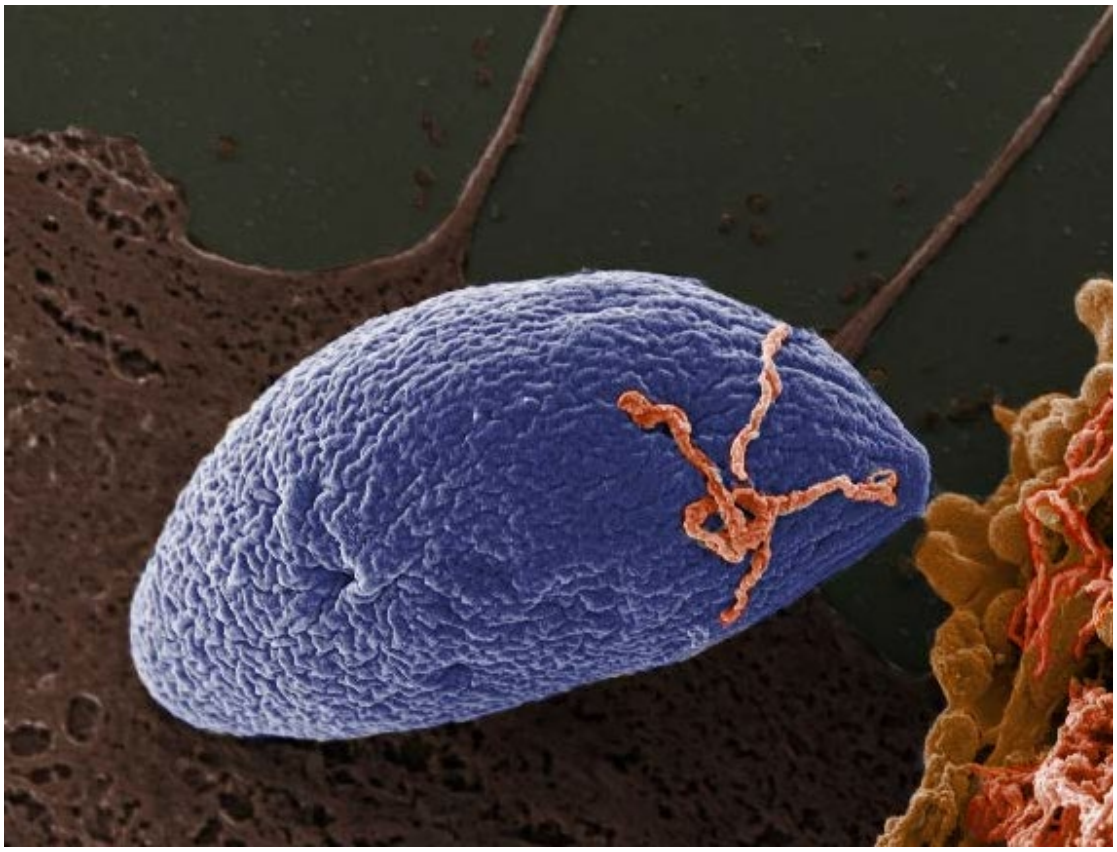
Project description

The major focus of the project lies on *N. caninum* and *T. gondii*, which cause major diseases in farm animals and have a tremendous global economic impact, most notably in ruminants. More recently, also *C. parvum* was included. Novel drugs and drug targets need to be identified in these parasites. In the last years, the parasite mitochondrion and kinase-mediated signaling have emerged as promising cellular and molecular targets, respectively. We have previously identified several compounds with profound in vitro activities, including bumped kinase inhibitors (BKIs) affecting calcium-dependent protein kinase 1 (CDPK1), and drugs targeting the mitochondrion such as endochin-like quinolones (ELQs), decoquinate (DCQ)-derivatives, artemisinin (ART)-derivatives, antimicrobial peptides and ruthenium based-organometallic complexes. However, only a subset of these drugs displayed promising activity in respective pregnant or non-pregnant mouse models, and some induced profound adverse effects, and/or impaired pregnancy outcome. None of the drugs act parasiticidal against *T. gondii* and *N. caninum* in vitro, since parasites can readily adapt to highly elevated concentrations, and continue proliferation. Additionally, preliminary studies on selected compounds have shown that several drugs with a defined mode of action bind to proteins that are different from their postulated targets, and these interactions could be responsible for adverse side effects in their host. By analyzing the proteomes in drug-tolerant/resistant parasites versus wild type strains, and by identifying drug-binding proteins in both parasites and hosts through differential affinity chromatography (DAC) coupled to mass spectrometry (MS) and proteomics (DAC-MS-proteomics), as well as by applying co-immunoprecipitation assays and phospho-proteomics, we show that anti-parasitic drugs can interact with several potential targets, and affect similar metabolic pathways or even share the same molecular targets in parasites and hosts.

We are doing this by pursuing the following experimental approaches: *T. gondii* and *N. caninum* are adapted to elevated drug pressure by stepwise increasing the compound concentration during in vitro culture. Adapted parasite populations are cloned, and the clones are phenotypically characterized in vitro, but also in vivo. Comparative proteomic analysis of drug-adapted versus non-adapted strains is used to identify differentially up- and downregulated proteins. In parallel, we identify parasite- and host drug-binding proteins using DAC-MS-proteomics. Selected proteins identified as potential targets are recombinantly expressed and antibodies are generated for further localization studies and biochemical characterization. Differentially regulated proteins and drug-binding proteins are then validated as drug targets by generating knockout strains using CRISPR-Cas9 and phenotypic characterization of mutant lines.

The capacity of the two apicomplexans to develop tolerance (physiological adaptation), and/or resistance (defined by mutations in the drug target) to anti-parasitic drugs is high, as has been shown in previous studies. Thus, by analyzing the differential gene expression in drug-adapted versus non-adapted parasites,

as well as in host cells, we seek to identify relevant mechanisms of action of the studied compounds. Proteins identified through DAC-MS-proteomics undergo target validation and functional characterization. Since apicomplexan parasites are eukaryotes sharing essential pathways with their hosts, resolving the mode of action of chemotherapeutics of interest is essential before undertaking extensive pre-clinical studies in animal models. This, and especially the application of DAC-MS-proteomics, allows to predict adverse side effects in vivo, and can contribute to the reduction of animal experimentation.



***Toxoplasma gondii* Tachyzoit (blau) in Zellkultur. Scanning Elektronenmikroskopie, gefärbt.**

SERO-EPIDEMIOLOGICAL INVESTIGATIONS IN EGYPT: SURVEYS ON *NEOSPORA CANINUM, TOXOPLASMA GONDII, BESNOITIA BESNOITI, TRICHINELLA* SPP., AND OTHER PATHOGENS

Researchers at IPA: Prof. Dr. Caroline Frey.

External collaborators: Prof. Dr. Ragab Fereig (University of Quena, Egypt).

Project background: In Egypt, a growing population is heavily dependent on safe and secure food supplies. Parasitic pathogens may either jeopardize human hleath (zoonotic agents such as *T. gondii*, *Trichinella* spp.) or affect animal production (e.g. *N. caninum* and *B. besnoiti*). Very little is known about the epidemiology of these and other pathogens in Egypt.

Project description: Serum samples are collected from a wide variety of domestic animals, both pet animals and farm animals, and analysed for antibodies to specific pathogens. Furthermore, alternative samples, such as milk and meat juice, are compared to serum samples, as they might be more readily available. Commercial test kits are used to ensure reproducibility and comparability with other studies.

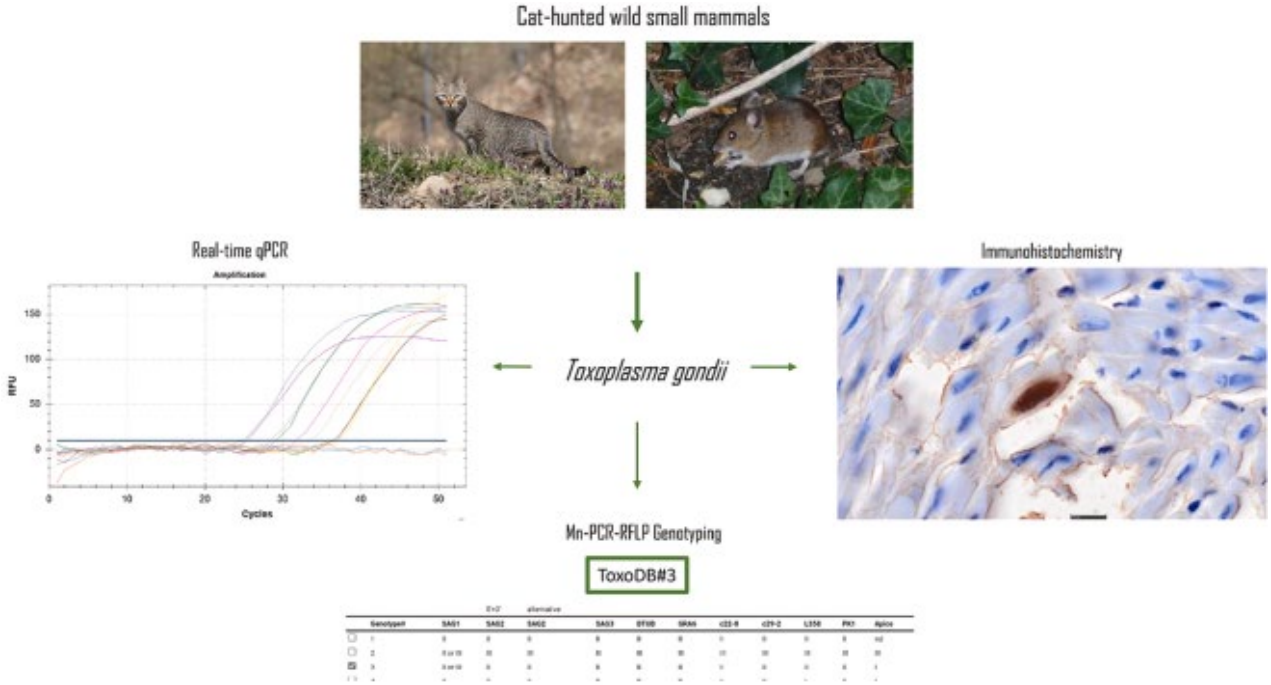
TOXOPLASMA GONDII IN CAT-HUNTED SMALL MAMMALS

Researchers at IPA: PD Dr. Walter Basso, Prof. Dr. Caroline Frey, Dr. Gastón Moré, Prof. Dr. Norbert Müller, Miguel Pardo Gil.

External colllaborators: Dr. Thomas Briner (Naturmuseum Solothurn), Prof. Dr. Peter Deplazes (University of Zurich), Dr. Daniel Hegglin (SWILD & University of Zurich), Dr. Maja Rütten (PathoVet, Tagelswangen).

Project background: *Toxoplasma gondii* is described to manipulate rodents' behaviour in such a way that they are easier prey for cats. Most studies, however, have been performed under laboratory conditions and it remains yet unknown, if this can also be observed in the natural environment.

Project description: Brain and skeletal muscle samples of cat-hunted wild small mammals were tested by *T. gondii*-specific PCR, and the circulating *T. gondii* genotypes in cat prey were determined. To evaluate exposure to cat faeces, the presence of *Taenia taeniaeformis* metacestodes was investigated at necropsy. The prevalence of *T. gondii* in cat-hunted rodents (6 different species) varied between 14.6% and 0%. All completely genotyped *T. gondii* parasites, exhibited the ToxoDB #3 genotype, a Type II variant. We additionally analysed 48 trap-captured *Arvicola amphibius* s.l., which all tested negative for *T. gondii* infection, contrasting with the higher prevalence in cat-hunted *A. amphibius* s.l. (0% vs. 11.1%; p = 0.0176). Furthermore, *T. taeniaeformis* was detected in both groups, indicating widespread contamination with cat faeces in the sampled areas. These results provide evidence that *T. gondii* infected rodents are at higher risk to be predated by cats and therewith support the behaviour manipulation hypothesis.



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Graphische Zusammenfassuch der Studie zu *Toxoplasma gondii* in von Katzen erbeuteten Wildnagern.

DISSECTING RESISTANCE MECHANISMS AND IDENTIFYING NEW DRUG TARGETS FOR THE LIVER FLUKE *FASCIOLA HEPATICA* PZ00P3_216088

Researchers at IPA: Dr. Natalie Wiedemar, Prof. Dr. Caroline Frey, Dr. Maryna Galat, Dr. Diana Gliga, Marc Kaethner, Prof. Dr. Britta Lundström-Stadelmann, Dr. Matías Preza.

