Ministeriet for Fødevarer, Landbrug og Fiskeri

Statens Skadedyrlaboratorium

Årsberetning Annual Report 2000

Danish Pest Infestation Laboratory

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Årsberetning
Annual Report
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Kgs. Lyngby, Denmark, 2001

The Danish Pest Infestation Laboratory (DPIL) carries out research and compiles information concerning insect pests on livestock, in stables, stocks, buildings and the materials used.

Research also covers rats, mice, water voles and common moles. The objective is to achieve the highest possible level of pest control while minimizing the impact on the environment.

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

DPIL also provides a consultancy service advising on particularly complicated pest problems, for example, on farms, in the food industry and in homes.

Statens Skadedyrlaboratorium (SSL) gennemfører forskning og indsamler viden, der vedrører skadelige insekter på husdyr, i stalde, lagre, bygninger og anvendte materialer. Endvidere arbejdes med rotter, mus, mosegrise og muldvarpe. Målet er at opnå størst mulig bekæmpelse med mindst mulig miljøbelastning.

Særlige indsatsområder er kemisk bekæmpelse, alternativ bekæmpelse og forebyggelse, skadedyrs biologi og adfærd, pesticidresistens og pesticiders miljøpåvirkning samt medicinske og veterinære problemer forårsaget af skadedyr.

SSL yder desuden konsulentbistand til afhjælpning af særligt komplicerede skadedyrsproblemer, f.eks. på landbrugsejendomme, i levnedsmiddelbranchen og i boliger.

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Forord

Det er mig en glæde at præsentere laboratoriets årsberetning 2000.

Laboratoriets økonomi er ikke blevet forbedret i løbet af 2000. Laboratoriets forskning er fortsat på et tilfredsstillende niveau, og årsberetningen indeholder en række resultater af høj kvalitet. Det er fortsat et ønske, at forskning i biologisk og mikrobiologisk bekæmpelse kan blive styrket for at sikre fastholdelse af denne specielle ekspertise.

Laboratoriets udvidelse og ombygning påbegyndtes i foråret 2000, og den 1. september kunne der holdes rejsegilde for de nye bygninger. Det er planen, at de nye bygninger kan ibrugtages i begyndelsen af 2001, og hele renoveringsprocessen ventes tilendebragt i december 2001. Laboratoriet ser frem til at kunne arbejde i moderne faciliteter med betydelig bedre plads end tidligere. Det har været en stor fornøjelse at samarbejde med entreprenøren, som har overholdt tidsplanen med stor præcision, og som har løst de usædvanlige problemer med stor kreativitet.

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 2000 i internationale konferencer eller kongresser i Belgien, Brasilien, Frankrig, Schweiz, Tjekkiet og Tyrkiet.

Arbejde for WHO. SSL er "WHO Collaborating Centre on Pesticide Resistance". Siden 1991 har J. B. Jespersen været medlem af "WHO Expert Panel of Vector Biology and Control".

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 styringsgruppe for udvikling og implementering af bæredygtig husdyrproduktion i udviklingslande. I 1996 opnåedes støtte til en Concerted Action (ENMARIA) med henblik på at udvikle og implementere strategier til forebyggelse af insekticid- og acaricid-resistens i Europa. Indsatsen involverer 13 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.

L. Stengård Hansen og T. Steenberg er medlemmer af en COST Action om "Biological control of pest insects and mites, with special reference to Entomophthorales". L. Stengård Hansen er desuden medlem af management committee og viceformand for arbejdsgruppe IV om "Biocontrol of arthropod pests in stored products".

Undervisning

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

Konsultationen

Bemærkelsesværdige enkeltsager og karakteristiske variationer i antallet af henvendelser i 2000

Generelt har der været lidt færre henvendelser end i de foregående år. Dette har med undtagelse af gedehamse været gældende for alle de dyr, der normalt resulterer i flest henvendelser. Det kan skyldes, at der i løbet af året blev lagt 40 af de mest efterspurgte vejledninger ud på laboratoriets hjemmeside. Næsten 45.000 besøgende er der samlet set registreret for de aktuelle vejledninger.

Antallet af henvendelser, der vedrører **hovedlus** (*Pediculus capitis*), har for første gang i mange år været faldende. Det er dog ikke konsultationens indtryk, at dette skyldes færre problemer med hovedlus. Forklaringen kan være, at Sundhedsstyrelsen, Lægemiddelstyrelsen og Statens Skadedyrlaboratorium har udarbejdet en fælles vejledning, som er tilgængelig på internettet.

I maj måned var der usædvanligt mange forespørgelser fra mennesker, der oplevede en invasion af **brunmider** (*Bryobia praetiosa*). Brunmider lever af at suge plantesaften fra bl.a. græsser og kan undertiden i græsplæner opformeres i et meget stort antal. Om foråret i varmt vejr kan miderne "gå på vandring", og støder de på et hus (oftest hvor græsplænen går helt op til huset), kan de via revner og sprækker trænge ind i huset i stort antal. Brunmiderne er helt uskadelige for mennesker og huse, men det store antal, som de forekommer i, kan virke skræmmende for nogen.

Sammenlignet med forrige år har der været langt færre henvendelse om **mus** (*Muridae*). Det kan enten skyldes, at museplagen reelt ikke har været så stor i år eller at vejledningen om mus er lagt ud på laboratoriets hjemmeside. Det er dog konsultationens indtryk, at selvom antallet af henvendelser om mus generelt har været meget lav, har der i stigende grad været tale om **halsbåndsmus** (*Apodemus flavicollis*). Det har dog kun i ganske få tilfælde været muligt med sikkerhed at fastslå, at der var tale om halsbåndsmus.

I juli måned modtog konsultationen en henvendelse om en meget generende mideplage i et nybyggeri. En besigtigelse af bygningerne fastslog, at det drejede sig om **Gamasider** med artsnavnet *Kleemannia plumosus.* Disse mider lever overvejende af skimmelsvampe og trives på steder med høj fugtighed. Nærmere undersøgelser viste, at miderne sandsynligvis stammede fra det vegetabilske isoleringsmateriale, der var brugt i forbindelse med gulvkonstruktionen. Tilsvarende tilfælde med mideplager i nye bygninger er beskrevet i udenlandsk litteratur. Efterhånden som bygningerne tørrer, vil miderne forsvinde. Den værste plage kan afhjælpes med varmebehandling og sprøjtning med en pyrethrinholdig væske.

I foråret og specielt i efteråret var der flere henvendelser om **Græsfluer** (*Thaumatomyia notata*), end der har været siden 1993. Det er især om efteråret, at denne lille flue kan samle sig i uhyre sværme og trænge ind i bygninger, hvor den søger et sted at overvintre. Om foråret når den igen vågner op, kan den endnu en gang give anledning til gener indendørs. Fluerne gør ingen skade, og problemerne afhjælpes bedst ved at tætne de revner og sprækker, hvor de kan trænge ind, samt eventuelt anvende en fluespray med pyrethrin indendørs.

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 tre smøremiddel-formuleringer indeholdende aktivstoffet spinosad i forskellige koncentrationer blev afprøvet i 20 m^3 klimarum i laboratoriet og endvidere sammenlignet med et smøremiddel indeholdende aktivstoffet azamethiphos. Der kunne ikke påvises en signifikant forskel i effektiviteten af de tre spinosad-formuleringer indbyrdes eller mellem disse og reference-midlet.

Afprøvning i svinestalde af fluemiddel påført som granulatplader eller smøregift. Hen over sommeren blev der gennemført en undersøgelse i 17 stalde af effektiviteten af en bait indeholdende aktivstoffet spinosad i en 1%-formulering. Midlet blev malet i smalle striber på staldoverflader, eller plader med granulat blev hængt op i staldene. Effekten på mængden af fluer i staldene blev målt ugentligt med to parallelle metoder. Der blev foretaget sammenligninger af effektiviteten ved forskellige behandlingsmetoder og sammenlignet med ubehandlede stalde. Midlet var i sig selv effektivt både som granulat på plader og som smøremiddel. Da pladerne var relativt store (0,2 m^2), var det i de fleste stalde ikke muligt at placere dem tæt nok på produktionsdyrene og fluernes foretrukne opholdssteder. Derfor var fluebekæmpelse med pladerne kun i få tilfælde effektiv. Når midlet blev anvendt som smøregift kunne det påføres overflader tættere på svinene, dog altid uden for deres rækkevidde, og her fungerede midlet tilfredsstillende i alle tilfælde.

Fluefælde med proteinholdig lokkemad. En fluefælde til udendørs brug blev testet i laboratoriet for sin evne til at fange stuefluer. Fælden indeholder et proteinpulver i vand, som efter nogle dages aktivering i varme (direkte sollys) udsender dufte, som kan lokke fluer til. Der blev testet én fælde ad gangen i et 20 m^3 klimarum med 2000 fritflyvende fluer pr. test. I gennemsnit blev 25% af fluerne fanget i løbet af 4 timer. Til sammenligning fangede fælder, som kun indeholdt vand og ikke proteinpulver, 0% af fluerne. Resultatet af testen var derfor, at den proteinholdige lokkemad var i stand til at tiltrække stuefluer. Undersøgelsen viser dog ikke noget om fældernes effektivitet i praksis under udendørs forhold.

Hyphomyceter til fluebekæmpelse i stalde. Projektet blev indledt i 1997 og afsluttet i 2000. Formålet var at undersøge mulighederne for bekæmpelse af stuefluer og stikfluer i stalde ved anvendelse af insektpatogene svampe. En kortlægning viste, at svampe fra Hyphomycetes forekommer naturligt i stue- og stikfluebestande i danske kvæg- og svinebesætninger, men de udgør ingen væsentlig mortalitetfaktor. Svampene kan imidlertid let opformeres, og smitteforsøg viste, at især stuefluer er meget følsomme over for disse svampe. Inden fluerne dør af svampeinfektion, påvirkes deres æglægning, så der produceres mindre afkom. Svampene vurderes at have potentiale som fluebekæmpelsesmiddel, og fremover vil det være væsentligt at få udviklet effektive udbringningsmetoder.

Mikrobiologisk bekæmpelse af fluer på græssende kreaturer. Projektet blev indledt i 1997 og afsluttet i 2000. Formålet var at undersøge mulighederne for bekæmpelse af fluer på græssende kreaturer ved anvendelse af insektpatogene svampe. En kortlægning viste, at fluer indsamlet fra græssende kreaturer var inficeret af en række insektpatogene svampe, men forekomsten var ubetydelig set fra et bekæmpelsessynspunkt. Laboratorieforsøg viste imidlertid, at flere svampearter har et betydeligt potentiale for anvendelse i mikrobiologisk bekæmpelse af fluer på græssende kreaturer. En fremtidig anvendelsesmåde kan være fælder, hvor svampene kombineres med tiltrækkende duftstoffer.

Sprøjtemiddel til bekæmpelse af biller i fjerkræhuse. Masseforekomst af biller kan være et problem i fjerkræproduktionen. Der blev hen over sommeren foretaget en undersøgelse hos 4 slagtekyllingeproducenter af et sprøjtemiddel til bekæmpelse af biller i kyllingehusene. Sprøjtemidlet indeholder aktivstoffet chlorpyrifos i en mikro-indkapslet 20% formulering.

