

Management in relation to health and food safety in organic pig production

Acronym: MANORPIG

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Sammendrag:

Økologisk svineproduktion er en relativ ny produktionsform med et stort vækstpotentiale. Forbrugerne forventer, at økologisk svineproduktion gennemføres på en måde, der sikrer grisene et højt niveau af sundhed og velfærd, og at produktsikkerheden er høj. Det er en stor udfordring for økologisk svineproduktion at udvikle sig på en måde, der fastholder og inden for visse områder forbedrer husdyrsundhed og fødevarerikkerhed uden, at husdyrvelfærden bliver kompromitteret. Det er almindelig anerkendt, at mange problemer med sygdomme, zoonoser og husdyrvelfærd kan reduceres gennem forbedret management. Formålet med dette projekt er at udvikle managementstrategier til forebyggelse og håndtering af udvalgte sygdomme, zoonoser og velfærdsproblemer.

Parasitter er et væsentligt husdyrsundheds- og velfærdsproblem i mange økologiske svinebesætninger. Endoparasitinfektioner medfører nedsat fodereffektivitet og nedsat væksthastighed hos grisene. Viden til bekæmpelse af parasitter i økologisk svineproduktion er sparsom. I dette projekt gennemføres et eksperiment til undersøgelse af, hvornår og hvor meget pattegrise inficeres med endo-parasitter. Endvidere beskrives infektionseffektiviteten af naturligt smittede græsmarker og virkning af at pløje og reetablere græsdaekket.

Rotter kan være reservoir for patogene mikroorganismer som feks *Salmonella*, *Leptospira*, *Yersinia*, *Erysipelothrix rhusiopathiae* (rødsygebakterien) og *Brachyspira hyodysenteriae* og derved være en risikofaktor for sygdomme og zoonoser i økologisk svineproduktion. En stigende rottebestand vil utvivlsomt medføre betydelig risici for smitte med ovennævnte sygdomme. Traditionel rottebekæmpelse med gift er uønsket i økologisk husdyrproduktion. Det er derfor vigtigt, at der udvikles effektive men giftfrie strategier til bekæmpelse af gnavere i økologisk svineproduktion. Viden om de faktorer, der påvirker niveauet af rotter i økologisk svineproduktion er meget mangelfuld. I nærværende projekt laves der derfor en kortlægning, der identificerer disse faktorer i systemer med udendørs svineproduktion i Danmark. På grundlag af kortlægningen gennemføres en detaljeret beskrivelse af rotters økologi i udvalgte økologiske svinebedrifter, og der udarbejdes strategier til kontrol af rotter.

For at sikre et højt niveau af sundhed og produktsikkerhed er det nødvendigt at kunne måle og vurdere de konkrete risici, der er i den enkelte besætning. Dette kan gøres ved hjælp af en metode til risikoanalyse, der kaldes HACCP. Ved denne metode identificeres risikofaktorer og risiconiveauer estimeres. Samtidig opstilles der nogle kritiske kontrolpunkter, som skal afsløre, hvornår der opstår risiko for problemer med zoonoser og sygdomme på den enkelte bedrift. I projektet udvikles der endvidere en protokol til registrering på de kritiske kontrolpunkter, der udover at kunne anvendes direkte i svineproducentens produktionsstyring også kan tjene som dokumentation overfor omverdenen.

Det tager lang tid for en ny svinepasser at blive god til den daglige pasning i en økologisk svinebesætning. Det kan derfor være en hjælp for ham/hende for en periode at følge et systematisk handlingsprogram for pasning. Et systematisk handlingsprogram er en detaljeret beskrivelse af den daglige pasning, som sikrer et minimum af sundhed, husdyrvelfærd og produktsikkerhed. I projektet udvikles og evalueres et systematisk handlingsprogram med fokus på håndtering af sygdomme, zoonoser og husdyrvelfærdsproblemer. Der er p.t. kun begrænset publiceret viden tilgængelig for udvikling af et systematisk handlingsprogram for økologisk svineproduktion. Handlingsprogrammet udvikles derfor under anvendelse af et ekspertpanel, der består af erfarne forskere, rådgivere og økologiske landmænd.

