

Parasitological Society of Southern Africa

The following are abstracts of posters and invited papers presented at the 28th Annual Scientific Meeting – *Parasitological Challenges 2000 and Beyond* – 27–29 September 2000, University of the Orange Free State, Bloemfontein, South Africa

Abstracts of Posters

Reproduction of scyphidiid peritrichs associated with South African molluscs

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Binary fission, pre-conjugation fission, conjugation, the development of telotrochs, and encystment all form part of the life cycles of species belonging to the order Sesselida Kahl, 1933. The reproduction of each species of peritrich is fine-tuned to its ecological niche. Much remains to be explained about peritrich reproduction, especially in regard to how elements of reproduction are tied to environmental conditions or changes. During March and April 2000 the reproductive processes of scyphidiid peritrichs associated with *Patella* Linnaeus, 1758, and *Haliotis* Linnaeus, 1758, species were studied at the De Hoop Nature Reserve on the south coast of South Africa. Results obtained from this fieldwork were combined with those from fieldwork carried out by the Aquatic Parasitology Research Group at various other localities along the South African coast. Scyphidiid peritrichs of the genus *Mantoscypidia* Jankowski, 1980, were studied with the aid of light microscopy, photographs were taken of live specimens' various reproductive processes, and live observations were consequently made for a few hours or until the peritrichs died. Specimens were also fixed in Bouins or 4 % GNF for scanning electron microscopy studies. Conjugation was mostly observed in mantoscypidians occurring on the gills of *Patella*, while most mantoscypidians occurring on haliotids were observed in the process of binary fission.

Case study: isolation and treatment of *Isoospora felis* in a stray kitten

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A stray kitten, adopted by a family resident in Pretoria North, developed acute diarrhoea. The kitten was presented to Pretoria North Animal Clinic in December 1999. Despite treatment that included various antibiotic regimens, rehydration therapy and deworming, the diarrhoea persisted. Other symptoms included dehydration and weight loss. A faecal sample was submitted to the Parasitology Division, Onderstepoort Veterinary Institute, in January 2000 and *Isoospora felis* was isolated. The kitten was treated with a single dose of clazuril at 5 mg/kg body mass. The diarrhoea subsided gradually over 48 hours. Another faecal sample was taken 5 days post-treatment and no *Isoospora felis* was isolated.

Comparison of three different methods for detection of eggs of *Stilesia hepatica* in sheep

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Diagnosis of *Stilesia hepatica* by means of faecal egg counts in the live animal has always been difficult. Three methods, namely conventional McMaster; a method described by Schröder and Van Amelsfoort (1988, SAVA Congress), and an amended method described by Calitz were compared for efficacy. Twenty sheep were used in the 1st phase of the trial: the conventional method described by Schröder and Van Amelsfoort was performed on faecal samples taken from the sheep. The sheep were then slaughtered and the

worm burdens classified from 1 to 5 according to the severity of the infection. Results from the methods used to detect the eggs in the faecal samples were then compared to the worm burdens. In the 2nd phase of the trial all 3 methods were compared in 15 sheep in exactly the same way as has been described for the 1st phase. It became clear that the diagnosis of *Stilesia hepatica* remains difficult. As in the case of roundworms, there is no correlation between faecal worm egg counts and parasite burdens. The main advantage of the method described by Calitz is that smaller quantities of faeces (3 g) are needed and therefore qualitative diagnosis in the individual animal is more feasible than in the method described by Schröder and van Amelsfoort, where 60 g of faeces are required. There is also no correlation among the 3 methods described.

Survey of intestinal parasites in African children from 8 primary schools in the Gauteng and North West Provinces, South Africa

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Intestinal parasite surveys were performed between April 1996 and October 1998 on 449 African children, between the ages of 9 and 16, at 8 primary schools in Gauteng and North West Provinces. The aim of the study was to determine the prevalence of intestinal parasites in schoolchildren in everyday good health. Stool samples were concentrated with the formalin-ether sedimentation technique and smears were stained with a modified acid-fast stain. Intestinal parasites were found in 249 (55.5 %) of the 449 samples tested. In total, 16 parasite species were recovered from the 249 positive children, 7 of whom had mixed parasite infections with 2 or more pathogenic species. *Giardia lamblia* was found in 8.2 % of the 449 children tested and was the most prevalent pathogenic parasite, followed by *Ascaris lumbricoides*, then *Hymenolepis nana*. *Entamoeba coli* was found in 34 % of the children and was the most prevalent non-pathogen. The rates of infection followed socioeconomic status, as might be expected, with the highest infection rate in schoolchildren from an informal settlement. More parasite surveys need to be performed throughout South Africa, so that accurate assessments of parasite burdens can be obtained and mapped. This will aid in the control of parasitic infections and provide valuable information for further research and management strategies.

Pilot survey of nematophagous fungi from agricultural environments

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Pastures are contaminated by various species of infective nematode larvae that are ingested by domestic livestock during grazing. The nematophagous fungus, *Duddingtonia flagrans*, has been shown to be effective in reducing pasture contamination by the infective larvae of cyathostomes, *Ostertagia ostertagi* and *Haemonchus contortus*. The resistance of *H. contortus* to anthelmintics in South Africa necessitates the formulation of alternative strategies for control. Among these is the possibility of isolating a local strain of *D. flagrans* and testing it for efficacy in the reduction of pasture contamination by the 3rd-stage larvae of *H. contortus*. The aim of the study was to isolate nematophagous fungi from selected agricultural sources within 200 km of Onderstepoort, South Africa. The modified sprinkling technique was used for the initial isolation on 2 % water agar containing 0.02 % tetracycline hydrochloride to

suppress bacterial growth, followed by purification and maintenance on 1:10 corn meal agar. The survey yielded 11 isolates of nematophagous fungi from 178 samples of soil, faeces from livestock, compost and aqueous suspensions of 3rd-stage *H. contortus* larvae. The lessons learnt during the initial phase are being applied to the main project which is in progress. In a survey conducted in Australia, 16 isolates of *D. flagrans* were obtained from 1742 samples. It would seem that a sample size in the region of 1000 will be required before we can realistically expect to isolate a local strain of *D. flagrans*.