På hver lokalitet blev 3 kyllingehuse inddraget i undersøgelsen, to huse blev behandlet og et tredje var ubehandlet kontrol. Sprøjtemiddelbehandlingen blev foretaget i tomgangsperioden mellem to kyllingeflokke. Der blev først sprøjtet i husene, efter at alle de normale rengørings- og desinfektions-procedurer var blevet udført, kun få timer inden der blev fordelt ny strøelse, og næste hold kyllinger sat ind. Der blev sprøjtet i et 2 meter bredt bånd – 1 meter op ad væggene og 1 meter ud på gulvet – i hele husets omkreds. Desuden blev alle revner og sprækker behandlet, - 2 meter op ad væggene og ud over hele gulvarealet.

Effekten af behandlingerne blev undersøgt med fældefangster af biller i husene i de to opvækstrotationer før og efter sprøjtemiddel behandlingen. Fire arter af biller optrådte i husene i varierende antal, *Alphitobius diaperinus* (lille melbille), *Typhaea stercorea* (håret skimmelbille), *Ahasverus advena* (vandrende kornbille) og *Carcinops pumilio*. Mængden af biller før og efter behandlingen blev sammenlignet statistisk, og det kunne konkluderes, at antallet af biller var blevet tydeligt reduceret som følge af sprøjtemiddelbehandlingen.

Kyllingemider. I et samarbejde med Bradley A. Mullens fra Department of Entomology på University of California at Riverside blev betydning af sult for kyllingemiders reaktion på varmestimuli undersøgt. Det viste sig, at efter blot 2 dages sult er kyllingemiderne meget motiverede for at lokalisere en ny vært at suge blod fra. De reagerer derfor kraftigt på stimuli, som indikerer tilstedeværelsen af en potentiel vært. Denne kraftige reaktion holder i mindst en uge. Efter 2-3 ugers sult reagerer færre mider på tilsvarende stimuli, sandsynligvis fordi midernes reserver af energi og/eller væske udtømmes. Det vil derfor forøge midernes chance for at overleve, hvis de gemmer reserverne, indtil det er helt sikkert, at der er en vært i nærheden.

Efter at SSL i de sidste par år har lavet forskellige ”pilot”-undersøgelser af insekt-patogene svampes potentiale til bekæmpelse af kyllingemider samt kyllingemidernes adfærdsrespons på forskellige ekstrakter indeholdende naturlige feromoner har vi i 1999 i samarbejde med partnere i tre EU-lande lavet en ansøgning til EU´s 5. rammeprogram om alternative metoder til bekæmpelse af kyllingemider. Ansøgningen fik en positiv evaluering og forhåbentlig kan dette projekt initieres i 2001.

Biologisk bekæmpelse af melmøl i møllerier. År 2000 var det sidste år af dette projekt, hvis mål var at finde nyttedyr, der var egnede til bekæmpelse af melmøl i industrimøllerier. I projektets første faser er biologien hos to arter af nyttedyr, en rovmide og en snyltehveps blevet undersøgt i laboratoriet. Undersøgelserne viste at begge arter er aktive, formerer sig og udvikler sig ved temperaturer ned til 15°C, hvilket skønnes afgørende for deres praktiske anvendelighed i kølige områder i møllerierne. Begge arter blev derfor anvendt i feltforsøg i 2000.

Snyltehvepsen *Trichogramma turkestanica* blev udsat i fire områder i et mølleri. Resutatet varierede mellem næsten ingen møl og tætheder, som var meget højere end tæthederne i de foregående år, hvor melmøllene blev bekæmpet med pyrethriner. Resultaterne er ved at blive analyseret med henblik på en afgørelse af, om snyltehvepsene havde betydning for memøltæthedens størrelse i et eller to af udsætningsområderne.

Der blev desuden gennemført en feltafprøvning med rovmiden *Blattisocius tarsalis*. Forsøget foregik i et 1100 m^3 stort lokale med mølproblemer. Der blev udsat rovmider ugentligt, ialt knapt 140.000 mider. Med forbehold for forsøgets omfang var resultatet af den biologiske bekæmpelse på møllen overordentlig positivt. Melmølbestanden vurderet ved fangst i feromonfælder var den laveste i de seneste 5 år, og man fandt det på møllen ikke nødvendigt at foretage kemisk bekæmpelse.

Hurtigmetoder til påvisning af svamp og skadedyr i korn og kornprodukter. NIT (Near Infrared Transmittance Spectroscopy) anvendes af kornbranchen til hurtig bestemmelse af protein- og vandindhold i korn. Der er interesse for at anvende denne teknik til vurdering af en række hygiejneparametre.

SSL har deltaget i et 1-årigt samarbejde med andre danske og svenske partnere om mulighederne for at anvende NIT til påvisning af mykotoxiner og skadedyr. To arter af skadedyr er blevet undersøgt: kornsnudebillen *Sitophilus granarius* og kornmiden *Lepidoglyphus*. Der er fremstillet serier af kornprøver med variende indhold af disse to arter. Prøverne er scannet på et NIT-instrument, og de resulterende spektra analyseret i relation til det faktiske indhold af skadedyrene. Den foreløbige konklusion er, at kornsnudebiller kun kan påvises i tætheder, der ligger langt over praktiske niveauer med den nuværende analyseprocedure. Der blev opnået mere lovende resultater med mider, idet der blev fundet en god korrelation mellem faktiske og målte værdier. Samarbejdet søges videreført i et nyt projekt, der omfatter svampe og mider.

Lagerskadedyr i majs i Afrika. De sidste måneder af dette Ph.D. projekt blev brugt til databearbejdning, sammenskrivning af publikationer og afhandling, der ventes forsvaret først i 2001.

Pattedyrafdelingen

Et nyt coumatetralyl-præparat blev afprøvet og godkendt til rottebekæmpelse.

Resistens mod antikoagulante rottebekæmpelsesmidler. I alt 439 brune rotter fra 29 kommuner blev afprøvet for resistens. Resistens mod bromadiolon blev for første gang konstateret i Kjellerup kommune.

Populationseffekter af antikoagulant resistens hos brune rotter. Der blev indsamlet flere data i dette Ph.D.-projekt, der fortsætter til efteråret 2001. Resistente rotte har et højere behov for vitamin K, og det kan medføre, at de er i dårligere form end de følsomme rotter under normale forhold. Derfor kan det forventes, at resistens vil forsvinde fra en population, når der ikke anvendes antikoagulanter. Denne hypothese afprøves i adskillige halvnaturlige populationer, hvor resistensens tilstedeværelse bliver registreret over en periode på to år - med og uden brug af antikoagulanter. Resistensniveauet bliver målt med Blood Clotting Response (BCR) og ædeforsøg.

Ved hjælp af mikrosatelliter undersøges de enkelte individers reproduktive succes, og den genetiske populationssammensætning følges under hele forløbet. For alle rotter i forsøgspopulationerne udarbejdes der en DNA-profil baseret på 17 mikrosattelit-markører. Det molekylære arbejde foregår på DNA-laboratoriet, Zoologisk Institut, Københavns Universitet.

Et forhøjet behov for vitamin K er kendt fra flere britiske antikoagulant-resistente rottestammer. I et specialeprojekt undersøges behovet for vitamin K hos resistente rotter fra flere lokaliteter i Danmark. Rotterne får en vitamin K-fattig diæt i op til to uger, og deres blodstørkningsevne bliver registreret.

Genetisk mangfoldighed hos vilde rotter blev undersøgt ved hjælp af mikrosatteliter i populationer fra hele Danmark. Projektet, der forventes afsluttet i løbet af sommeren 2001, undersøger den geografiske differentiering mellem populationer på nationalt og lokalt niveau for at belyse spredningsmønstre.

En vidensyntese om økologisk svineproduktion blev udarbejdet under FØJO-programmet. SSL deltog i dette arbejde for at undersøge de smitterisici, der er forbundet med den forhøjede kontakt med den vilde fauna på frilandsarealer og de vanskeligheder, der er for at organisere en økologisk acceptabel skadedyrsbekæmpelse. Arbejdet fortsætter i 2001 i et egentigt forskningsprojekt.

***Pneumocystis* forekomst** blev undersøgt i rotter fra vilde danske populationer i samarbejde med John Radcliffe Hospital, Oxford, England, og Københavns Universitet. Tre nye former af *P. carinii* blev fundet. Undersøgelsen viste også, *P.carinii*-former hos mennesker og rotter er vidt forskellige.

Forekomst af Hanta-virus blev undersøgt, i samarbejde med Forest Research Institute, Finland, i flere gnaverarter, der var fanget i nærheden af patienters bopæl på Fyn og i Jylland. Blod- og vævsprøver blev indsamlet og vil blive undersøgt for Hanta-virus antistoffer eller virus.

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 i Tanzania, der bliver afsluttet i 2001, undersøges det, hvilken betydning prædatortryk har for rotternes populationsdynamik. Det sker ved, at rotterne bliver fulgt i en fangst-genfangst-undersøgelse på forskellige forsøgsarealer, hvor prædatorer enten bliver udelukket, tilladt eller endda tiltrukket. I samtidige eksperimenter blev 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.

I laboratoriet blev *M. natalensis*-rotter udsat for flere neutrale predatorlugte for at undersøge deres adfærdsreaktion. Arbejdet fortsætter i 2001.
Resultater fra tidligere populationsdynamisk arbejde blev integreret i en populationsdynamisk model. Modellen blev forbedret ved en indsamling af laboratoriedata om rotternes reproduktionsevne og feltdata om ungernes overlevelse i den første periode, efter at de forlader reden. Modellen blev betydeligt udvidet ved, at en økonomisk komponent blev indbygget.

STAPLERAT er et nyligt startet forskningsprojekt med EU-støtte. Projektet undersøger gnavernes rolle som skadevoldere, deres biologi og bekæmpelse i kornmarker i Østafrika. Projektet, der kører i tre år, har partnere fra Ethiopien, Kenya, Tanzania, Zambia, Norge, Belgien og Italien og koordineres af SSL.

Et projekt om græsningseffekter på små pattedyr i lavbundsarealer blev udført i Fussingø ved hjælp af et fangst-genfangst-studium i seks folde med forskellig belægningsgrad af stude eller får. Dataindsamlingen blev afsluttet i 2000, og resultaterne er under bearbejdning. I et specialeprojekt blev der indsamlet telemetri-data om markmusens fouragerings- og spredningsadfærd under forskelligt græsningstryk.

Dansk Pattedyratlas. SSL er en af de deltagende partnere i dette projekt. I løbet af år 2000 blev gnaver- og spidsmusforekomster på Æbelø undersøgt.

Effektivitetsvurdering af bekæmpelsesmidler og lægemidler

Vurderingen af effektiviteten og anvendeligheden af de kemiske bekæmpelsesmidler, der anmeldes til god-kendelse 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 i 2000 effektivitet af nogle produkter til bekæmpelse af lus, flåter og lopper.

Andre oplysninger i årsberetningen

I afsnit 12 kan man finde de insekter og pattedyr, der holdes i kultur på Statens Skadedyrlaboratorium.