1. Summary

Organic pig production is a relatively new production concept with promising possibilities for growth. A major challenge in organic pig production is to maintain and in some areas to improve animal health and food safety without compromising animal welfare. It is assumed that many problems concerning diseases, zoonoses and animal welfare can be reduced by improved management in organic pig production systems. The purpose with this project is to develop management strategies for controlling diseases, zoonoses and animal welfare problems.

Parasites are a major problem for animal health and welfare in many organic pig production systems. Knowledge relevant for parasite control in organic pig production is scarce. In an experiment in this project the parasite transmission rate in piglets is described and the long term infectivity of naturally contaminated pastures are measured. Also the effect of ploughing and reestablishing of the grass is examined.

Rodents are assumed to be an important risk factor for diseases and zoonoses in organic pig production systems. Traditional rodent control with application of rodenticides is not desirable in organic pig production. It is therefore necessary to develop organically acceptable and efficient rodent control strategies for organic pig production. Since knowledge on pest supporting factors in Danish outdoor pig production systems is lacking, a survey identifying these factors will be carried out. The ecology of the pest problem is investigated in organic pig farm cases and strategies for controlling the most important pest problems will be developed.

The development of strategies preventing health and food safety problems needs to acknowledge the complex interaction between diseases/zoonoses, production systems and management which prevail in organic pig production. It is also important that strategies for controlling diseases and zoonoses do not compromise animal welfare. Hazard-Analysis-Critical-Control-Point (HACCP) is a risk analysis concept, which in recent years have been described for applications at the livestock farm level. A HACCP concept for application in an organic pig farm is developed in this project focussing on CCP's for diseases, zoonoses and animal welfare problems.

Organic pig production is a relatively new production form and most stockmen are inexperienced and need to develop suitable management routines. A concept for operational management for inexperienced farmers or for farmer with present management problems has been developed and is called Systematic Operation Programmes (SOP). In this project a SOP focussing on the control of diseases, zoonoses and animal welfare problems is developed and evaluated. In the development phase experience from researchers, advisors and farmers are elicited in an expert opinion study.

2. Research group

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3. Introduction

Less than one percent of the pigs produced in Denmark are produced as organic. However market analysis has shown that organic pig meat could have a share between 15 and 30% of the home market and further that the possibilities for export are promising (Hermansen 2000). The consumers of organic pig meat are known to associate organic pig production with a high standard of animal health and welfare and also a high degree of food safety.

The future development of organic pig production in Denmark and elsewhere in EU is affected by the EU-regulation 1804/1999 (Anonymous 1999) which was implemented in August 2000. The EU-regulation gives a framework for animal health and welfare management in organic pig production and has an influence on the methods that can be employed to prevent food safety hazards such as zoonoses. Prophylactic treatment with anthelmintics and antibiotics is forbidden. In case of disease alternative treatments of the animals should be considered as first choice, and the withdrawal period for antibiotics or anthelmintics is considerably longer than in non-organic production. There are also limitations on how often an animal can be treated with allopathic medicine and still remain organic.

Pigs in organic production systems benefit from a low animal density and good possibilities for expressing normal behaviour such as locomotion, foraging, exploration and nest building. From a health point of view organic pig production is characterised by fewer problems with respiratory diseases compared to intensive in-door production. Outdoor pigs are however more exposed to parasites than in-door pigs and there is an increased risk for transmission of pathogens from reservoirs or vectors in the wild fauna.

In general the level of infections with parasites and pathogen bacteria, the severity of infections, and the effects of infections on production and animal welfare depend on management. Since the production systems are new management routines develop in a 'trial an error' manner on each farm. An international group of scientists in an EU-network for animal health and welfare in organic agriculture has evaluated the consequences of EU-regulation 1804/99 on animal health and welfare in organic livestock production. They give research which: 'maximise the potential of management strategies for disease control' top priority when specifying further research required (Padel & Keatinge 2000). Thus there is a need for developing management strategies to facilitate a high level of animal health and food safety in a sustainable organic pig production.