Functional micromorphology of the chicken head louse *Cuclotogaster heterographus*

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Infestations of chewing chicken head lice result in weight loss and decreased egg production in adult birds, while heavy infestations in young chickens may be fatal, seriously affecting chicken production particularly in resource-poor communities. This SEM study investigated the micromorphology of these lice to understand how they attach to, orientate and feed on their hosts. The lice were collected from infested fowls and fixed in 70 % ethanol. After ultrasonic cleaning, they were prepared for SEM, and viewed in a Leica Stereoscan 420 SEM at 5 to 10 kV. The mouthparts included the robust mandibles, which may fold medially over a group of barbules to attach the louse securely to the feather. A pair of maxillary palps and shorter medial labial palps lie just posterior to the mandibles, and each bears a number of terminal peg-like sensory setae. Each leg has 2 tarsal claws. The larger curved claw closes between 3 opposing pretarsal sclerites to firmly grasp the barbules of the feather. These unique pretarsal sclerites are distally elongated, each with a terminal conical seta. The 2nd slightly curved horn-like claw was not observed to close against the pretarsal sclerites but remains open at an angle to the large claw. This study confirmed the sexual dimorphism of the 5-segmented antennae. Three specialised sensoria were observed on the antennae. These chemosensory sensoria enable the eyeless lice to orientate on their host. With more than 12 species of lice infesting domestic chickens, it was hoped that this SEM study would identify some morpho-taxonomical characteristics whereby *C. heterographus* may be more easily identified.

Parasites found on the blacktail, *Diplodus sargus capensis*, from the south and east coasts of South Africa

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The blacktail, *Diplodus sargus capensis*, is primarily an inshore species, favouring turbulent seas and rocky shores. It moves in and out of this zone with the tides, and it also often occurs in small shoals over the edges of deeper reefs and around offshore pinnacles. During field trips to the south coast of South Africa at De Hoop Nature Reserve and east coast at Bazley, numerous specimens of *D. sargus capensis* were collected and examined for parasites. Collection methods included the use of hand lines and fishing rods. After collection the fishes were taken to a fully equipped field laboratory where every specimen was thoroughly examined for different groups of parasites occurring in and on the host. All parasites found were removed and fixed according to standard methods for that specific group. *Diplodus sargus capensis* is infected by a wide variety of parasites. These include a tongue replacement isopod, *Cerathotoa imbricata*, and a monogenean, *Polyplabrus diplodii*, from the gills. A few copepods of the family Lernaepodidae were found attached to the gill arches. The gallbladder was infected with myxosporeans of the genus *Myxidium*, and adult aspidogastrea trematodes were found in the intestine.

The effect of egg parasitism by an *Amira* sp. (Hymenoptera: Encyrtidae) on the population size of *Peuceetia striata* (Araneae: Oxyopidae) in the Free State

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Parasitism of spiders and their egg sacs by insects is limited to a few specialist families, i.e. the Mantispidae (Neuroptera), Acroceridae (Diptera), and some Ichneumonidae, Scelionidae, Pteromalidae and Encyrtidae species (all Hymenoptera). In this study 20 egg sacs of *Peuceetia striata* Karsch, 1878 (Araneae: Oxyopidae), were collected from *Melolobium candicans* bushes in grassland and the number of egg sacs infested by *Amira* sp. (Hymenoptera: Encyrtidae), parasitised and unparasitised eggs, spiderlings, and adult parasitoids in the egg sacs, was determined. Infested spider eggs, wasp pupae and adults are illustrated with SEM photographs. Egg parasitism by the wasps apparently did not have a significant effect on the population size and reproductive potential of the spiders. The spiders used mechanisms to reduce parasitism by the wasps, namely parental care and camouflage.

Lamproglena sp. (Copepoda: Cyclopoida) from the largescale yellowfish (*Barbus marequensis*) and the smallscale yellowfish (*Barbus polylepis*) from Mpumalanga, South Africa

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The genus *Lamproglena* was established in 1832 by Alexander von Nordmann and comprises 37 nominate species with a cosmopolitan distribution. Of the 37 species, 13 have been reported from Africa with 4 (*L. monodi* Capart, 1944; *L. clariae* Fryer, 1956; *L. barbicola* Fryer, 1961; and *L. cornuta* Fryer, 1964) recorded from southern Africa. *Lamproglena* specimens were collected from the gill filaments of *Barbus marequensis* A. Smith, 1841, and *Barbus polylepis* Boulenger, 1907. Specimens were fixed and preserved in 70 % ethanol. In the laboratory they were studied using the wooden slide technique. Before dissection copepods were stained and cleared in lactic acid in which lignin pink was dissolved. Conventional methods were used for scanning electron microscopy. *Lamproglena* sp. shows typical morphological characteristics of the genus *Lamproglena* but differs from the 2 species recorded from *Barbus* hosts (i.e. *L. jordani* and *L. barbicola*) by the following: the 3 thoracic segments are partly fused in *L. jordani*, whereas those of *Lamproglena* sp. are distinctly separated by constrictions, the abdomen of *L. jordani* is 2-segmented while that of *Lamproglena* sp. is indistinctly 3-segmented, and the segmentation and chaetotaxy of the 2nd antenna of the last 2 species differ. *Lamproglena* sp. appears very similar to *L. barbicola* but the latter is almost 2 mm longer overall, with distinct differences in segmentation of the leg-bearing segments and the abdomen as well as segmentation and chaetotaxy of the 1st and 2nd antennae. *Lamproglena* sp. shows considerable similarity in general appearance to *L. litchia*, which is apparently the only marine species within the otherwise freshwater genus *Lamproglena*.