I afsnit 13 kan man finde medarbejdernes publikationer og forsøgsrapporter udarbejdet i 2000 og første halvdel af 2001.

I afsnit 14 kan man læse om effektivitetsvurderinger af pesticider og medicinske og veterinærmedicinske produkter.

I afsnit 15 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 2000 Annual Report.

The finances of DPIL did not improve in the course of 2000. The research level of the laboratory is still satisfactory, and the Annual Report contains a number of results of high quality. The laboratory continues to work for a strengthening of research into biological and microbiological control in order to maintain this special expert knowledge.

The extension and renovation work of the DPIL was commenced in the spring of 2000, and on the 1st of September the topping-out ceremony for the new buildings took place. According to plan the laboratory can start using the new buildings in the beginning of 2001, and completion of the entire renovation process is excpected by December 2001. The staff is looking forward to working in modern facilities with much more room than before. It has been a great pleasure to cooperate with the building contractor who has followed the schedule with great precision and who has solved the unusual problems with great creativity.

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
Danish Bilharziasis Laboratory
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 2000

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

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

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

DIRECTOR
Nils Bille

SECRETARIAT, ACCOUNTS AND BOOKKEEPING
Inge Børgesen
Maj-Britt Børgesen (from 08.06 until 09.08)
Marianne Christensen (part-time)
Lisbeth Gammelgaard (part-time)
Jette Hansen (part-time)
Ilse Hall Jensen
Kirsten Engell Jørgensen (part-time until 30.11)
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* (until 31.08)
Tove Steenberg*

Technicians
Aase Borges (part-time)
Claus W. Dahl (from 01.10)
Lars Damberg
Eva Hald
Henriette Hansen (until 31.07)
Nicolai Hansen
Mette Hovgaard (from 01.10 until 31.10)
Gitte Jensen
Dorthe Kyster
Ib Bjarne Nielsen

Bodil Malle Pedersen (part-time)
Kirsten Peschel
Santina Petersen (from 06.11)
Minna Wernegreen (part-time)
Mirjana Zibar

MAMMAL DEPARTMENT

Scientists
Herwig Leirs (Head)
Ann-Charlotte Heiberg (Ph.D. student)
Jens Lodal
Solveig Vibe-Petersen (Ph.D. student until 31.10)
Solveig Vibe-Petersen (from 01.11)

Technicians
Sarah Adams
Folmer Jensen
Iver Munch Skadborg

TECHNICAL MANAGEMENT
Jørgen Christensen

* Senior scientists

2.3 Ph.D. and M.Sc. students

Ann-Charlotte Heiberg, Ph.D. student (University of Copenhagen)
Vibeke Kalsbeek, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen)
Christian Nansen, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen)
Solveig Vibe-Petersen, Ph.D. student (Royal Veterinary and Agricultural University, Copenhagen until 31.10)

Ditte Hendrichsen, M.Sc. student (University of Copenhagen)
Thomas Lisborg, M.Sc. student (University of Odense)
Mette Drude Kjær Markussen, M.Sc. student (University of Copenhagen)
Hanne Martin-Lejeune, M.Sc. student (University of Copenhagen)
Katrine Mohr, M.Sc. student (University of Copenhagen)
Thomas Nørgaard, M.Sc. student (University of Aarhus)
Hans Henrik Petersen, M.Sc. student (University of Copenhagen)
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

L. Stengård Hansen participated in the first meeting of EU COST-action 842 on “Biological control of pest insects and mites, with special reference to Entomophthorales”, 14-15 February, in Brussels, Belgium. L. Stengård Hansen was elected member of the management committee and vice-chairperson of Working Group 4 on “Biocontrol of arthropod pests in stored products”.

J. B. Jespersen, M. Kristensen and L. Stengård Hansen participated in the XXI International Congress of Entomology, 20-26 August, Foz do Iguassu, Brazil. M. Kristensen and J. B. Jespersen presented a poster entitled: “Multiple acetylcholinesterase phenotypes in Danish field populations and laboratory strains of the housefly *Musca domestica*”. J. B. Jespersen co-authored a paper presented by Ian Denholm entitled “Combating Insecticide Resistance: ENMARIA and the European perspective”. L. Stengård Hansen presented a paper entitled “*Trichogramma turkestanica*, a candidate for biological control of *Ephestia kuehniella* in flour mills”.

J. B. Jespersen participated in the 13th European SOVE meeting, Society for Vetor Ecology, 24-29 September, Belek, Antalya, Turkey. J. B. Jespersen acted as a member of the Scientific Committee for the meeting.

O. Kilpinen participated in the Third Annual Workshop of EU Cost Action 833 “Mange and Myiasis in Livestock”, 28-29 September, Ceske Budejovice, Czech Republic, giving a lecture “Host seeking behaviour of the chicken mite”.

T. Steenberg participated in a meeting of EU COST action 842 ”Biological control of pest insects and mites with special reference to Entomophthorales”, 28-30 September, in Zürich, Switzerland.

H. Skovgård participated in Ecology Conference 2000, 1-2 November, in Vamdrup, Denmark.

3.2 Visits and co-operation

DPIL staff paid visits to the following countries:

22 October, 1999–31 May, 2000, S. Vibe-Petersen visited Sokoine University of Agriculture (SUA), Rodent Research Unit, Morogoro, Tanzania. The visit was related to her Ph.D. project.

18-29 February, L. Stengård Hansen and H. Skovgård visited International Institute of Tropical Agriculture, Cotonou, Benin, H. Skovgård to develop a proposal on “Integrated control of the Angoumois Grain Moth, *Sitotroga cerealella* (Ol.) in resource poor farmers’ maize stores in the Guinea Savanna area of Benin” and L. Stengård Hansen as supervisor for Ph.D. student C. Nansen on his project on the larger grain borer *Prostephanus truncatus* in natural habitats.

21-25 February, H. Leirs and S. Vibe-Petersen participated in a course concerning analysis of capture-mark-recapture data, at the CNRS in Montpellier, France.

10 April-10 May, H. Leirs visited the Sokoine University of Agriculture in Morogoro, Tanzania, carrying out field studies on population ecology of Mastomys-rats and discussing with students.

17 April and 13-14 September J. B. Jespersen participated in joint meetings in Plaisir and Limours, France, respectively, to work out a research proposal aiming at the development of a new natural insecticide for sustainable agriculture and public health uses.

19 May–25 June, A.-C. Heiberg visited Oregon State University (OSU), Institute of Zoology. The visit at OSU was related to her Ph.D. project.

8-9 August, H. Leirs visited the University of Oslo, Norway, to discuss ongoing bio-economics modelling work.

16-20 August, L. Stengård Hansen participated in a field trip, visiting grain storage and processing facilities in the state of Parana, Brazil.

1-9 September, H. Leirs and S. Vibe-Petersen visited the Sokoine University of Agriculture in Morogoro, Tanzania, for the first co-ordination meeting for the Staplerat-project.

13-23 September, H. Leirs visted Laos and Vietnam as a short-term consultant for DANIDA, discussing possibilities for rodent research with the International Rice Research Institute.

9-12 October, S. Vibe-Petersen visited the University of Antwerp, Belgium, as part of her data analysing and discussions with colleagues.

26-27 November, H. Leirs visited the Natural Resources Institute at the University of Greenwhich, England, and participated in a workshop on the need for new initiatives in rodent management research in developing countries.

11-12 December, J. B. Jespersen, K.-M. Vagn Jensen, M. Kristensen, and N. Bille visited Umweltbundesamt, Berlin Dahlem, Germany to discuss subjects of mutual interest.

13–20 December S. Vibe-Petersen visited University of Oslo (UIO), Oslo, Norway as part of data analysing for her PH.D. project.

DPIL was visited by the following colleagues and other guests:

6-7 June, J.-E. Bergh, Dalarna University, Sweden, visited the DPIL to discuss preparation of a paper on the effect of anoxic treatment on museum pests with K.-M. Vagn Jensen and L. Stengård Hansen.

16 June-14 July, Bradley A. Mullens from the Department of Entomology at University of California at Riverside. U.S.A., visited the DPIL for a collaborative research project on “Behavioural reactions of chicken mites to temperature gradients after variable periods of starvation”.

22-23 June, L. Stengård Hansen and P. S. Nielsen hosted a meeting with European colleagues with a view to develop a proposal for an EU-project.

26-27 September, Nils Chr. Stenseth, H. Andreassen from University of Oslo, Norway, and Anders Skonhoft from University of Trondheim, Norway, visited DPIL to discuss collaborative work on the bio-economics of rodent control.

19 October, John Williams, UK, visited DPIL to discuss fly problems in Europe.

1 November, DPIL was visited by a group of PCOs from Mortalin, Haslev, Denmark.

27 November, Ian Denholm, IACR-Rothamsted, Harpenden, UK, visited DPIL to discuss ENMARIA matters.
28 November–1 December, Grant Singleton from CSIRO, Canberra, Australia, Nils Chr. Stenseth and H. Andreassen from University of Oslo, Norway, visited DPIL to discuss collaborative work on rodent population dynamics and control.

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.

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:
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 2000 J. B. Jespersen participated in one Management Committe meeting. O. Kilpinen participated in the Third Annual Workshop, 27-30 September, in Ceské Budějovice, Czech Republic, where he presented a paper on the chicken mite *Dermanyssus galinae*.

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 770 persons participated.

4.2 Lectures

10 February, H. Leirs gave a research seminar “Ratting in the rain: population dynamics of African *Mastomys* rats” at the Department of Population Biology, Copenhagen University.

2 March and 2 November, O. Kilpinen gave lectures on “Biology and importance of ectoparasites with emphasis on fleas, lice and mites” for master students on the study of International Health at the University of Copenhagen.

16 March, L. Stengård Hansen gave two lectures on pests related to storage and processing of food for food technology students at the Royal Veterinary and Agricultural University, Copenhagen.

20 March, J. B. Jespersen gave two lectures on “Flies and mosquitoes” for students at The Royal Veterinary and Agricultural University, Copenhagen.

13 April, J. Lodal gave a lecture on rats, mice and voles, their biology, control and resistance problems for a group of visitors from Anticimex, Sweden.

29 November, different projects on biological and microbial pest control were presented to students from the Royal Veterinary and Agricultural University visiting the DPIL

29 November, L. Stengård Hansen gave a lecture on biological control of flour moths for agronomy students from the Royal Veterinary and Agricultural University, Copenhagen.

4.3 External examiner and reviewer duties

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

L. Stengård Hansen served as external supervisor for a Ph.D. student at the Royal Veterinary and Agricultural University, Copenhagen.

J. B. Jespersen served as external examiner for a Ph.D. Student at the Royal Veterinary and Agricultural University, Copenhagen.

J. B. Jespersen served as supervisor for a Ph.D. student at the Royal Veterinary and Agricultural University, Copenhagen and an M.Sc. Student at Roskilde University, Roskilde.

J. B. Jespersen, as external examiner, participated in reviewing the qualifications of applicants for a position as associated professor at The Royal Veterinary and Agricultural University, Copenhagen.