External collaborators: Dr. Miguel Cabada, Prof. Dr. Jane Hodgkinson, Prof. Dr. Jennifer Keiser, Prof. Dr. Gabriela Knubben-Schweizer, Prof. Dr. Tosso Leeb, Prof. Dr. Mar Siles-Lucas, Dr. Susan Wyllie, Dr. Neil Young.

Project background: Trematode parasites, such as the liver fluke, *Fasciola hepatica,* still cause a heavy disease burden in veterinary and human medicine. What they all have in common is a complex life cycle involving molluscs as indermediate hosts and mammals as final hosts. In the case of *Fasciola hepatica*, the intermediate host is a lymnaeid snail and the end hosts can be a range of different mammals. In the mammalian host, the parasites travel through the liver as juvenile flukes and reside in the bile ducts as adult flukes, leading to the disease fasciolosis that is characterized by inflammatory and obstructive liver symptoms. In Europe, *F. hepatica* is mostly an agricultural problem in domestic ruminants, leading to economic losses. However, the parasite also affects several million people, mostly in the Global South, and is considered a neglected tropical disease. While multiple drugs are used to treat fasciolosis in domestic animals, only one of them, triclabendazole, kills all intra-mammalian stages of the parasite and is the only drug approved to treat fasiolosis in humans. After four decades of use, resistance against triclabendazole has become increasingly prevalent in *F. hepatica*. TCBZ resistance has been linked to a 3 million base-pair locus in the parasite genome, but the nature and mechanisms of resistance are still unknown. Unravelling those mechanisms could provide us with valuable insights on the mode of drug action and drug-target binding, and identification of resistance markers could help to guide treatment and management regimes in the field. Furthermore, insights on the resistance mechanisms could provide valuable information for the development of urgently needed future drugs.

Project description: This Ambizione project focuses on two aspects in *F. hepatica*: (1) to investigate the occurrence of triclabendazole resistance in Switzerland and to study resistance mechanisms and (2) to find new drugs and drug targets. First, the required methodologies will be established at the Instiute of Parasitology. They involve the *in vitro* culture and drug testing of adult parasites, the infection of the intermediate snail host for replication of parasites, the *in vitro* cultivations and drug testing of juvenile parasites and the implementation of automated read-outs of parasite viability, for example the quantification of parasite movements as proxy for parasite viability.
To study triclabendazole resistance, adult *F. hepatica* will be sampled from infected ruminant livers and tested *ex vivo* for their triclabendazole sensitivities to investigate the occurrence and frequency of resistance in Switzerland. Once sample collection has yielded a sufficient number of isolates with different levels of sensitivity / resistance, the genomes of these parasites will be sequenced using pool-sequencing, and a population genomic analysis will be applied to identify genomic loci associated with the resistance phenotype. These genomic regions will then further be scrutinized to find candidate genes and candidate sequence variants for triclabendazole resistance. The identified genes and variants will subsequently be followed up with mechanistic studies depending on their nature.
In the second part of the project, the established methodologies will be applied to screen compound libraries for molecules that are able to inactivate juvenile *F. hepatica*. The obtained hits will further be characterized with dose-activity assays, they will be tested in adult parasites and in parasite isolates known to be triclabendazole resistant. Most interesting compounds will be tested in mammalian cells and will further undergo mechanistic studies in order to characterize the drug target and the mode of drug action.

Frisch excystierte juvenile *F. hepatica* Parasiten, die benutzt werden für Drug Assays.

ZOONOTIC TREMATODES (*SCHISTOSOMA* SPP. AND *FASCIOLA* SPP.) IN LAKE CHAD REGION

Researchers at IPA: Prof. Dr. Caroline Frey, Prof. Dr. Britta Lundström-Stadelmann, Dr. Natalie Wiedemar.

External collaborators: Dr. Helena Greter (PI; Swiss TPH, Allschwil) & Prof. Dr. Salome Dürr (PI; VPHI, Bern), Dr. Karin Darpel (IVI, Mittelhäusern), Dr. Ramon Eichenberger (Universität Zürich), Dima Farra (VPHI, Bern), Rahila Gazida Loum (VPHI, Bern), Dr. Diana Gliga (IPA), Prof. Dr. Claudia Daubenberger (Swiss TPH), Dr. Salome Hosch (Swiss TPH).

Project background: This is a multidisciplinary project investigating the occurrence of the trematodes and their snail intermediate hosts in the lake Chad region. Schistosomes, especially hybrid forms between *S. bovis* and *S. haematobium*, and *Fasciola* spp. (*F. hepatica, F. gigantea*) are zoonotic parasites. Little is known about their occurrence in ruminants and equids in Lake Chad region, Chad.

Project description: Fecal samples from ruminants (sheep, goats, cattle) and equids (donkeys, horses) as well as blood samples from the same animals were collected at Lake Chad. In slaughtered animals, adult flukes were collected from the liver and the mesenterial blood vessels. Fecal sedimentation to detect eggs of trematodes as well as serological detection of antibodies in ruminants against *Fasciola* spp. has been directly performed in Chad. Fecal samples will also be analysed by sedimentation and flotation at IPA, to determine apparent prevalence of gastrointestinal parasites in these livestock species. Antibodies against *Fasciola* spp. in equids will be detected using an in-house ELISA at IVI, Mittelhäusern. Adult flukes will be molecularly analysed for species-identification.

TREATMENT OF EUROPEAN POND TURTLES BY PRAZIQUANTEL

Researchers at IPA: Prof. Dr. Caroline Frey, Prof. Dr. Britta Lundström-Stadelmann, Marion Stettler.

External collaborators: Dr. Stefan Hoby (Tierpark Bern), Prof. Dr. Jennifer Keiser (Swiss TPH), Dr. Nelson Marreros (HAFL).

Project background: Spirorchiidosis, caused by blood flukes of the genus *Spirorchis,* is a disease of great concern for the critically endangered European pond turtle (*Emys orbicularis*) in Switzerland. The endogenous life cycle of the parasite often leads to systemic granulomatous inflammatory reactions, thrombosis, and death. Praziquantel (PZQ) is the treatment of choice against adult *Spirorchis* spp. in green (*Chelonia mydas*) and in loggerhead (*Caretta caretta*) sea turtles and is therefore considered for the treatment of *E. orbicularis*.

Project description: This study aimed to establish a safe, easily applicable PZQ treatment for *E. orbicularis*, based on pharmacokinetics and tolerability. Three application methods were tested in a total of 12 adult *E. orbicularis*. Each turtle received a total of 75 mg/kg PZQ via IM (*n* = 3 turtles), SC (*n* = 3 turtles), or PO (*n* = 6 turtles) administration. Blood was collected 3, 6, 24, and 48 h after the first administration to determine the plasma concentration of PZQ using high-performance liquid chromatography coupled to mass spectrometry. Maximum measured R-PZQ concentrations (C_{max}) were reached after 6 h. The mean C_{max} of the total PZQ in the PO-treated EPT group was 1,929 ng/ml. Significantly higher concentrations were measured after IM and SC injection. Transient side effects were evident after IM administration (local swelling and lameness), whereas no adverse drug effects were observed after PO and SC administration. Based on these results and the ease of administration to *E. orbicularis*, SC injection of PZQ at 25 mg/kg q3h times 3 serves as promising treatment application for the future.

THE MOLECULAR BASIS OF ADAPTATION OF AEDES MOSQUITOES, VECTORS OF VIRAL DISEASES, TO SALTWATER ENVIRONMENTS

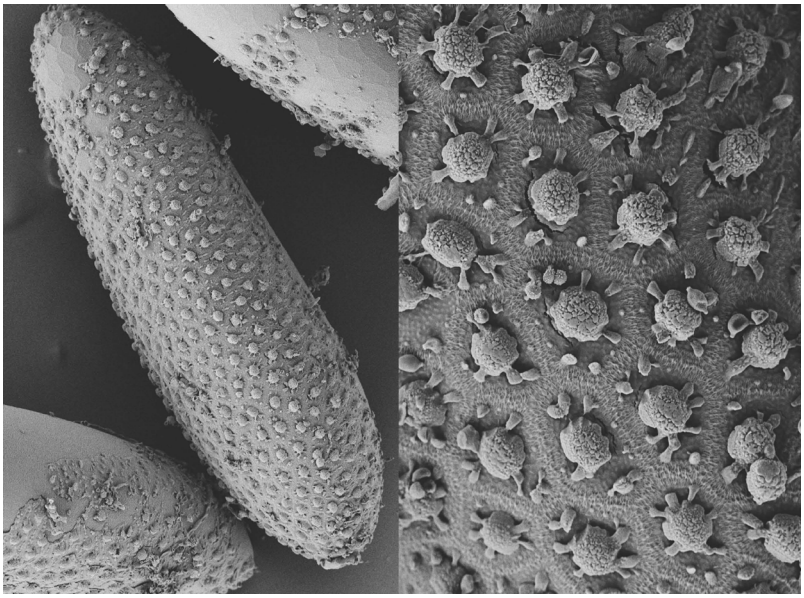
Researchers at IPA: Prof. Dr. Andrew Hemphill.

External collaborators: Prof. Dr. Noble Surendran, MSc. Sivasingham Arthiyan, MSc. Kokila Sivabalakrishnan, Dr. Arunasalam Naguleswaran, Prof. Dr. Isabel Roditi.

Project background: Vector-borne diseases constitute an enormous health burden, particularly in tropical and sub-tropical regions. Mosquitoes of the genus Aedes transmit the viruses responsible for yellow fever, Dengue, Zika and Chikungunya. Dengue is rapidly reaching pandemic proportions and currently constitutes a major health problem in Sri Lanka. At the same time, cases of Chikungunya are increasing. In the absence of vaccines or drugs for these diseases, vector control is the only means of limiting their spread. Like many other mosquitoes, *Aedes* species breed in stagnant fresh water. A surprising recent finding is that *Aedes* mosquitoes in Sri Lanka have adapted to breed in brackish water as well, thereby extending the area where transmission of Dengue virus can occur.

Project description: This collaborative grant aims to elucidate the physiological and molecular basis of adaptation using next generation sequencing (RNA-seq), proteomics and structural investigations employing scanning and transmission electron microscopy. We perform recombinant expression of selected proteins that are either up-or downregulated in Aedes reared in brakish and fresh water, respectively, in bacteria, raise corresponding antibodies and will study the localization of these proteins within mosquitoes using immunofluorescence and immuno-electron microscopy. The project also contains two training components - a workshop to teach bioinformatics to students in Sri Lanka and two three-

month stays in Swiss laboratories for Sri Lankan PhD students to learn recombinant protein technology and electron microscopy. Wells with brackish water are common in households on the Jaffna Peninsula in northern Sri Lanka and may have contributed to selection of Aedes mosquitoes that are tolerant to salinity. At present, national and international dengue control guidelines target only freshwater breeding sites. This knowledge gain is expected to help control dengue transmission. Furthermore, understanding the basis of adaptation has wider implications for the spread of other mosquito-borne diseases, including malaria and West Nile virus, which are transmitted by other species of mosquitoes.



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Links ganzes Ei, rechts Detailansicht der Ei-Oberfläche.

TRYPANOSOMA BOUFFARDI-LIKE INFECTION IN ALPINE SWIFTS

Researchers at IPA: Dr. Gastón Moré, PD Dr. Walter Basso, Prof. Dr. Caroline Frey.

External collaborators: Dr. Saskia Keller (PI; FIWI, Bern), Dr. Pia Cigler (FIWI, Bern), Prof. Dr. Irene Adrian-Kalchhauser (FIWI, Bern), Dr. Pierre Bize (Schweiz. Vogelwarte), Dr. Christoph Meier (Schweiz. Vogelwarte).

Project background: Alpine swifts are a monitored species in Switzerland, present only in the breeding season in summer. There was a marked drop in fledglings observed in the last years. Necropsied dead nestlings presented with haemorrages and high *Trypanosoma* burdens were detected in their blood.

Project description: *Trypanosoma* sp. from blood could be cultured *in vitro* and molecular characterization including whole genome sequencing is underway. Morphometrically, it resembled *T. bouffardi* first described in songbirds from Africa, but no molecular data from this species is available. Louse flies, namely *Crataerina* melbae/*C. acutipennis*, were shown to be comptenet vectors for these *Trypanosoma* sp. Monitoring of Alpine swift colonies is ongoing with the Swiss Ornithological Institute and intervention strategies for louse fly control will be investigated.

DIAGNOSIS AND EPIDEMIOLOGY OF INFECTIONS BY CYST-FORMING COCCIDIAN PARASITES IN DOMESTIC AND WILD ANIMALS

Researchers at IPA: PD Dr. Walter Basso, Dr. Gastón Moré, Prof. Dr. Caroline Frey, Dr. Diana Gliga, Dr. Miguel Pardo Gil, Johanna Kauter, Sinah Lückner, Carlotta Filippini, Albane Meuwly.