Identification of rickettsia-like organisms in ticks (Acari: Ixodidae) in South Africa

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Rickettsiae of the spotted fever group (SFG) are maintained in ticks and their mammalian hosts. *Rhipicephalus sanguineus* is recognised as the major vector of *Rickettsia conorii* in Europe. Previous studies on southern African ticks have shown that various species are infected

with rickettsia-like organisms (RLOs), mainly *Amblyomma hebraeum* (72 %), *A. sparsum* (33 %), *A. variegatum* (17 %), *Hyalomma marginatum rufipes* (11 %), *R. simus* (11 %), *Haemaphysalis leachi* (6 %), *A. rhinocerotis* (5 %) and *H. truncatum* (5 %). Hard-bodied ticks were collected from domestic and wild animals in the Free State, Northern Cape, Eastern Cape and KwaZulu-Natal Provinces of South Africa. The prevalence of RLOs in ticks was determined by using haemolymph testing. Polymerase chain reaction restriction fragment length polymorphisms (PCR-RFLPs) were used to characterise the RLOs in the ticks. Various tick species were found to be infected with RLOs. No RLOs could, however, be demonstrated in *R. sanguineus* (0/331). This study indicates that in South Africa RLOs may be found in a large number of tick species, many of which have not previously been described as being infected with these organisms in Africa.

Geometric morphometric analysis of the male and female body shapes of *Hyalomma truncatum* and *H. marginatum rufipes*

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The conventional method for identifying the 2 *Hyalomma* species is based on morphological characteristics, shape of the scutum, depth of cervical field, number of punctations on the scutum and the number of setae around the circumference of the spiracles. These characteristics are relative. Geometric morphometric analysis is a powerful statistical technique that can be used to successfully identify phenetic relationships between taxa and could be an additional tool for taxonomists. Geometric morphometrics were used to compare the body shape of males and females of the 2 *Hyalomma* species by identifying and analysing 16 landmarks on the dorsal aspect of the specimens. Relative warp analysis was performed on the data set and the results of the first 2 relative warps plotted against each other. Thin-plate-spline analysis was also performed on the consensus shape of the males and females. The results, based purely on body shape, indicate that we might be dealing with 2 subspecies, with speciation still in progress. Although geometric morphometric analysis is a useful tool, especially where cladistic data are particularly homoplastic, it must not be used as the only basis for hypotheses of natural relationships.

Some parasites of the butter barbel, *Schilbe intermedius* Rüppell, 1832, from the Okavango Delta, Botswana

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The silver catfish, *Schilbe intermedius* Rüppell, 1832, is widely distributed throughout southern Africa and is found mostly in shoals, usually in standing or slow-flowing open water with emergent or submerged vegetation. These smooth skinned, elongated fish may reach 160 mm in length and have sharp, finely serrated spines on the dorsal and pectoral fins. This is a very important subsistence species and is occasionally kept in aquariums. During 2 extensive fieldtrips in 1998 and 1999 to the Okavango River system in Botswana, 70 specimens of *S. intermedius* were examined for the presence of both gill and blood parasites. Specimens of *S. intermedius* were collected using a series of gill nets. The live fish were taken to a field laboratory where they were kept alive in aerated aquaria and subsequently examined for parasite infections. All parasites collected were fixed according to the standard methods for each specific group. It was found that the gills of these fish were infected with monogeneans of the genus *Schilbetrema*, myxosporeans of the genus *Henneguya* and a trichodinid species. Furthermore, a trypanosome was found parasitising the blood of this fish species.

An ecological complex of parasitic fungi associated with *Drosophila* spp. that utilize *Opuntia ficus-indica*

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Cactus pear (*Opuntia ficus-indica*) is an important alternative crop in the semi-arid regions of southern Africa upon which numerous insects and diseases have recently become problematic. Dipterous species, such as vinegar flies (*Drosophilidae*), are known vectors of fungal pathogens and the objective of this study was to investigate *Drosophila melanogaster* and *D. hydei* in this regard. Specimens ($n = 100$) of each species were individually captured on *O. ficus indica* plants on the University of the Orange Free State campus and placed in Eppendorf tubes to prevent cross-contamination. They were then placed on potato-dextrose agar (PDA) in Petri plates which were incubated at 25 °C until mycelium became visible. At least 10 genera of mycelial fungi were identified of which *Mucor* spp. (43.2 %; 32.2 %) and *Fusarium* spp. (16.1 %; 7.7 %) were most prominent from *D. melanogaster* and *D. hydei*, respectively. Yeasts represented 22 % and 21.4 % of isolations from *D. melanogaster* and *D. hydei*, respectively. *Paecilomyces*, an entomogenous fungus, was isolated from *D. hydei* (2.9 %) and its possible use as a bio-control agent of *Drosophila* spp. is discussed. Other unidentified fungal species isolated from *D. melanogaster* and *D. hydei* represented 18.7 % and 35.8 %, respectively. Pathogenicity tests on mature *O. ficus-indica* cladodes were positive for several of the fungal genera. As far as we could ascertain, this is the only study of *Drosophila* spp. as a vector of fungal parasites of *O. ficus-indica*.