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

H. Leirs served as adviser to four M.Sc. students at the University of Copenhagen, a M.Sc. student at the University of Odense and two M.Sc. students at the Kenyatta University (Nairobi, Kenya). He also regularly advised students at the Royal Veterinary and Agricultural University, Copenhagen.

H. Leirs served as external examiner for a Ph.D.-thesis at the Friedrich-Schiller Universität Jena (Germany) and an M.Sc. dissertation at the Potchefstroom University for Higher Christian Education, (Potchefstroom, South Africa)

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

H. Leirs served as referee for Advances in Vertebrate Pest Management, Proceedings of the 8th African Small Mammals Symposium, Oikos and Journal of Tropical Ecology.

J. Lodal served as referee for Advances in Vertebrate Pest Management.

S. Vibe-Petersen served as referee for a manuscript for Mammalia.

5. Advisory work

5.1 Number of inquiries arranged by species

In 2000 DPIL answered approximately 11.000 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, 72% were telephone calls, 21% letters (often with animals enclosed for identification), 4% were e-mails and 3% visits to the laboratory. Many were answered by dispatching a leaflet on the subject, whereas others required replies in more detail, sometimes after extensive studies. Some of the inquiries led to inspections on location, but this type of examination is laborious and has been kept at a minimum since other engagements have priority at the laboratory. Most of the visits concerned attacks of wood-boring insects in buildings.

The species which generated the most inquiries were the hornet (*Paravespula spp.*), the common black ant (*Lasius niger*), the common furniture beetle (*Anobium punctatum*), head lice (*Pediculus humanus capitis*), the mole *(Talpa europaea)*, 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 44% of the total number of inquiries.

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.

Table 5a. Number of inquiries in 2000

Leaflets (in Danish) in paper version are available on pests marked with an asterisk (*) – approx. 1/3 of these leaflets are available in an electronic version as well.

	Thysanura	**Børstehaler**	
*	*Lepisma saccharina*	Sølvkræ	112
*	*Thermobia domestica*	Ovnfisk	5
*	**Collembola**	**Springhaler**	9
	Orthoptera	**Retvinger**	
*	*Acheta domestica*	Husfårekylling	23
*	*Tachysines asynamorus*	Væksthusgræshoppe	2
	Blattaria	**Kakerlakker**	
	Blatta orientalis	Orientalsk kakerlak	4
*	*Blattella germanica*	Tysk kakerlak	82
	Neostylopyga rhombifolia	Harlekin kakerlak	2
	Periplaneta americana	Amerikansk kakerlak	14
	Pycnoscelus surinamensis		1
*	*Supella longipalpa*	Brunstribet kakerlak	2
	Blattaria div.	Kakerlakker div.	50
	Isoptera	**Termitter**	1
	Dermaptera	**Ørentviste**	
*	*Forficula auricularia*	Alm. ørentvist	20
*	**Copeognatha**	**Støvlus**	187
	Mallophaga	**Pelslus og fjerlus**	1
	Siphunculata	**Lus**	
	* *Pediculus capitis*	Hovedlus	502
	Pediculus corporis	Kropslus	2
*	*Phthirus pubis*	Fladlus	7
	Siphunculata div.	Lus div.	2
*	**Thysanoptera**	**Thrips**	21
	Hemiptera	**Næbmunde**	
	Cimex lectularius	Væggelus	129
*	*Reduvius personatus*	Støvtæge	9
	Hemiptera div.	Tæger, bladlus, cikader div.	36
	Neuroptera	**Netvinger**	
*	*Chrysopa* spp.	Guldøjer	19

	Lepidoptera	**Sommerfugle**	
*	*Aphomia sociella*	Humlevoksmøl	49
*	*Caradrina clavipalpes*	Tagorm	4
*	*Endrosis sarcitrella*	Klistermøl	10
*	*Ephestia elutella*	Kakaomøl	2
*	*Ephestia kuehniella*	Melmøl	21
*	*Hofmannophila pseudospretella*	Frømøl	37
*	*Plodia interpunctella*	Tofarvet frømøl	444
	Pterophoridae spp	Fjermøl	3
*	*Tinea pellionella*	Pelsmøl	25
*	*Tineola bisselliella*	Klædemøl	47
*	*Lepidoptera* div.	Sommerfugle div.	124

	Coleoptera	**Biller**	
*	*Alphitobius diaperinus*	Lille melbille	3
	Amphimallon solstitiale	Sankthansoldenborre	8
*	*Anobium punctatum*	Alm. borebille	433
*	*Anoplodera rubra*	Rød blomsterbuk	7
	Anthrenus spp	Tæppebiller	173
	Araecerus fasciculatus	Kaffebønnebille	1
*	*Attagenus pellio*	Pelsklanner	8
*	*Attagenus smirnovi*	Brun pelsklanner	274
	Bostrychidae	Bostrychider	7
	Bruchidae	Bønnebille	5
*	*Callidium violaceum*	Violbuk	8
*	*Carabidae*	Løbebiller	34
	Cerambycidae	Træbukke	12
	Clytus arietis	Hvepsebuk	9
	Coccinellidae	Mariehøns	2
*	*Criocephalus rusticus*	Brun træbuk	12
	Cryptolestes ferrugineus	Rustfarvet kornbille	4
*	*Cryptophagus* spp	Skimmelbiller	16
*	*Dermestes haemorrhoidalis*	Husklanner	79
*	*Dermestes lardarius*	Flæskeklanner	53
	Dermestes maculatus		1
*	*Ernobius mollis*	Blød borebille	9
	Europhryum confine		5
*	*Hadrobregmus pertinax*	Rådborebille	17
*	*Hylesinus fraxini*	Askebarkbille	2
*	*Hylobius abietis*	Nåletræssnudebille	4
*	*Hylotrupes bajulus*	Husbuk	28
*	*Lasioderma serricorne*	Tobaksbille	37
*	*Lyctus* spp	Splintvedbiller	1
	Melolontha melolontha	Alm. oldenborre	11
*	*Nacerdes melanura*	Bolværksbille	6
	Niptus hololeucus	Messingtyv	1
*	*Ocypus olens*	Stor rovbille	3
	Oryzaephilus mercator	Jordnøddebille	18
*	*Oryzaephilus surinamensis*	Savtakket kornbille	32
*	*Otiorhynchus sulcatus*	Væksthussnudebille	11
*	*Otiorhyncus* spp	Øresnudebille	22
	Phyllopertha horticola	Gåsebille	9

*	*Phymatodes testaceus*	Bøgebuk	39
	Prionus coriarius	Garveren	2
	Ptinus pectinicornis	Kamhornet borebille	3
	Ptinus fur	Alm. tyvbille	5
*	*Reesa vespulae*	Amerikansk klanner	7
	Scolytidae	Barkbiller	16
	Serica brunnea	Natoldenborre	3
*	*Sitona lineatus*	Stribet bladrandbille	14
*	*Sitophilus granarius*	Kornsnudebille	42
*	*Sitophilus oryzae*	Rissnudebille	34
	Sitophilus zea-mais	Majssnudebille	1
	Staphyllinidae	Rovbiller	11
*	*Stegobium paniceum*	Brødbille	131
*	*Tenebrio molitor*	Melbille	38
	Thylodrias contractus	Larveklanner	1
	Tribolium castaneum	Kastaniebrun rismelbille	1
*	*Tribolium confusum*	Rismelbille	31
*	*Tribolium destructor*	Lysolbille	4
	Trogoderma angustum	Smal frøklanner	7
*	*Xestobium rufovillosum*	Egens borebille	6
	Coleoptera div.	Biller div.	112
	Hymenoptera	**Årevinger**	
	Andrena spp.	Jordbier	38
	Apis mellifica	Honningbi	13
	Bombus spp.	Humlebier	53
*	*Camponotus* spp.	Herkulesmyrer	23
*	*Colletes daviesanus*	Murbi	237
	Formicidae	Myrer	149
	Formica rufa	Rød skovmyre	38
	Hypoponera punctatissima		1
	Lasius fuliginosus	Orangemyre	17
*	*Lasius niger*	Sort havemyre	465
*	*Lasius umbratus and others*	"Gule myrer"	38
*	*Monomorium pharaonis*	Faraomyre	26
	Osmia spp.	Murerbier	11
*	*Paravespula* spp.	Gedehamse	1311
*	*Siricidae*	Træhvepse	17
	Sphecoidae	Gravehvepse	12
	Sylvicola fenestralis	Vinduesmyg	1
*	*Vespa crabro*	Stor gedehams	19
	Hymenoptera div.	Årevinger div	74
	Diptera	**Tovinger**	
	Bibionidae	Hårmyg	5
	Borboridae	Springfluer	2
*	*Calliphoridae*	Spyfluer	47
*	*Ceratopogonidae*	Mitter	9
	Chironomidae	Dansemyg	3
*	*Crataerina pallida*	Mursejlerlusflue	1
	Culicidae	Stikmyg	14
*	*Drosophila* spp.	Bananfluer	123
	Eristalis spp.	Dyndfluer	6

*	*Fannia canicularis*	Lille stueflue	32
	Musca autumnalis	Kvægflue	2
*	*Musca domestica*	Stueflue	51
*	*Mycetophilidae*	Svampemyg	34
	Ornithomyia spp.	Lusfluer	4
	Phoridae	Pukkelfluer	4
*	*Pollenia* spp.	Klyngefluer	66
*	*Psychodidae*	Sommerfuglemyg	38
	Scenopinus fenestralis	Vinduesflue	1
	Simuliidae	Kvægmyg	3
	Stomoxys calcitrans	Stikflue	5
	Syrphidae	Svirrefluer	5
*	*Tabanidae*	Klæger	7
*	*Thaumatomyia notata*	Græsflue	23
	Tipulidae	Stankelben	9
	Diptera div.	Tovinger div.	91
	Siphonaptera	**Lopper**	
	Ceratophyllus spp.	Fuglelopper	75
*	*Ctenocephalides* spp.	Katte- og hundelopper	192
	Ceratophyllus (Monopsyllus) sciurorum sciurorum	Egernloppe	3
*	*Pulex irritans*	Menneskeloppe	2
	Siphonaptera div.	Lopper div.	53
	Pests on textiles	Tekstilskadedyr	261
	Pests in food	Kolonialskadedyr	46
	Pests in wood	Træskadedyr	78
	Various insects	**Diverse insekter**	88
	Acarina	**Mider**	
*	*Acarus siro*	Melmide	28
*	*Argas reflexus*	Duemide	2
*	*Bryobia praetiosa*	Brunmide	42
*	*Cheyletiella* spp.	Pelsmider	4
*	*Dermanyssus* spp.	Fuglemider	17
*	*Dermatophagoides* spp.	Husstøvmider	8
	Gamasidae	Gamasider	2
*	*Glycyphagus domesticus*	Husmide	2
*	*Ixodes ricinus*	Skovflåt	54
	Listrophoridae		1
	Oribatidae	Pansermider	1
*	*Rhipicephalus sanguineus*	Husflåt	8
*	*Sarcoptes scabiei*	Fnatmide	7
*	Mites in grain, straw and hay	Lagermider	13
	Acarina div.	Mider div.	54
*	**Araneae**	**Edderkopper**	48
*	**Pseudoscorpiones**	**Mosskorpioner**	7
*	**Diplopoda**	**Ægte tusindben**	92

