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## Poster Session 2 – Workshop Rodent-Borne Diseases

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### 62 *Schistosomiasis* in the Senegal River Basin and the role of wild rodents as reservoir hosts

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*Schistosomiasis* is a neglected tropical disease (NTD) of profound medical and veterinary importance caused by dioecious trematodes of the genus *Schistosoma*. This NTD affects over 240 million people globally, with the highest burden in sub-Saharan Africa. *Schistosoma* parasites are characterized by complex multi-host dynamics and interspecific interactions leading, under certain conditions, to viable hybridizations between human and animal schistosomes with subsequent zoonotic transmission. Anthropogenic land-use changes and the progressive loss of ecological barriers may have also favoured interactions between different *Schistosoma* species. Our study elucidated the role of wild rodents as potential reservoirs of zoonotic *Schistosoma* species and hybrids in the Senegal River Basin, a region subject to dramatic anthropogenic change. Between May 2016 and November 2017, we trapped, humanely euthanized and necropsied small mammals from sites around Lake Guiers and the town of Richard Toll, Senegal, applying a multi-locus molecular analysis to identify the isolated *Schistosoma* spp. and estimate local prevalence. A total of 671 small mammals were captured over 4,089 trap nights. *Schistosoma mansoni*, occasionally coupled with zoonotic *Schistosoma haematobium*/*Schistosoma bovis* hybrids, and *Schistosoma bovis* were isolated in the portal system and/or mesenteric vessels of 24 out of 367 *Mastomys huberti* mice (prevalence 6.6%; intensity range 2-64) and 6 out of 257 *Arvicanthis niloticus* rats (prevalence 2.3%; intensity range 1-44). Infection prevalence was highly focal among study sites, with rates up to 52.6% and 28.6% in the villages of Gueo and Temey, respectively. Our findings emphasize the role of *Mastomys huberti* and *Arvicanthis niloticus* as important zoonotic reservoirs of *Schistosoma* species and hybrids, potentially amplifying transmission to humans. In the Senegal River Basin, as in many other endemic areas of sub-Saharan Africa, the breakdown of ecological barriers warrants the application of a One Health, multi-host framework to better tailor setting-specific *schistosomiasis* control programmes, enhancing public health interventions.

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### **63 Rodents diversity and pathogen carriage at Limpopo National Park villages, Mozambique**

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The Limpopo National Park (LNP) is a Mozambican Trans Frontier Conservation Area of global interest. Within the park, people, domestic and wild animals live together, as well as potential high diversity of rodents and rodent-borne pathogens also. Rodents are known pests and important carriers/reservoir of pathogens but also food source in rural communities increasing human exposure risk. Some data confirm occurrence of *Toxoplasmosis*, *Leptospirosis* and plague in Mozambique but little is known about rodent role in these diseases ecology in the country. As climate change may increase contact between humans and wildlife and therefore increase pathogens spillover, it is critical to study diseases occurrences and dynamics in risky areas like LNP. The present study aims to understand the diversity of rodents at LNP villages, their pathogen carriage and roles in disease ecology. Thus, with the permission of LNP authorities and villagers a total of 6 villages from core (2) and buffer (4) zones were studied. Rodents were trapped and specimens were ethically sacrificed. Skull, skin and tissue samples for DNA analyses (COI and Cytb genes) were used for taxonomic identification. Specimens' health-status was recorded and samples collected during meticulous necropsies. Pathogens screening is now being carried out (LAT for *Toxoplasma gondii*; MACROLepto for *Leptospira* "S" spp.). Thirty-five rodents of three different genera (*Rattus* sp., *Aethomys* sp. and *Mus* sp.) were captured, a rich rodent tissue and parasites collection was assembled and identification at species level is in process. The general health-status was poorer in rodents from core zone than those from buffer zone villages. Buffer zone rodents only had fleas while core zone rodents had mites, fleas and large endoparasites. *Toxoplasma gondii* and *Leptospira* spp. screenings are still under analysis. This study can assist other One Health approach studies and may allow health prediction and disease risk mapping in Mozambique.