Efficacy of an Amitraz/Cypermethrin pour-on against *Sarcoptes scabiei* var. *suus*

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Pigs with a natural infestations of *Sarcoptes scabiei* var. *suus* were treated with a pour-on formulation containing amitraz 1 % m/v, cypermethrin 1 % m/v and piperonyl butoxide 5 % m/v to establish its efficacy. The pigs were ranked in the descending order of pre-treatment (Day 1) mite infestations. Pigs with the highest infestations were blocked into replicates and then within each replicate were allocated at random to groups so that each group consisted of 6 pigs. The ranking and allocation method ensured that both mildly and heavily infested pigs were evenly distributed among both the treated and untreated control groups. Animals in the untreated control group were not treated with a placebo. Pigs in the treated group were treated with the pour-on at an application rate of 2.5 ml/5 kg body mass 3 times at Day 0, Day 7 and Day 14. The remedy was applied along the dorsal midline of the pigs, starting from the poll and continuing to the base of the tail. Each inner ear was also treated with 10 % of the total dose. Skin scrapings and clinical examinations were conducted weekly to Day 49 (Week 7). No live mites were found in any of the post-treatment skin scrapings from the treated pigs, while the untreated control animals maintained their infestation throughout the trial period.

Period of protection provided by Ivermectin and Doramectin to *Sarcoptes scabiei* var. *suus*

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In order to determine the period of protection provided by ivermectin and doramectin to pigs artificially infested with a field strain of *Sarcoptes scabiei* var. *suus*, Twenty-two mite-free pigs were ranked according to body mass and allocated at random to 3 groups. The untreated control group and the treatment groups consisted of 8 animals each. The groups were again ranked into subgroups of 2 animals each. The 2 treatment groups were treated on Day 0

with either ivermectin at a dose rate of 300 µg/kg body mass by intramuscular injection or doramectin at a dose rate of 300 µg/kg body mass by intramuscular injection. The pigs were artificially infested with *Sarcoptes scabiei* on Days 7, 14, 21 and 28. The mites were placed into both ears of pigs allocated for infestation. Immediately after insertion of the mites, the ears were taped closed with porous adhesive plaster for approximately 24 hours. Mange lesions and mite counts were performed 14 and 21 days after each infestation, except for the 1st subgroup of each of the 3 groups, which were evaluated only after 21 days. The study indicated that ivermectin provided a minimum of 14 days and a maximum of 20 days protection against artificial infestations of *Sarcoptes scabiei*, while doramectin provided a minimum of 7 days' and a maximum of 13 days' protection. The artificial infestations of *Sarcoptes scabiei* in the untreated control pigs indicated that the climatic conditions did not hinder the infestations and that the infestation procedure was reliable.

Single vs two treatments of Ivermectin against *Psoroptes communis ovis*

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Mite-infested sheep were ranked according to pre-treatment percentage body coverage of scab tissue and were allocated at random to groups consisting of 6 animals each. One group was treated twice with a 7-day interval, injected subcutaneously in the groin area with ivermectin at a dose rate of 200 µg/kg body mass, while the other group was treated only once in exactly the same way as the 1st group. Apart from the untreated control group, another group of 6 animals was treated with doramectin at a dose rate of 300 µg/kg body mass by subcutaneous injection in the groin area. Mite assessments were conducted up to Day 42. Mites were found on some of the animals in both the ivermectin and doramectin treatment groups during the Day 7 examination. No mites were found on any animals in any of the treatment groups during subsequent examinations on Days 14, 21 and 42. Although a few new green lesions were detected in some of the animals that were only treated once with ivermectin, no significant differences in lesion healing were noticeable between the different treatments during the Days 21 and 42 examinations. By contrast, 4 of the untreated control animals had to be removed from the study on Day 21 because the scab lesions and mite numbers had increased to such an extent that the health of the animals was adversely affected. Single and paired treatments, with a 7-day interval, of ivermectin at a dose rate of 200 µg/kg body mass, were 100 % effective in the therapeutic control of an artificial infestation of *P. c. ovis* in sheep.

Efficacy of an Amitraz drug delivery system against adult *Haemaphysalis leachi* on dogs

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A 9 % m/m amitraz drug delivery system was evaluated for efficacy on dogs artificially infested with a laboratory-bred South African strain of *Haemaphysalis leachi*. The animals were artificially infested with 20 ticks from Week 1 and weekly thereafter; after each tick count. Tick counts were conducted weekly. The amitraz drug delivery system had a knockdown effect of 55 % after 2 days and increased to 85 % after 7 days. A residual effect of more than 90 % was evident from Week 2 to Week 22 and more than 80 % up to Week 24.

Dangers from the deep – fact or fiction, we investigate

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Fish parasites were collected from *Clarias gariepinus*, *Labeo capensis*, *Labeo umbratus*, *Barbus kimberleyensis*, *Barbus aeneus*, *Cyprinus carpio*

and *Micropterus salmoides* at Vaal Dam and Vaal Barrage. Fish were examined for parasites, which were removed and preserved. Blood and slime smears were scanned for parasites. Gills and intestines were examined for parasites. A *Trypanasoma* sp. was observed in the blood of *Clarias gariepinus*, which correlated with the presence of leeches collected from the body surface, presumably a representative of the genus *Bathrocopdella*. Various cestodes were collected internally from *Labeo umbratus*, *Micropterus salmoides*, *Clarias gariepinus*, *Barbus kimberleyensis* and *Barbus aeneus*. Adult *Rhabdochona esseniae* (Nematoda) were collected from the intestines of *Clarias gariepinus*, *Barbus kimberleyensis* and *Labeo umbratus*, with *Paracmallanus cyathopharynx* (Nematoda) also collected from the intestines of *Clarias gariepinus*. Larval nematodes of the genus *Contracaecum* sp. were collected in the body cavity of *Clarias gariepinus* and *Barbus kimberleyensis*. *Lamproglana clariae* (Arthropoda) were collected from the gills of *Clarias gariepinus* and *Argulus japonicus* (Arthropoda) from the body surface of *Clarias gariepinus*, *Labeo capensis*, *Labeo umbratus*, *Barbus kimberleyensis*, *Barbus aeneus* and *Cyprinus carpio*. The greatest diversity of parasites was observed on *Clarias gariepinus*, possibly because it is a scavenger species. *Barbus* spp. provided the largest diversity of intestinal parasites.