External collaborators: Dr. Patrick Scherrer (FIWI), Dr. Marie-Pierre Ryser (FIWI), Dr. Iris Marti (FIWI), Dr. Selene Rubiola (University of Turin, Italy), Dr. Patrik Zanolari (NTK Bern), Dr. Gereon Schares (FLI, Germany), Dr. Maja Ruetten (Pathovet AG), Dr. Radu Blaga (ANSES, France), Dr. Filip Damek (ANSES, France), Dr. Nathalia Scioscia (CONICET, Argentina), Dr. Dadin P Moore (CONICET, Argentina), Dr. Lucia M Campero (CONICET, Argentina), Maria C. Venturini (LAINPA, Argentina).

Project background: The cyst-forming coccidia (Apicomplexa, Sarcocystidae) are a group of protozoan parasites including species of major importance in veterinary and human medicine, such as *Neospora caninum*, *Toxoplasma gondii*, *Besnoitia* spp. and *Sarcocystis* spp.
Toxoplasma gondii is able to infect all warm-blooded animals and humans, causing one of the most common zoonoses worldwide. While infections may have a subclinical course, under special circumstances they can cause life-threatening disease both in animals and humans. Chronically infected meat-producing animals such as pigs, ruminants, and game, play an important role in public health because they represent important sources of *T. gondii* infection for humans through consumption of undercooked meat. In addition, both *T. gondii* and *N. caninum* infections represent major causes of abortion in small ruminants and cattle, respectively.
Besnoitia besnoiti is the causative agent of bovine besnoitiosis, a chronic debilitating skin disease that may have a fatal outcome and can be associated with orchitis and infertility in bulls. In Switzerland, it is a reportable disease, within a national eradication program.
Sarcocystis spp. infections may be subclinical or associated with fever, weakness, cyanosis, dyspnoea, neurological signs, abortion, eosinophilic myositis and/or death depending on the *Sarcocystis* and host species. Some *Sarcocystis* species are zoonotic.
The high clinical and economical significance of these parasites as cause of disease in animals and humans encouraged the research on their biology, epidemiology, and clinical implications, and pointed out the need for development of immunological and molecular tools to improve the routine diagnosis and epidemiological research.

Project description:
Aims of this research project are (i) to estimate the occurrence and distribution of *T. gondii*, *N. caninum, Sarcocystis* spp. and/or *Besnoitia* spp. infections in South American camelids, goats, sheep, cattle, pigs, and different wild animal species; (ii) to optimize serological and molecular tests for diagnosis; (iii) to identify risk factors, which may favour infection with these protozoa; (iv) to assess the association of infection with cases of abortion and/or disease in these animal species, and (v) to investigate the epidemiology and molecular aspects of these parasites.

6. ABSCHLÜSSE / DEGREES

6.1 DOKTORARBEITEN ABSCHLÜSSE /DOCTORAL AND PHD THESES

2022

Diana Gliga, thesis title: "*Neospora caninum* infections in Swiss cattle: Switzerland-wide seroprevalence and identification of risk factors for infection". (Dr. vet. med.)

Seraina Meister, thesis title: "Avian malaria and further parasites in white storks and captive birds". (Dr. vet. med.)

2023

Dennis Imhof, thesis title: "Vaccine and chemotherapy strategies to control toxoplasmosis and neosporosis". (PhD)

Miguel Pardo Gil, thesis title: *"Toxoplasma gondii* infections in cat-hunted small mammals and possible association with behavioural manipulation". (Dr. vet. med.)

Patrick Scherrer, thesis title: "*Toxoplasma gondii* infections in protected wild mammals in Switzerland: lynx (*Lynx lynx*) and beaver (*Castor fiber*)". (Dr. vet. med.)

Rebecca Furtado Jost, thesis title: "Role of domestic cats as definitive host of *Echinococcus multilocularis*". (Dr. vet. med.)

6.2 MASTERARBEITEN ABSCHLÜSSE / MASTER THESES

2023

Lea Hiller, project title: "New treatment options against the fox tapeworm", Oct. 2023. (MSc vet. med.)

Anna Schneider, project title: "Cestodes in domestic and wild carnivores in Switzerland", Oct. 2023. (MSc vet. med.)

Pascal Zumstein, project title: "Novel chemotherapeutic treatments of alveolar echinococcosis: Screening of the MMV Pandemic Response Box and characterization of the *Echinococcus multilocularis* L-threonine dehydrogenase as a potential drug target", May 2023. (MSc Biology)

2022

Carmen Luginbühl, project title: "Endoparasites and management of reindeer in Switzerland", Oct 2022. (MSc vet. med.)

Marion Stettler, project title: "Pharmacokinetics of praziquantel in European pond turtles (Emys orbicularis)", Aug. 2022. (MSc vet. med.)

Sheena Chaudhry, project title: "Drug testing against *Echinococcus multilocularis*", Jun. 2022. (MSc Biology)

Carling Schlange, project title: "Novel compound- and vaccine-based treatment and prevention strategies against *Toxoplasma gondii* and *Neospora caninum* infections", May 2022. (MSc Biology)

Noe Haudenschild, project title: "Leucinostatin derivates as potential treatment against the apicomplexan parasites *Toxoplasma gondii & Neospora caninum.* Apr. 2022. (MSc Biology)

7. Preise und Ehrungen / Awards and Honors

2022

Britta Lundström-Stadelmann: Re-elected president of the Swiss Society of Tropical Medicine and Parasitology (SSTMP).

Andrew Hemphill: Honorary professorship Universidad Complutense Madrid.

Patrick Scherrer: Best oral presentation "*Toxoplasma gondii* infection in the Eurasian beaver (*Castor fiber*) in Switzerland" at the 6th International Meeting on Apicomplexan Parasites in Farm Animals (Apicowplexa).

Rebecca Furtado Jost: Selected by the dean to represent Vetsuisse Bern at the 8th German French Summer school in Leipzig, Germany (20th June to 1st July 2022).

2023

Andrew Hemphill: Honorary professorship Universidad Complutense Madrid.

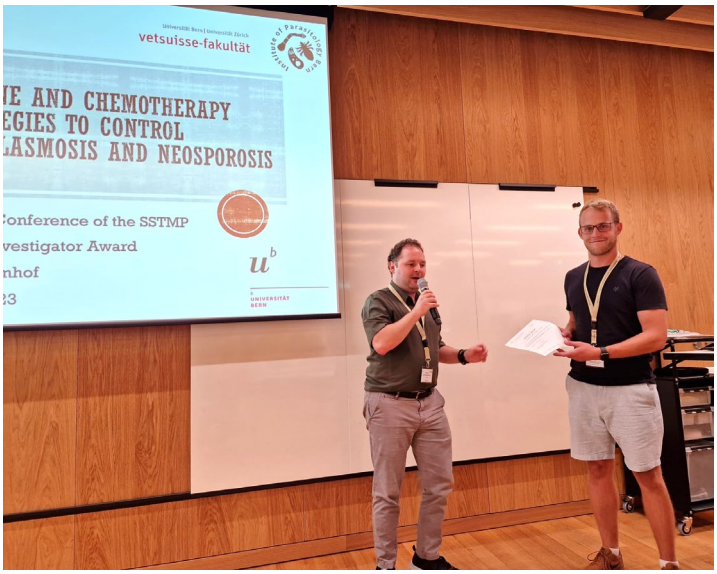
Dennis Imhof: Young Investigator Award from the SSTMP for the best thesis "Vaccine and chemotherapy strategies to control toxoplasmosis and neosporosis".

Maria de Sousa: Best oral presentation "Activity and efficacy of the bumped kinase inhibitor BKI-1708 *in vitro* and in non-pregnant and pregnant toxoplasmosis and neosporosis mouse models" at the annual SSTMP meeting.

Anissa Bartetzko: Best presentation "Cutting off the oxygen: Metabolic changes and differential gene expression depending on oxygen condition *in E. multilocularis*." at the SSTMP student meeting.

Lea Hiller: Alumni Preis der Vetsuisse-Fakultät Bern für die Masterarbeit «Drug testing on *Echinococcus multilocularis* - Searching for new therapeutic options against Alveolar Echinococcosis».

Patrick Scherrer mit dem Award für den besten Vortrag.



Dr. Dennis Imhof erhält den Preis der SGTP für seine Doktorarbeit.

8. ÖFFENTLICHKEITSARBEIT / PUBLIC RELATIONS

8.1 PUBLIKATIONEN / PUBLICATIONS

Peer-reviewed scientific articles (chronologically)

2023

1. Galat M, Moré G, Frey CF, Kovalenko G, Maliuk I, Halka I, Sytiuk M, Bezymennyi M, Galat V, Jokelainen P. Seroprevalence of *Toxoplasma gondii* in wild boars (*Sus scrofa*) hunted in Ukraine. Int J Parasitol Parasites Wildl. 2023 Dec 29;23:100901. doi: 10.1016/j.ijppaw.2023.100901.

2. Kaethner M, Rennar G, Gallinger T, Kämpfer T, Hemphill A, Mäder P, Luque-Gómez A, Schlitzer M, Lundström B. *In vitro* activities of dithiocarbamate derivatives against *Echinococcus multilocularis* metacestode vesicles. Trop Med Infect Dis. 2023, 8(12),517; doi: 10.3390/tropicalmed8120517.

3. Cigler P, Moré G, Bize P, Meier CM, Frey CF, Basso W, Keller S. Trypanosomiasis: An emerging disease in Alpine swift (*Tachymarptis melba*) nestlings in Switzerland? Int J Parasitol Parasites Wildl. 2023 Dec 12;23:100895. doi: 10.1016/j.ijppaw.2023.100895.

4. Bentancourt Rossoli JV, Moré G, Soto-Cabrera A, Moore DP, Morrell EL, Pedrana J, Scioli MV, Campero LM, Basso W, Hecker YP, Scioscia NP. Identification of *Sarcocystis* spp. in synanthropic (Muridae) and wild (Cricetidae) rodents from Argentina. Parasitol Res. 2023 Dec 12;123(1):31. doi: 10.1007/s00436-023-08036-6.

5. Schlange C, Müller J, Imhof D, Hänggeli KPA, Boubaker G, Ortega-Mora LM, Wong HN, Haynes RK, Van Voorhis WC, Hemphill A. Single and combination treatment of *Toxoplasma gondii* infections with a bumped kinase inhibitor and artemisone *in vitro* and with artemiside in experimentally infected mice. Exp Parasitol. 2023 Dec;255:108655. doi: 10.1016/j.exppara.2023.108655.

6. Sprague D, Kaethner M, Park S-K, Rohr CM, Harris JL, Maillard D, Spangenberg T, Lundström-Stadelmann B, Marchant JS. The Anthelmintic Activity of Praziquantel Analogs Correlates with Structure–Activity Relationships at TRPMPZQ Orthologs. ACS Med. Chem. Lett. 2023, 14, 11, 1537 – 1543. doi.org/10.1021/acsmedchemlett.3c00350.

7. Albisetti A, Hälg S, Zoltner M, Mäser P, Wiedemar N. Suramin action in African trypanosomes involves a RuvB-like DNA helicase. Int J Parasitol Drugs Drug Resist. 2023 Dec;23:44-53. doi: 10.1016/j.ijpddr.2023.09.003.

8. Lüthin S, Zollinger A, Basso W, Bisig M, Caspari N, Eng V, Frey CF, Grimm F, Igel P, Lüthi S, Regli W, Roelfstra L, Rosskopf M, Steiner B, Stöckli M, Waidyasekera D, Waldmeier P, Schnyder M, Torgerson PR, Hertzberg H. Strongyle faecal egg counts in Swiss horses: A retrospective analysis after the introduction of a selective treatment strategy. Vet Parasitol. 2023 Nov;323:110027. doi: 10.1016/j.vetpar.2023.110027.

9. Fereig RM, El-Alfy ES, Abdelbaky HH, Abdel-Hamid NH, Mazeed AM, Menshawy AMS, Kelany MA, El-Diasty M, Alawfi BS, Frey CF. Seroprevalence of *Toxoplasma gondii, Neospora caninum* and *Trichinella* spp. in Pigs from Cairo, Egypt. Vet Sci. 2023 Nov 27;10(12):675. doi: 10.3390/vetsci10120675.

10. Oberli A, Furrer L, Skoko L, Müller N, Gottstein B, Bittel P. A novel multiplex real-time polymerase chain reaction for the molecular diagnosis of metacestode infections in human patients. Clin Microbiol Infect. 2023 Nov;29(11):1451.e1-1451.e5. doi: 10.1016/j.cmi.2023.07.032.