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### **64 Mice in and around the city of Utrecht, The Netherlands, are carriers of *Clostridium difficile* but not ESBL-producing *Enterobacteriaceae*, *Salmonella* spp. or MRSA**

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Globally, the house mouse (*Mus musculus*) is the most widely spread mammal apart from man and is a commensal, benefiting from food and shelter available from humans and their kept animals. Mice in buildings are a hygiene hazard because they harbour several zoonoses and animals diseases. The aim of this study was to gather information on specific antibiotic-resistant bacteria in house mice caught in the urban environment. Mice caught in snap traps during pest control activities in and around the city of Utrecht, the Netherlands, during May – June 2014, October – November 2015 and September – November 2016 were collected for analysis. The gut contents were analysed for ESBL/AmpC-producing *Enterobacteriaceae*, *Salmonella* spp., and *Clostridium difficile* and the oral cavities were swabbed for methicillin resistant *Staphylococcus aureus* (MRSA). In total 109 house mice and 22 wood mice (*Apodemus sylvaticus*) were examined. ESBL-producing *Enterobacteriaceae*, *Salmonella* spp. and MRSA were not found. Of n = 80 mice, 35.0% carried *Clostridium difficile* (ribotypes in descending order of frequency: 014/020, 258, 002, 005, 013, 056, 081, and two unknown ribotypes). In conclusion, mice in and around the city of Utrecht are not important carriers of ESBL/AmpC-producing *Enterobacteriaceae*, *Salmonella* spp. or MRSA but their droppings are a hazard for transmission of *Clostridium difficile* to humans and the environment.

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### 65 Detection of *Rickettsia* pathogens in small rodents and their ectoparasites in Lithuania

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*Rickettsiae* are emerging pathogens causing public health problems in many countries around the world. The reservoir role of small rodents in rickettsiae life-cycles is still unclear and there are a lack of studies focusing on the investigation of rickettsial pathogens in rodents and their ectoparasites across Europe. We aimed to investigate the presence and prevalence of *Rickettsia* spp. in rodents and their ectoparasites (ticks, mites and fleas) in Lithuania. A total of 238 small rodents representing six species *Apodemus flavicollis*, *Myodes glareolus*, *Micromys minutus*, *Microtus oeconomus*, *Microtus agrestis* and *Microtus arvalis* were trapped during 2013–2014. Altogether, 1,261 ectoparasites (596 *Ixodes ricinus* ticks, 550 mites of five species and 115 fleas of eight species) were collected from these rodents. The overall prevalence of *Rickettsia* spp. in rodents was 27.6 %, with a higher prevalence detected in *Micromys minutus* (45.9%), followed by *Apodemus flavicollis* (32.8%), and *Myodes glareolus* (14.3%). *Rickettsia* DNA was detected in eleven species of ectoparasites. The highest infection rate was found in fleas (43.5%), followed by *Ixodes ricinus* ticks (MLE=26.5%) and then mites (MLE=9.3%). Sequence analysis of partial *gltA* and 17kDa genes revealed the presence of *Rickettsia helvetica* in rodents, while in rodents ectoparasites were detected *Rickettsia helvetica*, *Rickettsia felis*, *Rickettsia monacensis*, *Rickettsia* sp. and rickettsial endosymbionts. In rodents' fleas four *Rickettsia* spp. were identified, while in *Laelapidae* mites three *Rickettsia* spp. occurred in *Ixodes ricinus* ticks only *Rickettsia helvetica* was found. This is the first report of the occurrence and molecular characterization of *Rickettsia* spp. in rodents and their ectoparasites in Baltic countries.

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### 66 Detection of *Leptospira* and seasonal prevalence of fleas collected from rodents in Mukwe Constituency, Kavango-East Region of Namibia