Guest and invited speakers

Malaria in South Africa and a developing regional approach to the problem

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South Africa is not exempt from the potential ravages of malaria with its debilitating effects on communities and development. Malaria transmission follows a distinctly seasonal pattern, and experiences marked inter-annual fluctuations leading to periodic epidemics. The potential distribution of the disease, based on historical data, extends well into South Africa. Malaria became a notifiable disease in 1958 and notifications have been captured with varying degrees of completeness since. Marked changes in the epidemiology of malaria in the mid-1980s, largely due to the spread of chloroquine resistance, emphasised the need for good-quality incidence data. This led to increased research funding into computerised malaria information systems. The importance of the spatial aspects of malaria and the potential of geographical information systems (GIS) in analysing the distribution of the disease was also realised, and this added further impetus. The first district level maps of malaria were published in 1996. Increased collaboration between malaria control authorities and malaria research at both National and Provincial level is ongoing, towards further development of a national and regional malaria information system. National malaria case numbers over the last 30 years follow a distinct long-term exponential upward trend. Drug resistance surely seems to be the overriding factor driving the great increase in malaria incidence since the 1980s. However, the situation is almost certainly aggravated by a range of factors.

- Population migration from uncontrolled malaria areas, in particular southern Mozambique.
- High rainfall in the malaria areas.
- Insecticide resistance in *Anopheles funestus*.
- Drug resistance by the malaria parasite *Plasmodium falciparum*.

The implications of these factors for effective malaria control and measures being put in place to combat the problem will be discussed.

Insecticide resistance in malaria vector mosquitoes and implications for malaria control

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An effective malaria control programme incorporates case management, treatment with appropriate drugs and an efficient

mosquito control operation. Traditionally, house spraying with residual insecticides, mainly DDT, has been the strategy employed for vector control. More recently, pyrethroid insecticides have replaced DDT in many areas, including the malarious provinces of South Africa. Insecticide-treated bed nets are an alternative means of vector control and are popular in many African countries. Insecticide resistance to dieldrin and DDT in malaria vector mosquitoes was first detected in the late 1950s. Today, *Anopheles gambiae* in West Africa and Kenya and *Anopheles funestus* in South Africa and Mozambique, are resistant to pyrethroids. The implications of this resistance for the use of bed nets and house-spraying are discussed.

Malaria prophylaxis in non-immune travellers – 2000

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As most people are aware, malaria, once thought to be under control, is on the rampage, with 300–500 million people contracting the disease annually, and as many as 3 million deaths every year, the vast majority of which are children under the age of 5 years, living in sub-Saharan Africa. For travellers, this disease poses a significant risk, as they have no immunity and prevention is becoming a challenging clinical and public health problem owing to widespread development of drug-resistant strains of malaria and an increase in travel to exotic locales, many of which are high-risk malaria areas. Ignorance is a significant cause of the problem, and the lack of access to information on prophylaxis makes it difficult to change this problem. In South Africa, the Department of Health publishes guidelines on prophylaxis with guidance and input from the Malaria Advisory Group's subcommittee on chemoprophylaxis and therapy (SCAT). These recommendations need to be updated regularly and made known to all people giving advice on malaria prophylaxis.

Topics discussed in this presentation include:

- The importance of measures taken to protect against mosquito bites, and the reason behind them.
- Assessing the risk of acquiring malaria, looking at factors such as location, accommodation and season.
- The merits and disadvantages of the recommended drug regimes, particularly taking patient factors into consideration.
- Dispelling the myth of prophylaxis masking the symptoms.
- Regimes not recommended.
- New drug options on the horizon.
- Factors increasing success of preventative measures including compliance.
- The urgency of seeking medical attention if symptoms occur, as no prophylaxis is 100 % effective.

Management of malaria

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Malaria is the world's most important parasitic infection. The disease affects an increasing number of non-immune travellers to tropical areas and people resident in endemic areas, where the major impact, in terms of morbidity and mortality, is in children. *Plasmodium falciparum* is responsible for more than 95 % of cases in southern Africa. Malaria most commonly presents with fever, headache and rigours. The clinical signs and symptoms may mimic many other diseases including influenza, typhoid, hepatitis, meningitis and septicæmia. Malaria should be suspected in anyone with these symptoms who has travelled to a known malaria area, and the diagnosis should be confirmed or excluded by looking for the parasite in the peripheral blood. Repeated blood smears may be required. The diagnosis and management of malaria is an emergency. Chemotherapy of malaria depends on the severity of the infection, the patient's age, the degree of background immunity (if any), the likely pattern of susceptibility to antimalarial drugs, and the cost and availability of suitable agents. Widespread chloroquine resistance by *Plasmodium falciparum* leading to treatment failure is well documented in Asia, South America and Africa. Sulphadoxine –

pyrimethamine is an alternative for uncomplicated malaria in many parts of Africa but rapid development of resistance is of concern and has emerged in northern KwaZulu-Natal. Quinine is the mainstay of treatment of severe malaria in Africa. Multidrug-resistant malaria has emerged in areas of South East Asia, and mefloquine and an artemisinin are used in combination. The artemisinin derivatives (qinghaosu) are the most rapid-acting of all antimalarial agents, as well as having an effect on decreasing transmission of disease. Artemether is as effective as quinine for severe malaria, with a trend toward greater effectiveness of artemether in areas where there is quinine resistance. Development of new, affordable and effective antimalarials is limited. Atovaquone-proguanil, pyronaridine, benflumetol and chlorproguanil-dapsone are being evaluated. An infection with *P. falciparum* may progress rapidly to a multisystem disease. The clinical manifestations depend on age, and the presence or absence of immunity. Hypoglycaemia, impaired consciousness and convulsions, severe anaemia, and respiratory distress due to lactic acidosis are common in young children. Renal failure, hypoglycaemia, cerebral malaria, and pulmonary pathology are important complications in non-immune adults. Many ancillary treatments have been tried in severe malaria but none have been shown to unequivocally affect outcome.