11. Sánchez-Sánchez R, Imhof D, Hecker YP, Ferre I, Re M, Moreno-Gonzalo J, Blanco-Murcia J, Mejías-López E, Hulverson MA, Choi R, Arnold SLM, Ojo KK, Barrett LK, Hemphill A, Van Voorhis WC, Ortega-Mora LM. An early treatment with BKI-1748 exhibits full protection against abortion and congenital infection in sheep experimentally infected with *Toxoplasma gondii.* J Infect Dis. 2023 Oct 27:jiad470. doi: 10.1093/infdis/jiad470.

12. Furtado Jost R, Müller N, Marreros N, Moré G, Antoine L, Basso W, Frey CF. What is the role of Swiss domestic cats in environmental contamination with *Echinococcus multilocularis* eggs? Parasit Vectors. 2023 Oct 9;16(1):353. doi: 10.1186/s13071-023-05983-y.

13. Fereig RM, Jirapattharasate C, Frey CF. Editorial: Recent trends in infection biology and control of protozoan parasites. Front Cell Infect Microbiol. 2023 Sep 20;13:1292591. doi: 10.3389/fcimb.2023.1292591.

14. Wolfer LA, Basso WU, Frey CF, Schuller S, Amphimaque B, Jankovic J, Howard J, Peters LM. Biliary *Enterocytozoon bieneusi* infection in a dog under immunomodulatory therapy. J Small Anim Pract. 2023 Aug;64(8):535-538. doi: 10.1111/jsap.13612.

15. Hemphill A, Leitão A, Ortega-Mora LM, Cooke BM. ApicoWplexa 2022: 6th international meeting on apicomplexan parasites in farm animals. Int J Parasitol. 2023 Aug;53(9):459-461. doi: 10.1016/j.ijpara.2023.05.003.

16. Kaethner M, Preza M, Kaempfer T, Zumstein P, Tamponi C, Varcasia A, Hemphill A, Brehm K, Lundström-Stadelmann B. Establishment and application of unbiased *in vitro* drug screening assays for the identification of compounds against *Echinococcus granulosus* sensu stricto. PLoS Negl Trop Dis. 2023 Aug 4;17(8):e0011343. doi: 10.1371/journal.pntd.0011343.

17. Rodenbücher AL, Walkenhorst M, Holinger M, Perler E, Amsler-Kepalaite Z, Frey CF, Mevissen M, Maurer V. Pumpkin seeds, lemongrass essential oil and ripleaf leaves as feed additives for *Ascaridia galli* infected laying hens. Vet Res Commun. 2023 Jun;47(2):817-832. doi: 10.1007/s11259-022-10042-5.

18. Hänggeli KPA, Hemphill A, Müller N, Heller M, Uldry AC, Braga-Lagache S, Müller J, Boubaker G. Comparative Proteomic Analysis of *Toxoplasma gondii* RH Wild-Type and Four SRS29B (SAG1) Knock-Out Clones Reveals Significant Differences between Individual Strains. Int J Mol Sci. 2023 Jun 21;24(13):10454. doi: 10.3390/ijms241310454.

19. Müller J, Preza M, Kaethner M, Rufener, R, Braga S, Uldry AC, Heller M, Lundström-Stadelmann B. Targeted and non-targeted proteomics to characterize the parasite proteins of *Echinococcus multilocularis* metacestodes. Frontiers Cellular and Infection Microbiology. Front Cell Infect Microbiol. 2023 May 30;13:1170763. doi: 10.3389/fcimb.2023.1170763.

20. Sivabalakrishnan K, Thanihaichelvan M, Tharsan A, Eswaramohan T, Ravirajan P, Hemphill A, Ramasamy R, Surendran SN. Resistance to the larvicide temephos and altered egg and larval surfaces characterize salinity-tolerant *Aedes aegypti*. Sci Rep. 2023 May 19;13(1):8160. doi: 10.1038/s41598-023-35128-1.

21. Kronenberg PA, Deibel A, Gottstein B, Grimm F, Müllhaupt B, Meyer Zu Schwabedissen C, Aitbaev S, Omorov RA, Abdykerimov KK, Minbaeva G, Usubalieva J, Siles-Lucas M, Pepe P, Rinaldi L, Spiliotis M, Wang J, Müller N, Torgerson PR, Deplazes P. Serological Assays for Alveolar and Cystic Echinococcosis-A Comparative Multi-Test Study in Switzerland and Kyrgyzstan. Pathogens. 2022 Apr 27;11(5):518. doi: 10.3390/pathogens11050518.

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24. Müller J, Schlange C, Heller M, Uldry AC, Braga-Lagache S, Haynes RK, Hemphill A. Proteomic characterization of *Toxoplasma gondii* ME49 derived strains resistant to the artemisinin derivatives artemiside and artemisone implies potential mode of action independent of ROS formation. Int J Parasitol Drugs Drug Resist. 2023 Apr;21:1-12. doi: 10.1016/j.ijpddr.2022.11.005.

25. Kronenberg PA, Reinehr M, Eichenberger RM, Hasler S, Laurimäe T, Weber A, Deibel A, Müllhaupt B, Gottstein B, Müller N, Hemphill A, Deplazes P. Monoclonal antibody-based localization of major diagnostic antigens in metacestode tissue, excretory/secretory products, and extracellular vesicles of *Echinococcus* species. Front Cell Infect Microbiol. 2023 Mar 16;13:1162530. doi: 10.3389/fcimb.2023.1162530.

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27. Scherrer P, Ryser-Degiorgis MP, Marti IA, Borel S, Frey CF, Mueller N, Ruetten M, Basso W. Exploring the epidemiological role of the Eurasian lynx *(Lynx lynx)* in the life cycle of *Toxoplasma gondii*. Int J Parasitol Parasites Wildl. 2023 Mar 21;21:1-10. doi: 10.1016/j.ijppaw.2023.03.005.

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29. Fereig RM, Ibrahim RM, Khalil AM, Frey CF, Khalifa FA. Evaluation of Clinical and Biochemical Traits in Egyptian Barki Sheep with Different Growth Performances. Animals (Basel). 2023 Mar 7;13(6):962. doi: 10.3390/ani13060962.

30. Khordadmehr M, Sazmand A, Almasi P, Shahbazi P, Ranjbar V, Otranto D, Hemphill A. Natural infection with *Toxoplasma gondii, Neospora caninum* and *Sarcocystis* species in domestic pigeons *(Columba livia domestica)* in Iran. Comp Immunol Microbiol Infect Dis. 2023 Feb;93:101946. doi: 10.1016/j.cimid.2023.101946.

31. Autier B, Manuel C, Lundstroem-Stadelmann B, Girard JP, Gottstein B, Gangneux JP, Samson M, Robert-Gangneux F, Dion S. Endogenous IL-33 accelerates metacestode growth during late-stage Alveolar Echinococcosis. Microbiol Spectr. 2023 Feb 14:e0423922. doi:10.1128/spectrum.04239-22.

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34. Imhof D, Pownall W, Hänggeli KPA, Monney C, Román LR, Ortega-Mora LM, Forterre F, Oevermann A, Hemphill A. Immunization with a Multivalent Listeria monocytogenes Vaccine Leads to a Strong Reduction in Vertical Transmission and Cerebral Parasite Burden in Pregnant and Non-Pregnant Mice Infected with *Neospora caninum.* Vaccines (Basel). 2023 Jan 11;11(1):156. doi: 10.3390/vaccines11010156.

35. Borel N, Ciuria S, Flury T, Basso WU, Ruetten M. Zoonotic potential of guinea pigs: Outbreak of cryptosporidiosis combined with chlamydiosis in a breeding guinea pig herd. Schweiz Arch Tierheilkd. 2023 Jan;165(1):59-63. English. doi: 10.17236/sat00383.

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38. Meister SL, Wyss F, Wenker C, Hoby S, Basso WU. Avian haemosporidian parasites in captive and free-ranging, wild birds from zoological institutions in Switzerland: Molecular characterization and clinical importance. Int J Parasitol Parasites Wildl. 2022 Dec 26;20:46-55. doi: 10.1016/j.ijppaw.2022.12.005.

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41. Desiatkina O, Mösching M, Anghel N, Boubaker G, Amdouni Y, Hemphill A, Furrer J, Păunescu E. New Nucleic Base-Tethered Trithiolato-Bridged Dinuclear Ruthenium(II)-Arene Compounds: Synthesis and Antiparasitic Activity. Molecules. 2022 Nov 24;27(23):8173. doi: 10.3390/molecules27238173.

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45. Fereig RM, Abdelbaky HH, Mazeed AM, El-Alfy ES, Saleh S, Omar MA, Alsayeqh AF, Frey CF. Prevalence of *Neospora caninum* and *Toxoplasma gondii* Antibodies and DNA in Raw Milk of Various Ruminants in Egypt. Pathogens. 2022 Nov 7;11(11):1305. doi: 10.3390/pathogens11111305.

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64. Dettwiler I, Troell K, Robinson G, Chalmers RM, Basso W, Rentería-Solís ZM, Daugschies A, Mühlethaler K, Dale MI, Basapathi Raghavendra J, Ruf MT, Poppert S, Meylan M, Olias P. TIDE Analysis of *Cryptosporidium* Infections by gp60 Typing Reveals Obscured Mixed Infections. J Infect Dis. 2022 Feb 15;225(4):686-695. doi: 10.1093/infdis/jiab417.

65. Weingartner M, Stücheli S, Jebbawi F, Gottstein B, Beldi G, Lundström-Stadelmann B, Wang J, Odermatt A. Albendazole reduces hepatic inflammation and endoplasmic reticulum-stress in a mouse model of chronic *Echinococcus multilocularis* infection. PLoS NTD. 2022 Jan 14;16(1):e0009192. doi: 10.1371/journal.pntd.0009192.

66. Frey CF, Basso WU, Zürcher-Giovanni S, Marti I, Borel St, Guthruf S, Gliga D, Lundström-Stadelmann B, Origgi FC, Ryser Degiorgis MP. The golden jackal (Canis aureus): A new host for *Echinococcus multilocularis* and *Trichinella britovi* in Switzerland. Schweiz Arch Tierheilkd. 2022 Jan;164(1):71-78. doi: 10.17236/sat00338.

67. Schönbächler K, Olias P, Richard OK, Origgi FC, Dervas E, Hoby S, Basso W, Berenguer Veiga I. Fatal spirorchiidosis in European pond turtles *(Emys orbicularis)* in Switzerland. Int J Parasitol Parasites Wildl. 2022 Jan 11;17:144-151. doi: 10.1016/j.ijppaw.2022.01.004.

Peer-reviewed Reviews and book-chapters

2023

1. Basso W., Cassini R. Chapter: Parasites Present in Meat and Viscera of Terrestrial Farmed Animals, in Dikeman M. (Ed.) Encyclopedia of Meat Sciences, 3rd Edition, 2023, Elsevier pp 50-64. doi.org/10.1016/B978-0-323- 85125-1.00200-3. ISBN: 9780323851251.

2. Campero LM, Basso W, Moré G, Fiorani F, Hecker YP, Echaide I, Cantón GJ, Cirone KM, Campero CM, Venturini MC, Moore DP. Neosporosis in Argentina: Past, present and future perspectives. Vet Parasitol Reg Stud Reports. 2023 Jun;41:100882. doi: 10.1016/j.vprsr.2023.100882.

3. Müller J, Hemphill A. *Toxoplasma gondii* infection: novel emerging therapeutic targets. Expert Opin Ther Targets. 2023 Apr-May;27(4-5):293-304. doi: 10.1080/14728222.2023.2217353.

Outreach articles

4. Luginbühl C., Basso W., Zanolari P. Rentierhaltung und Parasiteninfektionen bei Rentieren in der Schweiz. Forum Kleinwiederkäuer, Schweizer Fachzeitschrift für Züchter und Halter von Schafen, Ziegen, Hirschen und Herdenschutzhunden, Verlagsgenossenschaft Caprovis, 11/2023, 6-11.
5. Frey CF. Winteraktive Ektoparasiten - auch im Winter können Hunde befallen werden. Schweizer Hunde Magazin 8/2023, Seiten 42-45.
6. Basso W. Eine Gefahr für Tier und Mensch: Die Tropische Rattenmilbe (Ornithonyssus bacoti). Welt der Tiere 6/2023. ISSN-Nr. 2235-0683.
7. Basso W. Mittelmeerferien mit dem Hund - Wie kann man ihn vor parasitären Erkrankungen schützen? Schweizer Hunde Magazin 5/2023, Seiten 48-51.
8. Frey CF. Vorsicht vor Parasiten - Einige Parasiten können von Hund und Katze auf den Menschen übergehen! Welt der Tiere 5/2023, Seiten 18-21.

