Ministeriet for Fødevarer, Landbrug og Fiskeri
Statens Skadedyrlaboratorium

Årsberetning
Annual Report
1999

Danish Pest Infestation Laboratory
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The Danish Pest Infestation Laboratory conducts research and experimental tests while accumulating knowledge on pests harmful to livestock, barns, storage houses, buildings and material used.

Furthermore, the laboratory aims at accomplishing optimum control while still watching out for any adverse effects on the environment.

Main research areas are: chemical control, alternative control, prevention, pest biology and behaviour, pesticide resistance, medical and veterinary problems caused by pests and by the environmental impacts of pesticides.

Furthermore, the Danish Pest Infestation Laboratory offers advisory services with a view to solving particularly complicated problems relating to pests on agricultural property, in dwellings and in the food industry.

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Forord

Det er mig en glæde at præsentere laboratoriets årsberetning 1999.

Laboratoriets økonomi er ikke blevet forbedret i løbet af 1999. Det er endnu ikke lykkedes at finde erstatning for de projekter under ministeriets rammeprogrammer, som udløber ved årets udgang. Programmerne har givet en mængde gode resultater, som er under publikation. Men det er vigtigt, at der etableres nye finansieringsmuligheder, hvis ekspertisen skal fastholdes.

Det er fortsat laboratoriets politik at knytte Ph.D.-studerende til projekterne for dermed at medvirke til forskeruddannelsen.

I løbet af året er mange ressourcer anvendt på udarbejdelse af byggeplaner, og vi er nu parat til at påbegynde nybyggeri af 1200 m^2 og ombygning af 800 m^2. Planerne er at gennemføre byggeriet i etaper, således at aktivitetsniveauet på forskningssiden kan opretholdes. En vis turbulens i dagligdagen må dog forventes.

Laboratoriet har påbegyndt det nye årtusinde med at tage IT i brug. Årsberetningen udkommer i år kun elektronisk. Vurderet på den hidtidige anvendelse af SSL's hjemmeside forventer vi ikke, at det skulle volde problemer. Men for en sikkerheds skyld kan man stadig rekvirere en papirversion ved henvendelse.

Til slut bringes en tak til bestyrelsen og alle medarbejdere for et godt samarbejde i det forløbne år.

N. Bille

Dansk resumé af den engelske årsberetning

(SSL= Statens Skadedyrlaboratorium)

Der henvises til den engelske tekst for en nærmere omtale af de enkelte afsnit (se indholdsfortegnelsen).

Internationalt samarbejde

Årsberetningen indledes med en omtale af det internationale samarbejde, der spiller så stor en rolle for SSLs virke både med hensyn til at udveksle informationer og ideer, og ved at SSL yder rådgivning og undervisning til folk i andre lande og internationale organisationer.

En række medarbejdere deltog i 1999 i internationale konferencer eller kongresser i Belgien, Grækenland, Tjekkiet, England, Brasilien, Australien, Finland, Frankrig, Tyskland, Norge og Spanien.

Arbejde for WHO. SSL er "WHO Collaborating Centre on Pesticide Resistance", og J. Keiding har siden 1962 været medlem af "WHO Expert Panel of Vector Biology and Control". J. B. Jespersen blev i 1991 også udpeget som medlem af dette panel.

Arbejde for FAO. Siden 1998 har J. B. Jespersen været medlem af FAO Panel of Experts on Resistance in Parasites.

Arbejde for EPPO. Siden oktober 1994 har J. Lodal været permanent medlem af EPPO Rodent Control Panel.

Arbejde for EU. Siden 1988 har J. B. Jespersen været medlem af SEMG, som er en videnskabelig styrings-gruppe for udvikling og implementering af bæredygtig husdyrproduktion i udviklingslande. I 1996 opnåedes støtte til en Concerted Action med henblik på at udvikle og implementere strategier til forebyggelse af insekticid- og acaricid-resistens i Europa. Indsatsen løber i 2½ år og involverer 12 europæiske lande samt industriens repræsentanter og ledes af J. B. Jespersen. Fra 1998 har J. B. Jespersen været medlem af en Cost Action vedrørende bekæmpelse af skab og myasis hos husdyr.

Undervisning

I lighed med tidligere år har laboratoriet afholdt kurser om skadedyr og skadedyrbekæmpelse: muldvarpe-bekæmpelse og gnaverbekæmpelse. Endvidere har laboratoriet holdt foredrag for grupper af kolleger og studerende.

Konsultationen

Bemærkelsesværdige enkeltsager og karakteristiske variationer i antallet af henvendelser i 1999

I år har der været det største antal henvendelser om **mus (*Muridae* spp.)** siden registreringen begyndte i 1952. Hyppigheden i forekomst af mus afhænger meget af den aktuelle fødemængde, og hvor mild vinteren er, og dette kan være en del af forklaringen på de mange henvendelser om mus. I de senere år har konsulenterne haft det indtryk, at flere og flere henvendelser drejer sig om **halsbåndmusen (*Apodemus flavicollis*)**, men det er kun i få tilfælde, at dette er blevet bekræftet. Halsbåndmusen, der først og fremmest er knyttet til skov og områder med parklignende karakter, søger tilsyneladende i højere grad end tidligere ind i huse.

I juni måned fik laboratoriet indsendt en prøve fra en sælunge, der var blevet indleveret til Kattegatcentret, fordi moderen havde forladt den. Dyrlægen, der undersøgte sælen, fandt utøj omkring sælens næse og mente, at der måske var tale om flåter. Det viste sig at være **sællus (*Echiropthirius horridus*)**, og det er vist første gang i laboratoriets historie, at denne luseart er set.

Antallet af henvendelser om problemer med **katteloppper *(Ctenocephalides felis)*** faldt fortsat i 1999, mens antallet af henvendelser om **hovedlus *(Pediculus capitia)*** endnu en gang var det højeste nogensinde. De midler, der findes på markedet til forebyggelse og bekæmpelse af kattelopper, er tilsyneladende meget effektive, mens der er stigende problemer, når det gælder bekæmpelse af hovedlus på mennesker. Der er endnu ikke lavet undersøgelser i Danmark, som kan klarlægge, om de midler, der findes i handelen til bekæmpelse af hovedlus, er blevet mindre effektive, eller om de mange problemer skyldes andre årsager.

I 1998 var der mange henvendelser fra mennesker, som var bekymret for, om den snegl, de havde fundet i haven, var en **iberisk skovsnegl** (***Arion lusitanicus*)**, der i de sidste par år er blevet registreret stadig flere steder i Danmark. I 1999 var der en del færre henvendelser, hvilket måske kan skyldes, at der ikke har været nær så megen medieopmærksomhed omkring denne snegl i det forløbne år. I langt de fleste tilfælde - både i 1998 og 1999 - kunne laboratoriet da også berolige med, at der var tale om helt uskyldige snegle.

Fuglelopperne (*Ceratophyllus* spp.) var meget aktive i april 1999, og antallet af henvendelser i denne måned var usædvanligt højt sammenlignet med gennemsnittet af tidligere års henvendelser. Antallet af henvendelser om disse lopper kan svinge meget fra år til år. Baggrunden for dette kendes ikke, men det kan hænge sammen med, om vejret er godt i april og maj måned, hvor lopperne er mest aktive.

Mange haveejere har haft problemer med **muldvarpe (*Talpa europaea*)** og især **mosegrise** (***Arvicola terrestris***), der har været mere aktive end normalt i næsten alle årets måneder. En del af forklaringen kan være en lavere dødelighed på grund af en mild vinter. En anden årsag kan være, at der i perioder med megen regn er sket oversvømmelser af mange gangsystemer, og derved er dyrene blevet tvunget til at søge til mere tørre arealer, hvor de så må lave nye gangsystemer og muldskud.

Undersøgelser og afprøvninger

Insektafdelingen

Laboratoriets samling af resistente fluestammer udgjorde ved årets udgang 21 stammer. Disse repræsenterede et bredt udsnit af resistensmekanismer og oprindelser. Stammerne anvendes til undersøgelse af nye midler og resistensforskning i ind- og udland. Detaljerede oplysninger om de enkelte stammer kan ses i Tabel 6a i det engelsksprogede afsnit.

Smøregifte mod stuefluer. Effektiviteten af en 0,1% bait-formulering indeholdende aktivstoffet fipronil blev afprøvet i 20 m^3 klimarum i laboratoriet. Smøregiften blev sammenlignet med 2 smøremidler indeholdende aktivstofferne azamethiphos (10%) eller methomyl (1.1%) og var fuldt så effektiv som disse.

Feltafprøvning af et middel med steriliserende effekt på voksne fluer. Larvemidlet triflumuron kan også virke sterilisende på voksne fluer. Midlet blev derfor afprøvet mod voksne fluer på fire gårde gennem en hel fluesæson fra maj til september. Plader imprægneret med sukker som lokkemad og triflumuron som aktivstof blev hængt op i staldene. Effekten på fluetætheden blev målt ugentligt og sammenlignet med fluetætheden på to ubehandlede gårde. De imprægnerede plader var ikke i stand til at begrænse mængden af fluer på tilfredsstillende vis.

Biologisk bekæmpelse af stuefluer og stikfluer med snyltehvepse. Stuefluer og stikfluer kan ved høje tætheder være yderst generende over for husdyr og mennesker. Fluerne kan ligeledes overføre forskellige sygdomme og ved deres generende adfærd nedsætte husdyrenes tilvækst og mælkeydelsen i kvægbesætninger.

Som led i en undersøgelse af mulighederne for alternative eller supplerende metoder til brugen af insekticider har Fødevareministeriet nu på fjerde år støttet et projekt med henblik på anvendelse af snyltehvepse til bekæmpelse af stue- og stikfluer i grise- og kvægbesætninger i Danmark. De tre foregående år er anvendt på at beskrive artssammensætningen af de snyltehvepse, der forefindes på udvalgte gårde, og deres sæsonmæssige aktivitet (se SSL's årsberetning 1997). Dette arbejde har ført til indkredsning af to potentielle arter af snyltehvepse, *Spalangia cameroni* og *Muscidifurax raptor,* der begge er almindelige og dominerende på de fleste gårde. Ligeledes er spredningsaktiviteten af *S. cameroni* blevet undersøgt, og det viste sig, at inden for det første døgn efter en udsætning spredte snyltehvepsene sig kun få meter fra udsætningsstedet. Denne rigiditet til spredning ændrede sig kun lidt selv efter en uge, hvilket betyder, at når *S. cameroni* anvendes til kontrol af stue- og stikfluer, bør udsætningen foregå mange steder i staldmiljøet. Kender man de steder, hvor fluerne opformeres, kan udsætningen selvfølgelig koncentreres til disse steder i stalden. Temperaturen spiller en vigtig rolle for snyltehvepsenes spredning, idet høje temperaturer (> 25°C) i stalden øger risikoen for, at alle udsatte hvepse flyver væk fra systemet med ingen eller begrænset fluebekæmpelse til følge.

Dette fjerde år er anvendt til at studere vinteroverlevelse af *S. cameroni*, *M. raptor* og *Urolepis rufipes* i nogle udvalgte stalde. Det generelle billede er, at *M. raptor* og *U. rufipes* kan overleve i fluepupper op til 6 måneder, hvorimod kun få individer af *S. cameroni* overlever vinteren. Staldtemperaturen spiller en vigtig rolle for, hvor stor en del af den oprindelige startpopulation, der overlever. Hvis temperaturen ligger imellem 12-15°C, vil en meget høj procentdel af snyltehvepsene overleve vinteren. Dette tal daler i takt med faldende vintertemperaturer i staldene. Oftest er svinestalde varmere om vinteren end kvægstalde, hvilket betyder højere overlevelse af snyltehvepse i disse systemer.

Konklusionen er, at hvis *S. cameroni* skal anvendes til bekæmpelse af fluer i stalde, må den udsættes hvert forår i april eller maj måned, inden tætheden af fluer begynder at stige kraftigt. Derimod, hvis *M. raptor* eller *U. rufipes* kan etablere sig i staldsystemet, vil de overlevende vinterpopulationer kunne medvirke til en tidlig regulering af fluepopulationerne. Det kan måske være nødvendigt med et lille løbende supplement af udsatte *M. raptor* eller *U. rufipes* for at bibeholde et højt parasiteringstryk af fluepupper i stalden.

I 1999 blev der ligeledes ugentligt udsat *S. cameroni* på to gårde (en svine- og kvægbesætning) for at måle deres bekæmpende effekt over for disse to fluearter. Populationerne af stuefluer blev holdt på et lille og acceptabelt niveau igennem hele sæsonen fra april og til oktober, hvorimod *S. cameroni* ingen synlig effekt havde på stikfluepopulationerne. De lovende forsøg fortsættes i år 2000 på de samme gårde, men med inddragelse af en ekstra svinebesætning.

Hyphomyceter til fluebekæmpelse i stalde. I laboratorieforsøg med neddypning af voksne stuefluer i sporesuspensioner blev udvalgt tre arter af insektpatogene svampe med god effekt (100% døde seks dage efter smitte). Tilsvarende undersøgelser med stikfluer kunne desværre ikke gennemføres på grund af for høj kontroldødelighed. Foderforsøg, hvor svampesporer blev tilført sukker, viste, at stuefluer kunne inficeres på denne måde, omend dødeligheden var lavere, end når fluerne blev dyppet i sporesuspensioner. Formentligt kan effekten dog øges ved at øge sporedosis og eksponeringstiden.

Entomophthora muscae sensu lato. De insektpatogene svampe *Entomophthora muscae* og *E. schizophorae* er blevet studeret i relation til stuefluer i et Ph.D projekt. Resultaterne er omtalt i tidligere årsberetninger og er nu blevet sammenskrevet i fire artikler til publikation i internationale tidsskrifter. I det forløbne år er det blevet undersøgt, hvorvidt disse svampe angriber stikfluen, *Stomoxys calcitrans*. Resultaterne viser, at svampene inficerer stikfluer - dog med en meget lavere frekvens end hos stuefluen.

Den grønne kokasseflue. I et samarbejde med C. Sommer på Den Kgl. Veterinær- og Landbohøjskole blev der i årets løb gennemført et projekt, hvor insektmidler, der hældes på ryggen af kreaturer ("pour-ons"), blev undersøgt på fluer, der ikke er målet for bekæmpelsen. Alle midlerne, der blev undersøgt, var baseret på syntetiske pyrethroider. Ungkreaturer blev behandlet med produkterne og gødning fra dem blev brugt til at undersøge overlevelse, reproduktion, størrelse og adfærd hos den grønne kokasseflue. Det kunne påvises, at brugen af syntetiske pyrethroider i "pour-ons" tydeligt påvirkede de målte parametre og dermed kokassefluens muligheder for at udvikle sig normalt.

Mikrobiologisk bekæmpelse af fluer på græssende kreaturer. I projektet er tidligere undersøgt den naturlige forekomst af insektpatogene svampe i forskellige fluearter tilknyttet græssende kreaturer. I den resterende del af projektet fokuseres der på smitteforsøg med svampe fra Hyphomycetes overfor voksne individer af bl.a kvægflue. Smitteforsøg, hvor sporerne blev tilført som suspension, viste at ud af ti undersøgte svampeisolater var et isolat af svampen *Metarhizium anisopliae* det mest virulente overfor såvel hunner som hanner. Kvægflue-hunner så ud til generelt at være mere modtagelige overfor svampeinfektion end hanner. Der er også foretaget forsøg hvor svampene blev tilført i form af en sukkerbait forsynet med svampesporer.

Myg. På trods af manglende videnskabelig dokumentation findes der på markedet adskillige produkter, som angiveligt skulle repellere myg ved hjælp af ultralyd. I en undersøgelse af Eric Valverde på Danmarks Tekniske Universitet i samarbejde med SSL blev effekten af lydstimulering på mygs adfærd undersøgt. Myggene blev holdt i små bure og stimuleret med enkelt-tone lydpulser af varierende længde og intensitet. Resultaterne viste ingen effekt af ultralyd (op til 40 kHz og 100 dB) på myggenes adfærd. Der blev observeret en vis tiltrækkende effekt af lavfrekvent lyd (400-500 Hz) på hanmyg, men dette er et kendt respons på flyvetonen fra hunmyg. Konklusionen er, at der ikke er nogen tydelig effekt af ultralyd på myggenes adfærd og derfor heller ingen indikation af, at ultralydsapparater kan repellere myg.

Hovedlus (Pediculus capitis). I 1999 afsluttede laboratoriet en spørgeskemaundersøgelse om hovedlus. Undersøgelsen omfatter perioden juni 1997 til maj 1998, og der indkom spørgeskemaer fra 70% af landets apoteker og 80% af landets kommunale sundhedsplejeordninger. Af de spørgeskemaer, der blev uddelt til børn på udvalgte skoler og institutioner i København og Silkeborg, har forældrene besvaret 48%.

Blandt de børn, der har deltaget i undersøgelsen, har 33% haft lus én eller flere gange i løbet af det år, som undersøgelsen har omfattet. I mange tilfælde var der også lus i resten af familien, hvis barnet havde lus - oftest hos moderen og/eller de mindre søskende.

Der er flere tilfælde af lus blandt børn i alderen 3-10 år sammenlignet med børn på 11-15 år. Problemer med lus er spredt over hele året, men der er stadig en tydelig "lusesæson" i august, september, oktober og november.

Hovedlus er hyppigst blandt børn med længere eller helt langt hår sammenlignet med børn, der har kortere eller helt kort hår. I undersøgelsen var der en væsentligt større andel af pigerne, der havde lus end af drengene. Det kan på baggrund af det indsamlede materiale forklares med, at der blandt piger er flere langhårede børn end blandt drenge. Det er kun blandt de helt korthårede børn, at der er flere med lus i skolefritidsordningerne sammenlignet med børn, der opholder sig andre steder efter skole.

Det meste af den information, som forældrene får om hovedlus, kommer via sundhedsplejeordning og/eller apoteket. Apoteket og sundhedsplejeordningen får især deres information om lus fra lægemiddelproducenterne og Statens Skadedyrlaboratorium. Både forældre, apoteker og sundhedspleje gør opmærksom på, at alle oplysninger og anbefalinger fra myndigheder og lægemiddelproducenter bør være enslydende.