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Biotic and abiotic factors can alter abundance and community composition of rodents and that of associated parasites. Aim of the study was to measure the impact of climatic variables (temperature/relative humidity) on rodent populations and on population dynamics of associated micro- and ecto-parasites. We monitored the prevalence and diversity of pathogenic *Leptospira*, the etiological agent of leptospirosis, and fleas, arthropod vectors of medical importance in mammals sampled over a period of 11 months in the Kavango East region of Namibia. In total, 121 small mammal hosts were examined for *Leptospira* infection through real time PCR, yielding an overall prevalence of 9.9%. However, only a single *Leptospira* species could be genotyped and identified as *Leptospira kirschneri* in one host species (*Saccostomus campestris*). Throughout the study period, almost all mammal species harboured the same flea species, which included *Cryptonella numae* (1.8%), *Pulex irritans* (43.0%), *Parodontis riggenbachi riggenbachi* (12.9%), *Synosternus caffer* (3.9%) and *Xenopsylla* species (38.3%). Using the Kruskal-Wallis test, the monthly population fluctuation of fleas varied significantly on *Mastomys natalensis* ( $\chi^2=29.440$ ,  $df=10$ ,  $P=0.001$ ), *Steatomys pratensis* ( $\chi^2=30.521$ ,  $df=10$ ,  $P=0.001$ ) and *Saccostomus campestris* ( $\chi^2=32.681$ ,  $df=10$ ,  $P=0.0001$ ). However, no significant difference in the number of fleas per month was found for *Gerbilliscus leucogaster* ( $\chi^2=10.831$ ,  $df=10$ ,  $P=0.371$ ). The Pearson correlation showed a weak positive trend between the abundance of fleas on small mammal hosts with temperature ( $r=0.3$ ,  $df=9$ ,  $N=11$ ,  $P=0.310$ ) as well as weak positive trend between flea abundance and relative humidity ( $r=0.6$ ,  $df=9$ ,  $N=11$ ,  $P=0.109$ ). Lastly, there was a very strong positive correlation ( $r=0.8$ ,  $df=9$ ,  $N=11$ ,  $P=0.0058$ ) between average abundance of small mammals and average abundance of fleas. Therefore, climatic variables (temperature and relative humidity) were found to have an influence on the abundance of small mammals and fleas. The impacts of seasonal patterns highlighted by this investigation on human health are discussed.

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### **67 Rodents from a rice milling station in Bangladesh infected with *Toxoplasma gondii***

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In order to complete its parasitic cycle of life, *Toxoplasma gondii* reproduces in feline animals as these are the protozoan's definite host. Because rodents are prey animals to cats, rodents contribute to the transmission and reproduction of *Toxoplasma gondii*. Not much is known or scientifically published about the occurrence of *Toxoplasma gondii* in Bangladesh. Therefore we tested rodents from a typical Bangladesh rice mill for *Toxoplasma gondii*. We found 2.9% of the rodents (n=34) to be positive for *Toxoplasma* DNA, which shows that rodents present in rice-production facilities could carry *Toxoplasma gondii*. To determine the prevalence of *Toxoplasma* in rodents from Bangladesh, we will carry out further research based on a larger sample size.

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### 68 Leptospirosis and toxoplasmosis in wild rodents in The Netherlands

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Because rodents are known to carry zoonotic pathogens, it is of the essence to be aware of the rodent-borne pathogens that are present. There is impaired knowledge on rodent-borne diseases in The Netherlands, which limits the opportunities for preventive measures and complicates the assessment of risk of transmission to humans. In order to increase the knowledge on rodent-borne pathogens, we selected *Leptospira* spp. and *Toxoplasma gondii* from a list of prioritized emerging pathogens relevant for The Netherlands. Leptospire have the ability to survive in moist environments, and can be transmitted to living organisms via contact with a contaminated water source. In total, 351 rodents were tested for leptospira, and 284 for *Toxoplasma gondii* presence. Rodents were trapped at food production sites; on pig farms and dairy farms in various regions of the country. We found 5.7% of the rodents (n=351) positive for *Leptospira* DNA, and none of the rodents tested positive for *Toxoplasma gondii* DNA. Our results show that rodents could be useful as an indicator for the environmental contamination and/or the contamination in wildlife for *Leptospira* spp.

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### 69 Leptospirosis in rodents in peri-urban Bangladesh

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*Leptospirosis* infections come to attention as an increasing global health problem. *Leptospirosis* is a re-emerging zoonosis of world-wide significance with south-east Asia as one of the most noteworthy epicentres. It is assumed that rodents are critical as host for a variety of leptospiral serovars. The south-east Asian country Bangladesh has humid climate which is perfect for the survival of *Leptospira*. Presence of rodents in this country could be a serious risk for human infection, especially in peri-urban areas on locations where food is stored. We carried out a study on rodents living in a rice mill in Bangladesh to gain more understanding of the multi-host epidemiology of *Leptospira*. Of the 221 rodents tested, 11.8% were infected with pathogenic *Leptospira*. To identify the *Leptospira* species we sequenced the results, indicating the presence of *Leptospira interrogans* and *Leptospira borgpetersenii*. Rodents of the *Bandicota* species (20/100) were significantly more likely to be infected than those of the *Rattus* class (3/87). These results endorse the prominence of rodents as hosts of pathogenic leptospires. Furthermore, the results show that human exposure to pathogenic *Leptospira* may be considerable. Our study stresses the necessity to improve rodent management and to further quantify the public health impacts of this neglected emerging zoonosis in Bangladesh.