4. State of the art

Organic pig production is a small-scale production compared to organic milk production and knowledge on animal health and welfare in existing systems is scarce. In a field survey Roepstorff et al. (1992) found that helminths and ectoparasites were more common in organic outdoor pig production than in non-organic intensive in-door units. Roderick and Hovi (1999) found in a postal questionnaire a low level of diseases in organic pig production. Parasites were seen as the biggest problem, whereas diarrhoea and respiratory diseases were seen as minor problems. Also Leeb and Baumgartner (2000) found in a clinical prospective study that endo- and ectoparasites were the main problem. In a Danish case study on four organic farms, Vaarst et al. (2000), found that lameness was a common clinical finding in sows, and respiratory diseases and parasites were problems in some fattening pig herds. In a prospective clinical field study Vermeers et al. (2000) found that endoparasites and post weaning problems were health problems of concern. Hansson et al. (1999) found significantly less chronic pleuritis and more leg problems in organic pigs than in non-organic pigs. Hald et al (1999) compared level of *Salmonella* infections between intensive in-door systems, conventional out-door system, and organic pig farms. Based on serology on meat juice they found no differences between organic and conventional production. However the number of organic farms in the study was very small.

Endoparasites must in general be considered one of the major constraint for welfare as well as economy in organic swine production (Nansen & Roepstorff, 1999). Thus, two Danish survey studies have both shown high prevalences of *Ascaris suum*, *Oesophagostomum* sp., and *Trichuris suis* (Roepstorff et

al., 1992; Carstensen et al., 2001). The high infection rates in the organic herds are caused by the fact that development and survival of infective parasite stages and thus the helminth transmission rates are markedly increased, when the pigs have access to outdoor areas or when they are housed on deep-litter, especially because routine medical prophylaxis is prohibited. Furthermore, organic diets with high levels of insoluble dietary fibre and a relatively low digestibility may favour establishment and fecundity of the worms (Petkevicius et al., 1996,1999).

Infections with *A.suum* and *Oesophagostomum* sp. are normally subclinical, primarily reducing the feed conversion rate and causing poor growth rates (e.g. Hale et al., 1981), and *A.suum* furthermore cause liver condemnations due to migrating larvae. Recent investigations on possible interactions between parasites and bacteria indicate, that *Salmonella* infections superimposed on subclinical *Oesophagostomum* infections may have a higher and more persistent course of faecal bacterial excretion compared to *Salmonella* infections in helminth-free pigs (Steenhard et al., 2001). Immunosuppression induced by *T. suis* has been shown to be a contributory cause for severe bacterial colitis (Mansfield & Urban, 1996).

Piglets being infected in the farrowing pens by a small number of *Ascaris suum* eggs may cause much greater growth retardation and enlargement of internal organs (intestine, liver) at 7 weeks of age than hitherto observed in other age groups (Mejer et al., 1999). When extending the observation period beyond 7 weeks of age, the growth rate has been severely reduced until an intervening anthelmintic treatment restored the growth rate (390 g/day before treatment, 750 g/day after treatment) (Mejer, unpublished). Highly immune sows do not protect their piglets from *A.suum* infections by for example colostral antibodies, as piglets of immune sows obtain the same worm burdens (Mejer et al., 1999) or even may contract significantly higher worm burdens (Boes et al., 1999) than piglets of helminth naïve sows. Whatever the underlying mechanisms are, these very new results indicate that the piglets are much more vulnerable than hitherto realised, and observations from pigs born on pasture indicate that they are in fact infected early in life (Roepstorff et al., 1992).

Development and survival rate of porcine helminth eggs/larvae on pastures have been examined (Larsen & Roepstorff, 1999) and studies using sentinel tracer pigs have shown that pigs may face very high transmission rates of for example 1000-2000 *Oesophagostomum* larvae or *A.suum* eggs per day when pigs were turned out on moderately contaminated pastures (Roepstorff & Murrell, 1997). The underlying reason is that the parasite eggs/larvae are accumulated in the soil and that free-range pigs eat considerable amounts of soil. It has thus been calculated that 10-20% of the faecal dry matter origin from the soil (Wendt et al., 2001).