Apoteket og sundhedsplejeordningen efterlyser mere viden omkring en eventuel resistensudvikling over for de lusemidler, der er i handelen.

Gødningsbiller. Fire billearter (*Alphitobius diaperinus*, *Typhaea stercorea*, *Ahasverus advena* og *Carcinops pumilio*) findes normalt i danske slagtefjerkræhuse. Disse biller er meget vanskelige at bekæmpe og giver ofte problemer. Gødningsbiller kan - udover deres rolle som mulige bærere af smittekim, der forårsager sygdomme hos mennesker og fjerkræ - gøre skade på bygninger, fremkalde allergier samt være til betydelig gene.

I 1999 blev en større treårig undersøgelse afsluttet. Den havde til formål at forske i disse billers forekomst og biologi, udvikle strategier til bekæmpelse af dem samt studere deres rolle med hensyn til overførsel af sygdomme. Projektet involverer samarbejde mellem Statens Veterinære Serumlaboratorium, Dansk Slagtefjerkræ, SSL (projekt-koordinator) og mange dyrlæger og fjerkræavlere. Resultaterne af denne forskning er beskrevet detaljeret i projektets slutrapport.

Vi studerede også disse billers tolerance over for almindeligt brugte insekticider, men fandt ingen tegn på insekticidresistens. På trods af denne mangel på resistens er man kommet til den konklusion, at de nuværende anstrengelser for at bekæmpe gødningsbiller stort set er utilstrækkelige. Vi har derfor til hensigt at forske nærmere i bekæmpelse af gødningsbiller i fremtiden i et forsøg på at afhjælpe dette problem.

Kyllingemiders adfærdsrespons på værtsstimuli. Kyllingemider (*Dermanyssus gallinae*) er blodsugende ektoparasitter på fjerkræ. De tilbringer det meste af tiden gemt i revner og sprækker og kommer kun frem for at suge blod. Mider fra vores laboratoriekultur blev stimuleret med kombinationer af vibrationer og CO_2 eller teknisk luft. Stimuleringerne blev udført ved forskellige lysintensiteter for at undersøge midernes adfærdsrespons under forhold, der minder om dag og nat.

Videoanalyser af adfærdsresponset viste, at ved lav lysintensitet (3 lux) fungerer både vibrationer og CO_2 som aktiveringsstimuli for kyllingemiderne, og der ses en synergistisk effekt. Ved høj lysintensitet (80 lux) ses et "fryse"-respons, når aktiverede mider stimuleres med CO_2; de stopper op og forbliver ubevægelige. I tilfælde af efterfølgende vibrationer bevæger miderne sig igen, men kun så længe de mærker vibrationerne, derefter stopper de op igen. Efter 1-2 minutter begynder de at bevæge sig igen, og der ses en synergistisk effekt af vibrationer og CO_2 på aktivitetsniveauet efter 2 minutter. Dette adfærdsrespons tolkes som et forsvar mod at blive ædt af den potentielle værtsfugl. Et pust CO_2 angiver, at fuglens opmærksomhed er rettet mod miden, og denne bør derfor forblive ubevægelig. Vibrationer derimod angiver, at fuglen bevæger sig, og derfor er dens opmærksomhed næppe rettet mod miden, og det er derfor relativt sikkert for miden at bevæge sig igen. Den bør endda søge ekstra aktivt, fordi der lige har været en potentiel vært i nærheden. Ved lav lysintensitet er der naturligvis ingen risiko for at blive set, og miden kan bevæge sig uanset CO_2-stimuleringen.

Aktivering af kyllingemider med en temperaturgradient. Voksne kyllingemider fra vores laboratoriekultur blev undersøgt for, hvor lille en temperaturændring, der kan aktivere dem. Miderne blev holdt i et næsten mørklagt (3 lux) klimarum og stimuleret med en temperaturgradient ved belysning på undersiden af den platform, som de opholdt sig på. Midernes respons blev optaget på video og senere analyseret. Det viste sig, at helt ned til 0,005°C/sekund var nok til at aktivere miderne. Det viste sig også, at det var hastigheden af temperaturændringen frem for den faktiske temperaturændring, som miderne reagerede på.

Betydningen af parasitinfektioner på æglæggende høners adfærd og helbred. I samarbejde med den Kgl. Veterinær- og Landbohøjskole i København blev det undersøgt, hvad betydning infektioner af endoparasitten *Ascaridia galli* og ektoparasitten *Dermanyssus gallinae* har på æglæggende høners adfærd og helbred. Seks grupper på hver 15 høner blev holdt under identiske forhold. To grupper blev inficeret med *A. galli*, to grupper med *D. gallinae*, og to grupper blev holdt som uinficerede kontrolgrupper. I perioder med kraftig vækst i kyllingemidepopulationen blev der observeret en signifikant lavere blodprocent hos de mideinficerede høner i forhold til de andre grupper, og i den kraftigst inficerede gruppe døde 40% af hønerne inden for 6 dage. Desuden havde de mideinficerede høner en signifikant lavere kropsvægt end de fire andre grupper (hønerne med endoparasitten havde også en lavere kropsvægt end kontroldyrene). Endelig blev der observeret signifikant mere fjerpudsning og hovedkradsning hos de mideinficerede høner, som på den måde var under tydelig stresspåvirkning. Konklusionen på undersøgelsen er, at kyllingemider kan have meget stor betydning for æglæggende høners sundhed og velfærd.

En foreløbig undersøgelse af svampeisolaters effekt på kyllingemider. I en foreløbig screening af seks svampeisolaters (2 isolater af *Paecilomyces fumosoroseus*, 2 af *Metarhizium anisopliae* og 2 af *Beauveria bassiana*) effekt på kyllingemider blev der fundet størst effekt af et *B. bassiana* isolat, som dræbte 85% af miderne i løbet af 8 dage. Yderligere undersøgelser forventes udført i 2000.

Biologisk bekæmpelse af melmøl i møllerier. Melmøl er et økonomisk vigtigt skadedyr i industrimøller. Efter at gasning med methylbromid er blevet forbudt, er møllerne tvunget til at finde andre metoder til bekæmpelse af skadedyr. I dette projekt undersøges mulighederne for at udvikle metoder til biologisk bekæmpelse af melmøl.

Der er i 1999 gennemført omfattende undersøgelser af biologien hos en snyltehveps, der angriber ægstadiet, *Trichogramma turkestanica* Meyer. Det viste sig i løbet af 1999, at denne stamme var blevet fejlidentificeret, og at det tidligere navn *T. evanescens* således var forkert. Laboratorieundersøgelserne er gennemført ved 15°C, 20°C, 25°C og 25°C og har omfattet bestemmelse af den aldersspecifikke overlevelse og fekunditet. *T. turkestanica* lægger mellem 40 og 82 æg pr. hun ved de anvendte temperaturer. Livslængden hos voksne snyltehvepse varierer mellem 32 dage ved 15°C og 2 dage ved 30°C. Der er desuden gennemført undersøgelser af omfanget af ”host feeding”, hvor hunnen punkterer et værtsæg med læggebrodden og optager noget af den udsivende væske. Melmølæggene dræbes ved denne adfærd, som således øger snyltehvepsens betydning som mortalitetsfaktor for en melmølpopulation. Omfanget af “host feeding” var overraskende høj: f.eks. var 50% af de dræbte melmølæg ved 20°C døde som følge af “host feeding”.

Undersøgelserne omkring rovmiden *Blattisocius tarsalis* er blevet videreført. Udviklingstiden for *B. tarsalis* er hidtil kun blevet undersøgt ved relativt høje temperaturer, og udviklingstiden blev derfor undersøgt ved 15°C, 21°C og 25°C. Ved disse temperaturer var der en lineær sammenhæng mellem temperatur og udviklingshastigheden.

Fekunditeten af *B. tarsalis* er blevet undersøgt ved 15°C og 21°C. Ved 15°C kunne rovmiderne parre sig, men hunnerne lagde ikke æg. Hunner, der havde lagt æg ved 25°C, kunne dog lægge ved 15°C, men det foregik med en meget lav rate. Ved 21°C opnåede rovmiden en maksimal æglægningsrate på 1 æg/dag, hvilket er betydeligt lavere end publicerede data fra 27°C.

Lagerskadedyr i majs i Afrika. Dette Ph.D.-projekt har til formål at belyse biologien hos “the larger grain borer”, *Prostephanus truncatus*, et lagerskadedyr, der gør stor skade på majs- og kassavalagre i Afrika, og som desuden findes i skov- og kratvegetationen uden for lagrene. Projektet er placeret i Benin, hvor billens forekomst søges undersøgt med feromonfældefangster, som analyseres i kombination med vegetationsanalyser og klimaregistreringer i en skov. Der er gennemført omfattende undersøgelser både i felten og i laboratoriet for at afdække hvilke træsorter i skoven, billen lever i, men det har ikke været muligt endnu at udpege en eller flere træsorter, som kan forklare det meget store antal biller i fælderne. Der fortsættes med undersøgelse af rødder og frø. Ved hjælp af en simuleringsmodel er det påvist, at temperatur er en vigtig faktor for forekomst af biller i fælderne. Substratets betydning for hannernes feromonproduktion undersøges ved gaskromatografi; det har foreløbigt vist sig, at hanner der lever på majs, producerer større mængder feromon end hanner, der lever på træ.

Effekten af lav iltkoncentration på museumsskadedyr. Undersøgelserne af effekten af behandling med kvælstof (iltkoncentration 0,35%) på museumsskadedyr er fortsat med følgende tre forsøgsdyr: *Anthrenus museorum*, æg; *Anthrenus verbasci*, pupper og *Trogoderma angustum*, larver. Ægstadiet blev eksponeret op til 72 timer; larver og pupper i max. 96 timer. Under disse betingelser blev der ikke opnået 100% dødelighed i forsøgene; larverne af *T. angustum* var mindst følsomme, idet halvdelen overlevede 96 timers behandling.

En foreløbig afprøvning af et sandlignende produkt til kontrol af sort havemyre, *Lasius niger*. Testproduktet, som mindede om finkornet sand, blev anbragt i en ring uden om en lokkemad af marmelade, hvortil der var god aktivitet af myrer. Testproduktets evne til at holde myrerne inden for ringen inde og myrerne uden for ringen ude blev sammenlignet med fugtigt strandsand. Det viste sig, at testproduktet ikke kunne forhindre myrerne inden for ringen i at passere barrieren, men der var ingen myrer uden for ringen, som forsøgte at passere barrieren. Desuden blev det vist i forsøg, hvor myrer blev tvunget til at gå på en behandlet overflade, at alle myrerne døde i løbet af 4 timer. Denne foreløbige undersøgelse har vist, at testproduktet kan have potentiale som barriere mod myrers indtrængen i huse.

Pattedyrafdelingen

Et specialkabel, der blev undersøgt for modstandsdygtighed mod gnav af rotter, viste stor modstandsdygtighed mod alvorlig skade, mens et standardkabel til sammenligning blev fuldstændigt ødelagt.

Resistensundersøgelserne med den brune rotte omfattede 548 rotter. Der blev fundet resistens mod coumatetralyl i to nye kommuner og mod bromadiolon i en ny kommune.

En rottefælde blev i en prototypeversion undersøgt for en opfinder med henblik på at optimere udformningen.

Populationseffekter af resistens hos brune rotter undersøges i laboratoriekulturer, der bliver udsat for forskellige selektionstryk med bromadiolon. Meningen er at vurdere, om antallet af resistente dyr i en population aftager, når der ikke bruges antikoagulanter i denne population. Dyrenes resistensstatus undersøges med Blood-Clotting-Respons teknikken (som tillader, at de overlever resistenstesten), og deres bidrag til efterfølgende generationer undersøges ved hjælp af DNA-metoder. Denne del af projektet finder sted i samarbejde med Københavns Universitet. Projektet forventes færdiggjort i 2001.

Blood-Clotting-Response teknikken (BCR) blev afprøvet som et alternativ for rutinetestning af resistens mod antikoagulanter i rotter, der bliver indsendt til SSL fra hele landet. BCR kan ikke bruges for at angive en grad af resistens, men kan anvendes til opdagelse af begyndende resistens, inden den bliver af alvorlig praktisk betydning.

Den afrikanske gnaver *Mastomys natalensis's* populationsbiologi blev undersøgt i flere projekter, både i felten i Tanzania og i laboratoriet. I et 3-årigt feltforsøg, der startede i 1998 i Tanzania, undersøges det, hvilken betydning prædatortryk har for rotternes populationsdynamik: i forskellige forsøgsarealer bliver prædatorer udelukket, tilladt eller endda tiltrukket, og rotterne bliver fulgt i en fangst-genfangst-undersøgelse. I nogle samtidige eksperimenter bliver det undersøgt, om rotterne selv opdager forskellene i prædationstrykket, og hvordan de reagerer på det. Disse forsøg bruger adfærdsobservationer med video-optagelser og indirekte målinger af gnavernes vilje til at fouragere. Forsøgene afsluttes i 2000. Resultater fra tidligere populationsdynamisk arbejde blev integreret i en populationsdynamisk model. Modellen viste sig ikke at være så god til at forudsige populationsudbrud som enkle regressionsmodeller, men den er meget anvendelig til at afprøve forskellige bekæmpelsesstrategier.

I anledning af et udbrud af Marburg-feber i Congo deltog SSL i et WHO-hold, som prøvede at finde det vilde reservoir for Marburg-virus. Vævsprøve fra 14 vilde arter blev indsamlet fra den guldmine, hvor patienterne sandsynligvis blev smittet, men ingen af dem viste spor af denne virus.

Et projekt om græsningseffekter på små pattedyr i lavbundsarealer blev udført i Fussingø ved hjælp af et fangst-genfangststudium i seks folde med forskellig belægningsgrad af stude eller får. Dataindsamling afsluttes sent i år 2000.

Effektivitetsvurdering af bekæmpelsesmidler og lægemidler

Vurderingen af effektiviteten og anvendeligheden af de kemiske bekæmpelsesmidler, der anmeldes til godkendelse og klassificering hos Miljøstyrelsen, er en vigtig opgave for SSL. Resultatet danner grundlag for bedømmelsen af nye etiketter og brugsanvisninger.

I nogle tilfælde måtte der kræves mere dokumentation for effektiviteten eller ændring i anvendelsesområdet, før midlet kunne indstilles til godkendelse. I andre tilfælde kunne vi ikke gå ind for midlets anvendelse til det ønskede formål. Der tages ved denne vurdering hensyn til specielle danske forhold, f.eks. med hensyn til udvikling af resistens mod midlet eller mod beslægtede midler.

I 1999 indledte SSL et samarbejde med Lægemiddelstyrelsen med henblik på at deltage i arbejdet med at udarbejde EU-retningslinier for afprøvning af effektivitet af visse medicinske og veterinære lægemidler. Herudover evaluerede vi effektivitet af nogle produkter til bekæmpelse af lus, flåter og lopper.

Andre oplysninger i årsberetningen

I afsnit 14 kan man finde de insekter og pattedyr, der holdes i kultur på Statens Skadedyrlaboratorium.

I afsnit 15 kan man finde medarbejdernes publikationer og forsøgsrapporter udarbejdet i 1997 og første halvdel af 1998.

I afsnit 16 kan man læse om effektivitetsvurderinger af pesticider og medicinske og veterinærmedicinske produkter.

I afsnit 17 findes en oversigt over de af Statens Skadedyrlaboratorium anerkendte bekæmpelsesmidler mod skadedyr.

1. Introduction

It is a pleasure for me to introduce the laboratory's 1999 Annual Report.

The finances of the laboratory did not improve in the course of 1999. So far we have not succeeded in replacing the projects funded under the framework programmes of the Ministry which expire by the end of the year. These projects have yielded many fine results that are now in the process of being published. It is important, however, to establish new funding possibilities in order to keep our expert knowledge.

The laboratory will continue the policy of including Ph.D. students within its research projects, since we see this as an important contribution to the education of scientists.

During 1999 many resources have been used in the preparation of construction plans, and we are now ready to start building an additional 1200 m^2 and renovating 800 m^2. According to the plans, construction will be carried out by stages so that our level of research activity can be maintained, although some disturbances must be expected.

The new millennium brings the further achievement of IT within the laboratory. As a result the Annual Report is now only published electronically. Based on the number of people currently consulting DPIL Homepage, we do not expect it to cause any problems, but as a precaution it will still be possible to ask for a paper version.

Finally, I would like to thank the Board and the entire staff for their fine cooperation during the past year.