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### **70 Detection of *Bartonella* spp. in red squirrel (*Sciurus vulgaris*) and their ectoparasites in Lithuania**

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*Bartonella* are vector-borne gram-negative bacteria causing blood-borne infections. Small mammals are reservoir hosts of *Bartonella* spp. and their ectoparasites such as fleas, ticks, sand flies, lice and mites are potential vectors. Rodents are one of the most important reservoirs for *Bartonella* pathogens. *Bartonella washoensis* was found in squirrels as the main reservoir and was isolated from human in the USA. The aim of this study was to investigate the presence of *Bartonella* infections in red squirrels and their ectoparasites using molecular tools in Lithuania. DNA from red squirrels was extracted by using a genomic DNA purification kit, according to the manufacturer's instructions. DNA from fleas and ticks was extracted by using 2.5% ammonium hydroxide. *Bartonella* DNA in samples was detected using a nested-PCR of the ITS region. Positive PCR products were selected for DNA sequencing. A total of 39 red squirrels victims of road traffic were found. Squirrels were found to be infested with *Ixodes ricinus* ticks (191) and *Ceratophyllus sciurorum* fleas (36). *Bartonella* spp. DNA was detected in 15 (38.5%) samples of squirrels, 2 (1.0%) sample of ticks and 20 (55.5%) samples of fleas. The ITS region sequences showed that *Bartonella washoensis* were detected in squirrels and their ectoparasites. The results of this study suggest that *Ceratophyllus sciurorum* fleas may be substantial vector for transmitting of *Bartonella washoensis* in red squirrels in Lithuania.

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### 71 Genetic diversity of *Bartonella* strains in small rodents

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*Bartonella* infections have been documented in a wide range of mammals and 15 *Bartonella* species have been detected in small rodents. Several rodent-associated *Bartonella* species have been related to human diseases. However, there is a lack of studies on the presence and diversity of *Bartonella* pathogens in small rodents in Baltic region. The objectives of this study were to investigate the prevalence and genetic diversity of *Bartonella* strains in different species of small rodents from Lithuania. We collected spleens from seven small rodent species captured in different parts of Lithuania during 2013-2016. The presence of *Bartonella* was examined by real-time PCR targeting the *ssrA* gene. Species identification and molecular characterization of bacteria strains were based on sequence analysis of two housekeeping genes (*rpoB*, *groEL*) and the intergenic species region. *Bartonella* DNA was detected with different prevalence in *Apodemus flavicollis*, *Micromys minutus*, *Myodes glareolus*, *Microtus oeconomus*, *Microtus agrestis* and *Microtus arvalis* rodents. Sequence analysis of *Bartonella* isolates showed that the *Bartonella* strains circulating among the investigated rodents are heterogenic and belonged to *Bartonella grahamii*, *Bartonella taylorii* and *Bartonella rochalimae* genogroup. Phylogenetic analysis based on each of the targets demonstrated the presence of different *Bartonella grahamii* and *Bartonella taylorii* strains associated with different species of rodents. This is the first report on molecular characterization of *Bartonella* strains in multiple rodent species from Baltic region. Our findings provide evidence of wide distribution of human pathogenic *Bartonella grahamii* in Lithuania.

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### **72 Resistance to last-resort human antimicrobial agents among gram-negative bacteria recovered from Barcelona Norway rats (*Rattus norvegicus*)**

**Marta Mari-Almirall<sup>1</sup>, Yaiza Vallejo<sup>1</sup>, Sara Sabaté<sup>2</sup>, Sandra Franco<sup>2</sup>, Laura Muñoz<sup>1</sup>, Maria Nieto<sup>1</sup>, Clara Cosgaya<sup>1</sup>, Jordi Pascual<sup>2</sup>, Ignasi Roca<sup>1</sup>, Tomás Montalvo<sup>2</sup>**