Why ticks suck! Practical and physiological issues discussed

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Ticks lead double lives. On the host, they act as a parasite, sucking blood and secreting saliva that may cause paralysis or can contain a pathogen. While off the host they 'suck' water vapour from the air to maintain hydration, which greatly extends their survivability while waiting for a host. During feeding, ticks must rid themselves of excess water. They have just the opposite problem off the host. The subject of this presentation is the remarkable adaptability of ticks in these 2 settings with emphasis on the amazing salivary glands. I discuss osmoregulatory functions and how these glands facilitate feeding. Secreted salts facilitate water vapour uptake and provide an avenue for storage excretion off the host. While feeding, salivary components impact on vasodilation of capillaries around the bite site, they keep platelets from aggregating, they block coagulation at several points in the clotting process, among other things. So how may our understanding of these important physiological functions provide us with some way to control ticks in these 2 very different places on and off the host? There are many questions and possibly a few answers about these incredible parasites that attack humans and their domestic animals.

The helminth parasites of African freshwater fishes, challenges for 2000 and beyond

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The first paper on the helminth parasites of African freshwater fishes appeared in 1861. Since then, more than 450 publications have appeared on the subject, reporting more than 580 adult helminth parasites as well as several larval forms from 370 different species of fish. Much of the information contained in these publications is concerned with the morphology and systematics of the parasites encountered. It is, therefore, fitting that in the new millennium attention should be focused on the applied and practical aspects of parasitism. The future exploitation of fish populations is dependent on the effect of parasites and their control. Studies on the ecology and life cycles of parasites contribute tremendously to planning strategies for their control. Disruption of the life cycle by prevention of contamination of waters by snails and other organisms or by bird faeces reduces infections. Fry, the most susceptible stage, become infected early when copepods form a significant component of their diet. Filtration can remove plankton in tanks and hatcheries in intensive fish farming, but is not applicable in natural waters. At the moment, there are a few parasites that have been introduced to

African freshwater fishes, some with serious consequences. The ecology of introduction should be thoroughly studied, particularly in fish farming, fishery management and stocking. The increased extent and speed of importation of fish for the restaurant trade or for the ornamental fish trade should be examined and assessed. The influence of dams and man-made lakes on parasitism should be studied as the variations in the abundance of hosts also influence the composition and the abundance of parasites. Helminth parasites not only affect the organs they infect, but they also induce gross pathological changes on their fish hosts. The changes affect growth rates of fishes and reduce their reproductive capacity. Blood parameters, enzyme activities and liver functions are also affected. In some cases, infections are associated with cellular and humoral immune responses. Research in this field of immunology should be undertaken with the potential for production of vaccines against certain specific parasites, particularly in fish farming.

Juvenile hormones in ixodid ticks – real or desired perspective?

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Modern progress in insect pest control (discovery of 'insecticides of the third generation' represented by synthetic analogues of insect developmental hormones) has been aided mainly by investigations in the field of insect endocrinology. Unfortunately, there is a paucity of information on the endocrinology of chelicerate arthropods, and particularly of ixodid ticks. These harmful pests of medical and veterinary importance are similar to insects with regard to ecdysteroid hormones that initiate the moulting processes. The situation with regard to juvenile hormones (JH) as *status quo* factors in insect development, however, is quite controversial in ticks. The actual presence and operation of JH in ticks is questioned and even neglected in some recent JH studies, although the presence of JH has been discovered in ticks by analytical methods. Some encouraging perspectives for studies on the endocrinological aspects of ixodid tick development have emerged during investigations on reparative regeneration of their limbs and sensory organs. An analysis of regenerative changes in Haller's sensory organ of the South African tick *Ixodes rubicundus* has permitted the formulation of a hypothesis that morphogenetic processes during regeneration depend on the JH content in accordance with the role of JH as *status quo* factors. This hypothesis was confirmed by special experiments on the effect of the insect JH analogue methoprene and JH antagonist precocene on the regeneration of Haller's organ in nymphal and adult *Ixodes ricinus*. The results provided convincing although unique evidence for the participation of compounds, corresponding to insect JH, in the control of tick development. It also illustrated the similarity of ixodid ticks to insects and other arthropods in this aspect of endocrinology. Further investigations are necessary to elucidate the role of JH role in tick development and reproduction.

The epidemiology and control of sheep scab within the European Union

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Ovine psoroptic mange (sheep scab), caused by the mite *Psoroptes ovis*, has been the scourge of all the sheep-rearing countries of the world, and is almost always the focus of expensive, mostly government-run control programmes. Since the Second World War a number of countries have managed to totally eradicate *P. ovis* from their sheep flocks (Australia, Canada, New Zealand and the USA). Other countries have either failed to eradicate or only achieved temporary eradication, with the disease returning at a later date. Today scab remains a serious problem in South America, North and South Africa, Europe, the Middle East and Central Asia. It can be assumed that scab was introduced into the former European colonies with the first consignments of sheep shipped in to support the growing colonies. The European Union does not currently consider

scab to be an important disease and attitudes to the disease within the member states vary, particularly regarding legislation and control requirements. This paper outlines the current parasitological factors concerning the control of sheep scab within the member states of the EU (e.g. current control methods, mite biology and the development of acaricide resistance) and how these factors have contributed to the difficulties in eradicating the disease. Particular emphasis will be paid to the problems faced by the major European sheep producers: i.e. the United Kingdom, Spain, France and the Republic of Ireland.