N. Bille

2. Management and organization

2.1 Board of the Danish Pest Infestation Laboratory

Members:

Niels Ørnbjerg
Dansk Bilharziose Laboratorium
Chairman

Lars Damberg
Danish Pest Infestation Laboratory

Annie Enkegaard
Danish Institute of Agricultural Services, Flakkebjerg

Peter Esbjerg
Royal Veterinary and Agricultural University
Vice-chairman

Lise Stengård Hansen
Danish Pest Infestation Laboratory

Hans Kristensen
Danish Agricultural Advisory Centre

Elisabeth Nørbygaard
Danish Medicines Agency

Peter Weile
Danish Environmental Protection Agency

Ellis Byrgiel Sommer
Research Secretariat, Danish Directorate for Development, Observer

2.2 Staff 1999

E-mail addresses for DPIL staff are available on the Web-site

in Danish: http://www.dpil.dk/frames/vejv_frm.htm

in English: http://www.dpil.dk/frames/evejv_frm.htm

DIRECTOR
Nils Bille

SECRETARIAT, ACCOUNTS AND BOOKKEEPING
Inge Børgesen
Maj-Britt Børgesen (from 16.05 until 15.08)
Marianne Christensen (part-time)
Lisbeth Gammelgaard (part-time)
Jette Hansen (part-time)
Ilse Hall Jensen
Kirsten Engell Jørgensen (part-time)
Hanne Olsen
Volker Pieper

INFORMATION TECHNOLOGY
Vibeke Rostgaard Schmidt

DEPARTMENT OF ENTOMOLOGY

Scientists
Jørgen Brøchner Jespersen (Head)
Lise Stengård Hansen* (part-time)
Karl-Martin Vagn Jensen*
Vibeke Kalsbeek (Ph.D. student)
Ole Østerlund Kilpinen
Michael Kristensen*
Mette Knorr (part-time)
Per Sejerø Nielsen*
Henrik Skovgård Pedersen*
Anne Marie Rasmussen (part-time)
Andrew Spencer*
Tove Steenberg*

Technicians
Aase Borges (part-time)
Ulrik Cold (until 30.11)
Lars Damberg
Eva Hald
Henriette Hansen
Nicolai Hansen
Gitte Jensen
Dorthe Kyster
Ib Bjarne Nielsen
Bodil Malle Pedersen (part-time)

Kirsten Peschel
Minna Wernegreen (part-time)
Mirjana Zibar

MAMMAL DEPARTMENT

Scientists
Herwig Leirs (Head)
Thomas Bolbroe (until 28.02)
Ann-Charlotte Heiberg (Ph.D. student)
Jens Lodal*
Solveig Vibe-Petersen (Ph.D. student)

Technicians
Sarah Adams
Kristian Fordsmand (until 30.06)
Folmer Jensen
Iver Munch Skadborg (from 08.11)

TECHNICAL MANAGEMENT
Jørgen Christensen

* Senior scientists

2.3 Ph.D. and M.Sc. students

Michael Carlsen, Ph.D. student (University of Aarhus – until 06.05)
Ann-Charlotte Heiberg, Ph.D. student (University of Copenhagen)
Vibeke Kalsbeek, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen)
Saskia Mercelis, Ph.D. student (University of Antwerp, Belgium)
Christian Nansen, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen)
Solveig Vibe-Petersen, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen)

Ditte Hendrichsen, M.Sc. student (University of Copenhagen)
Thomas Lisborg, M.Sc. student (University of Odense)
Katrine Mohr, M.Sc. student (University of Copenhagen)
Thomas Nørgaard, M.Sc. student (University of Aarhus)
Tina Stendal Svendsen, M.Sc. student (University of Copenhagen)

2.4 Guest scientist

As in previous years we have had the pleasure of frequently seeing J. Keiding, Scientist Emeritus.

3. International collaboration

3.1 Conferences

J. B. Jespersen participated in the management committe meeting of the Working group on Mange and Myiasis in Livestock, EU Cost Action 833, 25 January, Brussels, Belgium.

S. Vibe-Petersen participated in the NORFA course for Ph.D. students, Rodent Population Dynamics: Pest Control & Environmental Monitoring, Tune, Denmark, 7-13 February. She presented the paper “Predation and population dynamics in African *Mastomys* rats: potential for integrated pest management?”

A. Spencer, J. B. Jespersen and M. Knorr participated in the national “Theme day on Salmonella”, where they presented a paper on “Biller i dansk Fjerkræproduktion: Angrebsniveau, biologi og bekæmpelse”, and “Kan biller overføre Salmonella og Campylobacter mellem to rotationer af slagtekyllinger?”, 7 April, in Foulum, Denmark.

H. Leirs attended the First Project Coordination Meeting for Management of Rodent Pests in Rice-Based Farming Systems in Southeast Asia, 19-21 April, Canberra, Australia. He gave a guest lecture “Age structure differences in *Mastomys natalensis*.”

J. B. Jespersen attended the Third ENMARIA business meeting and a workshop on “Combating insecticide resistance”, 25-29 May, in Thessaloniki, Greece. Together with Ian Denholm he presented a paper entitled “Overview of Insecticide resistance”.

H. Leirs, J. Lodal, M. Carlsen, T. Bolbroe, S. Vibe-Petersen and A. C. Heiberg participated in the Third European Congress of Mammalogy, 29 May-3 June, Jyväskylä, Finland. H. Leirs convened the symposium “Applied ecology and small mammal management”. M. Carlsen gave a lecture entitled “The effects of predation on winter and spring body weights and onset of reproduction in *Microtus agrestis*”. This paper was co-authored by J. Lodal, H. Leirs and T. S. Jensen. S. Vibe-Petersen gave a lecture “Prey dynamics of African rats under different predation pressure”. T. Bolbroe presented a poster “Behavioural response of field voles under mustelid predation risk in the laboratory: more than neophobia.”. A. C. Heiberg presented a poster “Population effects of anticoagulant rodenticide resistance in Norway rats.”

H. Leirs and S. Vibe-Petersen participated in the 8th International Symposium on African Small Mammals, 4-9 July, Paris, France. H. Leirs was a Member of the Scientific Committee, convened the session “African small mammals as pests” and chaired another session “Ecology”. He gave a keynote lecture “The rodent problem in Africa: Challenges for ecologically-based management”. S. Vibe-Petersen presented a lecture “Predation in populations of *Mastomys natalensis*: potential for pest management?” H. Leirs co-authored two posters on “The recolonisation of ‘emptied’ maize fields by rodents: implications for rodent control” and “The bats (Chiroptera) from Kikwit, Democratic Republic of the Congo”.

K.-M. V. Jensen and J. B. Jespersen attended the 3rd International Conference on Urban Pests, where K. M. V. Jensen presented two papers entitled “Interaction between entomopathogenic fungi (Deuteromycotina: hyphomycetes) and the biology of German cockroaches (*Blattella germanica* (L.)) (Dictyoptera: blattellidae)” and “The impact of a single treatment with the chitin synthesis inhibitor lufenuron on German cockroach (*Blattella germanica* (L.) (dictyoptera: blattellidae)) populations”, 19-22 July, in Prague, Czech Republic.

O. Kilpinen and J. B. Jespersen attended the 17th International Conference of the World Association for the Advancement of Veterinary Parasitology, where Ole Kilpinen presented a poster entitled “Effects of the chicken mite *Dermanyssus gallinae* on egg layers”, 15-19 August, in Copenhagen, Denmark.

L. S. Hansen and P. S. Nielsen participated in a meeting in the IOBC working group on "Integrated protection of stored products" in Berlin, Germany, 22-24 August. L. S. Hansen presented a paper entitled: "The effect of *Trichogramma turkestanica* Meyer (Hymenoptera: Trichogrammatidae) on *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) in relation to temperature". P. S. Nielsen presented a paper entitled "IPM in Danish flour mills, present use and limitations".

M. Kristensen participated in the Seventh Congress of the European Society for Evolutionary Biology, Barcelona, Spain, 23-28 August.

J. B. Jespersen participated in the International Symposium on "Biological Control Agents in Crop and Animal Protection, where he presented a paper on "Methods for biological control of arthropod pests in organic animal husbandry", 24-28 August, Swansea, UK.

O. Kilpinen participated in Cost Action 833 in Cluj, Romania, 1-3 September, presenting a talk "Problems caused by the chicken mite, *Dermanyssus gallinae,* in the Danish egg production".

H. Leirs, J. Lodal and A. C. Heiberg participated in the 2nd European Vertebrate Pest Management Conference, 6-8 September, Braunschweig, Germany. A. C. Heiberg gave a lecture and presented a poster on "Population effects of anticoagulant rodenticide resistance in Norway rats". H. Leirs convened the symposium "Anticoagulant Rodenticide Resistance" and became member of the permanent Steering Committee for the European Vertebrate Pest Management Conference. J. Lodal presented a paper entitled "Distribution and levels of anticoagulant resistance in rats (*Rattus norvegicus*) in Denmark".

H. Leirs attended the meeting of the European Research Network for Control of Viral Hemorrhagic Fevers, 9-11 September, Fondation Mérieux, Lyon, France.

H. Leirs and S. Vibe-Petersen participated in the Symposium "Dynamics in time and space: basic and applied issues", Norwegian Academy of Science and Letters, 15-17 September, Oslo, Norway. H. Leirs gave an invited lecture: "The population dynamics of the multimammate rat in Africa".

J. B. Jespersen and H. Skovgaard participated in the NJF Seminar No. 303: Ecological Husbandry in the Nordic Countries, where J. B. Jespersen presented a paper entitled "Arthropod pest problems in organic animal husbandry and methods for their control", 16-17 September, Horsens, Denmark.

J. B. Jespersen participated in the Meeting of the FAO Working Group on Parasite Resistance and the FAO/ INDUSTRY Contact Group Meeting, 20-25 September, Juiz de Fora, Brazil.

3.2 Visits and co-operation

DPIL staff paid visits to the following countries:

20 October 1998–19 May 1999, S. Vibe-Petersen visited Sokoine University of Agriculture (SUA), Rodent Research Unit, Morogoro, Tanzania. She visited SUA again from 22 October 1999 for a scheduled stay until 30 May 2000. Both stays were related to her Ph.D. project.

21 March–2 April, H. Leirs visited Cyprus as a short-term consultant for the World Health Organisation (EMRO-Alexandria), advising the Government of Cyprus on the development of at national plan for rodent control.

8-16 and 23-28 April, H. Leirs visited the Sokoine University of Agriculture, Morogoro, Tanzania, in the framework of several ongoing rodent projects there.

April-May, C. Nansen spent a month at the Department of Entomology, Oklahoma State University, U.S.A. where Dr. Thomas Phillips taught him basic gaschromatography techniques as tools for studies of insect semiochemicals.

14-22 May, H. Leirs travelled to Durba, Democratic Republic of the Congo, as a consultant for the World Health Organisation for ecological research during the Marburg epidemic outbreak.

19-20 May, N. Bille, J. B. Jespersen, K.-M. V. Jensen and J. Lodal visited Umweltbundesamt, Institut für Wasser, Boden und Lufthygiene, Berlin, Germany, to discuss resistance to pesticides in insects and rodents, guidelines for testing of household insecticides and the EU-Biocide directive.

3-8 June, H. Leirs, T. Bolbroe, S. Vibe-Petersen and A. C. Heiberg visited the Biological Stations at Kilpisjärvi and Pälläsjärvi, Finland, and participated in small mammal trapping there.

22 October–22 December, K. Mohr visited the Sokoine University of Agriculture, Morogoro, Tanzania, to carry out the field work for her M.Sc. thesis.

H. Leirs visited the University of Antwerp (Belgium) and the University of Oslo (Norway) several times in the framework of collaborative projects.

DPIL was visited by the following colleagues and other guests:

11-13 January, DPIL hosted the coordination meeting for the ISTC-project K-159 “Monitoring plague foci in Kazakstan”. The meeting was attended by Prof. A. A. Ashimov, Prof. Svetlana Sokolova (Institute for Informatics and Control Problems, Almaty. Kazakhstan), Dr. V. Aikimbayev, Dr. V. Ageyev, Dr. S. Pole (Kazakh Anti-Plague Research Institute, Almaty. Kazakhsta), Dr. E. Carniel (Institut Pasteur, Paris), Prof. N. C. Stenseth (University of Oslo), Dr. H. Henttonen (Finnish Forestry Research Institute, Helsinki), Dr. M. Pletschette, Prof. N. Bounaga (European Commission DGXII, Brussels), K. S. Larsen (KSL Consulting, Denmark) and N. Bille, H. Leirs, O. Kilpinen (DPIL).

15 February, Dr. Grant Singleton, CSIRO Division of Wildlife and Ecology, Canberra, Australia to discuss rodent management research and give a lecture on immunocontraception in wildlife control.

15-17 February, Apia Massawe, Sokoine University of Agriculture, Morogoro, Tanzania, to discuss her Ph.D. project on rodent ecology in different Tanzanian maize field types.

20 February-7 March, Dr. Elias Papadopoulos, Thessaloniki, Greece, on training visit on insecticide resistance.

19-23 April, Kjersti Hovde Christensen, Oslo, Norway on training visit on insect breeding methods and insecticide test techniques.

20 April, we were visited by a group from the Swedish pest control company Anticimex.

11-21 May and 7-14 June, Dr. Jan-Erik Bergh, Dalarne University College, Sweden, conducting investigations for a project on modified atmospheres and museum pests.

11 August, Dr. Ian Denholm, IACR Rothamsted, UK, to discuss ENMARIA business matters.

18 August, Professor A. Liebisch, Hannover, Germany, to discuss insect vector control.

1-3 September, DPIL hosted a coordination meeting to prepare an international collaborative project on rodents and pests in staple crops. The meeting was attended by Dr. R. H. Makundi (Sokoine University of

Agriculture, Morogoro, Tanzania), Dr. N. Oguge (Kenyatta University, Nairobi, Kenya), A. Sichilima (Ministry of Agriculture, Solwezi, Zambia), Prof. Dr. R. Verhagen (University of Antwerp, Belgium), Prof. Dr. N. C. Stenseth (University of Oslo, Norway) and H. Leirs, S. Vibe-Petersen (DPIL).

3 September, Professor G. Hoffmann, Umweltbundesamt, Institut für Wasser, Boden und Lufthygiene, Berlin, Germany, to discuss biology and control of insects of public health importance.

7-8 October, Dr. P. Chapman, CSL, York, UK to prepare common application for the EU 5th Framework Programme.

7 October, a group of eight scientists from Vietnam to hear a lecture on IPM in stored products by P. S. Nielsen and a lecture on rodent control by H. Leirs.

11 November, Dr. K. L. Heong, International Rice Research Institute, Laguna, Philippines, to discuss potential future collaborative projects.

23–30 November, Dr. Koné A. Blaise, National Institute of Public Hygiene, Abidjan, Cote D`Ivoire, to obtain training on insecticide resistance test techniques and breeding of flies and cockroaches.

2-3 December, Dr. Jutta Hermann and Renata Taskin, Umweltbundesamt, Institut für Wasser, Boden und Lufthygiene, Berlin, Germany, to discuss testing of insecticides and implementation of the EU Biocidal Directive.

3.3 WHO Collaborating Centre and Expert Panel

DPIL is a "WHO Collaborating Centre on Pesticide Resistance". The terms of reference are:

1. To study insecticide resistance developments in flies, cockroaches and rodents, and to establish discriminating concentrations/exposure times to different pesticides used for the control of these pests.

2. To maintain strains of susceptible and resistant colonies for the above studies and serve as a reference centre providing material from the above colonies for other WHO collaborators.

3. To study how to overcome resistance problems caused by the above-mentioned pests through delay approaches, alteration, change of control methods or a combination of methods.

Much of the work summarized in the section “Scientific and technical work” fulfils the terms of the centre.

Since 1991 J. B. Jespersen has been a member of the WHO Expert Advisory Panel on Vector Biology and Control, and in 1996 he accepted an invitation to serve as a member for a further period of four years.

3.4 FAO Expert Panel on Resistance in Parasites in Livestock

In 1998 J. B. Jespersen became a member of the FAO Panel of Experts on Resistance in Parasites in Livestock. In 1999 he participated in a Working Group Meeting and a joint FAO/Industry Contact Group Meeting, 20-25 September, Juiz de Fora, Brazil.

3.5 Scientific and Environmental Monitoring Group (SEMG)

In 1985 the European Commission formed the SEMG to monitor the application of insecticide in the Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) on Malawi, Mozambique, Zambia and Zimbabwe. In 1992 the mandate of SEMG expanded to include other effects of tsetse control with regard to land use and other possible environmental effects. In addition the activities of SEMG were not to be restricted to just RTTCP, but could now also involve all other EDF-funded projects in Africa. In 1997 the role and mandate of the SEMG were reviewed again. The mission of SEMG is now to support the European Commission, its member states and partners in the development and implementation of socially, economically and environmentally sustainable livestock production systems for agriculture. At a meeting in Brussels on September 23-24, 1997, the new terms of references were discussed, agreed upon, and referred to the member states.

J. B. Jespersen has been the Danish member of SEMG since 1988.

3.6 ENMARIA: European Network for the Management of Arthropod Resistance to Insecticides and Acaricides

ENMARIA (European Network for the Management of Arthropod Resistance to Insecticides and Acaricides), a new EU-funded Concerted Action, was launched in November 1996 to promote the development and implementation of management strategies for insecticide and acaricide resistance throughout Europe, thereby minimizing reliance on these chemicals and avoiding their increased use following resistance outbreaks. Nominated participants in ENMARIA include scientists and advisors from 13 countries and the agrochemical industry's Insecticide Resistance Action Committee (IRAC). ENMARIA hopes to achieve progress in four main areas - compilation of a European resistance database, workshops, training visits and publicity.

The database will detail all individuals and institutions engaged in insecticide and acaricide resistance research activities and all available information on the incidence, impact and management of resistance in EU and EFTA countries. It will also include information on insect strains (especially susceptible reference strains) cultured by different laboratories that could be shared to save unnecessary duplication of effort.

The workshops will aim at developing and promoting standardized methods for detection and monitoring of resistance and at identifying and disseminating guidelines for its management. The first workshop was held at IACR-Rothamsted in April 1997, in conjunction with the Resistance '97 International Conference on Pesticide Resistance. The second workshop took place in Almería in southern Spain in May 1998, whereas the third workshop took place in Thessaloniki, Greece in May 1999. Difficulties encountered in these regions with insect and mite control encapsulate well the need to integrate resistance management tactics with non-chemical approaches and are relevant to protected horticulture and agriculture throughout Europe.

ENMARIA sponsors technical training visits, focusing on techniques for monitoring resistance and evaluating resistance. Until now 10 such training visits have been funded.

The primary long-term objective of ENMARIA is to encourage close and formal scientific collaboration on resistance research between European laboratories, thereby avoiding duplication of effort and expertise. In addition, ENMARIA will remain committed to creating an environment more favourable for the implementation of resistance management strategies, notably by promoting open and frequent dialogue between researchers, pest management advisors, the agrochemical industry and regulatory authorities.

Involvement in ENMARIA is open to all interested individuals and organizations; further details are available from the main coordinators whose details are as follows:

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ENMARIA has established a Website giving information about its activities. The Homepage includes logos, maps and details of participants, and the site will eventually include working papers prepared by national representatives reviewing resistance problems in their respective countries. The address is: http://www.res.bbsrc.ac.uk/enmaria/

3.7 Mange and Myiasis in Livestock in Europe

As part of the European co-operation in the field of scientific and technical research, a European Concerted Action 833 on Mange and Myiasis in Livestock was established in 1998 with the following objectives:

1. To develop accurate means of diagnosis of mange and myiasis in livestock and so prevent suffering and improve animal welfare.

2. To develop effective and environmentally sensitive methods of treatment and control of these diseases and so increase economic performance and decrease pressure on the environment.

3. To increase the epidemiological knowledge of these diseases in order to facilitate control and eradication programmes.