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Gram-negative pathogenic bacteria are shared between humans and animals but also the intra- and the inter-species exchange of genetic determinants of resistance are common between bacterial pathogens. Recent reports have identified multidrug-resistant bacteria from sewage samples in different parts of the world but there is no data regarding the potential role of urban rats as reservoirs and source of antimicrobial resistant bacteria that are relevant to human health. From January through November 2017, two hundred and twelve Norway rats (*Rattus norvegicus*) were captured with kill traps in different sections of the Barcelona sewers. Intra-rectal samples from captured animals were cultured on selective media for the isolation of ESBL and/or carbapenem resistant gram-negative bacteria. Species identification was performed by MALDI-TOF/MS and antimicrobial susceptibility was determined by disc diffusion, and Etest and microdilution when necessary, following EUCAST guidelines. Detection of genes encoding ESBL and carbapenemases was performed by PCR and Sanger sequencing. Pulsed-field gel electrophoresis was used to study the clonal relatedness of all isolates and MLST analysis was performed on selected isolates. Overall, 229 isolates were recovered and identified, in order of abundance, as either *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter* spp., *Raoultella ornithinolytica*, *Serratia* spp., *Citrobacter* spp., and *Pseudomonas* spp. Resistance to extended-spectrum cephalosporins was high among *Escherichia coli*, *Klebsiella pneumoniae* and *Enterobacter* spp (>50%) associated with carriage of ESBL. Resistance to carbapenems was identified in roughly 10% of the isolates, mostly associated with carriage of KPC and NDM carbapenemases. Isolates with the same mechanism of resistance were clonally related but overall there was high clonal diversity. Our results show alarming levels of antimicrobial resistance to clinically relevant antibiotics among gram-negative bacteria colonizing the intestinal tract of Barcelona rats. Additional studies to analyze transmission of resistance mechanisms and bacterial strains between humans and urban rats are ongoing.

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### 73 Evaluation of rodent control to fight Lassa fever through mathematical modelling

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The Natal multimammate mouse (*Mastomys natalensis*) is the reservoir host of Lassa virus, an arenavirus that causes Lassa haemorrhagic fever in humans in West Africa. Because there exists no vaccine for human use and therapeutic options are limited to the broad-spectrum antiviral ribavirin, rodent control and adjusting human behaviour are currently considered the only options for Lassa fever prevention. In order to investigate the efficiency of rodent control performed during a four-year field experiment in Upper Guinea, we developed a mathematical model to test different control strategies (yearly density control, continuous density control and rodent vaccination). For the field study, rodenticide baits were placed each year in three rural villages, while three other villages were used as controls. Rodents were trapped before and after every treatment and their antibody status and age were determined. Data from the field study was used to parameterize the mathematical model. In the field study, we found a significant negative effect on seroprevalence over the years in the treatment villages, but the effect (5% reduction per year) was small given the effort. As the populations also recovered rapidly after the rodenticide treatment, we conclude that a yearly control strategy is unlikely to significantly reduce Lassa virus spillover to humans. In agreement with this finding, the mathematical model supports the use of continuous density control and rodent vaccination to eliminate Lassa virus from the rodent population, but discourages the use of yearly density control. Our model can be used by policymakers as a first indication of how long, frequent and when rodent control should be done in order to eliminate Lassa virus in rural villages.

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### **74 Responses of rodent reservoirs of zoonotic diseases to anthropogenic land-use change: a meta-analysis**

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Rodents are important reservoirs for a large number of zoonotic pathogens. The replacement of native habitats by productive lands (e.g. agricultural crops and forestry plantations) can increase the abundance of rodent reservoirs, which can generate an increase risk of pathogen exposure to humans. In this study, we conducted a meta-analysis concerning the responses of rodents to land-use change, in order to assess the general effect of land-use change on abundance of rodent species in relation to their reservoir status for several pathogens. We collected data from the PREDICTS database and we grouped rodent species into three categories (reservoir, non-reservoir and future reservoir), according to a recently published reservoir status categorization of rodents species. We retrieved 58 case studies dealing with 54 rodent species from several geographical areas. Rodent reservoirs were significantly more abundant in areas with non-native vegetation compared to sites of native vegetation. On the other hand, non-reservoir species were more abundant in sites of native vegetation. Future reservoirs did not show a clear pattern regarding their response to habitat modification. To our knowledge, this is the first study that evaluates globally the effect of land-use change on rodents with implications for disease risks. Our findings are in agreement with the hypothesis that rodent reservoirs tend to respond differently to human disturbances than non-reservoir species. This study may help the assessment of potential risk of rodent-borne diseases when land-use change occurs.