	Chilopoda	**Skolopendre**	
*	*Geophilus carpophagus*	Jordskolopender	1
	Chilopoda div.	Skolopendre div.	12
*	**Oniscoidea**	**Bænkebidere**	69
	Oligochaeta	**Sadelbørsteorme**	
	Lumbricidae	Regnorme	7
	Gastropoda	**Snegle**	
	Arion lusitanicus	Iberisk skovsnegl	88
*	*Limacidae*	Kældersnegle	36
	Gastropoda div.	Snegle div.	36
	Amphibia	**Padder**	4
	Lamellibranchiata	**Muslinger**	
	Teredo navalis	Pæleorm	4
	Reptilia	**Krybdyr**	2
	Aves	**Fugle**	
*	*Columba livia domestica*	Tamdue	68
	Pica pica	Husskade	2
	Aves div.	Fugle div.	10
	Mammalia	**Pattedyr**	
	Apodermus flavicollis	Halsbåndmus	76
*	*Arvicola terrestris*	Mosegris	411
	Chiroptera spp	Flagermus	8
	Felis domestica	Huskat	5
*	*Martes foina*	Husmår	316
*	*Muridae*	Mus	332
	Mustela putoris	Ilder	3
	Mustela putorius	Ilder	4
*	*Rattus norvegicus*	Brun rotte	159
	Sciurus vulgaris	Egern	7
*	*Talpa europaea*	Muldvarp	268
	Vulpes vulpes	Ræv	28
	Mammalia div.	Pattedyr div..	45
	Various animals	**Diverse dyr**	128
	Imaginary animals	**Indbildte dyr**	49
	Pesticides	**Bekæmpelsesmidler**	139
	Sundries	**Diverse**	277

5.2 Some of the cases and characteristic variations in the number of inquiries in 2000

In the year 2000 the laboratory received fewer inquiries in general than previously. With the exception of hornets this was the case for all the species normally asked about. The reason for this might be the fact that 40 of the most demanded leaflets which describe different pests are available on the Internet. Nearly 45,000 Internet visitors have been registered during the year.

The number of inquiries concerning **headlice** (*Pediculus capitis*) showed a downward tendency for the first time in many years. Nevertheless it is not the impression of the laboratory that problems with headlice have decreased. The reason might be that DPIL has worked out a comprehensive leaflet in co-operation with the National Board of Health and the Danish Medicines Agency with answers to most questions about headlice. This leaflet is the most frequently visited site on the DPIL Homepage.

In May there was an unusually high number of enquries from people who experienced an invasion of **clover mites** (*Bryobia preaetiosa*). Clover mites feed on sap which they suck out of grasses and clover. Sometimes these mites can appear in large numbers on lawns. In the spring when the weather gets warm, the mites migrate and when they meet a house they often enter it through cracks. The clover mites are harmless to humans and houses, but their big numbers often frighten people.

Compared to last year the number of inquiries about **mice** (Muridae) decreased a lot. The reason may either be that there have been fewer mice or the fact that information on mice now is available on the DPIL homepage. It is the laboratory's impression that even though the number of inquiries about mice has been very low, there has been an increasing amount of questions concerning the **yellow-necked field mouse** (*Apodemus flavicollis*). This fact was also pointed out last year, but in most cases it was not possible to establish it with certainty.

In July the laboratory received an inquiry from residents of a new building who were annoyed by mites indoors. An inspection in the building revealed that the mites were *Kleemania plumosus* belonging to the family ***Gamasidae***. These mites eat mainly mould fungus and consequently live in places with high humidity. Further inspection showed that the mites probably came from dried plant material that was used for insulation under the floors. Similar problems with these mites have been reported in foreign literature. When the buildings dry out, the mites disappear. The worst nuisance could be relieved by heating the buildings and by spraying with pyrethrin.

In the spring and in particular in the autumn there were several inquiries about **Grass Flies** (*Thaumatomyia notata*) than ever since 1993. In the autumn this little fly can gather in large numbers and enter buildings in their search for a place to overwinter. In spring when they leave their wintering places, they can cause a nuisance inside houses. The flies are harmless to people and buildings.

Scientific and technical work

6. Flies

6.1 Chemical control of *Musca domestica*

6.1.1 Laboratory evaluation of NAF granular formulations for control of *Musca domestica*

Three NAF formulations with 0.5%, 1.0% or 2.0% spinosad active ingredient were evaluated under laboratory conditions for efficacy against the housefly *Musca domestica*. A reference granular bait with 1.0% azamethiphos and an untreated non-toxic control were included in the evaluation.

Adult flies of a susceptible *Musca domestica* laboratory strain were allowed to feed on one of the three NAF baits during 48 hours after release into a large test chamber, in which they had access to the specific bait. The mortality (flies knocked down and dead) was recorded after 0.5, 1, 2, 4, 7, 24 and 48 hours.

There was no significant difference in the killing effect between the three NAF formulations. The flies were killed faster by the reference bait, however, by the end of the 48-hour trial period the three NAF formulations and the reference bait had all killed 99-100% of the flies. The three NAF formulations killed fewer female flies than male flies during the first 24 hours of the trials, whereas the reference bait killed as many female flies as male flies during the whole 48-hour period of the trial.

M. Knorr and J. B. Jespersen

6.1.2 Laboratory evaluation of outdoor protein-bait flytrap for control of *Musca domestica*

The performance of an outdoor flytrap, Green Planet Flytrap, with a protein/water mixture as bait was evaluated against adult flies of the housefly *Musca domestica* in a laboratory test chamber in a non-choice situation. In this non-choice test flies had access to water only besides the Flytrap. The flytrap is sold for outdoor trapping of houseflies and other flies. In such situations it is hung to e.g. a tree not higher than 1.5 metre above the ground and 5-10 metres from buildings. The trap is placed in direct sunlight for 3-5 days to ensure that the bait is activated quickly.

In this laboratory test the fly trap was tested in a test chamber at 28°C after the protein/water mixture had been activated for 6-8 days at 32°C. For each of five tests 2000 houseflies were released into the chamber. The performance was measured as the number of flies trapped after four hours. For comparison three control trials were made in the same way using the flytrap without the protein component of the bait, only loaded with water. The Green Planet Flytrap trapped between 11% and 44% of the flies in the test chamber during a four-hour period, with a mean of 25.1%. In the three control experiments, where no protein bait was used, only 1 fly was trapped. This difference is statistically significant at a 5% level.

It was concluded that the flytrap is able to attract, trap and kill houseflies when loaded with the protein source and activated according to the instructions for use. In the present experiment the trap caught 25% of the released experimental houseflies during a four-hour experiment. As the trap is exclusively for outdoor use, the results of the laboratory test cannot be used to foresee the efficacy in a field situation. Likewise, the efficacy of the trap in relation to number of days in use, density and species of flies, and climatic conditions etc. have not been demonstrated by this investigation.

J. B. Jespersen and M. Knorr

6.1.3 Field and laboratory evaluation of spinosad granular fly bait against *Musca domestica*

The efficacy of spinosad granular fly bait, containing 1% active ingredient, was evaluated under field conditions for control of the housefly. The bait was evaluated in large-scale field trials in Denmark in the housefly populations of 17 livestock units on six farms with pig-producing facilities. The trials were conducted from July until mid-autumn. The objective was to evaluate the fly control effect of spinosad granular fly bait when applied either on hang-boards or directly as paint-on bait and to make a preliminary assessment on the risk of development of spinosad resistance in the treated housefly populations.

On each trial location the infestation level was assessed during a 10-week trial period including a 2-week pre-treatment period, a 6-week period during treatment and a 2-week post-treatment period. Two of the farms were used as untreated controls and three isolated livestock units on a spinosad treated farm were used as treated controls with applications of either an azamethiphos 1% granular fly bait or a methomyl 1% granular fly bait. Flies for resistance testing in the laboratory were collected during the pre-treatment and the post-treatment periods.

The quantity of bait applied for one complete treatment of an animal unit was 250 g bait per 100 m^2 floor space of the unit. The hang-boards were made of white cardboard (67 cm × 30 cm) with 20 g of bait granules glued to one side. The hang-boards were placed in the units at sites as attractive to the flies as possible, but out of reach of the livestock animals and where they were not inconvenient for the farm working routines. The paint-on formulation was painted in narrow stripes in order to obtain a maximum bait/surface boundary attractive to the flies. A mixture with a 4:1 granule-to-water ratio was found to be most appropriate for application to the relevant surfaces without dripping and running off.

Spinosad granular fly bait applied to hang boards was in general only effective for housefly control in low-ceilinged units and only if the hang-boards could be placed close to places where most flies gathered. However, in the more high-ceilinged animal units where the houseflies tended to stay on or very close to the farm animals, it was not possible to obtain a satisfactory control of the flies by hang-boards. At first the hang-boards hung from the ceiling, suspended 1½-m above the feeding troughs. Moving them into the pens, still out of reach of the production animals, did not solve the problem.

Spinosad granular fly bait applied directly as paint-on bait controlled the housefly populations satisfactorily in all units. The most important reason for the paint-on bait being more effective than hang-boards was that the paint-on bait could be applied closer to the animals and other sites where flies congregated. In contrast it was difficult to place the relatively large hang-boards (67 cm x 30 cm) at sites attractive to the flies without placing them too close to the livestock animals or interfering with the farm working routines.

For comparison with Spinosad granular fly bait hang-boards, treatments with azamethiphos and methomyl applied to the same type of hang-boards were carried out. The efficacy of the hang-board application method used with the control fly-baits was influenced by the same type of problems as the spinosad granular fly bait treated hang-boards. The control of houseflies became effective in the treated control units when the hang-board treatment was later replaced by a paint-on bait treatment.

The level of insecticide resistance in the housefly populations in the trial farms to commonly used insecticides was moderate to high, and typical for Danish conditions. The resistance to spinosad was in all trial farms low to moderate, and we found no indication of induced resistance development in the spinosad treated units – being unlikely to happen as well with a selection scheme of covering only a few housefly generations.

M. Knorr, M. Kristensen and J. B. Jespersen

6.2 Insecticide resistance in *Musca domestica*

6.2.1 Speed of action of thiamethoxam and azamethiphos in *Musca domestica*

The speed of action of thiamethoxam and azamethiphos was tested by a new method developed at DPIL: Female houseflies, starved for 16 hours prior to testing, were tested individually in a petri-dish with a glass microscope slide with a centrally placed drop of insecticide. Three parameters were determined a) time from initiation of experiment until the fly starts eating, b) time from the fly starts eating until knockdown, and c) time from knockdown of the fly until death. The speed of action of thiamethoxam and azamethiphos were tested at two different concentrations in the susceptible housefly strain WHO. Approximately 100 flies were used for each product.

The fastest acting formulations contained 10% azamethiphos and 0.05% z-9-tricosene and 10% thiamethoxam and 0.05% z-9-tricosene; which showed 66 ± 8.8 sec. and 80 s ± 10 from the fly started eating and until death. There was no significant difference between both 10% formulations.