Altogether, 16 countries are involved in implementation of the COST Action 833, which is organized by the Management Committee. In 1998 J. B. Jespersen was appointed the Danish representative of the Management Committee. In 1999 J. B. Jespersen participated in one Management Committe meeting. Ole Kilpinen participated in the Second Annual Workshop, 2-3 September, in Cluj-Napoca, Romania.

3.8 EPPO (European and Mediterranean Plant Protection Organization)

As from October 1994 J. Lodal has become a permanent member of the EPPO Rodent Control Panel.

4. Educational activities

4.1 Training courses

In February and March nine one-day courses for personnel using phosphine-generating pellets for the control of moles and water voles were run by J. Lodal in various parts of the country. A total of 725 persons participated.

7-13 February, the laboratory hosted a NorFA (Nordisk Forskerutdanningsakademi) researcher course “Rodent population dynamics: pest control and environmental monitoring” at Tune Landboskole, with 27 Ph.D. students and 12 teachers from 14 countries. The course was organized by H. Leirs in collaboration with N. C. Stenseth (Oslo), H. Henttonen (Helsinki) and L. Hansson (Uppsala).

21-22 September a course on biology and control of insects, mites and rodents was run for military personnel intended to operate in foreign countries (L. S. Hansen, K.-M. V. Jensen, M. Kristensen and J. Lodal).

4.2 Lectures

20 January, J. B. Jespersen and H. Leirs gave lectures in a course on “Tropical Medicine” for senior military health staff, intending to operate in foreign countries.

26 January and 20 April, J. Lodal gave lectures on rat resistance to anticoagulants at an Authorization Course in Rat Control held by the Ministry of the Environment, Copenhagen.

11 March, L. S. Hansen gave two lectures on “Pests related to storage and production of food” for food technology students at the Royal Veterinary and Agricultural University, Copenhagen.

15 April, J. Lodal gave a lecture on the present situation of resistance to anticoagulants in the brown rat in Denmark at a meeting of Brancheforeningen for Kommunal Skadedyrbekæmpelse (an association of pest control companies involved in municipal pest control).

4 May, J. B. Jespersen gave two lectures on “Flies and mosquitoes” for students at the Royal Veterinary and Agricultural University, Copenhagen

18 May, L. S. Hansen gave a lecture on “Biology and control of seed destroying pests” for a group of students from developing countries participating in a course on seed pathology at the Plant Directorate.

27 May, A. Rasmussen gave a lecture on a questionnaire investigation on headlice for the participants in a Nordic lice conference.

1 October, H. Leirs, J. B. Jespersen, A. Spencer, K.-M. V. Jensen and P. S. Nielsen gave lectures to students in international health visiting DPIL.

1 and 15 October, L. S. Hansen gave two lectures on “Physical and other non-chemical methods for the control of pests in museums” at the Royal Danish Academy of Fine Arts – School of Conservation, Copenhagen. N. Bille and K.-M. V. Jensen gave lectures as well.

7 October, a group of eight scientists in plant protection from Vietnam visited the laboratory. P.S. Nielsen gave a lecture on IPM in stored products, H. Leirs gave a lecture on “Protecting stored grain against rats”.

4.3 External examiner and reviewer duties

L. S. Hansen served as external examiner for forestry students in forest entomology and ecology at the Royal Veterinary and Agricultural University, Copenhagen.

L. S. Hansen served as external supervisor for Ph.D. student C. Nansen, the Royal Veterinary and Agricultural University, Copenhagen.

A.-C.Heiberg served as referee for Crop Protection and Advances in Vertebrate Pest Management.

J. B. Jespersen served as external examiner for two Ph.D. students at the Royal Veterinary and Agricultural University, Copenhagen, and for one student at the Danish Bilharziasis Laboratory, Charlottenlund.

J. B. Jespersen served as supervisor for one M.Sc. student and one Ph.D. student at the Royal Veterinary and Agricultural University, Copenhagen, one M.Sc. Student at Roskilde University, Roskilde, and one student at the Technical University of Denmark, Kgs. Lyngby.

M. Kristensen served as a referee for the Advances in Vertebrate Pest Management.

H. Leirs served as a supervisor for one Ph.D. student at the Royal Veterinary and Agricultural University, Copenhagen, one Ph.D. student at the University of Copenhagen, one Ph.D. student at the University of Antwerp (Belgium), two Ph.D. students at the Sokoine University of Agriculture, Morogoro (Tanzania).

H. Leirs served as adviser to one M.Sc. student at the University of Copenhagen, one M.Sc. student at the University of Aarhus and one M.Sc. student at the University of Oslo (Norway). He also regularly advised students at the Royal Veterinary and Agricultural University, Copenhagen.

H. Leirs served as external examiner for one M.Sc. thesis at the Faculty of Science, University of Dar es Salaam, Tanzania.

H. Leirs served as Associate Editor for *Mammalia* (Paris).

H. Leirs served as referee for *Mammalia Journal of Zoology*, Pesticide Science, Biodiversity and Conservation, Tropical Zoology, Polish Journal of Ecology, Advances in Vertebrate Pest Management; as editor of a multi-authored book published in 1999, he reviewed and commented on several contributions.

H. Leirs served as a reviewer for several foreign institutes and funds.

J. Lodal served as a supervisor for one Ph.D. student, University of Aarhus.

5. Advisory work

5.1 Number of inquiries arranged by species

In 1999 DPIL answered approximately 12,550 general inquiries from farmers, the food industry and other firms, veterinary surgeons, doctors and other health services, the news media, and private individuals with pest problems. Of these inquiries, 75% were telephone calls, 20% letters (often with animals enclosed for identification), and 3% visits to the laboratory. Many were answered by the sending of a leaflet on the subject, whereas others required replies in more detail, sometimes after extensive studies. In June, the Website of the laboratory was launched on the Internet with a special link entitled “Questions about pests” resulting in a percentage of inquiries by e-mail of 2%. It is our aim to make all leaflets available to the public on the Website. The address is www.dpil.dk

In Table 5a, the inquiries are arranged by subject from a practical rather than a consistently zoological point of view. Many of the animal species or groups in the list do not deserve pest status. However, opinions vary and, for instance, in food articles any animal (or even trace of an animal) is often considered a problem. Every effort was also made to confirm that dubious animals were *not* pests.

Some of the inquiries led to inspections on location, but this type of frequently very time-consuming activity has been kept at a minimum since other engagements have priority. In 1999 there were 12 such inspections, paid for by insurance companies or other customers. Most of them concerned attacks of wood-boring insects in buildings.

As seen in Table 5a, the species which generated the most enquiries were the hornets (*Paravespula spp.*), the common black ant (*Lasius niger*), the common furniture beetle (*Anobium punctatum*), head lice (*Pediculus humanus capitis*), a mortar-attacking bee (*Colletes daviesanus*), the Indian meal moth (*Plodia interpunctella*), the dermestid beetle (*Attagenus smirnovi)*, the mouse (*Muridae*), the stone marten (*Martes foina)* and the water vole *(Arvicola terrestris)*. Together these ten subjects made up 50% of the total number of inquiries.

Table 5a. Number of inquiries in 1999

Leaflets (in Danish) are available on pests marked with an asterisk (*)

	Thysanura	**Børstehaler**	
*	*Lepisma saccharina*	Sølvkræ	151
*	*Thermobia domestica*	Ovnfisk	6
*	**Collembola**	**Springhaler**	12
	Orthoptera	**Retvinger**	
*	*Acheta domestica*	Husfårekylling	32
	Blattaria	**Kakerlakker**	
	Blatta orientalis	Orientalsk kakerlak	10
*	*Blattella germanica*	Tysk kakerlak	97
	Neostylopyga rhombifolia	Harlekin kakerlak	1
	Periplaneta americana	Amerikansk kakerlak	4
	Pycnoscelus surinamensis		1
*	*Supella longipalpa*	Brunstribet kakerlak	2
	Blattaria div.	Kakerlakker div.	65
	Isoptera	**Termitter**	9
	Dermaptera	**Ørentviste**	
*	*Forficula auricularia*	Alm. ørentvist	12
*	**Copeognatha**	**Støvlus**	177
	Mallophaga	**Pelslus og fjerlus**	3
	Echiropthirius horridus	Sællus	1
	Siphunculata	**Lus**	
	Linognathus setosus	Hundelus	1
*	*Pediculus capitis*	Hovedlus	622
	Pediculus corporis	Kropslus	2
*	*Phthirus pubis*	Fladlus	2
	Siphunculata div.	Lus div.	3
*	**Thysanoptera**	**Thrips**	27
	Hemiptera	**Næbmunde**	
	Cimex lectularius	Væggelus	126
	Cimex pipistrelli	Flagermusevæggelus	1
*	*Reduvius personatus*	Støvtæge	11
	Hemiptera div.	Tæger, bladlus, cikader div.	24
	Neuroptera	**Netvinger**	
*	*Chrysopa* spp.	Guldøjer	4
	Lepidoptera	**Sommerfugle**	
*	*Aphomia sociella*	Humlevoksmøl	68

*	*Endrosis sarcitrella*	Klistermøl	14
*	*Ephestia elutella*	Kakaomøl	3
*	*Ephestia kuehniella*	Melmøl	16
*	*Hofmannophila pseudospretella*	Frømøl	46
*	*Plodia interpunctella*	Tofarvet frømøl	411
	Pterophoridae spp	Fjermøl	3
*	*Tinea pellionella*	Pelsmøl	50
*	*Tineola bisselliella*	Klædemøl	38
*	*Lepidoptera* div.	Sommerfugle div.	96
	Coleoptera	**Biller**	
*	*Alphitobius diaperinus*	Lille melbille	3
	Amphimallon solstitiale	Sankthansoldenborre	4
*	*Anobium punctatum*	Alm. borebille	515
*	*Anoplodera rubra*	Rød blomsterbuk	11
	Anthrenus spp	Tæppebiller	234
*	*Attagenus pellio*	Pelsklanner	14
*	*Attagenus smirnovi*	Brun pelsklanner	366
	Bostrychidae	Bostrychider	6
*	*Callidium violaceum*	Violbuk	23
*	*Carabidae*	Løbebiller	43
	Carpophilus hemipterus	Tørfrugtbille	1
	Cerambycidae	Træbukke	10
	Cis boleti	Svampeborer	1
	Clytus arietis	Hvepsebuk	5
	Coccinellidae	Mariehøns	5
	Corynetes coeruleus	Skinkebille	3
*	*Criocephalus rusticus*	Brun træbuk	10
	Cryptolestes ferrugineus	Rustfarvet kornbille	4
*	*Cryptophagus* spp	Skimmelbiller	16
	Dermestes frischii	Hudeklanner	1
*	*Dermestes haemorrhoidalis*	Husklanner	112
*	*Dermestes lardarius*	Flæskeklanner	39
	Dermestes maculatus		2
*	*Ernobius mollis*	Blød borebille	5
	Europhryum confine		1
*	*Hadrobregmus pertinax*	Rådborebille	14
*	*Hylesinus fraxini*	Askebarkbille	1
*	*Hylobius abietis*	Nåletræssnudebille	4
*	*Hylotrupes bajulus*	Husbuk	35
*	*Lasioderma serricorne*	Tobaksbille	37
*	*Lyctus* spp	Splintvedbiller	5
	Lymexylidae	Værftsbiller	1
	Melolontha melolontha	Alm. oldenborre	5
*	*Nacerdes melanura*	Bolværksbille	2
	Niptus hololeucus	Messingtyv	1
*	*Ocypus olens*	Stor rovbille	15
	Oryctes nasicornis	Næsehornsbille	2
	Oryzaephilus mercator	Jordnøddebille	12
*	*Oryzaephilus surinamensis*	Savtakket kornbille	49
*	*Otiorhynchus sulcatus*	Væksthussnudebille	13
*	*Otiorhyncus* spp.	Øresnudebille	20
	Phyllopertha horticola	Gåsebille	17
*	*Phymatodes testaceus*	Bøgebuk	67

	Ptilodactyla spp.		3
	Ptinus fur	Alm. tyvbille	5
	Ptinus tectus	Australsk tyvbille	1
*	*Reesa vespulae*	Amerikansk klanner	8
	Rhyzopertha dominica	Kornkapuciner	1
	Scolytidae	Barkbiller	20
	Serica brunnea	Natoldenborre	3
*	*Sitona lineatus*	Stribet bladrandbille	9
*	*Sitophilus granarius*	Kornsnudebille	31
*	*Sitophilus oryzae*	Rissnudebille	14
	Sitophilus zea-mais	Majssnudebille	1
	Staphyllinidae	Rovbiller	12
*	*Stegobium paniceum*	Brødbille	131
*	*Tenebrio molitor*	Melbille	41
	Thylodrias contractus	Larveklanner	4
*	*Tribolium confusum*	Rismelbille	30
*	*Tribolium destructor*	Lysolbille	11
	Trogoderma angustum	Smal frøklanner	4
*	*Xestobium rufovillosum*	Egens borebille	4
	Coleoptera div.	Biller div.	112
	Hymenoptera	**Årevinger**	
	Andrena spp.	Jordbier	46
	Apis mellifica	Honningbi	14
	Bombus spp.	Humlebier	119
*	*Camponotus* spp.	Herkulesmyrer	47
*	*Colletes daviesanus*	Murbi	463
	Formicidae	Myrer	144
	Formica rufa	Rød skovmyre	63
	Lasius fuliginosus	Orangemyre	18
*	*Lasius niger*	Sort havemyre	727
*	*Lasius umbratus and others*	"Gule myrer"	46
*	*Monomorium pharaonis*	Faraomyre	36
	Osmia spp.	Murerbier	32
*	*Paravespula* spp.	Gedehamse	1278
*	*Siricidae*	Træhvepse	15
	Sphecoidae	Gravehvepse	13
	Tetramorium	Græstørvsmyre	3
*	*Vespa crabro*	Stor gedehams	42
	Hymenoptera div.	Årevinger div	59
	Diptera	**Tovinger**	
	Bibionidae	Hårmyg	13
	Borboridae	Springfluer	5
*	*Calliphoridae*	Spyfluer	63
*	*Ceratopogonidae*	Mitter	7
	Chironomidae	Dansemyg	11
*	*Crataerina pallida*	Mursejlerlusflue	1
	Culicidae	Stikmyg	40
*	*Drosophila* spp.	Bananfluer	101
	Eristalis spp.	Dyndfluer	3
*	*Fannia canicularis*	Lille stueflue	17
	Musca autumnalis	Efterårsflue	3
*	*Musca domestica*	Stueflue	60

*	*Mycetophilidae*	Svampemyg	31
	Ornithomyia spp.	Lusfluer	7
	Phoridae	Pukkelfluer	9
*	*Pollenia* spp.	Klyngefluer	56
*	*Psychodidae*	Sommerfuglemyg	36
	Simuliidae	Kvægmyg	2
	Stehepteryx hiriundinis	Svalelusflue	1
	Stomoxys calcitrans	Stikflue	6
	Syrphidae	Svirrefluer	3
*	*Tabanidae*	Klæger	9
*	*Thaumatomyia notata*	Græsflue	9
	Tipulidae	Stankelben	11
	Diptera div.	Tovinger div.	81
	Siphonaptera	**Lopper**	
	Ceratophyllus spp.	Fuglelopper	185
*	*Ctenocephalides* spp.	Katte- og hundelopper	200
	Ceratophyllus (Monopsyllus) sciurorum sciurorum	Egernloppe	1
*	*Pulex irritans*	Menneskeloppe	5
	Siphonaptera div.	Lopper div.	51
	Pests on textiles	Tekstilskadedyr	229
	Pests in food	Kolonialskadedyr	31
	Pests in wood	Træskadedyr	68
	Various insects	**Diverse insekter**	157
	Acarina	**Mider**	
*	*Acarus siro*	Melmide	21
*	*Argas reflexus*	Duemide	4
*	*Bryobia praetiosa*	Brunmide	20
*	*Cheyletiella* spp.	Pelsmider	8
*	*Dermanyssus* spp.	Fuglemider	25
*	*Dermatophagoides* spp.	Husstøvmider	9
	Gamasidae	Gamasider	4
*	*Glycyphagus domesticus*	Husmide	5
*	*Ixodes ricinus*	Skovflåt	68
	Oribatidae	Pansermider	4
*	*Rhipicephalus sanguineus*	Husflåt	2
*	*Sarcoptes scabiei*	Fnatmide	5
*	Mites in grain, straw and hay	Lagermider	2
	Acarina div.	Mider div.	42
*	**Araneae**	**Edderkopper**	44
	Scorpiones	**Skorpioner**	2
*	**Pseudoscorpiones**	**Mosskorpioner**	9
*	**Diplopoda**	**Ægte tusindben**	35
	Chilopoda	**Skolopendre**	

*	*Geophilus carpophagus*	Jordskolopender	1
	Chilopoda div.	Skolopendre div.	13
*	**Oniscoidea**	**Bænkebidere**	80
	Oligochaeta	**Sadelbørsteorme**	
	Lumbricidae	Regnorme	16
	Gastropoda	**Snegle**	
	Arion lusitanicus	Iberisk skovsnegl	114
*	*Limacidae*	Kældersnegle	54
	Gastropoda div.	Snegle div.	56
	Amphibia	**Padder**	4
	Lamellibranchiata	**Muslinger**	
	Teredo navalis	Pæleorm	6
	Reptilia	**Krybdyr**	6
	Aves	**Fugle**	
*	*Columba livia domestica*	Tamdue	125
	Pica pica	Husskade	5
	Aves div.	Fugle div.	10
	Mammalia	**Pattedyr**	
	Apodermus flavicollis	Halsbåndmus	45
*	*Arvicola terrestris*	Mosegris	523
	Chiroptera spp	Flagermus	15
	Felis domestica	Huskat	1
*	*Martes foina*	Husmår	374
*	*Muridae*	Mus	642
	Mustela erminea	Lækat	4
	Mustela putorius	Ilder	4
*	*Rattus norvegicus*	Brun rotte	221
*	*Rattus rattus*	Husrotte	1
	Sciurus vulgaris	Egern	6
*	*Talpa europaea*	Muldvarp	330
	Vulpes vulpes	Ræv	15
	Mammalia div.	Pattedyr div.	41
	Various animals	**Diverse dyr**	118
	Imaginary animals	**Indbildte dyr**	31
	Pesticides	**Bekæmpelsesmidler**	129
	Sundries	**Diverse**	220

5.2 Some of the cases and characteristic variations in the number of inquiries in 1999

This year saw the highest number of inquiries about **mice (*Muridae spp.*)** since the registration started in 1952. The frequency of incidence of mice is dependent on the topical amount of food and mildness of the winter, and this may explain the many inquiries about mice. In the past few years the advisers have had the impression that more and more inquiries concern the **yellow-necked field mouse (*Apodemus flavicollis*)**, but only in few cases has this been confirmed. The yellow-necked field mouse - being first and foremost connected with woods and areas of a parklike nature - obviously takes to more houses than before.