Current recommendations for acaricide use to control *Boophilus microplus*: where is the evidence?

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Cattle tick (*Boophilus microplus*) infestation has been a focus of activity for government veterinarians and stock inspectors and a source of loss to cattle farmers in Australia since the middle of the nineteenth century. Although there is a venerable history of research and development, containment and eradication have been the aspects of government involvement most visible to cattle producers. As a result of many years of emphasis on rigorous containment and eradication, some beliefs have drifted untested into the realm of axiom. The purpose of this paper is to examine the conventional control recommendations for cattle tick in the light of current knowledge and practices. Farmers have been advised to treat all animals on the same day, using plunge dips or spray races, charged with acaricides made up to full strength, according to a strategic regime of 3-weekly applications in spring to ensure that few or no ticks survive to reproduce in summer and autumn. With modern, expensive pour-on preparations, for economic reasons and to allow refugia of susceptible ticks, there is a reasonable case for treating some animals more often than others. There is conflicting information with respect to the method of application, with no firm evidence that the use of plunge dips or spray races is less likely to induce resistance. In addition, levels of multiple acaricide resistance are sufficiently high in Australia, and sensitivity of diagnostic tests sufficiently low to make installation of a plunge dip or spray race a very risky investment. Regulation prescribes the concentration of acaricides, so the recommendation on acaricide concentration should be followed regardless of any benefit in resistance management that might ensue from varying it up or down. There is some limited evidence to support strategic application patterns in spring, although the risk of non-target resistance in helminths resulting from such use of macrocyclic compounds must be high. Several of the conventional recommendations for tick control could well be challenged as being more appropriate to eradication than sustainable control programmes.

Fish blood infections off the shelf?

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Declining fish stocks in the surface waters of the northern Atlantic mean that future commercial exploitation may well focus on fishes from depths beyond the continental shelf. General parasite loads carried by deep-sea fish have been investigated, but their blood parasites have been largely ignored. Our purpose was to establish the variety and identity of blood infections in northeastern Atlantic deep-sea fishes, and to determine their effects on host cells. Fishes ($n = 114$) of 44 species in 34 genera, were trawled from depths between 747 and 4875 m during 2 *Challenger* cruises in the northeastern Atlantic. Fish were identified, sexed and measured. Blood smears were stained with Giemsa, and examined under oil-immersion. Measurements were made with an eyepiece graticule and stage micrometer. Blood infections identified included presumed viral erythrocytic necrosis (VEN) in a fish from the abyss west of Portugal, and VEN, 2 types of haemogregarines (Apicomplexa) and *Haemohormidium (incertae sedis)*, from fishes of

the Porcupine Seabight. Only 1 infection appeared to induce significant damage to host cells. Surprisingly, a variety of blood infections exist in northeastern Atlantic deep-sea fishes, and at least 1 seems to affect host cells adversely. How these infections are transmitted between fishes is unresolved.

Worldwide distribution of the family Trichodinidae (Peritrichia: Mobilida) from fishes

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The first representative of the order Mobilida Kahl, 1933, was reported by Leewenhoek in 1703 from *Hydra*. More than 80 years later this organism was described as *Cyclidium pediculus* O F Muller, 1786, but placed in the genus *Trichodina* some 50 years later. Since this description, many species belonging to this genus have been described from a great variety of hosts, without the use of constant characteristics. This led to taxonomic chaos, as most species were impossible to recognise again. A major breakthrough came in 1958 when Jiri Lom proposed a system of uniform characteristics based on silver impregnation to reveal the structures of the adhesive disc. Today the family Trichodinidae comprises 10 genera of which 7 have representatives associated with fishes. Species of the genus *Trichodina* are found associated with a wide variety of hosts, some are found on the body surface or gills of aquatic invertebrates, while others are found as ecto- and endosymbionts of amphibians and fish. Of all the genera in the family, the genus *Trichodina* is also the largest, with more than 180 species. Fish trichodinids are found in a variety of aquatic habitats, from freshwater to brackish and marine environments. As trichodinids are very common symbionts of fish, these ciliophorans have received much attention from fish aquarists and farmers, because some species have been implicated in mortalities of larvae and young fry under culture conditions.

KATQuick Malaria test – method for express diagnosis of *P. falciparum*-malaria: its effectiveness and specificity

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A delay in the diagnosis of *P. falciparum* malaria may lead to a lethal outcome. This poses the need for a rapid result in order to apply adequate and urgent treatment. The microscopic method is still considered to be a standard method. However, it requires competent staff, special laboratory equipment and time to obtain a result. The laboratories capable of microscopy are often too distant from villages. A new express KATQuick Malaria test for *P. falciparum*-malaria diagnosis, based on the detection of monoclonal antibody-antigen complexes of malaria parasites, has been developed in South Africa by KAT Medical CC. The effectiveness and specificity of the KAT test in comparison to microscopic method and, in the main series of experiments, to the ICT – test for specific diagnosis of *P. falciparum* and *P. vivax* was investigated. The main series of experiments was performed in Vietnam in the field in Binh Phuoc Province (a highly endemic area), as well as in Tadjikistan, and among persons who returned to Moscow from endemic regions (Tadjikistan, Kenya). The KAT Quick Malaria test was performed on 98 blood samples from feverish patients, using a genodiagnostic test (PCR) as a control. It was revealed that the effectiveness of the KAT test for *P. falciparum*-malaria diagnosis was 100 % versus 90.5 % by ICT. Two microscopically negative samples and 7 cases in which the thick blood films were unsuitable for microscopy that were positive on the KAT test were confirmed as malaria-positive by PCR. The absence of cross-reactions with *P. vivax*, and the fact that negative results with the KAT-test, microscopy and PCR for fever cases of non-malarial origin coincided, proved that the KAT test has a high specificity. The KAT test is easier to perform and faster than ICT. A highly sensitive PCR control method permitted verification of the KAT test in doubt-

ful cases. The potential to detect gametocytes of *P. falciparum* by the KAT test may have special importance in *P. falciparum* malaria foci where mass observations are carried out to evaluate measures for prevention of *P. falciparum*-malaria transmission.