8.2 Vorträge und Poster / Presentations and Posters

2023

Annual student's meeting of the Swiss Society of Tropical Medicine, Schwarzenberg, CH, Nov 9-10:

- Bartetzko A, Zumstein P, Preza M, Nyffeler C, Mathis D, Lundström-Stadelmann B. Cutting off the oxygen: Metabolic changes and differential gene expression depending on oxygen condition in *E. multilocularis*.
- Sousa MC, Imhof D, Hänggeli K, Choi R, Hilverson MA, Whitman GR, Arnold SKLM, Ojo KK, Van Voorhis WC, Dogget JS, Ortega-Mora LM, Hemphill A. Activity and efficacy of the bumped kinase inhibitor BKI-1708 *in vitro* and in non-pregnant and pregnant toxoplasmosis and neosporosis mouse models.
- Hänggeli K, Müller J, Boubaker G, Sousa M C, Vigneswaran A, Hemphill A. Use of CRISPR-Cas9 for the validation of TgME49_319730 as a valuable drug target of the ruthenium-based compound OD62-18.
- Vigneswaran A. Bradyzoite-Formation Deficient 1 (BFD1) - The new master regulator of differentiation in *Toxoplasma gondii.*

Teilnehmende des SGTP Studentenmeetings.

Conference of GEEFSM – Groupe d'Etudes sur l'Eco-pathologie de la Faune Sauvage de Montagne, Saluzzo, Italy, Sept 22-24 :

- Borel S, Keller S, Breitenmoser C, Origgi F, Marti I, Zürcher-Giovannini S, Frey CF, Basso W, Schweizer D, Kittl S, Ryser-Degiorgis MP. Causes of mortality and morbidity in free-ranging Eurasian lynx (*Lynx lynx*) in Switzerland, 2000-2022.

Annual meeting of the Swiss Society of Tropical Medicine and Parasitology (SSTMP) Meeting, Allschwil, CH, Sept 7-8 :

- Scherrer P, Marti I, Gerber N, Basso W. *Toxoplasma gondii* and *Neospora caninum* infections in Swiss gray wolves (*Canis lupus*).
- Kämpfer T, Gliga DS, Wiesner M, Basso W, Lundström-Stadelmann B. *In vitro* culture and treatment of *Taenia crassiceps* metacestodes.
- Moré G, Cigler P, Bize P, Colimas R, Meier C, Hemphill A, Frey CF, Keller SA, Basso W. *Crataerina* spp. are vectors for a *Trypanosoma* sp. threatening Alpine swift populations (*Tachymarptis melba*).
- Amdouni Y, Boubaker G, Müller J, Imhof D and Hemphill A. In vitro assessment of antimicrobial peptides as potential agent against *Toxoplasma gondii.* (Poster).
- Galat M, Moré G, Mikharovskyi G, Malyuk M, Ovchinnikova A, Kovalenko G, Joeres M, Schares G, Lundström-Stadelmann B, Frey CF. The first *Toxoplasma gondii* genotyping from sheep slaughtered for human consumption in Ukraine.
- Preza M, Kaethner M, Kaempfer T, Zumstein P, Tamponi C, Varcasia A, Hemphill A, Brehm K, Lundström-Stadelmann B. Advancing in drug discovery against *Echinococcus granulosus* sensu stricto: development and utilization of impartial in vitro screening assays.
- Wiedemar N, Gliga DS, Preza M, Galat M, Kaethner M, Frey CF, Lundström-Stadelmann B. Triclabendazole resistance in Swiss *Fasciola hepatica*. (Poster).
- Kaethner M, Zumstein P, Preza M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Lundström-Stadelmann B. Investigation and inhibition of the threonine metabolism of *Echinococcus multilocularis*.
- Zumstein P, Bartetzko A. Preza M, Kaethner M, Scorrano N, Kämpfer T, Lundström-Stadelmann B. Screening of the MMV Pandemic Response Box agianst *Echinococcus multilocularis* reveals novel potential chemotherapeutics. (Poster).
- Sousa M. C, Imhof D, Hänggeli K, Choi, R, Hilverson M. A, Whitman G. R., Arnold S. K. L. M, Ojo K. K., Van Voorhis W. C., Dogget, J. S., Ortega-Mora L-M, Hemphill A. Activity and efficacy of the bumped kinase inhibitor BKI-1708 *in vitro* and in non-pregnant and pregnant toxoplasmosis and neosporosis mouse models.

SGTP Vorstand anlässlich der Jahrestagung.

16th International Conference on Trichinellosis, Belgrade, Serbia, Aug 30- Sept 1:

- Basso W., Moré G., Gliga D., Ryser-Degiorgis M.-P., Müller N., Frey C.F. *Trichinella britovi* and *T. spiralis* infections in large carnivores and other wild species in Switzerland.
- Moré G., Pischon H., Merz S., Frey C.F., Pantchev N., Basso W. Cutaneous abdominal biopsy enabled the diagnosis of clinical *Trichinella britovi* infection in a hunting dog.

Drs. Walter Basso und Gastón Moré mit Prof. Caroline Frey am ICT-Kongress in Belgrad.

XXIX World Congress of Echinococcosis, Bishkek, Kyrgystan, Aug 28-30:

- Kaempfer T, Preza M, Scorrano N, Kaethner M, Hayoz M, Aebi Y, Largiader C, Brehm K, Lundström-Stadelmann B. Assessment of triclabendazole treatment against *Echinococcus multilocularis*.
- Preza M, Kaethner M, Kaempfer T, Zumstein P, Tamponi C, Varcasia A, Hemphill A, Brehm K, Lundström-Stadelmann B. Advancing in drug discovery against *Echinococcus granulosus* sensu stricto: development and utilization of impartial *in vitro* screening assays.

Dr. Matìas Preza und Tobias Kämpfer in Bishkek.

European Veterinary Parasitology College (EVPC) Conference, Paris, France, June 29-30:

- Kaempfer T, Gliga DS, Wiesner M, Basso W, Lundström-Stadelmann B. *In vitro* culture and treatment of *Taenia crassiceps* metacestodes. (Poster)
- Moré G, Rüegg – Van Den Broek P, Glardon O, Frey CF, Basso W. Identification and management of *Trichuris* sp. and *Giardia* sp. infections in captive Brazilian porcupines (*Coendou prehensilis*).
- Gliga DS, Moré G, Marti I, Frey CF, Basso W. Neglected lungworm species in European wildcats (*Felis silvestris*) from Switzerland.
- Cortes H, Moré G, Cardoso L, Basso W. First report of *Parafilaria bovicola* in Portugal.
- Rubiola S, Chiesa F, Civera T, Frey CF, Basso W, Moré G. Detection of *Sarcocystis bovifelis, S. cruzi, S. hominis* and a new *Sarcocystis* species in a beef steer with eosinophilic myositis.

GCB Symposium University of Bern, CH, June 29:

- Kaethner M, Zumstein P, Preza M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez, Lundström-Stadelmann B. Investigation and inhibition of the threonine metabolism of *Echinococcus multilocularis*.
- Kaempfer T, Preza T, Scorrano N, Kaethner M, Hayoz M, Aebi Y, Largiader C, Brehm K, Lundström-Stadelmann B. Assessment of triclabendazole treatment against *E. multilocularis*. (Poster)

Marine biological laboratory Woods Hole, June 16-Aug 3:

- Hänggeli K. Generation of distinct *Toxoplasma gondii* sag1-KO clones and characterization of their protein expression pattern by comparative proteomics. Biology of Parasitism: modern approaches. (Poster)

The Zoo and Wildlife Health Conference 2023, Valencia, Spain, June 7-10:

- Cigler P, Moré G, Bize P, Meier C, Colominas R, Frey CF, Basso W, Saskia K. Trypanosomiasis: an emerging disease in Alpine swift (*Tachymarptis melba*) nestlings in Switzerland?
- Meister SL, Wyss F, Wenker C, Hoby S, Basso W. Avian haemosporidiosis in zoological institutions in Switzerland: diagnostic, clinical relevance and control measures.

T**agung der DVG-Fachgruppe Parasitologie und parasitäre Krankheiten**, Munich, Germany, May 15-17:

- Cigler P, Moré G, Bize P, Colominas R, Meier C, Hemphill A, Frey CF, Keller S, Basso W. Infektionen mit *Trypanosoma* sp. und *Crataerina* spp. in Verbindung mit einer erhöhten Sterblichkeitsrate bei Alpensegler (*Tachymarptis melba*)
- Furtado Jost R, Müller N, Marreros N, Basso W, Moré G, Antoine L, Frey CF. Wie wichtig ist die Hauskatze für die Kontamination der Umwelt mit *Echinococcus multilocularis* Eiern?
- Rubiola S, Chiesa F, Civera T, Hemphill A, Frey CF, Basso W, Moré G. Detection of four different *Sarcocystis* species in a beef steer with eosinophilic myositis, including a new *Sarcocystis* species.
- Grolimund D, Burren A, Probst S, Schwarz J, Wiederkehr D, Frey CF. Einsatz und Wirksamkeit von Kokzidiostatika-haltigem Futter bei Schweizer Fleischkaninchen.

Denise Grolimund, Dr. Maryna Galat, Dr. Walter Basso, Prof. Caroline Frey, Dr. Pia Cigler & Rebecca Furtado Jost an der DVG-Konferenz in München.

30th annual meeting of the German Society for Parasitology, Giessen, DE, Mar. 15-17:

- Kaethner M, Preza M, Kaempfer T, Zumstein P, Tamponi C, Varcasia A, Hemphill A, Brehm K, Lundström-Stadelmann, B. Objective in vitro drug testing for *Echinococcus granulosus*.
- Kaethner M, Zumstein P, Preza M, Grossenbacher, P, Lochner, M, Schürch, S, Regnault, C, Villalobos Ramirez, D, Lundström-Stadelmann, B. The Achilles' heel of the fox tapeworm? - Investigation of the threonine metabolism of *Echinococcus multilocularis*.
- Hemphill A. Differential chromatography coupled to mass spectrometry: a 3R relevant tool to identify common binding proteins of a broad range antimicrobial peptide and potentially other compounds active against *Toxoplasma gondii.*
- Hemphill A. Proteomic characterization of *Toxoplasma gondii* ME49 derived strains resistant to artemisinin derivatives artemiside and artemisone implies potential mode of action independent of ROS formation.
- Hänggeli K, Hemphill A, Müller N, Schimansju B, Olias P, Müller J, Boubaker G. A comparative proteomic analysis of *Toxoplasma gondii* RH wild-type and four SRS29B (SAG1) knock-out clones to understand the impact of sag1 disruption on the gene expression profile during the lytic cycle in vitro.

Swiss Vector Entomology Group (SVEG) meeting, Zurich, Switzerland, Jan 19-20:

- Moré G, Bize P, Cigler P, Colimas R, Hemphill A, Keller SA, Frey CF, Basso W. *Crataerina* spp. as potential vectors for *Trypanosoma* sp. in Alpine swifts *(Tachymarptis melba)*?

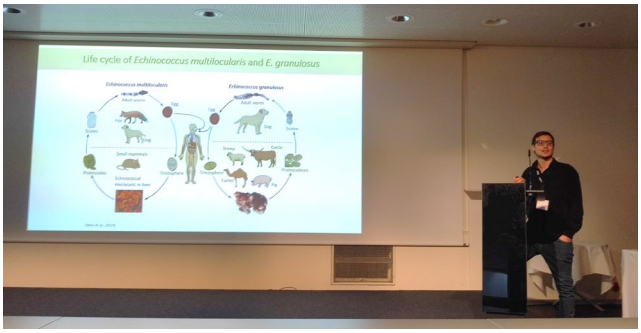
2022

Swiss Society of Tropical Medicine and Parasitology Students Meeting, Bern, CH, Nov 9:

- Zumstein P, Preza M, Kaethner M, Kaempfer T, Lundström-Stadelmann B. Screening of the MMV Pandemic Response Box against *E. multilocularis*.
- Kaethner M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Zumstein P, Lundström-Stadelmann B. Starving a deadly parasite: Investigation and inhibition of the threonine metabolism of the fox tapeworm *Echinococcus multilocularis*.

Joint annual conference of the Swiss Society of Tropical Medicine and Swiss Society of Tropical and Travel Medicine, Bern, CH, Nov 10-11:

- Kämpfer T, Preza M, Scorrano N, Kaethner M, Hayoz M, Yebi Y, Largiader C, Brehm K, De Brot S., Lundström-Stadelmann, B. Assessment of triclabendazole treatment against *E. multilocularis*.
- Preza M, Kaethner M, Kaempfer T, Tamponi C, Varcasia A, Lundström-Stadelmann B. *In vitro* drug screening against *Echinococcus multilocularis* and *E. granulosus*.
- Kaethner M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Zumstein P, Lundström-Stadelmann B. Hungry for threonine: metabolomics in *Echinococcus multilocularis*.
- Pardo Gil M, Hegglin D, Briner T, Müller N, Moré G, Frey CF, Deplazes P, Basso W. Does *Toxoplasma gondii* manipulate the behaviour of European water voles (*Arvicola amphibius* s.l.)?
- Cortes H, Basso W, Cardoso L. *Onchocerca lupi* in Portugal – past, present, and future.