In the month of June our laboratory received a sample from a baby seal taken to the ”Kattegat Centre”, because it had been abandoned by its mother. The veterinarian, who examined the seal, found vermin around its nose and considered it to be ticks. It turned out to be **seal lice (*Echiropthirius horridus*)**, and we think that it is the first time in the history of our laboratory that this species of lice has been seen.

The number of inquiries about problems with **cat fleas** ***(Ctenocephalides felis)*** decreased constantly in 1999, whereas the number of inquiries about **head lice** ***(Pediculus capitis)*** was once again the highest ever seen. The preparations available on the market for prevention and control of cat fleas are apparently very effective, whereas there are increasing problems when it comes to headlice on humans. In Denmark investigations have still not been made as to whether the preparations on sale for control of headlice have become less effective or whether the many problems stem from other causes.

In 1998 there were many inquiries from people being worried if the slug they had found in their garden was the **Iberian black slug (*Arion lusitanicus*)** that has been recorded in still more places in Denmark in the past few years. In 1999 there were not nearly as many inquiries which may be due to the fact that the media did not pay much attention to this slug. In the vast majority of cases - both in 1998 and 1999 - our laboratory was able to reassure that the slugs in question were quite harmless species.

Bird fleas (*Ceratophyllus* spp.) were very active in April 1999, and the number of inquiries in this month was unusually high compared with the average of inquiries of former years. The number of inquiries about the above fleas may fluctuate much from year to year. The reason for this is unknown; however, the weather conditions in the months of April and May when fleas are most active may be of great influence.

Many people with gardens have had problems with **moles (*Talpa europaea*)** and especially **water voles (*Arvicola terrestris*)**, which have been more active than normally in nearly all the months of the year. Part of the explanation may be lower mortality due to a mild winter. Another reason could be the fact that a higher water level in lakes and streams resulting from heavy rain-fall has forced especially water voles to move into drier areas where they normally do not occur.

Scientific and technical work

6. Flies

6.1 Chemical control of *Musca domestica*

6.1.1 Laboratory evaluation of Fipronil Fly-bait gel for control of the housefly *Musca domestica*

The efficacy of Fipronil Fly-bait gel, containing 0.1% active ingredient, was evaluated under laboratory conditions for control of houseflies. Two paint-on-baits containing 10% azamethiphos or 1.1% methomyl as active ingredients were used as references and furthermore an untreated control was included in the evaluation.

Adult flies of a susceptible *Musca domestica* laboratory strain were allowed to feed on bait during 48 hours after the release into a large test chamber, in which they had access to a plywood board treated with the test formulation. The mortality was recorded by counting of the number of knocked down and dead flies after ½, 1, 2, 4, 7, 24 and 48 hours of exposure to the bait. The mortality was recorded as “overall mortality” (all flies knocked down and dead at the specific time of recording) and as “immediate mortality” (the quantity of the knocked down and dead flies which were caught in a receptacle suspended closely beneath the painted board).

The baits were tested in two situations: 1) as *non-choice trials*, in which the flies had access to only water and bait, and 2) as c*hoice trials*, in which the flies had access to water, milk powder, sugar and bait.

Fipronil Fly-bait gel was at least as effective as the two reference-baits in both the non-choice trials and the choice trials.

During the initial 2 hours of exposure, the overall mortality to Fipronil Fly-bait gel was low compared to the methomyl reference bait but resembled the overall mortality to the azamethiphos reference bait. In the period of 2-4 hours after the initiation of bait exposure there was a marked increase in the mortality response to the Fipronil Fly-bait gel; and after 4 hours the differences between the overall mortality to methomyl and to Fipronil Fly-bait gel were small and no longer significant. This was the situation in both the non-choice trials and the choice trials. The overall mortality to the azamethiphos bait was generally smaller.

In the non-choice trials the overall mean mortality after 48 hours was above 95% to all three toxic baits. In the choice trial the overall mean mortality to the azamethiphos bait was 61% after 48 hours, whereas the mean mortality to the methomyl bait and Fipronil Fly-bait gel was 95% and 98%, respectively.

The flies were killed more slowly by Fipronil Fly-bait gel than by the reference baits. Approximately 20% of the flies killed by Fipronil Fly-bait gel were recorded close to the bait in the receptacles, whereas approximately 60% of the flies killed by the azamethiphos-bait or the methomyl-bait were recorded close to the bait.

M. Knorr and J. B. Jespersen

6.1.2 Field evaluation of triflumuron-impregnated targets for control of the housefly *Musca domestica* and the stable fly *Stomoxys calcitrans*

The efficacy of triflumuron-impregnated targets when exposed to adult flies was evaluated under field conditions. The targets were used in the animal holding facilities on four farms for control of the housefly, *Musca domestica*, and the stable fly, *Stomoxys calcitrans*. The trials went on for a whole housefly season in Denmark, running from May to the end of September. The control effect was evaluated by monitoring of the number of flies in the trial units, throughout the season. This was done once a week by estimation of the number of flies by direct observation, using the "DPIL Fly Index" method and by use of sticky traps.

The targets were impregnated with an average amount of triflumuron of 3 g a.i./m^2 target and with sugar. Two farms, H1 and H2, were treated with a high number of targets and two farms, L1 and L2, were treated with a low number of targets. The amount of impregnated target surface per 100 m^2 stable ground area was 26×0.15 m^2 on the H-farms and 13×0.15 m^2 on the L-farms. Two more farms, C1 and C2, were included as untreated controls. Application of the targets was made in mid May on all the farms and replacement of old targets with new targets later in the trial period was made on one farm (H1).

In the four livestock units of the two H-farms the fly pressure was high when the target treatment was initiated. In three of these units it was not possible to obtain a sufficient control, and in one unit the treatment may have resulted in part of the reduction in the number of flies. The 1998 fly season was exceptionally cold, and in the livestock units having indoor temperatures depending on the outdoor weather, the housefly populations did consequently not reach as high nuisance levels as usual. In the livestock units of the L-farms the targets were placed while the population size was still low after the winter. A common feature of the L-units was that the indoor temperature was quite depending on the outdoor temperature. The cold 1998 fly season was therefore an important factor in limiting the housefly pressure in the L-farm units during the trial season, but the temperature was probably not the only major reason. In two trial units with nursing sows, the infestation level would presumably have been higher without insecticide control.

The impregnated targets may limit reproduction in the housefly populations to a certain extent, but the method needs improvement in order to be satisfactorily effective. In heavily infested livestock units it was not possible to detect any effect of the targets even though a high number of targets was used. In livestock units where the fly production was limited due to low temperature, the targets may have been an important factor for obtaining satisfactory, low infestation levels. This was probably the case in some of the livestock units. But due to the cold summer the results in general were inconclusive as it was not possible to weigh the relative importance of cold weather effect and impregnated target effect.

The impregnated targets did not control the populations of stable flies, *Stomoxys calcitrans*, at all.

M. Knorr and J. B. Jespersen

6.1.3 Laboratory tests with fiprole RP782 against susceptible and resistant strains of the housefly *Musca domestica*

We evaluated the insecticidal effect of the fiprole RP782 on various laboratory strains of *Musca domestica* with topical application and feeding bioassay. The susceptible level of RP782 was determined in the susceptible reference strain WHO. The potential of cross-resistance was evaluated in five insecticide-selected laboratory strains with different patterns and levels of resistance to organochlorines, organo-phosphates, carbamates and pyrethroids.

Three of the highly insecticide-resistant strains ($39m_2b$, 381zb, 698ab) were susceptible to RP 782, one strain (690ab) had a low level of cross-resistance, and one strain (17e) was highly resistant to RP 782.

The lindane-resistant strain (17e) showed a high level of cross-resistance to topically and orally applied RP 782. The resistance mechanism involved was probably reduced sensitivity of the fiprole and lindane target site, the GABA-gated chloride channel and/or an increased metabolism of both structurally unrelated insecticides. A common resistance mechanism based on metabolism is not very likely since other resistant strains, which are characterized by increased general metabolism of xenobiotic compounds, are susceptible to RP 782. It is more likely that an increased general metabolism of the lindane-resistant strain has a multiplicatory effect on a target site-based resistance mechanism.

M. Kristensen and J. B. Jespersen

6.2 Insecticide resistance in *Musca domestica*

6.2.1 Route of uptake of CGA-293 and azamethiphos in a susceptible and multi-resistant strain of the housefly *Musca domestica*

The purpose of this investigation was to evaluate the route of uptake of CGA-293'343 in houseflies. This was analysed by comparing of the toxicity of CGA-293'343 and azamethiphos by tarsal contact test, topical application bioassay, standard feeding bioassay and forced feeding bioassay in the susceptible strain WHO and the multi-resistant strain 381zb.

Azamethiphos performed better compared to CGA-293'343 when applied topically to both susceptible and resistant houseflies. When applied topically in susceptible strains, azamethiphos was about >10 times more effective to kill similar amounts of houseflies. CGA-293'343 was more toxic and faster acting than azamethiphos in the tarsal contact bioassay in both susceptible and multi-resistant houseflies. The efficacy in the standard feeding bioassay of the two insecticides were almost identical, with azamethiphos showing an advantage in the immediate knockdown. Azamethiphos was more toxic than CGA-293'343 in the forced feeding bioassay in both susceptible and multi-resistant houseflies.

The differences in toxicity of CGA-293'343 and azamethiphos in the tarsal contact and the forced feeding bioassays thus seem to equal each other out, when tested in the combined standard feeding bioassay. Taken into consideration, that both products have different modes of action, this underlines the potential of CGA-293'343 as an important part in resistance management programs.

M. Kristensen and J. B. Jespersen

6.2.2 Resistance tests in housefly populations on Danish farms

To improve the use of existing insecticides and delay the onset of resistance and treatment failures, it is important with regular surveys to establish the real extent of insecticide resistance, even for species with an extensive resistance history. Regular surveys of resistance to insecticides of interest in relation to housefly control in Denmark have been carried out for many years at DPIL by collection of houseflies on farms in various parts of the country and tests of resistance on their offspring. Aerosols or space sprays with either pyrethrum or bioresmethrin both synergized with piperonyl butoxide, commonly used for housefly control, are still effective on most farms in Denmark, but give only temporary control. Residual synthetic pyrethroids are not allowed for housefly control on farms in Denmark. More widely used are persistent insecticide treatments, which are performed by paint-on baits with organophosphates, mainly azamethiphos or stick-on baits with the carbamate methomyl. Residual sprays with dimethoate are still registered for housefly control in Denmark. Larvicides containing the insect development inhibitors diflubenzuron or cyromazine were effective where breeding places could be treated properly. Larvicide usage is increasing in Denmark.

M. Kristensen and J. B. Jespersen

6.2.3 Resistance mechanisms of houseflies

Sixty-three individuals from each of our laboratory strains were assessed for activity towards the glutathione *S*-transferase substrates 3,4-dichloronitrobenzene (DCNB) and 1-chloro-2,4-dinitrobenzene (CDNB), the general esterase substrate ρ-nitrophenyl butyrate (ρNPB), and the P450 dependent monooxygenase substrate ρ-nitroanisol (ρNA). Specific activity towards the AChE substrate ATCI was measured in 63 individuals from each strain. The effect of three inhibitors, azamethiphos, methomyl and omethoate was also measured on each fly tested. The results gained showed many different insecticide resistance phenotypes.

M. Kristensen and A. Spencer

6.2.4 Laboratory strains kept in 1999

At the end of 1999, DPIL kept 21 strains representing a wide variety of resistance mechanisms and origins for use in testing and research work. A list of the strains and their origins is given in Table 6a. In all these strains, the resistance originated in the field. In several strains, selection with one (or two) insecticide(s) is carried out between one and four times a year in order to maintain the particular resistance.

As has been the case since the beginning of our investigation of resistance in houseflies in 1948, all our strains are available to laboratories that wish to use them for research, development of new insecticides, etc. This has assisted international research on insecticide resistance and given us useful feedback on our resistance problems.

J. B. Jespersen and M.Kristensen

Table 6a. Laboratory strains of *Musca domestica* maintained during 1999

	Strain	Origin	Year	Remarks	Lab pressure
1.	*Strains subjected to periodic insecticidal pressure (adult dipping, exposure to vapour, or feeding with treated sugar) from a compound to which at least part of the population showed clear resistance at the time of collection*				
	17 e	DK	1950		lindane
	150 b	DK	1955		diazinon*
	39 m_2b	DK	1969		tetrachlorvinphos*
	49 r_2b	DK	1970		dimethoate*
	381 zb	DK	1978		permethrin and dimethoate*
	690 ab	DK	1984		methomyl feeding*
	594 vb	DK	1988		azamethiphos feeding*
	213 ab	Sweden	1957	Pyr-R	pyrethrins/pbo*
	571 ab	Japan	1980	High OP-R	fenitrothion
	698 ab	Burma	1985	(not kdr)	DDT
	790 bb	DK	1997		diflubenzuron
	802 ab	DK	1997		cyromazine
	807 ab	DK	1997		diflubenzuron
2.	*Originally resistant field strains kept without insecticidal pressure*				
	7	DK	1948	Reverted DDT-R	None
	772 a	DK	1989	Common lab. test strain	None
	791 a	DK	1997	Multi-R	None
3.	*Susceptible strains*				
	BPM	Leiden	1955		None
	WHO Ij_2	Pavia	1988		None
	NAIDM	Texas	1991		None
4.	*Strains with Resistance mechanisms isolated*				
	A_2bb	DK	1982	Super-kdr Chr. 1, 2 and 3 with marker genes	None
	LPR	USA	1995	Pyr-R kdr, P450 monooxygenase	None

* Some resistance to various (other) OP compounds and to DDT

6.3 Biological control of *Musca domestica* and *Stomoxys calcitrans*

6.3.1 Parasitic wasps

The housefly, *Musca domestica* L. and the stable fly, *Stomoxys calcitrans* (L) are common pests on most livestock facilities in Denmark. The flies are a nuisance to animals as well as to humans and are potential vectors of diseases. Demands by farmers and the public for alternative or supplementary methods to control flies instead of the use of insecticides have increased steadily within the last twenty years - mainly because of the risk of insecticide residues in the animal product, the contamination of the environment and the fact that the flies develop resistance to some (or maybe all) insecticides in use. One alternative method is biological control, where natural enemies are mass-released to suppress the fly populations below nuisance levels.

The results of the three first years of a project (funded partially by the Ministry of Food, Agriculture and Fisheries, 1996-2000) to evaluate the possibilities of using pupal parasitoids (2-3 mm in size) for control of houseflies and stable flies are summarized here:

1: A full description of the species composition and seasonal activity of pupal parasitoids on pig and cattle farms in the country.

2: Two promising parasitoids, *Spalangia cameroni* and *Muscidifurax raptor*, have been isolated on the basis of primarily their high, relative abundance and activity in the field. *Spalangia cameroni* is the dominant species at indoor sites and *M. raptor* outdoors.

3: Life-history characteristics, like fecundity, survival, sex-ratio have been described for *S. cameroni* at constant temperatures. Maximum fecundity for the parasitoid lies in the temperature regime 25-30°C and with lowest fecundity close to 15°C. Survival declines with increasing temperatures, approx. 80 days at 15°C and approx. 10 days at 35°C. Independent of temperature or age, sex-ratio is female biased with about 60-70% females to males.

4: Movements of *S. cameroni* following mass releases have been studied for two years. The general trend was that females moved little from the point of release (5-8 m). On one occasion when the temperature reached 27-28°C in the stable nearly all released females (males including) dispersed from the system. Therefore, releases should be concentrated near areas of fly development due to the restricted movement of *S. cameroni*. Furthermore, in periods of hot weather or in stable systems with high temperatures there is a high risk that the released *S. cameroni* will disappear from the system with a consequently little effect on the fly populations.

5: Cultures of the most common parasitoids are established at SSL.

This fourth year has concentrated on two major tasks:

Firstly, winter survival of *S. cameroni*, *M. raptor* and *Urolepis rufipes* in stable environments shows that *M. raptor* and *U. rufipes* are able to survive in parasitized fly pupae (only in late larval stage) up to 6 months and without any substantial mortality compared with the initial start population. On the other hand, only a few individuals of *S. cameroni* can survive the winter period on Danish farms. Temperature is of great importance to the number of survivors during a winter period and especially to *S. cameroni* where prolonged periods of low temperatures result in substantial mortality.

Therefore, one conclusion of the study would be that *S. cameroni* has to be released each year if this species is going to have any influence on the fly populations early in the fly season. In contrast if *M. raptor* or *U.*

rufipes are established in the stable system it is likely that only a few releases are needed as supplements to the emerging winter populations of the parasitoids.

Secondly, weekly *S. cameroni* has been mass released on two livestock farms (one with pigs and one with cattle) from April and to October to study the impact on the *M. domestica* and *S. calcitrans* populations. The released parasitoids delayed the population increase of *M. domestica*, and the fly population never reached the nuisance level as was observed on the farms the year before, with no releases of parasitoids. On the other hand, the release of *S. cameroni* had no visible effects on the population development of *S. calcitrans* or their numbers.

Releases with *S. cameroni* are to be continued in 2000 on the same two farms and with the inclusion of one more pig farm.

H. Skovgård Pedersen

6.3.2. *Entomophthora muscae s.l.* in houseflies

Entomophtora muscae s. str. and *E. schizophorae* have been studied in relation to houseflies in Vibeke Kalsbeek's Ph.D. project (see DPIL Annual Reports 1996, 1997 and 1998). The work has been compiled into four manuscripts that have been submitted to international journals. The Ph.D. thesis will be completed in 2000.