The knock-down effect of the 1% formulations was significantly delayed to 137 ± 16 sec. for 1% thiamethoxam and 0.02% z-9-tricosene until death compared to 105 s + 15 for 1% azamethiphos and 0.02% z-9-tricosene. The baits with either 10% thiamethoxam or 10% azamethiphos and both with 0.05% z-9-tricosene led to the most rapid killing of houseflies. In addition most of the flies only ate once before paralysis and subsequent death.

M. Kristensen and J. B. Jespersen

6.2.2 Resistance to fipronil by insecticide selected strains and field populations of the housefly

The toxicity of fipronil against susceptible houseflies and the cross-resistance potential of fipronil were determined in seven laboratory housefly strains by topical application and feeding bioassay. The insecticide-resistant strains represented different mechanisms of resistance and different patterns of cross-resistance to pyrethroids, organophosphates, carbamates and organochlorines. The insecticide-resistant laboratory strains were susceptible to fipronil or showed a low level of cross-resistance to fipronil, with the exception of the highly γ-HCH resistant strain 17e. The 17e strain was >500-fold resistant to fipronil in the topical application bioassay and 27-fold resistant in the feeding bioassay. We also tested the toxicity of fipronil in feeding and γ-HCH in topical application bioassay on thirteen housefly field strains. One of the field strains were moderately resistant to fipronil and γ-HCH, as well as pyrethrin, dimethoate, azamethiphos and methomyl. A strong correlation between fipronil and γ-HCH toxicity was found in the field strains. The fipronil resistance observed in laboratory and field strains might be caused by elevated general detoxification or be the result of a target-site resistance mechanism with cross-resistance to γ-HCH.

M. Kristensen, J. B. Jespersen and M. Knorr

6.2.3 Laboratory strains kept in 2000

At the end of 2000, 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 2000

	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 Parasitoids

The housefly, *Musca domestica* L. and the stable fly, *Stomoxys calcitrans* (L) are common pests in most livestock facilities in Denmark.

The aim of this project is to evaluate the possibility of using pteromalid pupal parasitoids (2-3 mm in size) as control organisms against populations of houseflies and stable flies in dairy cattle and swine facilities. Here, the final results based on two years of releases will be summarized.

One parasitoid species, *Spalangia cameroni*, was selected as potential candidate for mass-release into stables against the houseflies and stable flies. From April and to the end of September in 1999 and 2000 *S. cameroni* was released weekly on one dairy cattle farm and two swine farms. In both years control of the housefly was acceptable and below nuisance level whereas the density of stable flies was lowered, but not to a satisfactory level in two farms.

As control for activity of the released parasitoid, laboratory-reared housefly puparia were exposed to parasitism in the stables seven days. Based on the sentinel pupae, parasitism by *S. cameroni* was between 40 and 50% per week during the release period which was a significantly higher level than observed on control farms and in the former year (1998) on the release farms. However, during July-August a high percentage of the exposed pupae were parasitized by *Muscidifurax raptor*, a naturally occurring parasitoid in the environment. Although the exposed sentinel pupal bags reflected the true parasitism level of *S. cameroni* poorly (mainly because many bags seldom could be placed in areas of direct fly development), the main conclusion is that *S. cameroni* seems a prospective candidate for control of the two nuisance flies. However, a few factors still need to be evaluated under field conditions, such as the minimum release interval without loss of effectiveness of the parasitoid, and whether combining two parasitoid species (*M. raptor* or *Urolepis rufipes*) could supplement the effect of *S. cameroni* in the stable environments.

Furthermore, *S. cameroni* and *M. raptor* were released on several organic farms with confined dairy cattle on deep bedding for a study of their horizontal and vertical distribution in the bedding materials. Distribution was measured by the placing of sentinel pupal bags in the bedding in order that parasitism (i.e. activity) of released wasps from points of releases could be recorded.

Although approximately the same numbers of both parasitoid species were released, *Spalangia cameroni* predominated in the pupal bags. *S. cameroni* dominated especially in pupal bags placed deep (20-25 cm) in the organic substrate, whereas both *M. raptor* and *S. cameroni* were recorded in the upper 5 cm.

In some cases, *M. raptor* emerged from a pupa that had already been parasitized by *S. cameroni*. If this is a general phenomenon, the addition of a second parasitoid might render the overall effect of biological control less efficient than releasing *S. cameroni* alone.

In conclusion, this first study period showed that *S. cameroni* and *M. raptor* - when released - could act synergetic against the flies, mainly because *S. cameroni* forages in the lower parts of the bedding whereas *M. raptor* stays in the upper layers.

H. Skovgård Pedersen

6.3.2 Hyphomyceteous fungi

In the last year of this project, the effect of three species of hyphomyceteous fungi on the fecundity of houseflies was studied. The fecundity decreased in flies infected with *Beauveria bassiana*, *Metarhizium anisopliae* or *Paecilomyces fumosoroseus*. Observations on the egg-laying behaviour of treated and untreated flies did not reveal any differences between the two groups, nor did dissections of the ovaries reveal significant differences in the development stage or number of follicles. At present, the reduction in fly fecundity caused by fungus infection therefore remains unexplained. Another study showed that if flies were placed under a suboptimal light regime, untreated flies withheld their eggs for up to five days, whereas fungus-treated flies deposited eggs almost irrespective of the changed light conditions. Under these conditions, which are unlikely to be common in the field, fungus-treated flies produced more offspring than did untreated flies. The mechanisms underlying this effect still remain to be explored.

T. Steenberg and J. B. Jespersen

7. Flies on pastured cattle

7.1 Microbial control of flies on pastured cattle

The project, initiated in 1997, was concluded in 2000. It included two parts: A field survey of the natural occurrence of entomopathogenic fungi in flies on pastured cattle, and a laboratory evaluation of the potential of different fungi for microbial control of these flies.

The survey showed that cattle flies are infected by a range of fungus species (Hyphomycetes and Entomophthorales). Isolates of Hyphomycetes were later used in the laboratory experiments. The prevalence of both groups of fungi was very low in both years, on all locations, and in all fly species. Thistles in the pastures acted as transmission site for *Entomophthora muscae s.l.*, and harboured numerous fungus-killed cadavers of non-pestiferous fly species. Different live cattle flies were observed on the thistles, but the fungal prevalence in cattle flies remained low.

Transmission experiments confirmed the high specificity of *E. muscae s.l.*, and emphasized that exploitation of the naturally occurring inoculum of *E. muscae s.l.* for fly control not is relevant. A number of hyphomyceteous fungi was shown to infect adult face flies (*Musca autumnalis*) and horn flies (*Haematobia irritans*) in the laboratory. An isolate of *Metarhizium anisopliae* was the most virulent against face flies when they were immersed in spore suspensions. The same isolates were tested against houseflies, and in comparison face flies are generally less susceptible to fungus infection. At 22 °C the mortality caused by the most virulent *M. anisopliae* 7 days after inoculation was only 10%, but this increased to over 90% after 14 days. The lethal time was reduced at 25°C, and 90% of the flies had died within 7 days at this temperature. Females of *M. autumnalis* are significantly more suceptible to fungus infection than males.

In conclusion, detailed information on the occurrence of entomopathogenic fungi in flies associated with pastured cattle was obtained in this project, and the infection experiments provided new information of importance for future exploitation of Hyphomycetes for microbial control of cattle flies.

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

7.2 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 accepted by or submitted to international journals. The Ph.D. thesis will be completed in 2001.

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

8. Arthropod pests in poultry production

8.1 Field evaluation of micro-encapsulated chlorpyrifos for control of poultry litter beetles

Under field conditions in chicken broiler houses, the effectiveness of micro-encapsulated chlorpyrifos (a.i. 20% w/w) was evaluated for the control of litter beetles, in particular the lesser mealworm, *Alphitobius diaperinus*.

The study was carried out on four separate broiler farms. On each farm, three houses were included. Two of these were treated and the third left untreated to act as a control. Beetles were sampled from each house in two successive broiler flocks with treatment taking place during the cleaning phase between these two flocks.

The treatment with micro-encapsulated chlorpyrifos took place in the empty period after all cleaning and disinfecting procedures in the houses had been performed, a few hours before new litter was distributed on the floor, and the chickens were installed.

The treatment covered the walls evenly from floor level to one meter above the floor, and it covered the floor one meter inwards from the walls. In addition, all wall cracks up to two meters above floor level and all floor cracks were treated as were other observed refuge sites in the houses. The product was used in the broiler houses at a dosage of 100 ml micro-encapsulated chlorpyrifos per 5.0 l spray solution.

The utilized amount of product was dependent on the state of the individual house. The quantity of product applied directly on the treated wall and floor surfaces was 1.0 l spray solution per 20 m^2 treated area, but due to the treatment of refuge sites, more product was applied in the houses. The actually amounts of product used in the broiler houses was on the average 1.0 l spray solution per 33.4 m^2 total ground area (range 20-45 m^2). The total ground area includes both the treated and the untreated floor area of a broiler house.

Four species of beetles were identified from samples during this trial: *Alphitobius diaperinus* (the lesser mealworm), *Typhaea stercorea* (hairy fungus beetle), *Ahasverus advena* (foreign grain beetle) and *Carcinops pumilio* (a histerid beetle).

The infestation level in the houses in the rotations of production before and after treatment was compared statistically. It was concluded that the treatment carried out with micro-encapsulated chlorpyrifos, after all cleaning and disinfecting procedures in the houses had been performed, caused a significant reduction in the litter beetle infestation in the broiler houses.

M. Knorr, J. B. Jespersen and A. Spencer

8.2 Behavioural reactions of chicken mite to temperature gradients after variable periods of starvation

In collaboration with Bradley A. Mullens from the Department of Entomology at the University of California at Riverside, a study was conducted with the aim of showing how the motivation of chicken mites for reacting to a host-related stimulus changes after variable periods of starvation.

Groups of adult female chicken mites were isolated on small platforms. The mites were kept in a temperature- and humidity-controlled room without access to food. After variable periods of starvation the behavioural response of the mites to a temperature gradient was studied. The temperature gradient was obtained by heating of the platform from below by a light bulb. A computer was used to control the stimulus and simultaneously collect data on the temperature changes occurring. The behavioural response of the mites was analysed by means of video recordings.

The analysis showed that after just one day of starvation the majority of the chicken mites were not activated by the temperature gradient which was approximately 0.0125 °C/sec. The following week the fraction of mites being activated increased to approximately 75% and after additionally one to two weeks the fraction dropped to around 30%.

This indicates that immediately after a blood meal has been digested, the mites are highly motivated for locating a new host to feed on. They are easily activated by a temperature gradient mimicking the presence of a host. However, after two or more weeks of starvation their energy reserves are so low, and/or they have reached a degree of dehydration which means that their chances of survival are lowered if they react to stimuli which do not lead to a blood meal. The stimulus must therefore be stronger or otherwise represent a clear indication that a new host is within reach of the mite.

O. Kilpinen

8.3 Alternative control methods against chicken mite

Based on preliminary studies of the potential of fungal isolates to control chicken mites and studies of the behavioural response of chicken mites to various extracts containing pheromones a project was developed in collaboration with three European partners and a proposal was sent to the EU Fifth Framework Programme. The project involves a combination of mite pathogenic fungi and pheromones. The proposal received a positive evaluation and contract negotiations are going on.