Evolution of cephalopod-parasitising *Doridicola* Leydig, 1853 (Copepoda)

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Although the copepod genus *Doridicola* Leydig was established in the middle of the 19th century, the family containing it – Rhynchomolgidae Humes & Ho – was not established until 1967. As it stands now, Rhynchomolgidae is the most diverse family of the poecilostomatoid copepods, comprising 42 genera and more than 230 species living on/in cnidarians (Hydrozoa and Anthozoa), molluscs (Bivalvia, Gastropoda and Cephalopoda) and echinoderms (Asterozoa and Ophiurozoa). *Doridicola* is the largest genus of this family, with 45 species. It is also the only genus of this family symbiotic with all 3 phyla of invertebrates in which the rhynchomolgids are found. A cladistic analysis of this genus was conducted to investigate whether there are historical (evolutionary) relationships among the species of *Doridicola* and the members of its 3 host phyla. Twelve characters with 34 states were selected to carry out the analysis. In total, 2231 equally parsimonious trees were obtained with a length of 107 steps (CI = 22, RI = 62). The hypothesis adopted indicates that the ancestral stock of the modern *Doridicola* diverged into 2 lineages early in its evolution, with one exploring life on octocorallians and the other on actiniarians and molluscs. The cephalopod-parasitising *Doridicola* spp. are closely allied to those occurring on nudibranchs in Europe and Madagascar, indicating an origin in the Tethys Sea.

Parasites as a biomonitoring tool for detection of habitat degradation

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The cost of chemical analysis, availability of appropriately-trained human resources and the constraint that chemical analysis is reliable only at the time of sampling, *i.e.* not indicative of long-term health of an aquatic ecosystem, are only a few of the reasons why water quality managers are looking into biomonitoring as an alternative or enhancing method to monitor quality of water. In this regard, a variety of test organisms are considered. These methods should be accessible to people with limited training and resources. Fish health is used as such an indicator, and although these methods are still at a developmental stage, this indicator appears to be of value. Evaluation of a fish health assessment index for the Institute of Water Quality Studies showed that the presence of parasites *per se* was an indicator that health of the fish and therefore the environment had deteriorated. This proved to be in direct conflict with personal experience of finding the most beautiful and interesting parasites in places with pristine water quality. Work for this project coincided with surveys for the effect of heavy metal pollution on fishes in the Olifants River, as this river is known to be situated in one of the most industrialised areas of South Africa. Initially, 2 sites 40 km apart were selected. The water quality of these sites differed, but the same fish species and parasite species occur there. The health of the fishes was compared according to the guidelines, and fishes were also examined for parasites. In a follow-up study, 2 dams were added to the 2 river points. Various fish species were examined to provide for habitat and species preferences. Results from these series of surveys indicate that a relationship exists between the health of the host and its environment, and the number and composition of the parasite fauna can also be indicative of changes in the environment. Endoparasites seem to be more prevalent in sites where poorer water quality prevails, whereas ectoparasites occur more frequently in water of better quality in the same river system. It is possible to accurately determine the correct location of a fish in an aquatic system in 90 % of cases by referring to its parasite fauna composition.

The explanation of this phenomenon is not simple. The increase in white blood cells in fishes at the site with poorer water quality may give an indication of the level of pollution stress, or may simply be the result of the higher endoparasite burden. It may even be coincidental, and therefore the hypothesis is at present being tested in another river system under similar conditions.

Fish parasites of the Okavango River and Delta, Botswana

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The Okavango Delta, situated in the sandy Kalahari Desert, is the largest inland delta in the world and one of the most important wetlands in Africa, hosting unique and diverse aquatic fauna and flora. Apart from its importance in the eco-tourism industry, the fish populations of the Delta serve as a valuable food resource for local communities. In addition to the sustained use of this natural resource by traditional fishermen, a local commercial fishing industry of limited extent is being operated under the close supervision of the Fisheries Section of the Department of Animal Health and Production. Furthermore, fish-farming has recently been identified as a lucrative growth potential in this region and at different places

interested parties have set up small-scale pilot projects. For the last 3 years our team has been studying the fish parasites in this system and has achieved some remarkable results. More than 140 species of parasites have been recorded, of which at least 50 are new species. During the early summer the floodplains are inundated with floodwaters from the highlands of Angola. In the following months the floodwaters gradually recede, isolating some pools from the river. In these shallow pools small fishes are trapped and are exposed to great diurnal fluctuations in temperature. Many of these pools are drinking places for game and domesticated animals and become murky. Under these adverse conditions, opportunistic parasites thrive, resulting in high infestations of known pathogens such as *Ichthyophthirius*, *Chilodonella*, *Ichthyobodo* and some species of trichodinids. In some places traditional basket-fishing will remove all these infected fishes. This practice is, however, on the decline and many of the floodplain pools will still harbour their infected fishes when the new floods arrive, exposing other fishes to these parasites. We are also concerned about the possible risk of human bilharzia, as both the intermediate snail hosts are widespread in the system, *Biomphalaria pfeifferi* being more abundant than *Bulinus globosus*. Until recently, the Okavango has not been an endemic area for human schistosomiasis, but with an increase in human activity this possible risk should be monitored.