Dr. Matìas Preza präsentiert an der SGTP-Jahrestagung.

ApicoWplexa, 6th International Meeting on Apicomplexan Parasites in Farm Animals Bern, CH, Oct 5-7:

- Scherrer P, Ryser-Degiorgis MP, Frey CF, Basso W. *Toxoplasma gondii* infection in the Eurasian beaver *(Castor fiber)* in Switzerland.
- Gliga DS, Basso W, Ardueser F, Moore-Jones G, Schares G, Zanolari P, Frey CF. Switzerland-wide *Neospora caninum* seroprevalence in cattle and identification of risk factors for infection.
- Maksimov P, Angulo Lara P, Galal L, Calero-Bernal R, Fernández-Escobar M, Mercier A, Lorenzi H, Joeres M, Koudela B, Blaga R, Globokar Vorhovec M., Stollberg K, Bier N, Sotiraki S, Sroka J, Piotrowska W, Kodym P, Basso W, Conraths FJ, Darde ML, Spano F, Vatta P, Caccio S, Jokelainen P, Ortega-Mora LM, Schares G. Genotyping *Toxoplasma*: whole genome sequences of isolates across Europe reveal more diversity within European Type II than expected.
- Joeres M, Maksimov P, Höper D, Calvelage S, Calero-Bernal R, Fernández-Escobar M, Koudela B, Blaga R, Globokar Vrhovec M, Stollberg K, Bier N, Sotiraki S, Sroka J, Piotrowska W, Kodym P, Basso W, Conraths FJ, Darde ML, Spano F, Caccio S, Ortega-Mora LM, Jokelainen P, Schares G. A novel ion ampliseq-based typing method of *Toxoplasma gondii* reveals an excellent typing resolution among Type II strains.
- Moré G, Öhm A, Ruetten M, Grimm F, Frey CF, Basso W. Identification of *Sarcocystis* species present in diaphragm muscles from wild boars *(Sus scrofa)* in Switzerland.
- Pardo Gil M, Hegglin D, Briner T, Müller N, Moré G, Frey CF, Deplazes P, Basso W. Are *Toxoplasma gondii* infected water voles (*Arvicola amphibius* s.l.) easy prey for cats?
- Kauter J, Damek F, Schares G, Blaga R, Schott F, Deplazes P, Sidler X, Basso W. Detection of *Toxoplasma gondii* specific antibodies in pigs using an oral fluid-based commercial ELISA: advantages and limitations.

- Hänggeli K, Hemphill A, Müller N, Schimanski B, Olias P, Müller J, Boubaker G. Quantification of integrated selection markers in *Toxoplasma gondii* knockouts. (Poster)
- Imhof D. Immunization with a multivalent *Listeria monocytogenes* vaccine leads to a strong reduction of vertical transmission and cerebral parasite burden in pregnant and non-pregnant mice infected with *Neospora caninum*.

Prof. Andrew Hemphill, Organisator des ApicoWplexa Meetings 2022.

ESVP (European Society of Veterinary Pathology)-ECVP (European College of Veterinary Pathology) Annual Meeting, Athens, Greece, Sept 7-10:

- Müller S, Basso W, Croci M, Czech C, Weber N, Weyrich A. Cutaneous leishmaniosis in a horse in Switzerland.

Parasitic Helminths: New Perspectives in Biology and Infection, Hydra, Greece, Aug 28-Sept 2:

- Kaethner M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Lundström-Stadelmann B. The Achilles' heel of the fox tapeworm? Investigation of the threonine metabolism of *Echinococcus multilocularis*. (Poster)

15th International Congress of Parasitology (ICOPA) 2022, World Federation of Parasitologists (WFP) Copenhagen, Denmark, Aug 21-26:

- Scherrer P, Ryser-Degiorgis MP, Borel S, Frey CF, Basso W. *Toxoplasma gondii* infection in free-ranging Eurasian lynx *(Lynx lynx)* in Switzerland: serological and molecular studies,
- Frey CF, Gottstein B, Basso W, Geissbühler U, Howard J, Ostermann S, Sager H, Marreros N. Alveolar echinococcosis in dogs: disease presentation, treatment options and serological diagnosis.
- Maksimov P, Angulo Lara P, Galal L, Calero-Bernal R, Fernández-Escobar M, Mercier A, Lorenzi H, Joeres M, Koudela B, Blaga R, Globokar Vorhovec M., Stollberg K, Bier N, Sotiraki S, Sroka J, Piotrowska W, Kodym P, Basso W, Conraths FJ, Darde ML, Spano F, Vatta P, Caccio S, Jokelainen P, Ortega-Mora LM, Schares G. Genotyping *Toxoplasma*: whole genome sequences of isolates across Europe reveal more diversity within European Type II than expected.

- Joeres M, Maksimov P, Höper D, Calvelage S, Calero-Bernal R, Fernández-Escobar M, Koudela B, Blaga R, Globokar Vrhovec M, Stollberg K, Bier N, Sotiraki S, Sroka J, Piotrowska W, Kodym P, Basso W, Conraths FJ, Darde ML, Spano F, Caccio S, Ortega-Mora LM, Jokelainen P, Schares G. A novel ion ampliseq-based typing method of *Toxoplasma gondii* reveals an excellent typing resolution among Type II strains.
- Chaudhry S, Zurbriggen R, Preza M, Kämpfer T, Kaethner M, Memedovski R, Scorrano N, Hemphill A, Doggett JS, Lundström-Stadelmann B. Dual inhibition of the *Echinococcus multilocularis* energy metabolism.
- Kaethner M, Preza M, Kämpfer T, Tamponi C, Varcasia A, Lundström-Stadelmann B. In vitro drug screening cascade for *Echinococcus granulosus*. (Poster)
- Kaethner M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Lundström-Stadelmann B. The Achilles' heel of the fox tapeworm? Investigation of the threonine metabolism of *Echinococcus multilocularis*. (Poster)
- Preza M, Kaethner M, Kämpfer T, Scorrano N, Lundström-Stadelmann B. The metabolism of *Echinococcus multilocularis* under new drug testing. (Poster)
- Hänggeli K, Hemphill A, Müller N, Schimanski B, Olias P, Müller J, Boubaker G. Towards understanding the role of SAG1 in *Toxoplasma gondii* infection biology using combined functional genomics and protemics: advantages and limitations.

IPA-Delegation mit zwei Kollegen des IPZ am ICOPA 2023.

Toxo XVI Congress, Riverside, Los Angeles, USA, May 22-26:

- Hemphill A, Anghel N, Müller J, Boubaker G, Imhof D, Serricchio M, Jelk J, BuetikoferP, Desitakina O, Paunesu E, Fuerrer J Heller M, Braga-Lagache S. Cellular and Molecular Targets of Nucleotide-Tagged Trithiolato-Bridged Arene Ruthenium Complexes in *Toxoplasma gondii* and *Trypanosoma brucei*. (Poster)
- Hänggeli K, Hemphill A, Müller N, Schimanski B, Olias P, Müller J, Boubaker G. The way back to the right path, SAG1 in *Toxoplasma gondii* - A combined functional genomics and proteomics approach. (Poster)

Tagung der DVG-Fachgruppe Parasitologie und parasitäre Krankheiten, Berlin, Germany, May 23-25:

- Joeres M, Maksimov P, Höper D, Calvelage S, Calero-Bernal R, Fernández-Escobar M, Koudela B, Blaga R, Globokar Vrhovec M, Stollberg K, Bier N, Sotiraki S, Sroka J, Piotrowska W, Kodym P, Basso W, Conraths FJ, Darde ML, Spano F, Caccio S, Ortega-Mora LM, Jokelainen P, Schares G. A novel ion ampliseq-based typing method of *Toxoplasma gondii* reveals an excellent typing resolution among Type II strains.

The Zoo and Wildlife Health Conference 2022 EAZWV, Emmen, The Netherlands, May 25-28:

- Scherrer P, Ryser-Degiorgis MP, Borel S, Frey CF, Basso W. Molecular characterisation of *Toxoplasma gondii* infecting free-ranging Eurasian lynx *(Lynx lynx)* in Switzerland.
- Stettler M, Lotz C, Probst A, Hofmann D, Marreros N, Hofer A, Lundström-Stadelmann B, Frey CF, Keiser J, Hoby S. Pharmacokinetics of praziquantel in European pond turtles *(Emys orbicularis)*.
- Gliga D, Frey CF, Ryser-Degiorgis MP, Basso W. First report of the feline lungworms *Troglostrongylus brevior* and *Angiostrongylus chabaudi* infecting European wild cats *(Felis silvestris)* in Switzerland.

GCB Symposium, online, Bern, Jan 27:

- Kaethner M, Grossenbacher P, Lochner M, Schürch S, Regnault C, Villalobos Ramirez D, Lundström-Stadelmann B. The Achilles' heel of the fox tapeworm? Investigation of the threonine metabolism of *Echinococcus multilocularis*. (Poster)

8.3 Invited Presentations

2023

Hemphill A. Application of differential affinity chromatography coupled to MS and proteomics for the identification of drug targets and for studies on the mode of action of anti-parasitic drugs. All 4 Animals, Associate Laboratory for Animal and Veterinary Sciences. **Faculdade de Medicina Veterinaria da Universidade de Lisboa**, Portugal, Nov 29, 2023.

Basso W. Tierverkehr und zu überwachende Tierseuchen: *Trypanosoma*-Infektionen beim Pferd. **BLV-Laborleitertagung**, Bern, CH, Oct 19, 2023.

Basso W. *Trichinella*-Infektionen in der Schweiz: Diagnostik und epidemiologische Situation bei Nutz- und Wildtieren, AGES Online-Seminar **«VII. Trichinen – Workshop» Österreichische Agentur für Gesundheit und Ernährungssicherheit**, Innsbruck, Austria, Sept 28, 2023.

Lundström-Stadelmann B and Frey CF. Top-Sharing. **IDEAS Retreat**. Ticino, CH, Aug 28, 2023.

Basso W. Bovine besnoitiosis in Switzerland, **1st European Workshop on Besnoitiosis**, Paris, France, June 29, 2023.

Basso W. "Parasitologie" **ITB III Aufbaukurs «Interpretation von Laborbefunden» Schweizerische Vereinigung für Schweinemedizin (SVSM)**, Bern, CH, June 16, 2023.

Frey CF. Parasitic protozoa in ready-to-eat food. **2nd Microbiological Risk Assessment Seminar 2023,** Liebefeld, CH, June 7, 2023.

Basso W. Cyst-forming coccidian parasites in veterinary medicine: clinical, diagnostic and epidemiological aspects. Continuing Education in Veterinary Parasitology for EVPC Diplomates and Residents "**VIPs in Zurich: Very Important Parasites in Zurich –from fundamental to applied research**" Zürich, CH, June 4-6, 2023.

Müller N. Molecular diagnosis and genetic differenciation of *Tritrichomonas* spp. **Universidade de Évora Departamento de Medicina Veterinária**, Portugal, June 1, 2023.

Hemphill A. Novel drugs and drug targets for the treatment of neosporosis. Virtual Seminar 2023 on Bovine Neosporosis: Quo Vadis. **Universidad Complutense Madrid**, Spain, May 25, 2023.

Basso W. “When and how *Angiostrongylus*, *Toxoplasma* and *Neospora* become “dangerous” for the neurological patient: **The parasitologist’s point of view, Societá Italiana de Neurologia Veterinaria (SINVET), Le Malattie Infettive del Sistema Nervoso** (online) April 15, 2023.

Andrew Hemphill. Novel drugs and targets for diseases caused by apicomplexan parasites. **Faculty of Graduate Studies, University of Jaffna**, Sri Lanka, April 18, 2023.

Frey CF and Lundström-Stadelmann B. Geschichten des Gelingens – Gleichstellungsmassnahmen von Hochschulen im Dialog. **University of Bern**, CH, Mar 8, 2023.

Hemphill A. How to write a scientific paper. Online seminar series on scientific communications, **University of Sassari**, Sardegna, Italy, Feb 28, 2023.

Frey CF. Les ecto- et endoparasites du chien et du chat sous la loupe. Séminaire de microscopie. **Boehringer-Ingelheim,** Bern, CH, Feb 16, 2023.

Frey CF. New (and not so new) players in the epidemiology of *Echinococcus multilocularis* in Switzerland. Online seminar. **Western College of Veterinary Medicine,** Saskatoon, Canada, Feb 11, 2023.