V. Kalsbeek, J. B. Jespersen and T. Steenberg

6.3.3. *Entomophthora muscae s.l.* in stable flies

Although stable flies (*S. calcitrans*) and houseflies often co-occur in stables, stable flies have not been reported to suffer infections from *E. muscae s.l.* In a survey of fungal pathogens in stable fly populations, adult flies were collected from four livestock farms in May, and during the peak fly season in August, September and October. Stable flies from all four farms proved to be infected by *E. muscae s.str.* in late summer, and flies from one farm were also infected with *E. schizophorae*. Infection levels ranged between 0.5% and 4%. In contrast, infection rates in houseflies sampled from the same stables reached up to 90%. Laboratory studies in the U.S. have shown *E. schizophorae* to be poorly adapted to stable flies. These field data indicate that this is also the case for *E. muscae s.str.* since 1) the fungus never causes epizootics in stable flies even when abundant inoculum is present due to epizootics in houseflies, 2) in contrast to houseflies fungus-infected stable flies are not attached firmly to the substrate via the proboscis, and infected flies are likely to fall to the ground before they can produce inoculum, and 3) many fungus-killed stable flies only produce scarce amounts of inoculum compared to houseflies.

T. Steenberg

6.3.4. Hyphomyceteous fungi

A number of fungal isolates were tested against adult houseflies in immersion tests. Three isolates were selected for further studies (*M. anisopliae*, *B. bassiana* and *P. fumosoroseus*). All caused 100% mortality within 6 days (mean lethal time 4 days). Similar tests with adult stable flies unfortunately had to be cancelled due to problems with unacceptable levels of mortality in controls.

Eight isolates were tested in bait experiments against adult houseflies. Conidia were mixed with sugar and supplied to flies that also had access to uncontaminated sugar as well as water. Six of the eight isolates caused mortality under these experimental conditions. The cumulated mortality only reached a maximum of 40%, but this will probably be increased if higher doses of spores are used and/or the period of time with access to the fungus bait is prolonged.

T. Steenberg and J. B. Jespersen

7. Flies on pastured cattle

7.1 Effects of synthetic pyrethroids against *Neomyia cornicina* (Fabricius)

In cooperation with Dr. C. Sommer, The Royal Veterinary and Agricultural University, Copenhagen a study was conducted to evaluate the effects against the non-target dung fly *Neomyia cornicina* (Fabricius) (Diptera: Muscidae) of synthetic pyrethroids given as pour-ons to cattle. The dung from calves treated with synthetic pyrethroids negatively influences - in varying degrees - survival, reproduction, size and behaviour of the common dung fly *Neomyia cornicina*. This was documented in assays where the larvae and imagines of *N. cornicina* were exposed to dung collected from calves treated with recommended pour-on doses of deltamethrin, flumethrin, cyfluthrin, or α-cypermethrin. With some of the pour-ons pre-imaginal mortality was significantly increased in dung collected up to at least 7 days after treatment. Nulliparous flies given 6-day access to dung collected 3 days after treatment with α-cypermethrin or deltamethrin showed little or no ovarian development (tendency for a comparable effect of flumethrin). The study strongly indicates that the use of synthetic pyrethroids affects the insect dung fauna. A paper on the subject is submitted.

K.-M. V. Jensen and J. B. Jespersen

7.2 Microbial control of flies on pastured cattle

This project, inititated in 1997, has now reached the stage where fungal isolates are screened in the laboratory for activity against adult face flies (*Musca autumnalis*) and horn flies (*Haematobia irritans*). Due to problems with high control mortality in the latter species, all tests in 1999 were made with *M. autumnalis*. Male and female flies were immersed in spore suspensions of ten different fungal isolates. At a concentration of 1 x 10^7 spores per ml, an isolate of *Metarhizium anisopliae* was the most virulent against both male and female flies, and caused mean mortalities of 56% and 88%, respectively, after 7 days. It appeared that females in general were more susceptible to infection compared to males. The tests will be repeated in the following year. In contrast to the results from the immersion test, isolates of *Beauveria bassiana* and *Paecilomyces fumosoroseus* caused the highest mortality when fungi were applied as inoculated sugar baits.

T. Steenberg, K.-M. V. Jensen and J. B. Jespersen

8. Mosquitoes

8.1 The effect of ultrasound on the behaviour of mosquitoes

Despite lack of scientific evidence, equipment is being sold that claim to repel mosquitoes based on the emission of ultrasound. An experimental set-up was designed by Eric Valverde at the Technical University of Denmark in collaboration with DPIL to investigate the possible repellent effect of ultrasound on mosquitoes. Mosquitoes (*Aedes aegypti* and *Culex* sp.) were confined in small cages and exposed to mono-frequency sound pulses with variable pulse length and sound intensity, and the behavioural response of the mosquitoes was observed on video. A frequency range from 400 Hz to 40 kHz was covered in the experiments.

The mosquitoes showed no behavioural response to the ultrasound stimulation at all (intensities up to 100 dB). A slight attractive response was observed when male mosquitoes were stimulated with low frequency sound (400-500 Hz). This is a well known response of male mosquitoes to the flight tone of female mosquitoes. The conclusion of the study is that ultrasound produces no clear behavioural response in mosquitoes, and thus there is no indication that commercial ultrasound devices could be effective in repelling mosquitoes.

J. B. Jespersen and O. Kilpinen

9. Lice

9.1 Headlice

The investigation took place from June 1997 to May 1998. Questionnaires were returned from 70% of the pharmacies and 80% of the school health care systems in this country. Of the questionnaires distributed to children from selected schools and institutions in Copenhagen and Silkeborg, parents have replied to 48%.

More than half the school health care professionals are of the opinion that problems with headlice have been increasing within the last five years. Among the children having participated in the investigation, 33% have had lice once or more during the year the inquiry has covered. In many cases also the rest of the family had lice if the child had lice - mainly the mother and/or the younger brothers and sisters.

There are more cases of lice among children aged 3-10 years compared with children aged 11-15 years. Problems with the occurrence of lice are spread all over the year; however, there is still a marked “lice season” in August, September, October and November.

Most often headlice are found among children with rather long or quite long hair compared with children having rather short or quite short hair. In the investigation, a considerably greater part of the girls than the boys had lice. In the light of the material collected, the explanation for this is the fact that there are more long-haired girls than boys. Only among the quite short-haired children, more had lice in the school youth centres compared with children staying in other places after school.

Most parents comply with the request from school or nursery school to examine their children for lice. However, only half of them do this regularly or spontaneously.

The majority of the information about headlice given to parents comes via school health care systems and/or pharmacies. School health care systems and pharmacies mainly receive information about lice from drug producers and the Danish Pest Infestation Laboratory. Both parents, pharmacists and school health care professionals point out that all information and recommendations from authorities and drug producers must be identical.

Pharmacies and school health care systems look for more information about the development of resistance to the lice remedies marketed.

A.-M. Rasmussen

10. Arthropod pests in poultry production

10.1 Litter Beetles

The litter beetles, *Alphitobius diaperinus* (the lesser mealworm), *Typhaea stercorea* (the hairy fungus beetle), *Ahasverus advena* (the foreign grain beetle) and *Carcinops pumilio* are commonly found in Danish poultry houses. These beetles are very difficult to control and often constitute a pest problem. In addition to their role as potential transmitters of human and avian disease, litter beetles can cause structural damage to poultry houses, can cause allergies, and are often a considerable nuisance.

A. Spencer

10.2 The role of litter beetles in the transmission of disease

This year saw the completion of a major three year study with the following specific objectives: (1) to investigate the occurrence, biology and behaviour of the beetles, (2) to develop and implement strategies for the prevention and control of the beetles, and (3) to investigate if persistent infections with *Salmonella* or *Campylobacter* are related to the occurrence of beetle infestations. The project involves collaboration between the Danish Veterinary Laboratory, the Danish Poultry Meat Association, the Danish Pest Infestation Laboratory (project co-ordinator), and many veterinarians and poultry meat farmers. The conclusions of the report are detailed in the final project report.

Most of the major conclusions of this study are detailed in the 1998 DPIL Annual Report.

Work will continue into the role of insects (including litter beetles) in the transmission of disease to livestock animals.

A. Spencer

10.3 Insecticide resistance in litter beetles

Our earlier work indicated that in many poultry facilities, litter beetles were apparently surviving significant insecticide use. This led us to hypothesize that insecticide resistance may be contributing to the control problems common in these facilities. We therefore carried out a resistance survey of Danish broiler houses. *Alphitobius diaperinus*, *Typhaea stercorea* and *Ahasverus advena* adults from up to 14 farms were analysed by residual exposure to three discriminating doses of five insecticides. This study found no evidence of significant resistance in any of the populations tested. From this we have concluded that resistance is unlikely to contribute to the widespread control failure experienced. Furthermore, the lack of resistance, even in populations from heavily treated houses, probably indicates that beetles are not exposed to the insecticides used.

A. Spencer

10.4 The control of litter beetles

Having concluded that current efforts to control litter beetles are largely inadequate. It is our intention to study the control of litter beetles in more detail in the future in an effort to overcome this problem.

A. Spencer

10.5 Behavioural response of the chicken mite to host-related stimuli

Chicken mites (*Dermanyssus gallinae*) are blood-sucking ectoparasites of poultry. The mites spend most of the time hidden in cracks and crevices in the vicinity of the birds, and they come out to feed mostly during the night. However, preliminary observations have shown that after a few days of starvation mites will also come out to search for a host during the day when stimulated with vibrations. The aim of this study was firstly to determine the frequencies of vibrations most effective in activating the mites, and secondly to investigate how carbon dioxide and vibrations affect the behaviour of chicken mites under different light intensities.

Mites taken from our laboratory culture were isolated in small arenas on plexi glass platforms and starved for at least 4 days prior to the experiments. The mites were stimulated with pure sine wave vibration pulses delivered to the platform on which they were standing, and with pulses of carbon dioxide (approximately 40%) blown on the mites. The experiments were carried out under different light intensities (3 to 80 lux) and the responses of the mites were recorded on video tapes for subsequent analysis.

Video analyses have shown that 2 kHz is the frequency of vibrations most effective at activating the mites. Furthermore, the behavioural response of chicken mites to vibrations and in particular carbon dioxide is highly dependent on the light intensity.

At the lowest light intensity (3 lux), the mites are activated by carbon dioxide as well as vibrations and there is a synergistic effect in case of subsequent stimulation with both types of stimuli: the mites start running fast and they continue to run for a long time, giving the impression that they are searching for a host.

At the highest light intensity (80 lux), carbon dioxide alone can have a weak, activating effect on resting mites. Already active mites react to carbon dioxide with a freezing response: they stop and remain motionless for a variable period. Vibration pulses activate the mites mostly during the pulse but also to some extent in between pulses. In the case of subsequent stimulation with both types of stimuli, the mites react to carbon dioxide with the freezing response and are activated by vibrations, but only for the duration of the pulse - as soon as the vibrations stop, the mites stop moving.

This behavioural response pattern is interpreted as a protection mechanism against being eaten by the potential host. A blow of carbon dioxide simulating the breath of a bird indicates that the bird might have seen the mite moving and therefore the best chance of surviving is to stop and remain motionless. A motionless mite, being no more than 1.0 mm long, is very difficult to see, particularly because birds usually see moving objects the best. Subsequent vibrations indicate that the bird is moving with its attention no longer on the mite and therefore it is relatively safe to keep searching for the host.

This is a behaviour that has never been described before, but it could be common among other ectoparasites having to approach a potential host during day time.

O. Kilpinen

10.6 Activation of chicken mites by a temperature gradient

Ten adult female mites were placed on each experimental platform and kept under a reversed day/night rhythm. All experiments were performed during the dark period on mites which had been starved for 5-8 days. The mites were stimulated with heat by a lamp underneath the platform The light bulb was controlled from a computer outside the room through a relay and a rheostat. A synchronous signal was sent to an LED placed next to the experimental platform, visualising stimulation periods on the video recordings. The behavioural reaction was recorded on video tape throughout the experiments.

Before and after each test, the temperature gradient was measured on an identical platform with a temperature probe fixed to the surface. The average temperature gradient (before and after stimulation) was assigned to each test.

By recordings of the fraction of mites being activated by the temperature gradient it was possible to estimate a threshold value of 0.005°C/sec. necessary for the activation of chicken mites. The results showed that temperature changes are an extremely effective activating stimulus which could be employed in the development of future control methods as a way of increasing the exposure to a control agent.

O. Kilpinen

10.7 Influence of parasitic infestations on the behaviour and health of laying hens (*Gallus gallus domestica*)

There has been conflicting reports about the effects of ectoparasitic chicken mites (*Dermanyssus gallinae*) and endoparasitic nematodes (*Ascaridia galli*) on livestock poultry. Therefore, experiments were initiated to investigate this question in collaboration with the Royal Veterinary and Agricultural University in Copenhagen.

Six experimental rooms each with 15 hens were installed at the RVAU. Two groups were infested with *D. gallinae* (D-groups), two groups were infected with *A. galli* (A-groups) and two uninfested groups were kept as control (C-groups). All groups were weighed weekly, and blood samples were taken three times during the experiment. Behavioural observations were made continuously, and video surveillance was carried out during the night. The infestation levels of ecto- and endoparasites were under continuous surveillance.

The chicken mite population showed an exponential increase to a peak level where the nuisance to everybody (man and animal) was so high that barriers were made of insecticides applied to the walls and in adjacent rooms in order to restrict the movement of the mites. However, this also had the effect that the mite population levelled out and partly decreased towards the end of the experiment.

At the peak of the mite infestation, the D-groups showed clear signs of anaemia as the average, packed cell volume was only 0.16 compared with 0.24 in the C-groups and 0.23 in the A-groups. Furthermore, the concentration of haemoglobin in an average blood cell was lower, and the volume of an average blood cell was higher. This indicates that the hens were losing blood (due to the mites) and that they compensated for it by increasing the production of erythrocytes. New erythrocytes are larger and have a lower concentration of haemoglobin than mature erythrocytes. At this time in the experiment, 6 out of 15 birds (40%) died within 6 days in the most heavily infested room. But the experiment was continued as the mite pressure levelled out, and the hens recovered.

Both treatments resulted in a significantly lower body weight. Almost from the initiation of the chicken mite infestation, the hens in the D-groups stopped gaining weight, and at the time when the mite population increased rapidly, the hens actually lost weight.

Behavioural observations showed that mite infested hens spend significantly more time with light feather picking activity - probably due to the mites running on the feathers and on the skin. This was observed both during the day and during the night. In one observation, on the average the hens in one of the mite infested rooms spent half the night with this activity, compared with 5-10% in the other groups.

No significant changes were observed in the immunological blood parameters, but this might be due to a large variation within the groups.

These studies clearly showed the massive impact that large populations of mites can have on the behaviour and physiology of hens. It is obvious that mite infestations must be controlled in order to improve the health and welfare of infested poultry.

O. Kilpinen

10.8 Preliminary screening of fungal isolates for control of chicken mites

As a preliminary screening, adult female chicken mites were exposed to spore suspensions of six different fungal isolates; two isolates of *Paecilomyces fumosoroseus*, two isolates of *Metarhizium anisopliae* and two isolates of *Beauveria bassiana*. The most promising candidate was an isolate of *B. bassiana* that caused 85% control within eight days. Further studies will be carried out to reveal in detail the fungal isolates with the best potential for control of chicken mites.

T. Steenberg and O. Kilpinen

11. Stored product pests

11.1 Official examination of consignments 1999

DPIL examines consignments of grain and other dried plant products intended for export. Based on the results of these examinations the Plant Directorate of the Ministry of Food, Agriculture and Fisheries issues a phytosanitary certificate for countries requiring such certification. In 1999 a total of 827 consignments was examined: 127 lots of grain, 124 lots of malt, 99 lots of dried peas, 99 lots of tobacco and 378 consignments of other products, mainly potato starch. Live insects were found in less than 1% of the consignments, all of them in lots of grain and malt. The following pest species were detected: *Sitophilus granarius*, *Ptinus tectus*, *Tribolium confusum*, *Oryzaephilus surinamensis*, *Cryptolestes ferrugineus*, *Plodia interpunctella*.

L. S. Hansen

11.2 Biological control of the Mediterranean flour moth *Ephestia kuehniella*

Use of natural enemies is a potential solution to problems with the Mediterranean flour moth *Ephestia kuehniella* in industrial flour mills. The aims of the present project is to identify candidate species for biological control of *E. kuehniella* and to describe appropriate application strategies. Two natural enemies are the subject of investigations, and important aspects of the biology of these two species have been studied during the past year.

A colony of an egg parasitoid, received under the name *Trichogramma evanescens* Westwood, “Lager” strain, has been subjected to intensive studies within this project since 1998. However, during the course of 1999 it was discovered that the strain had been misidentified. A test conducted at Wageningen Agricultural University, The Netherlands, using molecular methods revealed that the true identity of this strain is *T. turkestanica* Meyer. Thus, previous references to this species in DPIL Annual Reports from 1997 and 1998 must be read as *T. turkestanica*.

Investigations with *T. turkestanica* in 1999 were aimed at determining the age-specific fecundity and survival at four constant temperatures: 15°C, 20°C, 25°C and 30°C. The female fecundity was 67, 76, 82 and 40 eggs per female at 15°C, 20°C, 25°C and 30°C, respectively. The longevity of adult females ranged between 32 days at 15°C and 2 days at 30°C. Based on these and previous data the intrinsic rate of natural increase (r_m) at the temperatures used was found to be between 0.09 and 0.40. Furthermore, the studies were designed so that they included determination of the rate of host-feeding, i.e. the number of host eggs that are destroyed when the female punctures the host egg with its ovipositor and subsequently feeds on the fluids from the wound. The host-feeding rate was surprisingly high. For example, at 20°C it comprised 50% of the total mortality of the host eggs. Thus, host-feeding is an important factor in the total effect of *T. turkestanica* on a pest population. Furthermore, the investigations showed that *T. turkestanica* can be expected to be actively parasitising host eggs at temperatures as low as 15°C to 20°C, temperatures which are common in Danish flour mills during the spring.