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### **75 First bacteriological screening of Norway rats, *Rattus norvegicus*, in Barcelona (Spain)**

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The control of commensal Norway rat infestations by local authorities has been largely considered part of the public health protection. Norway rats carry several zoonotic pathogens and because rats and humans live in close proximity in urban environments, there is potential for transmission. Within this context the Agència de Salut Pública de Barcelona, in the framework of the rodent surveillance and control program carried out in the city, started, in 2016, a project that included a bacteriological study of Norway rats in the city of Barcelona. To identify some zoonotic bacteria agents carried by rats in Barcelona, from December 2016 to November 2017, we captured with kill traps 212 rats in different sections of sewer system. Samples from intestine and stool were analysed for *Listeria* spp., *Yersinia* spp., *Campylobacter* spp., *Salmonella* spp. and *Escherichia coli* resistant to beta-lactam acids, and kidney and bladder samples, for *Leptospira* spp. The results showed the following prevalences: *Listeria monocytogenes* (59%), *Yersinia enterocolitica* (18%), *Campylobacter jejuni* (7%), *Salmonella* spp (7%), *Escherichia coli* resistant to beta-lactam acids (71%) and *Leptospira* spp (12%). It should be noted the high prevalence of *Listeria monocytogenes* and *Escherichia coli* resistant to beta-lactam acids and with a moderate prevalence *Yersinia enterocolitica* and *Leptospira* spp. The risk of human exposure to these pathogens is a significant public health concern. Because these pathogens cause non-specific and often self-limiting symptoms in humans, infection in human populations is probably underdiagnosed. In conclusion, the results show that rodents could be a risk for the transmission of rat associated zoonoses in Barcelona.

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### 76 Education in health associated with gamification against leptospirosis

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Outbreaks of leptospirosis are reported in urban centers of several developing countries around the world. In Brazil, more than 12,000 cases of leptospirosis occur every year, mainly during urban epidemics, with the lethality of 12%. Most of these cases are related to low-income populations with precarious basic sanitation infrastructure, inadequate housing and high human concentration. Urban leptospirosis is the most prevalent in Brazil in recent decades. In the city of Salvador-Bahia/Brazil, new cases of leptospirosis happen annually in the peripheral districts during the rainy periods. The transmission occurs mainly in the domestic environment, where the soil-water interface is present, at regions prone to floods served by open-air sewers or with inadequate rainwater drainage. The level of the knowledge, attitudes and practices (KAP) of residents of these vulnerable areas can contribute to the identification of environmental factors favorable to rodents and of actions that can reduce the risk of contamination by *Leptospira*. Education in health practices associated with the gamification strategies (challenges, competition, performance feedback, collaborative work, rewards etc.) can motivate people to become aware of environmental risk factors with greater engagement and motivation. The objective of this study is to evaluate the KAP with young people and their families through the methodology of education and health associated with the strategy of gamification in two peripheral communities in Salvador. For this reason, workshops are being held in one public school and in two groups of young people and their families, using applications based on gamification.

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### **77 No role for rodents as alternative hosts for cutaneous leishmaniasis in S. Ethiopia**

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Cutaneous leishmaniasis (CL) is a disease caused by members of the trypanosomid parasite genus *Leishmania*. It is a zoonotic and vector borne infection with the pathogen being transmitted between hosts and from hosts to humans by phlebotomine flies. Females of these so-called sandflies feed on blood of mammals and when they ingest host macrophages infected with the amastigote stages of the parasite, the latter will develop into promastigotes that are then transmitted to another host at a next blood meal. The epidemiology and pathology of CL is complicated. In southern Ethiopia, the disease has a patchy distribution, linked to the ecological conditions that are important for the host and vector. *Hyraxes* (genera *Procavia* and *Heterohyrax*) are thought to be the major mammal host and consequently the disease is mostly found close to the rocky outcrops where these animals live. In some cases however, this is less clearly so and it has been suggested that rodents may be an alternative host, since they are known to be hosts for other species of *Leishmania* in other regions. We collected small mammals, mostly rodents, in Ochollo, a village with a high endemicity of CL in Arba Minch Zuria in the south of Ethiopia. Life traps yielded 138 rodents (8 species) and three shrews (1 species), captured near houses, in surrounding fields or near the places where hyraxes are living. Organ samples were taken and investigated for *Leishmania* DNA (kDNA real-time PCR, ITS1). kDNA was found in a single *Mus mahomet* but this was not confirmed in the ITS-1. On the other hand, of 25 hyraxes investigated, 5 were positive. So, while *Leishmania* was present in small mammals in the area, rodents do not seem to be an alternative host for this parasite.