Frey CF. Beleuchten Sie mit uns die Ekto- und Endoparasiten bei Hund und Katze. Mikroskopie-Seminar. **Boehringer-Ingelheim,** Bern, CH, Feb 9, 2023.

2022

Basso W. Avian malaria in bird collections from Swiss zoos”, Seminar Series Parasitology, Institute of Parasitology, Vetsuisse Faculty, **University of Zurich**, CH, Dec 20, 2022.

Basso W. Dog import and the risk of introduction and spreading of *Strongyloides stercoralis* in Switzerland. **Joint meeting 2022 of the Swiss Society of Tropical Medicine and Parasitology (SSTMP) & Swiss Society of Tropical and Travel Medicine (SSTTM)**, Bern, CH, Nov 10-11, 2022.

Frey CF. ESCCAP – providing free best-practice guidelines to help veterinarians and pet owners control companion animal parasites and avoid zoonotic and travel diseases. **Joint meeting 2022 of the Swiss Society of Tropical Medicine and Parasitology (SSTMP) & Swiss Society of Tropical and Travel Medicine (SSTTM)**, Bern, CH, Nov 10-11, 2022.

Basso W. *Toxoplasma gondii* und *Neospora caninum* Infektionen bei Neuweltkameliden in der Schweiz. **BLV-Laborleitertagung**, Bern, CH, Oct 19, 2022.

Frey CF. One Health - Was wissen wir über zoonotische Parasiten bei der Katze in der Schweiz? Launch NexGuard Combo, **Boehringer-Ingelheim, Zurich,** CH, June 30, 2022.

Frey CF. One Health – Que savons-nous des parasites zoonotiques chez le chat en Suisse? Launch NexGuard Combo, **Boehringer-Ingelheim, Lausanne,** CH, June 23, 2022.

Frey CF. One Health - Was wissen wir über zoonotische Parasiten bei der Katze in der Schweiz? Launch NexGuard Combo, **Boehringer-Ingelheim, Bern**, CH, June 2, 2022.

Lundström-Stadelmann B. Novel approaches for the treatment of alveolar echinococcosis. **Meeting of the Swiss Network of Echinococcosis**, online, May 16, 2022.

Frey CF. What can pigs tell us about environmental contamination with *E. multilocularis* eggs? **SSTMP Zoom series,** online, Apr 27, 2022.

Basso W. "*Toxoplasma gondii* - *Neospora caninum*" Parasitology course, Escuela de Medicina Veterinaria, **Pontificia Universidad Católica de Chile**, Chile, Feb 16, 2022 (Course, online).

Lundström-Stadelmann B. Novel approaches for the treatment of the fox tapeworm *Echinococcus multilocularis*. Mini symposium on the occasion of the retirement of Prof. Peter Deplazes, **University of Zürich**, CH, Jan 20, 2022.

9. Aus-, Fort-, und Weiterbildung / Teaching and Continuing Education

9.1 VETSUISSE CURRICULUM

2023

FS23: 473087 Parasitologie. 2. Studienjahr, 2 Stunden / Woche, Referenten: Caroline Frey, Walter Basso.

FS23: 473096 Schwerpunkt Nutztiere. 4. Studienjahr, 4 Lektionen. Referenten: Caroline Frey, Walter Basso.

HS23: 473087 Parasitologie. 3. Studienjahr, 2 Stunden / Woche, Referenten: Caroline Frey, Walter Basso, Gastón Moré, Diana Gliga.

HS23: 472667 Praktische Fertigkeiten IV, Parasitologie-Kurs, 4. Studienjahr, 30 Lektionen, Referenten Walter Basso, Gastón Moré, Caroline Müller.

2022

FS22: 473087 Parasitologie. 2. Studienjahr, 2 Stunden / Woche, Referenten: Caroline Frey, Walter Basso.

FS22: 473096 Schwerpunkt Nutztiere. 4. Studienjahr, 4 Lektionen. Referenten: Caroline Frey, Walter Basso.

HS22: 473087 Parasitologie. 3. Studienjahr, 2 Stunden / Woche, Referenten: Caroline Frey, Walter Basso.

HS22: 472667 Praktische Fertigkeiten IV, Parasitologie-Kurs, 4. Studienjahr, 30 Lektionen, Referenten Walter Basso, Gastón Moré, Caroline Müller.

9.2 MEDIZINISCHE PARASITOLOGIE / MEDICAL PARASITOLOGY LECTURES

2023

HS23: 2804 Medizinische Parasitologie und tropische Parasitosen, Vorlesung für Studierende der Naturwissenschaften, der Veterinärmedizin oder der Medizin: Britta Lundström-Stadelmann, Andrew Hemphill, Carmen Faso (IZB), Kerry Woods (ITPA), Walter Basso, Matias Preza, Heinz Sager, Magali Roques (IZB), Christof Grüring (IZB), 3 Stunden / Woche.

FS23: 2806 Molekulare Parasitologie, Britta Lundström-Stadelmann, Andrew Hemphill. (Teilpensum)

2022

HS22: 2804 Medizinische Parasitologie und tropische Parasitosen, Vorlesung für Studierende der Naturwissenschaften, der Veterinärmedizin oder der Medizin: Britta Lundström-Stadelmann, Andrew Hemphill, Norbert Müller, Carmen Faso (IZB), Kerry Woods (ITPA), Walter Basso, Matias Preza, Heinz Sager, Magali Roques (IZB), Christof Grüring (IZB), 3 Stunden / Woche.

FS22: 2806 Molekulare Parasitologie, Britta Lundström-Stadelmann, Andrew Hemphill. (Teilpensum)

9.3 Fort- und Weiterbildung / Continuing Education

Für die institutsinterne Fort- und Weiterbildung wurden wöchentlich alternierend Forschungsseminare und Journal-Clubs gehalten.

Es fanden regelmässige DIP-Seminare statt mit Forschungsvorträgen von internen und externen Gästen.

Diagnostische Kolloquien fanden regelmässig statt und beinhalteten die Besprechung interessanter und lehrreicher Fälle.

Das Institut hat 2022/2023 folgende Weiterbildungsveranstaltungen organisiert und durchgeführt:

- Hänggeli K, Gaspare Valenti A (hosts and chairs). Zoom seminar series of the Swiss Society of Tropical Medicine and Parasitology, insgesamt 22 Seminare.
- Caroline Frey: Mikroskopierkurs Endo- und Ektoparasiten bei Hund und Katze, Bern, 9.&16.2.2023.
- Walter Basso, Caroline Frey, Gaston Moré, Diana Gliga: "Trichinellose und Trichinendiagnostik: Theorie und Praxis", Bern, 22.6.2023.

9.4 Seminare externer Gäste / Seminars of Guests

2023

Eva Gluenz, "Dissecting gene function in *Leishmania* with CRISPR-Cas9 knockout screens", **Apr. 2023.**

Heinz Sager, "Hoping for a new drug – the joys and challenges of being an industrial parasitologist", **Jun. 2023.**

Pavlo Maksimov, "Intraspecific diversity in *Echinococcus multilocularis* at whole-genome and mitogenome levels", **Sept. 2023.**

Robin Gasser, "What's going on in Melbourne – Parasitology and beyond", **Sept. 2023.**

Staffan Svärd, "The two faces of *Giardia* - being fit matters", **Oct. 2023.**

Christoph Grüring, „Of EJs and cRBCs: using hematopoietic stem cells to study host cell determinants of *Plasmodium* red blood cell infection", **Nov. 2023.**

2022

Matthias Marti, "Unraveling genetic and environmental determinants of malaria transmission", **Nov. 2022.**

Bruno Gottstein, "Echinococcosis in monkeys", **Nov. 2022.**

9.5 Organisation von Symposien / Konferenzen / Organisation of Symposia / Conferences

2023

Lundström-Stadelmann, B: students' meeting, co-organizer, Swiss Society of Tropical Medicine and Parasitology (SSTMP), Schwarzenberg, **Nov. 2023.**

Lundström-Stadelmann, B: Joint annual meeting of the SSTMP, Allschwil, CH, **Nov. 2023.**

2022

Lundström-Stadelmann, B: Echinococcus Symposium, main organizer, Weggis, CH, **Mar. 2022.**

Hemphill A. ApicoWplexa 2022: 6th International Meeting on Apicomplexan Parasites in Farm animals, Bern, CH, **Oct. 5-7 2022**.

Lundström-Stadelmann, B: Joint annual meeting of the SSTMP and the SSTTM, main organizer, Bern, CH, **Nov. 2022.**

Lundström-Stadelmann, B: students' meeting, co-organizer, Swiss Society of Tropical Medicine and Parasitology (SSTMP), Bern, CH, **Nov. 2022.**

***Echinococcus* Meeting in Weggis, 2022.**

ApicoWplexa 2022 Bern.

10. DIENSTLEISTUNG / DIAGNOSTICS

10.1 AKKREDITIERUNG / ACCREDITATION

Die veterinärparasitologische **Diagnostik** ist durch die Schweizerische Akkreditierungsstelle (SAS) unter der **STS-Nummer 0678 nach ISO/IEC 17025:2017 akkreditiert**.

Das Institut nimmt regelmässig an folgenden internationalen Ringversuchen zur Leistungs- und Qualitätskontrolle teil:

- Ringversuche zum Nachweis von ***Trichinella*-Larven im Fleisch**, zur **molekularen Bestimmung von *Trichinella*-Arten** und zum **Nachweis von *Echinococcus* spp. in der Darmschleimhau**t des Endwirtes, organisiert vom European Union Reference Laboratory for Parasites, Istituto Superiore di Sanitá (ISS), Rome, Italien.

- Ringversuche zum **Nachweis von Antikörper gegen *Toxoplasma gondii*, *Neospora caninum* und *Besnoitia besnoiti*** im Serum von Wiederkäuern, organisiert vom UK VETQAS Proficiency Testing Service, London, England, und vom Friedrich-Loeffler Institut, Riems, Deutschland.

- Ringversuche zum Nachweis von ***Toxoplasma gondii*-DNA mittels qPCR,** organisiert vom EU Quality Control for Molecular Diagnostic, (QCMD), Glasgow, Schottland und vom Friedrich-Loeffler Institut, Riems, Deutschland.

- Ringversuch zur **Dourine-Serologie** organisiert durch das ANSES, Dozulé, Frankreich.

- Ringversuch zum **Nachweis von Magen-Darm-Strongyliden und Kokzidien beim Schaf,** welche qualitative und quantitative Analysen beinhaltet, sowie Koprokultur und Larvenidentifikation, organisiert vom Institut für Parasitologie und Tropenveterinärmedizin, Freie Universität Berlin, Deutschland.

Das IPB organisiert jährlich eine Qualitätskontrolle zum *Trichinella*-Nachweis im Fleisch und führt diese auch durch. Die Qualitätskontrolle besteht aus einem Haupt- und einem Nachversuch (für Teilnehmende mit suboptimalen Ergebnissen im Hauptversuch).

10.2 REFERENZLABOR / REFERENCE LABORATORY

Labor für Veterinärparasitologie*(*BLV-bewilligtes Labor für Tierseuchendiagnostik)
(Beteiligung per 31.12.2023): Dr. W. Basso (Leitung), Prof. Dr. C. Frey, Dr. G. Moré, Dr. D. Gliga, C. Salvisberg., C. Müller, U. Kurath, R. Ziegler, S. Lückner, D. Lüthi, E. Emmenegger.
QS-Leitung: Dr. W. Basso.

Das IPB amtet als **Nationales Referenzlabor für folgende Tierseuchen: Trichinellose, Toxoplasmose, Neosporose, Besnoitiose, Tritrichomonose und Beschälseuche (Dourine).**

Trichinellose: In den Jahren 2022-2023 erhielt das IPB mehrere Fälle von verdächtigen *Trichinella*-Larven von *Trichinella*-Untersuchungsstellen zur weiteren diagnostischen Abklärung. Nur in einem Fall konnte die Diagnose bestätigt werden: Im Jahr 2022 wurde *T. spiralis* bei einem Wildschwein im Kanton VD (erlegt in Frankreich, Region Montpellier) bestätigt. Die Probe wurde zur Bestätigung durch das Laboratoire Vétérinaire IGV, Lausanne eingesandt.
Darüber hinaus wurden in den Jahren 2022 - 2023 Infektionen mit *Trichinella britovi* bei 13 Wölfen und 8 Luchsen nachgewiesen.

Beratungstätigkeit: Zahlreiche telefonische Beratungen für Veterinärämter, Tierärzte, Labors und Schlachthöfe bei Fragen zur Durchführung der *Trichinella*-Diagnostik.
Versand von Referenzmaterialien für interne Kontrolle und Training an Labors, welche die *Trichinella*-Untersuchung durchführen
Das IPB hat im Jahr 2023 eine Weiterbildungsveranstaltung: "Trichinellose und Trichinendiagnostik: Theorie und Praxis" für das Laborpersonal und Fleischkontrolleure, welche in der *Trichinella*-Diagnostik tätig sind organisiert.