Investigations on the biology of the other species of natural enemy included in the project, the predatory mite, *Blattisocius tarsalis,* on eggs of *E. kuehniella* have continued. As the development of this species has previously only been investigated at temperatures between 25°C and 27°C, investigations of the development rate were conducted at 15°C, 21°C and 25°C. Within this temperature regime the relationship between development rate and temperature could be described by means of linear regression, which will facilitate the incorporation of the data in a simulation model. The results were in agreement with published data on the development time at 25°C and 27°C. A calculation of the thermal threshold for development was in accordance with previous observations on thresholds for activity and predation.

The fecundity of *B. tarsalis* was investigated at 15°C and 21°C. At 15°C, virgin females copulated, but failed to reproduce, but females which had oviposited at 25°C could also do so when transferred to 15°C, but at a low rate. At 21°C the peak oviposition rate was approximately 1 egg per day, which is lower than other results conducted at 27°C.

Both natural enemies will be used in field trials in 2000.

L. S. Hansen and P. S. Nielsen

11.3 Ecological constraints and spatial distribution of an introduced agricultural pest *Prostephanus truncatus* in natural habitats in West Africa

In the Ph.D. project on the larger grain borer *Prostephanus truncatus*, most of the previous year's activities were continued at the International Institute of Tropical Agriculture in Benin in order to increase the understanding of the ecology of *P. truncatus* outside maize stores. Vegetational studies were conducted in the Lama Forest. Two software packages have been used for spatial and ecological analyses of pheromone trap catches of the pest in the forest and in nearby maize stores. The vegetation types with the highest catch rates have been identified. Trap catches were generally highest in the most disturbed part of the forest; efforts are being made to identify specific host substrates mainly in this part of the forest. A predictive climate driven-model has been established to simulate changes in flight activity of the pest. Temperature was found to be an important factor for the occurrence of *P. truncatus* in traps.

Woody substrates were sampled intensively in the field and tested for their susceptibilty to *P. truncatus*. In West Africa, the only identified host substrate in forest environments is *Lannea nigritana* (Anacardiacea) previously girdled by Cerambycids. These branches, however, cannot adequately explain the large numbers of adult *P. truncatus* found during monitoring. Screening of potential non-wood substrates (roots and seeds) for *P. truncatus* in the forest was conducted as a subsequent phase to previous screening of woody substrates. The importance of substrate quality (woody substrates compared with maize) on male pheromone production is being studied quantitatively by means of gaschromatography. Preliminary results show that *P. truncatus* males fed on maize produce larger amounts of pheromone than males on wood.

Analysis and publication of the results will be conducted in 2000, which is the final year of the project.

C. Nansen and L. S. Hansen

12. Various other arthropods

12.1 The effect of low oxygen pressure on museum pests

This project aims at determining exposure times necessary for effective control of museum pests after nitrogen treatment (oxygen level 0.3%). The following species and stages were used in the study: *Anthrenus museorum*, all stages; *An. verbasci*, all stages; *Attagenus smirnovi*, eggs, larvae; *At. woodroffei*, larvae; *Ptinus tectus*, larvae, pupae, adults; *Reesa vespulae*, larvae; *Tineola bisselliella*, eggs; *Trogoderma angustum*, eggs, larvae. Exposures were conducted at 25°C and 55% RH with exposure times ranging between 6 and 72 hours.

The results of previous investigations were analysed, and the following conclusions were drawn: In most of the species and stages 100% mortality was obtained within 72 hours of exposure. The test species can roughly be divided into three groups: a relatvely sensitive group containing three stages of *An. museorum*, a relatively resistant group consisting of *An. verbasci* pupae, *At. smirnovi* larvae and *At. woodroffei* larvae, and the remaining species and stages as an intermediate group.

The following species and stages were selected for further studies. *An. museorum* eggs; *An. verbasci* pupae and *T. angustum* larvae. Exposures were conducted at 0.35% oxygen, 20°C and 50% RH. The eggs were exposed for maximum 72 hours, and the pupae and larvae for maximum 96 hours. None of the exposures resulted in 100% mortality. The larvae of *T. angustum* were extremely resistant with almost 50% of the test specimens surviving after 96 hours' exposure.

The investigations are conducted in collaboration with PRE-MAL (J.-E. Bergh) and the Danish Technical University (P. V. Nielsen).

L. S. Hansen and K.-M. V. Jensen

13. Rodents

13.1 Resistance to anticoagulants

13.1.1 Resistance in the brown rat

During 1999 a total of 548 brown rats (*R. norvegicus*) were received for anticoagulant resistance testing. New municipalities where resistance has been found are: coumatetralyl in Skjern (Jutland) and Stenlille (Zealand), and bromadiolone in Brøndby (Zealand).

J. Lodal

13.1.2 Population effects of anticoagulant rodenticide resistance in brown rats

Resistance to anticoagulant rodenticides has pleiotropic effects that can decrease the fitness of resistant rats compared to non-resistant rats when anticoagulants are no longer used. Thus, it can be hypothesized that resistance will disappear from the population if no anticoagulants are being used. In order to investigate this, a Ph.D. project was started in 1998 with experimental populations of resistant rats that were established with wild rats trapped in two localities in Denmark. These populations will be submitted to treatments with or without anticoagulant rodenticides, in order to investigate how the prevalence of resistance will change over time and how the resistance genes spread through the population.

Resistance in this project is determined by the use of the Blood Clotting Response (BCR) test. With microsatellite markers it will be possible to measure an individual's reproductive success as their contribution into next generation of rats can be traced, and thereby obtain a measurement of the individual fitness in relation to its state of resistance. Furthermore, we will measure changes of genetic composition due to the environmental selection over successive generations. All samples collected during 1999 from the four experimental populations are being typed with a total of 18 microsatellite markers in order to produce DNA profile of each individual rat. The molecular work is conducted at the DNA-laboratory, Department of Evolutionary Biology, Institute of Zoology, University of Copenhagen. The project will be running until August 2001.

A.-C. Heiberg

13.1.3 Implementing blood clotting response test for detection of anticoagulant rodenticide resistance

During 1999 a total of 161 rats were tested for bromadiolone resistance by means of the blood clotting response (BCR) test. Of these, 81 (40 females and 41 males) were then tested in a 0.005% feeding test in order to evaluate the power of the BCR test and finally to see if the BCR test will be able to replace the feeding test in most cases.

The BCR test is based on dosing of small amounts of anticoagulant together with menadione sodium bisulphite (MSB), a synthetic source of a vitamin k derivate, which can be utilised by resistant rats only. The animal’s blood clotting time is measured before and after dosing the anticoagulant. Increase in clotting time indicates an effect on the rat by the anticoagulant poison, whereas an unchanged clotting time indicates that the animal has not been affected significantly. Such rats will be considered resistant.

Survival of BCR declared resistant rats in the feeding test was correlated to the percentage clotting activity (PCA) of the animals. A *T-test* revealed no statistical significant difference between mean PCA of rats surviving or dying in the feeding test ($p < 0.2085$). The data for males and females, respectively, show that survivors' mean PCA did not differ from the PCA of the non-survivors (males, $p< 0,3940$; females, $p<$ 04282), see Table 13a below.

The survival in the feeding test did not correlate with the BCR test. However, the survival rate in the feeding test is strongly influenced by the length of the test (six days), and thus the feeding test is most likely to underestimate the level of resistance as rats being heterozygous for the resistance genes will probably die in a feeding test. The heterozygous rats will be detected in the BCR as this test is more sensitive. A better correlation between the two tests will probably exist if the feeding periods are shortened to four days (H. J. Pelz, pers.com)

Some preliminary conclusion can be drawn from these experiments. All rats known to be susceptible (22 control rats were included, they do not appear in Table 13a) were identified as susceptibles in the BCR (all had a PCA below 10%), and all 22 rats died shortly after the BCR test due to anticoagulant poisoning. Thus truly susceptible rats are easily identified by the use of BCR. However, we were not able to distinguish between degrees of resistance using BCR, only to identify the individuals carrying one or two copies of the resistant gene. Compared to the feeding test, this gives an opportunity to detect resistance, before it becomes a control problem.

Table 13a: Mean PCA calculated using PCA_4/PCA_0 x 100, where PCA_4 is the PCA after the administration of anticoagulant and PCA_0 before the administration.

		N	Mean PCA	SE	*p* (t-test SAS)
Females:					
	Survivors	18	108.11	6.4	
	Non-survivors	22	104.86	7.0	*0.4282*
Males:					
	Survivors	22	90.50	4.92	
	Non-survivors	19	84.10	6.42	*0.3940*
Total:					
	Survivors	40	98.43	4.15	
	Non-survivors	41	95.24	5.0	*0.2085*

A.-C. Heiberg

13.2 Other work on rodents and rodent management

13.2.1 Feeding decisions as an anti-predation strategy in the African multimammate rat

In an ongoing research project in Tanzania, populations of African Mastomys rats are submitted to different replicated predation treatments (predators excluded, predators allowed, and predators attracted). Any observed effects in that project could be due to direct effects of predation on survival, but also due to indirect effects caused by the rodents' individual reactions to the changed risk of predation. In order to investigate whether the differences in predation pressure are apparent to the individual rodents living in these areas, a number of experiments has been set up as an M.Sc. project.

In this project, the feeding decisions of the rodents are measured with a method known as the "giving-up-density"-method. For this method, a known amount of millet seeds was mixed with sand in a tray, and six trays were placed in each of the 10 study fields. Rodents that visit these trays during night were expected to search and remove seeds from the sand, until the density of the grains becomes so low that they no longer consider the profit of searching for more grains to balance the risk of doing so. The hypothesis was that animals in the fields, from which predators were excluded, would continue searching for the seeds in the trays to a lower final density, than in the fields where predators could hunt. Simultaneously, a number of the seed trays was monitored by a video camera in order to observe difference in the feeding behaviour of the rodents. Data collection was carried out at the Sokoine University of Agriculture in Morogoro, Tanzania from October to December 1999.

K. Mohr

13.2.2 Population ecology of the African field rat *Mastomys natalensis*

S. Vibe-Petersen continued the data collection for the Ph.D. project ”Predation pressure and population dynamics in African *Mastomys* rats: possibilities for integrated pest management?” at Sokoine University of Agriculture in Morogoro, Tanzania. The study began November 1997 and will terminate October 2000. *Mastomys* rats are common agricultural pest species in Sub-Saharan Africa. In an attempt to look for alternative methods of control than use of rodenticide, this study is a follow-up on previous results, which have indicated that predation may be an important mortality factor of the species. The aim of the study is to evaluate the effect of either attracting avian predators or excluding predators from maize-cultivated field plots of ½ ha (see also Danish Pest Infestation Laboratory, Annual Report 1998 for explanations on the set-up).

Preliminary analyses of the rodent CMR-data from the first trapping year indicate that the return rates of females in several months are lower in predator-attracted areas than in predator-excluded or control areas. This may indicate that females in predator-attracted areas have a lowered survival. Further, during the reproductive period it seems that reproducing females are trapped for a longer period in predator-excluded and control areas than in predator-attracted areas. Possibly this means that females in predator-attracted areas have a lowered reproduction. Analyses of frequency of raptor pellets have shown a clear correlation between pellet numbers and rodent population size. This suggests a numerical response of raptors to the rodent population.

Although there are some indications of an indirect effect of predators on the rodents, the rodent population dynamics still follows the usual seasonal variation that is known from literature, and no marked differences according to treatments of the plots are yet obvious. It is possible, however, that long-term exposure to increased predation risk may show a delayed effect in the rodent population dynamics and/or that the rodents are able to compensate for the increased predation pressure. Thus at present, the question of the effect of perch poles and nest boxes are still left open.

A second study, ”Population dynamics of *Mastomys natalensis* in different habitats: an experimental and modelling study” was undertaken as a Ph.D. study at the University of Antwerp (Belgium) with supervision from DPIL. The population dynamics of these rats are investigated in capture-recapture set-ups on a 3 ha field-fallow mosaic and a 1 ha maize mosaic. Recolonization of maize fields after control is studied on a set of additional experimental maize fields. The field work continues with monthly captures until mid-2001.

H. Leirs and S. Vibe-Petersen

13.2.3 A population dynamics model for rodent management in Africa

Rodents of the genus *Mastomys* are common in sub-Saharan Africa. They are important pests in agriculture, both in field crops and in post-harvest storage, as well as in public health, carrying diseases like Lassa fever and plague. Their population dynamics is characterized by irregular large fluctuations, both intraannually and interannually. In order to organize rodent control more efficiently, it is necessary to understand how and why the population sizes change and, if possible, to predict them.

We used already available robust capture-mark-recapture (CMR) data from several localities in East Africa to analyse *Mastomys* demography in detail, using state-of-the-art multi-state CMR statistics. The obtained estimates were used to parameterize a population dynamics model, building on a model developed at DPIL before. The population dynamics model was tested for its sensitivity to variations in parameter values and predictions of the model were verified with observed rodent densities from several existing time series from Tanzania. In the near future, the model will be verified for other parts of East Africa.

In order to refine the parameters of the model for reproduction and early survival, a colony of *Mastomys natalensis* rats was established at DPIL, and information was collected about their reproductive output.

H. Leirs

13.2.4 Search for the natural reservoir of Marburg virus

In early 1999, in the region of Durba, Democratic Republic of the Congo, an outbreak occurred of a hemorrhagic fever. After identifying the cause of the disease as Marburg virus, a relative of Ebola virus, the World Health Organisation decided to send out a research equipe in May. In order to identify the still unknown natural reservoir of the virus, an Ecological Investigatory Team was established with participants from the National Institute of Virology, South Africa, Centers for Disease Control, USA, Institut Pasteur, France, and DPIL. The mission was to be based on the simple assumption that the majority of cases of Marburg disease were arising as primary infections in the Gorumbwa goldmine, and therefore likely reservoir hosts were to be sought in the mine and its immediate environments. The aim was to trap and sample potential vertebrate hosts (rodents, bats) found in and around the mine. In total, 165 specimens belonging to 14 species were collected, most of them bats. Laboratory investigation of the collected blood and tissue samples did, unfortunately, not reveal any indications of the virus.

H. Leirs

13.2.5 Effects of grazing on small mammals in wet meadows

Differences in vegetation structure affect living conditions for small mammals with respect to food quality and quantity, cover against predators, etc. In the framework of a large project to investigate the different grazing systems as a nature management strategy, DPIL and the Royal Veterinary and Agricultural University (Copenhagen) investigate the population ecology and behaviour of rodents under different grazing pressure. The experimental areas are situated in Fussingø, Jutland, and subject to different grazing and/or mowing intensity by sheep or cattle. On six of these areas, a capture-recapture study with monthly trapping was carried out in 1999. The data collection will continue for another year.

H. Leirs

13.2.6 Cable resistance to gnawing

A special cable type for use in structures where rats often occur was tested for resistance against being gnawed and damaged by brown rats. It was compared with a standard cable of the same diameter, about 14 mm. The cables were exposed to singly-caged rats in glass cages. The special cable showed a high degree of resistance to severe damage, whereas the standard cable in many cases was completely destroyed.

J. Lodal

13.2.7 Rat trap

At the request of a Danish inventor a prototype of a special trap for rats was tested in the laboratory. The aim of the test was - through studies of the reactions of the rats to the trap - to find out how to optimize the function of the trap.

J. Lodal

14. List of species maintained at DPIL

The numbers in square brackets [a,b] after some of the species indicate the following: a = the number of strains kept at DPIL; b = the number of resistant strains (if tested); - = no information is available.

ARACHNIDA	**SPINDLER**
Acarina	**Mider**
Lepidoglyphus destructor	Kornmide
Blattisocius tarsalis	Rovmide
INSECTA	**INSEKTER**
Blattaria	**Kakerlakker**
Blatta orientalis	Orientalsk kakerlak
Blattella germanica [5,4]	Tysk kakerlak
Periplaneta americana	Amerikansk kakerlak
Supella longipalpa	Brunstribet kakerlak
Lepidoptera	**Sommerfugle**
Ephestia kuehniella	Melmøl
Plodia interpunctella	Tofarvet frømøl
Tineola bisselliella	Klædemøl
Coleoptera	**Biller**
Anthrenus museorum	Museumsklanner
Anthrenus verbasci	Almindelig tæppebille
Attagenus smirnovi	Brun pelsklanner
Attagenus unicolor (piceus)	Sort pelsklanner
Attagenus woodroffei	Båndet pelsklanner
Oryzaephilus surinamensis	Savtakket kornbille
Ptinus tectus	Australsk tyvbille
Prostephanus truncatus	(intet dansk navn)
Reesa vespulae	Amerikansk klanner
Sitophilus granarius	Kornsnudebille
Stegobium paniceum	Brødbille
Tribolium confusum	Rismelbille
Trogoderma angustum	Smal frøklanner
Trogoderma granarium	Khaprabille
Diptera	**Tovinger (myg og fluer)**
Fannia canicularis [5,-]	Lille stueflue
Haematobia irritans	Lille stikflue
Musca autumnalis	Kvægflue
Musca domestica [23,20]	Stueflue
Neomyia cornicina (*Orthellia caesarion*)	Grøn kokasseflue
Siphonaptera	**Lopper**
Ctenocephalides felis	Katteloppe
Xenopsylla cheopis	Tropisk rotteloppe

MAMMALIA	**PATTEDYR**
Apodemus sylvaticus	Skovmus
Apodemus flavicollis	Halsbåndmus
Mastomys natalensis	En afrikansk gnaver
Mus musculus/domesticus [3,1]	Husmus (lys og mørk)
Rattus norvegicus	Brun rotte
Rattus rattus	Husrotte

15. Publications and reports

15.1 Publications by members of staff in 1999

Bergh, J. E., L. Stengård Hansen, K.-M. Vagn Jensen, P. V. Nielsen, 1999: Lethal exposure times of anoxic treatment of eight species of museum pests. Poster, 12th Triennial Meeting of ICOM CC (International Council of Museums Committee for Conservation), August 29-September 3, 1999, Lyon, France.

Bolbroe, T., L. L. Jeppesen and H. Leirs. Behavioural response of field voles under mustelid predation risk in the laboratory: more than neophobia. Abstracts of the 3rd European Congress of Mammalogy, 29 May - 3 June 1999, Jyväskylä, Finland, p.74.