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### **78 *Puumala hantavirus* dynamics in bank voles: identification of environmental correlates to predict human infection risk**

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The *Puumala orthohantavirus* (PUUV) is a zoonotic pathogen of high relevance for public health in Europe. The widely distributed and forest-living bank vole (*Myodes glareolus*) is the reservoir of PUUV. PUUV infections in humans lead to a mild to moderate form of hemorrhagic fever with renal syndrome, called nephropathia epidemica. Time series of beech fructification, host abundance and human PUUV infections were analysed to reveal general patterns of PUUV epidemiology in central Europe. Spatially and temporally replicated live-trapping and serological analyses were performed to reveal seasonal and multi-annual dynamics of PUUV prevalence within host populations in relation to abundance. Further, the influence of various weather parameters on vole abundance was determined by time series analyses to predict outbreak dynamics of bank voles. Relevant weather criteria were then extrapolated to future climate scenarios to evaluate possible long-term changes in host dynamics. Results show that human PUUV infections are highly correlated to rodent host abundance in the present year and to beech seed production in the previous year. Rodent host dynamics were related to multi-annual and seasonal fluctuations of PUUV within host populations. Weather-based models predict bank vole abundance and hence human PUUV infection risk several months in advance. The extrapolation of climatic determinants of bank vole abundance to future climate scenarios indicated an increase in bank vole population outbreak frequency in the future, which might further PUUV epidemics in central Europe.

The studies provide new knowledge about general patterns of PUUV epidemiology in central Europe. Climatic determinants promoting tree seed production as driver of rodent host populations but also fluctuations of PUUV prevalence within reservoir populations in relation to population outbreaks can facilitate the future development of prediction models for human PUUV infections in central Europe.

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### 79 Survey on zoonotic helminthiasis in Norway rats, *Rattus norvegicus*, from the city of Barcelona

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The parasitological analysis of synanthropic rodent populations in urban settings has shown the presence of various zoonotic helminths, with implications on public health. However, the scarcity of studies from cities around the world is surprising. As part of a multidisciplinary study undertaken in the city of Barcelona (relative abundance, population structure and dynamics; viral, bacterial as well as parasitic –protozoa and helminths–zoonoses; and anticoagulant resistance), the helminthological analysis of 100 *Rattus norvegicus* individuals captured in the sewage system (85) and in parks (15) was carried out. Of the 10 species found, 5 were zoonotic: *Hymenolepis nana* (17%), *Hymenolepis diminuta* (33%), *Calodium hepaticum* (17%), *Gongylonema neoplasticum* (20%) and *Moniliformis moniliformis* (6%). The influence of sex and age of the rat on the prevalence of the zoonotic species was analysed by means of binary logistic regression. Age had an influence on the prevalence of *Hymenolepis diminuta* ( $\chi^2=5.199$ ;  $P=0.023$ ), higher in adults (OR=3.04), and in the case of *Calodium hepaticum* ( $\chi^2=16.622$ ;  $P<0.0001$ ), lower in adults (OR=0.10). The present study is the first helminthological analysis carried out in *Rattus norvegicus* in an urban area in Spain. Moreover, the presence of *Gongylonema neoplasticum* and *Moniliformis moniliformis* as parasites of Norway rats is reported for the first time in an urban environment in Europe. The results show the importance of peridomestic rodents, especially the brown rat, in the transmission of helminth zoonoses, acting as spreaders of the infective stages (eggs) of *Hymenolepis nana* and indirectly of *Calodium hepaticum*, and as reservoir of the three other species detected. Further studies at an urban level are required to shed more light on the role of the Norway rat in the transmission of parasites to the human population. Also, health care professionals should be better informed about the impact of parasitic zoonoses related to these rodents.