T. Steenberg, O. Kilpinen and J. B. Jespersen

9. Stored product pests

9.1 Official examination of consignments 2000

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 2000 a total of 1,085 consignments were examined: 339 lots of grain, 86 lots of malt, 147 lots of pulses (dried peas and beans), 100 lots of tobacco and 443 consignments of other products, mainly potato starch. Live insects were found in 1.4% of the consignments, all except one in lots of grain. The following species were found: *Sitophilus granarius* in the great majority of the infested samples, *Ptinus tectus*, *Oryzaephilus surinamensis*, *Cryptolestes ferrugineus*, and in one case two species of fungus beetles (*Cryptophagus* sp. and *Cartodere* sp.).

L. Stengård Hansen

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

The year 2000 was the final year of this project, the aim of which was to investigate possibilities for biological control of *Ephestia kuehniella* in industrial flour mills.

In previous years of the project two natural enemies have been subjected to laboratory studies, the egg parasotoid *Trichogramma turkestanica* and the egg predator *Blattisocius tarsalis*. Both species showed biological characteristics that made them eligible as candidates for field trials in flour mills. Among the traits that were considered important was their ability to be active, reproduce and develop at temperatures below 20°C.

The parasitoid *T. turkestanica* was introduced in four areas in one mill. Introductions were carried out weekly, starting in April. Flour moth population densities were monitored by the means of pheromone traps and parasitoid activity was checked by the means of sentinal host eggs. The overall results of the field trial ranged from complete absence of flour moths to much higher densities compared to previous years where chemical control was conducted with pyrethrin. These results are being analysed to determine whether the parasitoids were responsible for the effect in one or two of the areas.

The predatory mite *Blattisocius tarsalis* was introduced in one mill. The trial was carried out in an 1100 m^3 room with a 600 m^3 silo containing bran. This specific area had always experienced moth problems, which had been regulated by space treatments with pyrethrin when required. Nearly 140,000 mites were released from April to September at weekly intervals. Flour moth population densities were monitored by the means of pheromone traps. This year the population density was the lowest recorded in the last five years. As a consequence the mill did not find it necessary to carry out chemical control.

L. Stengård Hansen and P. Sejerø Nielsen

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

The final months of this project were used for data analysis, preparation of manuscripts and compilation of C. Nansen's Ph.D. thesis, which will be defended i 2001.

C. Nansen and L. Stengård Hansen

9.4 Rapid analysis methods for detection of pests and moulds in stored grain

Near infrared transmittance spectroscopy (NIT) is commonly used by commercial grain elevators in the Nordic countries for determination of protein and moisture content in the grain. The instruments are often connected in national networks which can be used to transfer calibration models between instruments. There is great interest in including hygienic parameters (mycotoxins, pests and other types of contamination) in this analysis process.

The DPIL has participated in a one-year study of the potential of NIT for detecting contamination due to moulds and pests in grain. Two pest species were included in the study: the granary weevil *Sitophilus granarius* and the storage mite *Lepidoglyphus desctructor*. In this preliminary study series of grain samples with varying levels of infestation were prepared and analysed on a NIT instrument. The spectra were subsequently analysed in relation to the actual numbers of pests in the sample to determine the degree of correlation. Preliminary results of the study indicate that it is difficult to use NIT in the present procedure for detecting granary weevils at acceptable infestation levels. The results with storage mites were more encouraging; a good correlation was found between actual and predicted mite densities.

The study was carried out in collaboration with Danish and Swedish research institutes and commercial companies, with H. Pettersson at the Swedish Agricultural University, Uppsala as project manager. The work was supported by the Nordic Industrial Fund. Further funds will be sought to continue the collaboration concerning storage mites and mycotoxins.

L. Stengård Hansen and M. Kristensen

9.5 Acoustical monitoring of insect pest species

This project was granted in December and will run from 2001 to 2003. The purpose of the project is to develop methods for a rapid, reliable and practical acoustic monitoring of the larvae of the grain weevil (*Sitophilus granarius*) in grain stores and populations of flour beetles (*Tribolium confusum*) inside building structures or machinery in flour mills.

P. Sejerø Nielsen and O. Kilpinen

10. Various other arthropods

10.1 Cockroach resistance

In a joint venture between Roskilde University Center and DPIL a comparative study of the effect of sub-lethal doses of chlorpyrifos on cockroach respiration has been carried out. Two strains of *Blattella gemanica* were used: a susceptible and a organophosphate-resistant strain. Metabolism was quantified by the accurate measurement of carbon dioxide release.

About half an hour prior to the measurement the individual cockroaches were placed in air-tight vials with a rubber cover. Air samples were taken from the vials, and the carbon dioxide content was determined. Glutathione S-transferase and glutathione peroxidase activities were also measured. All three parameters were then determined at specific times after exposure of the cockroaches to the insecticide.

The results of this study showed a significant difference in GST activity, peroxidase activity and carbon dioxide release between the two strains when exposed to chlorpyrifos. GST activity ceased after 115 hours, being significantly higher in the susceptible strain compared to the resistant strain, whereas the opposite is the case with peroxidase. Carbon dioxide releases varied immensely in the susceptible strain between 4 and 50 hours after exposure, whereas it was slightly higher but steady in the resistant strain. After 50 hours the two curves overlap, and no further differences were seen between the strains.

K.-M. Vagn Jensen

11. Rodents

11.1 Efficacy and palatability testing

A new coumatetralyl paste formulation was after a series of tests recommended approved for rat control.

J. Lodal

11.2 Resistance to anticoagulants

11.2.1 Resistance in the brown rat

During 2000 a total of 493 brown rats (*Rattus norvegicus*) from 29 municipalities were received for anti-coagulant resistance testing. In addition to confirming resistance levels found in a number of municipalities previously, bromadiolone resistance was found for the first time in the municipality of Kjellerup (Jutland).

J. Lodal

11.2.2 Population effects of anticoagulant rodenticide resistance in brown rats

Data collection for the Ph.D. project "Population effects of anticoagulant rodenticide resistance in brown rats" was continued. The project was started in August 1998 and will be terminated in August 2001.

Rats resistant to anticoagulant rodenticides may show an increase in the requirement for dietary vitamin K in order to maintain a production of blood clotting factors preventing internal haemorrhages. The increase in the need for vitamin K may result in reduced fitness. It can thus be hypothesized that resistance will disappear from the population when anticoagulants are no longer present. In order to investigate this, experimental populations of rats were established with wild rats trapped in two localities in Denmark where bromadiolone resistance was known to exist. The populations will be submitted to treatments with or without the anticoagulant rodenticide: bromadiolone and changes in the prevalence of resistance in the populations will be monitored for a period of two years.

Resistance to bromadiolone is determined by the use of the Blood Clotting Response (BCR) test in order to identify all phenotypically-resistant rats. All resistant rats are additionally tested with the traditional non-choice feeding test.

By means of microsatellite markers it is possible to measure an individual's reproductive success as its contribution to next generation of rats can be traced, and thereby a measurement of the individual fitness in relation to its state of resistance is obtained. Furthermore we will measure changes in the genetic composition due to environmental selection over several generations. All rats from the four experimental populations are being typed for a total of 17 microsatellite markers in order to describe DNA profile of each individual rat. The molecular work is being conducted at the DNA-laboratory, Department of Evolutionary Biology, Institute of Zoology, University of Copenhagen.

A.-C. Heiberg

11.2.3 Vitamin K requirement in Danish anticoagulant-resistant Norway rats

Several strains of anticoagulant resistant rats in Britain have an increased need for vitamin K. The need cannot always be met by natural conditions, and this phenomenon may be useful in resistance management. An M.Sc. project was started in 2000 to investigate vitamin K requirements in anticoagulant resistant Norway rats in Denmark. Rats were sampled from different geographical localities and tested for resistance to the anticoagulants warfarin and bromadiolone by means of blood clotting response tests. Vitamin K deficient diet was prepared, and rats were kept on the diet for 14 days. Response to the diet was observed as prolonged blood clotting times and reduced percent clotting activity (PCA), and vitamin K1 injections were given to investigate the dose level necessary to restore blood clotting function when the animal was depleted. Finally rats are submitted to a feeding test according to their level of resistance. The work continues and data analysis will start in the summer of 2001.

M. Drude Kjær Markussen

11.2.4 Genetic diversity in population of wild rats

In relation to the Ph.D project a master project was started in May 2000. By means of miocrosatellite markers genetic diversity is being investigated in 15 Danish populations of wild rats. Microsatellitte markers have proven valuable in connection with questions on migratory patterns, population structures and degree of relatedness within populations. The project aims to examine the level of geographical differentiation between rat populations and the degree of differentiation within a restricted geographical range in order to elucidate migratory patterns and population substructures. The project will terminate in the summer of 2001.

A.-C. Heiberg

11.3 Other work on rodents and rodent management

11.3.1 Pest problems in organic pig production

Within the framework of the Research Programme for Organic Agriculture (FØJO), a knowledge synthesis was made up as a state of the art in organic pig production. DPIL participated in this work in order to evaluate which specific risks could rise due to pest problems under conditions of outdoors pig production and the limited possibilities for pest control in organic systems. The knowledge synthesis will be the basis for further research.

H. Leirs and J. Lodal

11.3.2 *Pneumocystis* in Danish brown rats

Pneumocystis infections occurring in wild brown rats (*Rattus norvegicus*) trapped in Denmark were studied in a collaborative study involving Molecular Infectious Diseases Group, Department of Paediatrics, Institute of Molecular Medicine, John Radcliffe Hospital, Oxford, United Kingdom, and Institute of Medical Microbiology and Immunology, University of Copenhagen, Copenhagen. The study focused on similarities and differences between human- and rat-derived *Pneumocystis carinii* organisms. Evidence for three novel formae speciales of rat-derived *P. carinii* was found. Furthermore, the study showed that human- and rat-derived *P. carinii* organisms are very different, not only in genetic composition but also in population structure and natural history.

J. Lodal

11.3.3 Hanta virus

Hanta virus has been found in Danish patients, and rodents act as reservoir for human infections. As part of a project with the aim of finding reservoir rodents in Europe, we collaborated with Heikki Henttonen from Vantaa Research Centre, Forest Research Institute, Vantaa, Finland, in trapping rodents for serum sampling and checking for antibodies to Hanta virus. The rodents (mice and voles) were trapped in Funen and in Jutland in areas where patients may have achieved their infections. Some rodents have been found positive to Hanta virus antibodies.

J. Lodal and H. Leirs

11.3.4 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 intra- 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 continued this work in a project, supported by Danida's Council for Development Research.

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 improve existing population dynamics models.

In order to refine the model's parameters for reproduction and early survival, reproductive data were collected from a colony of *Mastomys natalensis* rats maintained at DPIL. Survival of young in the population where they were born, was investigated in the field in Tanzania, partly by the use (unsuccessful) of a system with nestboxes, partly (and with success) by the maintaining of captured pregnant females in cages until the newborn young could be marked and then be returned to the field. These data are now under analysis.