Van Cakenberghe, V., F. De Vree and H. Leirs, 1999: The bats (Chiroptera) from Kikwit, Democratic Republic of the Congo. Abstracts of the International Symposium on African Small Mammals, 4-9 July 1999, Paris, France, p.27.

Van Cakenberghe, V., F. De Vree and H. Leirs, 1999: A collection of bats (Chiroptera) from Kikwit, Democratic Republic of Congo. *Mammalia*, **63(3)**:291-322.

Carlsen, M., J. Lodal, H. Leirs and T. S. Jensen, 1999: The effect of predation risk on body weight in the field vole *Microtus agrestis*. *Oikos*, **87(2)**:277-285.

Carlsen, M., 1999: The effect of predation on field vole *Microtus agrestis* populations in fragmented forest habitats. Ph.D. Thesis. Danish Pest Infestation Laboratory/University of Aarhus. 143 pp.

Carlsen, M., J. Lodal, H. Leirs and T. S. Jensen, 1999: The effects of predation on winter and spring body weights and onset of reproduction in *Microtus agrestis*. Abstracts, 3rd European Congress of Mammalogy, Jyväskylä, Finland, May 29–June 3, 1999, p. 84.

Denholm I. and J. B. Jespersen, 1999: Overview of insecticide resistance, pp. 26-35 *in* Denholm, I, & P. M. Ioannides (eds): Combating Insecticide Resistance. Proceedings of a Symposium on Combating Insecticide Resistance. Thessaloniki. 125 pp.

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Heiberg, A.-C. and H. Leirs, 1999: Population effects of anticoagulant rodenticide resistance in Norway rats. Abstracts of the 3rd European Congress of Mammalogy, 29 May - 3 June 1999, Jyväskylä, Finland, p. 123.

Heiberg, A.-C. and H. Leirs, 1999: Population effects of anticoagulant rodenticide resistance in Norway rats. Abstracts of the 2nd European Vertebrate Pest Management Conference, 6-8 September 1999, Braunschweig, Germany, p. 26.

Jespersen, J. B., T. Steenberg, O. Kilpinen, and H. Skovgaard, 1999: Arthropod pest problems in organic animal husbandry and methods for their control. Abstract for NJF-seminar No. 303: Ecological Animal Husbandry in the Nordic Countries, Horsens, Denmark.

Jespersen, J. B., T. Steenberg, O. Kilpinen and H. Skovgaard, 1999: Methods for biological control of arthropod pests in organic animal husbandry. Abstract for International Symposium Biological Control Agents in Crop and animal protection, Swansea, UK.

Julliard, R., H. Leirs, N. C. Stenseth, N. G. Yoccoz, A.-C. Prévot-Julliard, R. Verhagen and W. Verheyen, 1999: Survival variation within and between functional categories of the African multimammate rat. *Journal of Animal Ecology,* **68**:550-561

Kilpinen, O., 1999: A poster entitled ”Effects of the chicken mite *Dermanyssus gallinae* on egg layers”. The 17th International Conference of the World Association for the Advancement of Veterinary Parasitology in Copenhagen, Denmark.

Kristensen M., J. B. Jespersen, A. G. Spencer, K.-M. Vagn Jensen, S. E. Jensen, L. M. Hansen, J. Clausen and S. A. Nielsen, 2000: Unødigt højt forbrug af insektgifte. Naturens Verden. Særnummer Februar, 28-31.

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5-1999 Kristensen, M. and J. B. Jespersen: Larvicidal efficacy of dicyclanil in tests with three resistant strains of the housefly *Musca domestica*, 9 pp.

6-1999 Jespersen, J. B. and M. Knorr Lauridsen: Laboratory evaluation of NAF granular formulations for control of the housefly *Musca domestica*, 14 pp.

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16. Evaluation of the efficacy of pesticides and medical and veterinary products

16.1 Pesticides

According to the Danish Act on Chemical Substances and Products (No. 231 of 21 April 1999), the registration of a new pesticide formulation requires documentation of the efficacy of the formulation used according to the directions on the label and under Danish conditions. The National Agency of Environmental Protection makes decisions on registration concerned with the control of the pest in question, but the Agency sends the applications to a hearing at the national laboratories, e.g. DPIL or the Plant Protection Centre. These institutes evaluate the efficacy and possible risks and drawbacks of using the formulation, including the potential for developing resistance and cross-resistance (see Annual Report 1982, p.102).

In 1999, pesticides submitted for evaluation and registration included formulations for control of rodents and various insects, such as houseflies and flies on cattle, fleas, ectoparasites on livestock, ants, cockroaches, storage pests, and household insects generally, as well as insects attacking wood or textiles. Several formulations were recommended for approval, but in some cases it was concluded that more documentation was needed, supplementary tests should be carried out, or it was recommended that, for certain reasons, the formulation should not be permitted for the use requested. The registration authorities generally followed our recommendations.

In 1999, DPIL received, as usual, a steady stream of drafts of new pesticide labels submitted to the National Agency of Environmental Protection for approval. In many cases changes were suggested or required in the directions for use.

16.2 Medical and veterinary products

Medical and veterinary medical products are registered according to a common EU-directive. Guidelines for testing the efficacy of such products have been worked out or is at the moment being established. In 1999, DPIL agreed with the Danish Medicines Agency - who makes decisions on registration of medicinal products - to comment on draft versions of guidelines for testing the efficacy of medical and veterinary products and to evaluate the efficacy and possible risks and drawbacks of using such products. In 1999, we commented on the “Guideline for the testing and evaluation of the efficacy of antiparasitic substances for the treatment and prevention of tick and flea infestations in dogs and cats" and "Guideline for efficacy testing of ectoparasiticides for sheep”. Besides we evaluated the efficacy of several products for control of headlice, ticks and fleas.

N. Bille

17. Formulations approved by the Danish Pest Infestation Laboratory as of 1 March 2000

Fortegnelse over bekæmpelsesmidler anerkendt af Statens Skadedyrlaboratorium 1. marts 2000

Trade name	Active material	Conc.	Company

1 Formulations for fly control (Midler til bekæmpelse af fluer)

I Space sprays for indoor fly control
(Forstøvningsmidler til udsprøjtning i luften til bekæmpelse af fluer i lukkede rum)

(a) Solutions approved for fly control using fine atomization of at least 0.5 cm^3 per m^3
(Opløsninger anerkendt til bekæmpelse af fluer ved fin forstøvning af mindst 0,5 cm^3 per m^3 rum)

Trade name	Active material	Conc.	Company
DLG Staldfluedræber	bioresmethrin	0.20%	AgroDan
	piperonylbutoxyd	0.75%	
Pytoxan Fluemiddel	pyrethrin I & II	0.4%	Bayer
	piperonylbutoxyd	2.4%	
Mortalin Special 86	pyrethrin I & II	0.4%	Mortalin
	bioresmethrin	0.05%	
	piperonylbutoxyd	2.40%	

(b) Aerosols approved for fly control when sprayed for at least 10 seconds (approx. 10 g aerosol) per 30 m^3
(Aerosoler (trykdåser) anerkendt til bekæmpelse af fluer ved sprøjtning i mindst 10 sekunder per 30 m^3 rum (svarende til ca.10 g aerosol pr 30 m^3))

Trade name	Active material	Conc.	Company
Kill-it stald spray N	pyrethrin I & II	0.36%	Bayer
	piperonylbutoxyd	2.16%	

(c) Aerosols approved for fly control when sprayed for at least 7 seconds (approx. 10 g aerosol per 30 m^3)
(Aerosoler (trykdåser) anerkendt til bekæmpelse af fluer ved sprøjtning i mindst 7 sekunder pr. 30 m^3 rum (svarende til ca. 10 g aerosol pr. 30 m^3))

Trade name	Active material	Conc.	Company
Mortalin Special Flueaerosol	pyrethrin I & II	0.40%	Mortalin
	bioresmethrin	0.05%	
	piperonylbutoxyd	2.40%	

Trade name	Active material	Conc.	Company

(d) *Aerosols approved for fly control when sprayed for at least 5 seconds (approx. 10 g aerosol per 30 m^3)*
(Aerosoler (trykdåser) anerkendt til bekæmpelse af fluer ved sprøjtning i mindst 5 sekunder pr. 30 m^3 rum (svarende til ca. 10 g aerosol pr. 30 m^3))

Flue Kvit*	pyrethrin I & II piperonylbutoxyd	0.40% 2.00%	Aeropak
Stald-chock fluespray D	pyrethrin I & II piperonylbutoxyd	0.40% 2.00%	Aeropak
Trinol Turbo jet mod fluer	pyrethrin I & II piperonylbutoxyd	0.40% 2.00%	Aeropak

* Norway only

(e) *Aerosols approved for fly control when sprayed for at least 6 seconds/ blue nozzle or 7 seconds/green nozzle (approx. 10 g aerosol per 30 m^3)*
(Aerosoler (trykdåser) anerkendt til bekæmpelse af fluer ved sprøjtning i mindst 6 sekunder med blå dyse eller 7 sekunder med grøn dyse pr. 30m^3 rum (svarende til ca. 10 g aerosol pr. 30m^3))

Trinol jetfluemiddel	pyrethrin I & II piperonylbutoxyd	0.40% 2.40%	Trinol

II Paint-on baits or treated strips approved for supplementary fly control in animal houses
(Smøremidler anerkendt til supplerende fluebekæmpelse i stalde)

Paint-on baits:

ALFICRON plus	azamethiphos	10%	Novartis
Malure Fluesmøremiddel	methomyl muscalure	1.07% 0.04%	Mortalin
Trinol smøremiddel	propetamphos muscalure	6% 0.04%	AgroDan

Treated strips:

		g per strip	
Malure fluepladder	methomyl muscalure	0.1111 0.0042	Mortalin

Trade name	Active material	Conc.	Company

III Larvicides approved for control of fly larvae
(Larvebekæmpelsesmidler anerkendt til bekæmpelse af fluelarver)

(a) Dosage 1 g a.i. per m²
(Dosering 1 g virkstof pr. m²)

Dimilin	diflubenzuron	25%	KVK
Trinol larvemiddel	diflubenzuron	25%	KVK

(b) Dosage 0.5 - 1 g a.i. per m²
(Dosering 0,5 - 1 g virkstof pr. m²)

Neporex WSG 2	cyromazin	2%	Novartis
Mortalin Cyromazin mod fluelarver	cyromazin	2%	Mortalin

IV Repellents (ear tags) approved for fly control on pastured cattle when two ear tags are attached to each animal
(Afskrækningsmidler (øremærker) anerkendt til bekæmpelse af fluer på græssende kvæg ved påsætning af to øremærker pr. dyr)

		g per tag	
Flectron	cypermethrin	1.02	Fort Dodge

V Repellents (liquids) approved for fly control on pastured cattle
(Afskrækningsmidler (væsker) anerkendt til bekæmpelse af fluer på græssende kvæg)

Renegade Pour-on	α-cypermethrin	1.5%	Fort Dodge
Flusa	α-cypermethrin	1.5%	Pharmacia & Upjohn

2 Formulations for control of fleas on pets and in their surroundings (Midler til bekæmpelse af lopper på kat og hund og i omgivelserne)

(a) Approved impregnated collars to be used in combination with group (c) or (d)
(Anerkendte, imprægnerede halsbånd anvendes kombineret med gruppe (c) eller (d))

Bifopet utøjshalsbånd til hunde til katte	propoxur	10%	Bifopet

Trade name	Active material	Conc.	Company
Lop-A' utøjshalsbånd til hunde til katte	propoxur	10%	Bifopet
Material Shop loppehalsbånd til hunde til katte	propoxur	9.4%	Bayer

(b) *Solutions approved for control of fleas in the surroundings (Sprøjtemidler anerkendt til bekæmpelse af lopper i omgivelserne)*

Gett	chlorpyrifos	0.8%	Dow AgroSciences
Absolut D	diazinon	2%	Bayer

(c) *Aerosols approved for preventive treatment of flea larvae in the surroundings (Anerkendte aerosoler godkendt til forebyggende bekæmpelse af loppelarver i omgivelserne)*

Pre-lop Spray	methopren	0.3%	Bayer

(d) *Pump spray approved for preventive treatment of fleas. The product acts as a flea ovicide when used on pet fur (cats or dogs) (Pumpespray anerkendt som forbyggende loppebehandling. Produktet forhindrer loppeæg i at klække, når katte- eller hundepels behandles)*

Anti-larve spray til katte	methopren	0.5%	Bayer
Material Shop kattespray med methopren	methopren	0.5%	Bayer
Pre-lop til katte	methopren	0.5%	Bayer

3 Formulations for flea control on farmed mink (Midler til bekæmpelse af lopper hos farmmink)

Pulvex	permethrin	1%	Schering Plough
Safrotin 1% D	propetamphos	1%	Novartis

Trade name	Active material	Conc.	Company

4 Apparatus for control of hornets (Midler til bekæmpelse af gedehamse)

Light trap for use in bakers' shops, etc.
(Lysfælde til brug i bagerforretninger, etc.)

Insect-0-Cutor	Elektrisk apparat		Tanaco

5 Apparatus for indoor mosquito control (Midler til indendørs bekæmpelse af myg)

Electric heater with vaporizing mats
(Elektrisk varmeplade med rygetabletter)

Kimo Myggetablet	d-trans-allethrin (S)-d-transallethrin piperonylbutoxyd	0.67% 3.33% 3.00%	Bjørn Hansen

6 Rodenticides for control of mice inside and around buildings (Midler til bekæmpelse af mus i og ved bygninger)

(a) Baits for general use
(Almindelige ædegifte)

Rentokil Klerat Rotteblok	brodifacoum	0.005%	Zeneca
Brota Musekorn	bromadiolon	0.01%	Mortalin
MausEx-Duo	bromadiolon	0.01%	Trinol
Materialshop musekorn D	difenacoum	0.005%	Zeneca
Ratak musekorn	difenacoum	0.005%	Zeneca
Trinol Musekorn	bromadiolon	0.01%	Trinol

(b) Bait for control of mice in or around buildings at temperatures below 16°C
(Ædegift til bekæmpelse af mus i og ved bygninger ved temperaturer under 16°C)

Alta Musepasta	chloralose	4.0%	Mortalin

Trade name	Active material	Conc.	Company

7 Formulations for control of the water vole (*Arvicola terrestris*) (Midler til bekæmpelse af mosegrise)

Bromadiolone concentrate for the impregnation of fresh apple slices used for control of water voles (Bromadiolon-koncentrat til fremstilling af bromadiolon-æbler mod mosegrise)

Brota Koncentrat	bromadiolon	0.25%	Mortalin

8 Rodenticides for control of rats (*Rattus norvegicus* and *R. rattus*) (Midler til bekæmpelse af rotter)

The following 35 products were approved by the Danish Pest Infestation Laboratory as of 1 March 1999. A list of the various products is published by the Ministry of the Environment. It may be obtained from the following addresses: Torben F. Jensen, Miljøstyrelsens Konsulent i Rottebekæmpelse for Jylland, Langdalsvej 38C, 8220 Brabrand, or Peter Weile, Miljøstyrelsens Konsulent i Rottebekæmpelse for Øerne, Strandgade 29, 1401 København K.

(Følgende 35 produkter var pr. 1. marts 1999 anerkendt af Statens Skadedyrlaboratorium. En liste omfattende de forskellige produkter er udgivet af Miljøstyrelsen. Listen kan erhverves ved henvendelse til følgende adresser: Torben F. Jensen, Miljøstyrelsens Konsulent i Rottebekæmpelse for Jylland, Langdalsvej 38C, 8220 Brabrand, eller Peter Weile, Miljøstyrelsens Konsulent i Rottebekæmpelse for Øerne, Strandgade 29, 1401 København K)

Hydroxycoumarines:

Baits (0.0025-0.01%)	*18 preparations*
Tracking powders (0.15%)	*3 preparations*
Solutions (0.005%)	*1 preparation*
Paraffin blocks (0.0025-0.01%)	*12 preparations*
Concentrate (0.25%) for fresh apple	*1 preparation*

9 Formulations for control of the mole (*Talpa europaea*) (Midler til bekæmpelse af muldvarpe)

Pellets containing 56-57% aluminium phosphide are approved for the control of moles. Restricted use. (Pellets med et indhold af 56-57% aluminiumphosphid er anerkendt til bekæmpelse af muldvarpe. Kan kun anvendes af personer, der har fået en særlig tilladelse.)

Trade name	Active material	Conc.	Company

10 Traps for control of rodents (Fælder til bekæmpelse af gnavere)

Trade name	Active material	Conc.	Company
RM Mosegrisefælden	Water vole trap		RM-Service

11 Device to prevent sewer rats entering buildings via waste pipes (Aggregat til forhindring af kloakrotters indtrængning i bygninger via faldstammer)

Trade name	Active material	Conc.	Company
Rottestop	Steel section to be inserted into ordinary waste pipe		SR-Stål

List of companies
Firmafortegnelse

Company Firma	**Address** Hjemsted	**Abbreviation used in chapter 17** Forkortelse anvendt i kapitel 17
Aeropak A/S	Hedensted	Aeropak
AgroDan A/S	Esbjerg	AgroDan
Bayer A/S	Kgs. Lyngby	Bayer
Bifopet Product Aps	Lynge	Bifopet
Dow AgroSciences Danmark A/S	Kgs. Lyngby	Dow AgroSciences
Fort Dodge Animal Health	Belgien	Fort Dodge
Hansen, Bjørn	Hellerup	Bjørn Hansen
KVK Agro A/S	Køge	KVK
Medimerc A/S	Tåstrup	Medimerc
A/S Mortalin	Haslev	Mortalin
Novartis Agri A/S	København Ø	Novartis
Pharmacia & Upjohn Animal Health	København K	Pharmacia & Upjohn
RM-Service/v. Herluf Rosing	Brønderslev	RM-Service
Schering Plough Animal Health A/S	Farum	Schering Plough
SR-Stål A/S	Søborg	SR-Stål
Tanaco Danmark A/S	Esbjerg	Tanaco
Trinol A/S	Nørresundby	Trinol
Zeneca Agro	København S	Zeneca