Toxoplasmose: In den Jahren 2022-2023 wurden *Toxoplasma gondii* Oozysten bei 2 Hauskatzen und 1 Wildkatze mittels Flotation + real-time PCR nachgewiesen. Darüber hinaus wurde *T. gondii*-DNA im Gewebe von einem Biber, einem Klippschliefer, einem Totenkopfäffchen, einem abortierten Schaf-Foetus und im Liquor von einem Hund nachgewiesen.

Beratungstätigkeit: Erläuterungen zur differentialdiagnostischen Bedeutung der Toxoplasmose im Rahmen parasitär bedingter Aborte bei Wiederkäuern sowie von Neuropathien beim Kleintier. Beratungen betr. vorbeugenden Massnahmen zur Verhinderung einer kongenitalen Toxoplasmose bei seronegativen schwangeren Frauen.

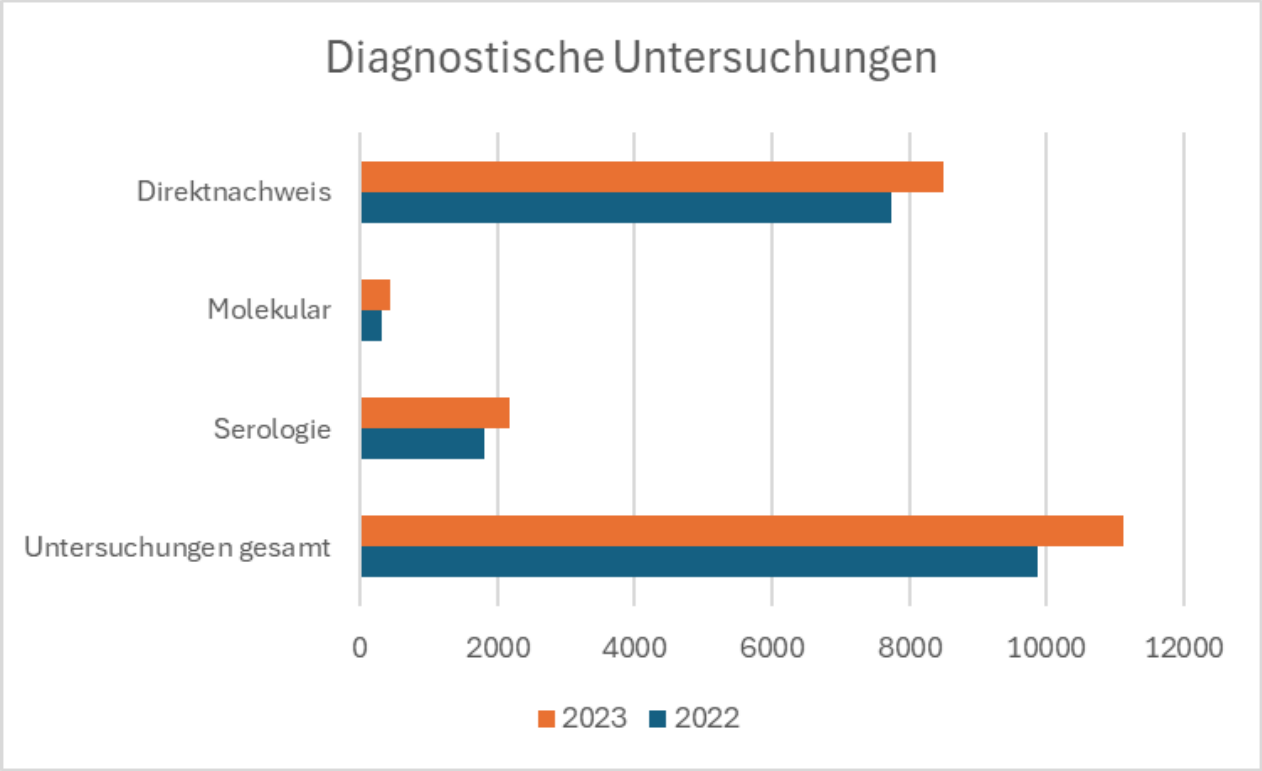
Neosporose: 2022 - 2023: *Neospora caninum* DNA wurde mittels real-time PCR bei insgesamt 8 von 56 (14.3%) abortierten Rinderföten nachgewiesen.
Beratungstätigkeit: Erläuterungen zur Bedeutung des Hundes bei der Übertragung von *N. caninum* auf Wiederkäuer, insbesondere das Rind. Zahlreiche telefonische Beratungen von TierärztInnen und TierhalterInnen im Zusammenhang mit *Neospora*-bedingten Rinderaborten sowie mit neurologischen Problemen beim Hund.

Besnoitiose: 2022-2023 wurde der Parasit in der Schweiz nicht festgestellt.
Beratungstätigkeit: Beratung bezüglich Importuntersuchungen von Rindern, Rentieren und Hirschen und zur differentialdiagnostischen Abklärung bei Hautproblemen.

Beschälseuche (*Trypanosoma equiperdum*): Der Parasit wurde 2022-2023 in der Schweiz weder serologisch noch direkt nachgewiesen. Beratungstätigkeit: Beratung bezüglich Import- bzw. Exportuntersuchungen von Pferden

Tritrichomonose: 2022-2023 wurden beim Rind keine Fälle gemeldet. Der Parasit tritt jedoch gehäuft bei der Katze auf.
Beratungstätigkeit: Erläuterungen zur Bedeutung der Tritrichomonose des Rindes im Rahmen parasitär bedingter Fruchtbarkeitsstörungen und Aborte beim Rind, im In- und Ausland. Beratungen in Bezug auf Epidemiologie, Diagnostik, Klinik und Behandlung von Tritrichomonas-Durchfällen bei Katzen.

10.3 DIAGNOSTIKAUFTRÄGE / DIAGNOSTIC SERVICES



Im Jahr 2022 wurden insgesamt 9'862 Untersuchungen durchgeführt. Davon waren 7'730 Direktnachweise (Koprologie, Kultur, Verdauung u.a.), 1'807 Serologien (AK- oder AG Nachweis) und 327 molekularbiologische Untersuchungen (PCR & Sequenzierungen).

2023 steigerte sich das Untersuchungsvolumen auf insgesamt 11'121 Untersuchungen, wovon 8'505 Direktnachweise, 2'188 Serologien und 429 molekularbiologische Untersuchungen waren.

11. Weitere Funktionen Tätigkeiten der Gruppenleitenden / Further Functions of the Group Leaders

11.1 Gesellschaften und Kommissionen / Societies and Committees

Walter Basso

Board Member EVPC, European Veterinary Parasitology College.

Member of the Executive Committee ESCCAP Schweiz, European Scientific Counsel Companion Animal Parasites.

Member of the Working Group "Veterinary Parasitology" SSTMP, Swiss Society of Tropical Medicine and Parasitology.

Member ICT, International Commission on Trichinellosis.

Caroline Frey

Vizepräsidentin ESCCAP Schweiz, European Scientific Counsel Companion Animal Parasites.

Member ICT, International Commission on Trichinellosis.

Member EVPC, European Veterinary Parasitology College.

Mitglied SGTP, Schweizerische Gesellschaft für Tropenmedizin und Parasitologie (Swiss Society for Tropical Medicine and Parasitology).

Mitglied SVVLD, Schweizerische Vereinigung für Veterinär-Labordiagnostik.

Mitglied GST, Gesellschaft Schweizer Tierärzte und Tierärztinnen.

HERminthology.

Andrew Hemphill

Mitglied, Schweizerische Gesellschaft für Tropenmedizin und Parasitologie (Swiss Society for Tropical Medicine and Parasitology).

Mitglied des Vorstandes der DGP, Deutsche Gesellschaft für Parasitologie (German Society for Parasitology).

Member, British Society for Parasitology.

Member, American Society for Parasitology.

Norbert Müller

Mitglied, Schweizerische Gesellschaft für Tropenmedizin und Parasitologie (Swiss Society for Tropical Medicine and Parasitology).

Mitglied DGP, Deutsche Gesellschaft für Parasitologie (German Society for Parasitology).

Britta Lundström-Stadelmann

Präsidentin SGTP/SSTMP, Schweizerische Gesellschaft für Tropenmedizin und Parasitologie (Swiss Society for Tropical Medicine and Parasitology).

Mitglied DGP, Deutsche Gesellschaft für Parasitologie (German Society for Parasitology).

Mitglied SFM, Svenska föreningen för mikrobiologi (Swedish Society for Microbiology).

Mitglied SGV, Schweizerische Gesellschaft für Versuchstierkunde (Swiss Laboratory Animal Science Association).

HERminthology.

Natalie Wiedemar

Mitglied Schweizerische Gesellschaft für Tropenmedizin und Parasitologie (Swiss Society for Tropical Medicine and Parasitology).

11.2 EVALUATIONSGREMIEN / SCIENTIFIC POSITIONS OF TRUST

Walter Basso

Gutachter/Examinator bei Dissertationen und Diplomarbeiten: Facultad de Ciencias Veterinarias, Universidad Complutense Madrid (Spanien).

Caroline Frey

Externe Begutachterin Berufung W3 Professur Parasitologie, Veterinärmedizinische Fakultät, Universität Leipzig.

Reviewerin für Banting fellowships, Canada.

Thesis committee member and examinator, PhD, Department of Biology, Indiana State University, USA.

Thesis committee member and examinator, PhD, Western College of Veterinary Parasitology, Canada.

Thesis committee member and examinator, PhD, The National veterinary school of Alfort (EnvA), France.

Andrew Hemphill

Reviewer für Alexander von Humboldt Stiftung.

Swissmedic Veterinary Medicine Experts Committee (VMEC), permanent member.

Norbert Müller

Principal Opponent PhD thesis, Uppsala University, SE.

Britta Lundström-Stadelmann

Reviewerin für Alexander von Humboldt Stiftung, GER.

Mitglied der SNSF Postdoc Mobility Evaluation Commission (EvCo), domain LS-B (Life Sciences Biology), CH.

Externe Reviewerin PhD thesis, University of Sassari, I.

Reviewerin für das Department for International Cooperation in Higher Education Austria, A.

Evaluation von Habilitation für die Universität Zürich, CH.

Reviewerin für Recruitment of Faculty position to Uppsala University, SE.

11.3 Universität Bern und Vetsuisse Fakultät / University of Bern and Vetsuisse Faculty

Walter Basso

Representative for the Institute of Parasitology in the “Mittelbau” (Intermediate Staff Faculty Members).

Member of the Mittelbau Board of Directors of the Vetsuisse Bern, as Representative for the Departement of Infectious Diseases and Pathobiology (DIP).

Member of the advisory group (Begleitgruppe Arbeitskreis Bern) in the ZoE-BTA Programm from the Federal Food Safety and Veterinary Office (BLV) to improve pig health in Switzerland.

Caroline Frey

Mitglied Vetsuisse Beförderungkommission, Vetsuisse Bern & Zürich.

Mitglied Struktur- und Berufungskommission Professur in Veterinärdermatologie, Vetsuisse Bern.

Mitglied HappyVet, Vetsuisse Bern & Zürich, GST, Graeub.

Echogruppe neues Curriculum Vetsuisse, Vetsuisse Bern.

Echogruppe Strategie 2030, Universität Bern.

Mentorin Educator Track, Vetsuisse Bern.

Britta Lundström-Stadelmann

Mitglied der Forschungskommission der Vetsuisse Fakultät Bern.

Mitglied Proteomics & Mass Spectrometry Core Facility Working Group of the DBMR, Universität Bern.

Mitglied Strukturkommission Veterinärparasitologie Professur, Vetsuisse Zürich.

Mitglied Neglected Disease Cluster of the Multidisciplinary Center for Infectious Diseases (MCID), University of Bern.

Mitglied of the University of Bern group of the Swiss Alliance against Neglected Tropical Diseases (SANTD).

Mitlgied der Kommission des Experimental Animal Center (EAC), Universität Bern.

Mentorin Vetment Programm, Vetsuisse Bern.

Natalie Wiedemar

Mitglied im Board des Vetsuisse Bern Mittelbau als Vertreterin des Departements für Infektionskrankheiten und Pathobiologie (DIP).

12. Institutanlässe / Internal Institute Events (all in 2023)

Schneetag auf dem Gurnigel.

Retreat mit dem IPZ am Walensee.

Hirschbeobachtung im Justistal.

Weihnachtsevent bei Traufer in Brienz.

Die selbstgeschnitzten Kühe an Weihnachten.