The population dynamics model for *M. natalensis* rats was extended considerably by including AN economics component so that the model can be used to predict/simulate not only the population effects of rodent management, but also their effects on crop yield and ultimately farmers' income.

H. Leirs

11.3.5 STAPLERAT: Protecting staple crops in eastern Africa: integrated approaches for ecologically-based field rodent pest management

Staple crops in eastern Africa are subject to serious pre- and post-harvest pest damage. Major losses can be attributed to rats, making them in several places the most important pre-harvest pest species. Indiscriminate use of rodenticides is neither efficient nor sustainable, and there is a need for ecologically-based management strategies. The STAPLERAT-project (supported by EU 5FP) is investigating the needed biological information and collecting data on the economic aspects of damage and controls. Based on these data, tools for the organization and evaluation of management strategies will be developed:

Information about contribution of the ecological conditions to rodent problems yields the basis for an integrated approach. Population dynamic information will be elaborated into early-warning systems and bioeconomic decision making models.
A number of specific alternative approaches are being tested:
- repellent dressings to protect planted seeds
- biological control with predators
- use of agroforestry techniques to decrease a field's attractiveness to mole-rats

STAPLERAT is a collaborative project with different partners in Africa and Europe: DPIL, University of Antwerp, Belgium, University of Rome "La Sapienza", Italy, University of Oslo, Norway, Sokoine University of Agriculture, Morogoro, Tanzania, Rodent Control Center, Morogoro, Tanzania, Kenyatta University, Nairobi, Kenya, Addis Ababa University, Ethiopia and Mutanda Research Station, Solwezi, Zambia. DPIL co-ordinates the project, which started on 1 September 2000 and runs for three years.

H. Leirs

11.3.6 Effects of grazing on small mammals in wet meadows

Differences in vegetation structure affect the living conditions for small mammals with respect to food quality and quantity, cover against predators, etc. Since 1998 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) have investigated 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. The data collection was completed in 2000, and data analysis will be finalized in 2001.

Additional data on the movements of field voles under different grazing pressure were collected by radio-telemetry in the same areas, as part of an M.Sc. project.

H. Leirs

11.3.7 Behavioural effects in *Mastomys natalensis* rats under exposure to predator odour

An M.Sc. project was started to investigate changes in explorative behaviour of *Mastomys natalensis* rats in relation to predator odours. The odour medium was placed in test arenas, and the frequency and duration of visits to the arena by single rats were video-recorded for the next 24 hours. The tested odour media were faeces from cats that had fed on dead *Mastomys* rats, faeces from cats that had been fed fish and a control experiment in which no odour was used. The experiments will be completed with a neutral odour medium (rabbit faeces), and data analysis will be finalized in 2001.

H. H. Petersen

11.3.8 Feeding decisions as an anti-predation strategy in *Mastomys natalensis* rats

Observed effects of predation pressure in populations of rodents can be due to direct effects of predation on survival, but also due to indirect effects caused by the rodents' individual behaviour responses to different levels of predation risk. In order to investigate whether differences in predation pressure are apparent to the individual rodents living in an area, a number of experiments was carried out in 1999 in Tanzania in fields with manipulated predation pressure. The rodents' feeding decisions were measured by means of a method known as the "giving-up-density" method, and their foraging was recorded on video. The data were analysed in 2000, and the work will be completed in 2001.

K. Mohr

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

Data collection for the Ph.D. project "Predation pressure and population dynamics in African *Mastomys* rats: possibilities for integrated pest management?" was continued at Sokoine University of Agriculture in Morogoro, Tanzania. The study began in November 1997 and will evaluate the effects of different avian predation pressure on populations of the agricultural pest species *Mastomys natalensis* in Sub-Saharan Africa.

Analysis of the rodent CMR-data showed that the population growth during the increase phase was more rapid in the absence of predators. Otherwise, the dynamics patterns resembled each other in all open treatment plots. Fencing of the field plots reducing the dispersal of rodents changed the effect of predation on population growth and peak size. Maize yield was largest in predator-attracted areas, indicating that other factors than direct mortality by predators affected the rodent damage. Manipulation of predation pressure by introducing perch poles and nest boxes does not affect rodent numbers directly, but may have an indirect beneficial effect on maize yield. Data analysis is ongoing.

S. Vibe-Petersen

11.3.10 Danish Mammal Atlas

A project aimed at mapping the distribution of Danish mammals was initiated in 2000. Zoological Museum of the University of Copenhagen and Natural History Museum, Århus, are responsible for the project. However, the project will be carried out in co-operation between researchers from the two museums and researchers from other research institutes, including DPIL. As part of the project the occurrence of rodent and shrew species on a small island, named Æbelø, situated north of Funen has been studied and published. Aage V. Jensen Charity Foundation sponsors the project.

J. Lodal

12. 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**
Dermanyssus gallinae	Kyllingemide
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

13. Publications and reports

13.1 Publications by members of staff in 2000

Asikainen, K., T. Hänninen, H. Henttonen, J. Niemimaa, J. Laakkonen, H.K. Andersen, N. Bille, H. Leirs, A. Vaheri and A. Plyusnin, 2000: Molecular evolution of Puumala Hantavirus in Fennoscandia: phylogenetic analysis of strains from two recolonization routes, Karelia and Denmark. Journal of General Virology, **81(12)**: 2833-2841.

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Kristensen, M., and J. B. Jespersen, 2000: Multiple acetylcholinesterase phenotypes in Danish field populations and laboratory strains of the housefly *Musca domestica*. XXI International Congress of Entomology, Foz do Iguassu, Brazil, Aug. 20-28, 2000. Abstract No. 2993.

Kristensen, M., A. G. Spencer, and J. B. Jespersen, 2001: The status and development of insecticide resistance in Danish populations of the housefly *Musca domestica* (L.). Pest Management Science **57(1)**: 82-89.

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Leirs, H, 2000: Ricefield rat problems and research in South-East Asia. Report of a consultancy to Laos and Vietnam. DANIDA, Copenhagen. 6 pp.

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Palmer, R. J., O. P. Settnes, J. Lodal and A. E. Wakefield, 2000: Population Structure of Rat-Derived *Pneumocystis carinii* in Danish Wild Rats. Applied and Environmental Microbiology **66** (11): 4954-4961.

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13.2 Appearances in the media

Jensen, K.-M. Vagn: Common black ants. Danish Broadcasting, 8 May

Jensen, K.-M. Vagn: "Leksikon": Cockroaches communication. Danish Broadcasting, 25 November

Lodal, J.: Rats, rat control and resistance. TV Danmark 2, 3 January

Lodal, J.: Rats and resistance to anticoagulants. Danish Broadcasting, Vejle, 5 January

Lodal, J.: Mole and water vole, activity and control. Danish Broadcasting, Næstved, 6 April

Lodal, J.: Mice inside houses. Danish Broadcasting, Østjylland, 29 August

Lodal, J.: How to transport rats for resistance testing? Danish Broadcasting, Vejle, 6 September

Nielsen, P. S.: Pest occurrence, DK 4, 27 October.

13.3 Unpublished reports on laboratory tests and/or field trials

The reports are confidential except those marked *

*1-2000 Jespersen, J. B.: Retningslinier for fluebekæmpelse på gårde med husdyr i 2000, 7 pp.

2-2000 Kristensen, Michael and J. B. Jespersen: Speed of action of thiamethoxam and azametiphos in the housefly *Musca domestica*, 9 pp.

2-2000, ver.2 Kristensen, M. and J. B. Jespersen: Speed of action of thiamethoxam and azametiphos in the housefly *Musca domestica*, 9 pp.

3-2000 Lodal, J.: Efficacy and palatability laboratory tests with a coumatetratyl paste for rat control (Racumin Paste), 15 pp.

5-2000 Kilpinen, O.: A preliminary screening for the effect of five insect development inhibitors on *Dermanyssus gallinae*, 12 pp.

6-2000 Lodal, J.: Acute oral study with an experimental rodenticide against adult male *Rattus rattus*, 9 pp.

1-2001 Kristensen, M. and J. B. Jespersen: Susceptibility to thimethoxam in Danish field populations of houseflies *Musca domestica*, 26 pp.

2-2001 Jespersen, J. B.: Retningslinier for fluebekæmpelse på gårde med husdyr i 2001, 7 pp.

3-2001 Knorr, M., J. B. Jespersen and M. Kristensen: Field evaluation of micro-encapsulated chlorpyrifos (Empire20®) for control of poultry litter beetles, 18 pp.

4-2001 Kilpinen, O. and K. M. Vagn Jensen: Evaluering af et kokosoliebaseret produkts effektivitet over for kattelopper (*Ctenocephalides felis,* Bouche) og tyske kakerlakker (*Blatella germanica* (L)), 10 pp.

5-2001 Jespersen, J. B and M. Knorr: Laboratory evaluation of Green Planet Flytrap for control of the housefly *Musca domestica*, 9 p.

6-2001 Knorr, M., M. Kristensen and J. B. Jespersen: Efficacy of Muscafin® against the housefly M*usca domestica* when applied under field conditions as hang-boards or as paint-on bait, 81 pp.

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

14.1 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.

In 2000, 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.

14.2 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 are 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 2000, 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

15. Formulations approved by the Danish Pest Infestation Laboratory as of 1 March 2001

Fortegnelse over bekæmpelsesmidler anerkendt af Statens Skadedyrlaboratorium 1. marts 2001

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
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 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%	

(c) 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))

Trade name	Active material	Conc.	Company
Flue Kvit*	pyrethrin I & II	0.40%	Aeropak
	piperonylbutoxyd	2.00%	
Stald-chok fluespray D	pyrethrin I & II	0.40%	Aeropak
	piperonylbutoxyd	2.00%	

Trade name	Active material	Conc.	Company
Trinol Turbo jet mod fluer	pyrethrin I & II piperonylbutoxyd	0.40% 2.00%	Aeropak

* Norway only

(d) 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
Trinol smøremiddel	propetamphos muscalure	6% 0.04%	AgroDan

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

Trade name	Active material	Conc.	Company

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(mærke)	
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))

Lop-A' propoxur utøjshalsbånd il 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

Trade name	Active material	Conc.	Company

(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

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-O-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

Trade name	Active material	Conc.	Company

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)

Brota Musekorn	bromadiolon	0.01%	Mortalin
MausEx-Duo	bromadiolon	0.01%	Trinol
Materialshop musekorn	difenacoum	0.005%	Syngenta
Ratak musekorn	difenacoum	0.005%	Syngenta
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

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 42 products were approved by the Danish Pest Infestation Laboratory as of 1 March 2001. 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.

Trade name	Active material	Conc.	Company

(Følgende 42 produkter var pr. 1. marts 2001 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%)	*20 preparations*
Tracking powders (0.15%-0.03%)	*6 preparations*
Solutions (0.005%-0.03%)	*3 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.)

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

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)

Rottestop	Steel section to be inserted into ordinary waste pipe	SR-Stål

List of companies
Firmafortegnelse

Company Firma	Address Hjemsted	Abbreviation used in chapter 15 Forkortelse anvendt i kapitel 15
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
Syngenta Crop Protection A/S	København S	Syngenta