Outdoor pig production units due to the increased availability of straw (shelter) and feed attract wild rodents such as rats and mice. Rodents can serve as an important reservoir for a number of pathogens such as different species or strains of *Salmonella*, *Leptospira*, *Yersinia*, *Brucella suis*, *Erysipelothrix rhusiopathiae*, and *Brachyspira hyodysenteriae* (Feenstra et al. 2000). In non-organic pig production, rodent infestations can readily be controlled by the application of rodenticides, but that strategy is not a desirable option in organic farming systems. Unless effective alternative rodent control strategies are developed, a significant increase in the population of rats is expected and consequently an increased risk for diseases and zoonoses in organic pig farms. Arthropod pests, particularly ectoparasites, may cause similar problems.

Sustainable and ecologically based rodent management requires a sound understanding of the pest species' biology (Singleton et al. 1999). To start with, an exact identification of the involved species is needed since even morphologically hardly distinguishable species can carry different pathogens (e.g. Stewart et al. 2000). Although there is an extensive knowledge about ways to kill rodents (Buckle & Smith 1994), very little is known about the ecology of free-living rats, and virtually nothing in farm and husbandry environments (see review by Macdonald et al. 1999). Rats generally stay close to their nests, but can occasionally move over large distances (Taylor & Quy 1978). Different species of mice move in different ways around agricultural buildings and the persistence of mouse populations varies dramatically according to the location of, for example, a haystack on a farm (Tattersal 1999, Tattersal et

al. 1997). Strategies aiming at preventing the establishment of rodent populations and decreasing their contact with the outdoor pigs must take such information into account. Collecting information about the rodents' whereabouts in the farm system and identifying the key factors in their life histories, which can be used as targets for control, are a necessary step to develop such strategies (Singleton et al. 1999).

A different disease and zoonoses pattern calls for different priorities for preventing and treating parasites, diseases and zoonoses in organic pig production compared to traditional in-door pig production systems. It is difficult to clean out-door areas for pathogens and options such as use of organic acids in the feed for preventing *Salmonella* is not possible. Prophylactic treatment with anthelmintics and antibiotics is forbidden, and there are limitations on how often the animal can be treated with allopathic medicine and still remain organic. Thus the conditions for managing health and food safety risks in organic pig production are different from other pig production systems. There is a great need for development of effective and acceptable management tools for controlling health and food safety problems in organic pig production.

The development of strategies for preventing diseases and zoonoses needs to acknowledge the complex interaction between diseases/zoonoses, production systems, and management which prevail in organic pig production. It is also important that strategies for controlling diseases and zoonoses do not compromise animal welfare. In veterinary epidemiology methods have been developed for risk management on a livestock farm. Hazard-Analysis-Critical-Control-Point (HACCP) is a risk analysis concept, which was originally developed in the 1970's by the food industry to ensure product safety. In recent years applications at the livestock farm level has been formulated (Pierson 1995; Noordhuizen & Welpelo 1996). The major elements in a HACCP are: identification of hazard, identification of risks associated with the hazards, identification of critical control points (CCP's), and a description of on-farm monitoring network for CCP's. HACCP-programmes have been suggested for targeting *Salmonella*-infections and respiratory diseases in conventional in-door pig production (Mousing 2000). A monitor program on CCP's can be used in day to day farm management. It can also produce documentation on the disease and food safety risks on a certain farm.

A similar concept has been developed for the assessment of animal welfare on a livestock farm (Sørensen et al. 2001). In this concept welfare indicators are identified and described, and an indicator protocol is made for on-farm monitoring. A suitable welfare indicator should be based on scientific knowledge, it should be able to measure changes over time, and it should be relevant for farm management. The welfare indicators must have an absolute relevance for animal welfare, it also has a marginal value in a certain protocol, and be measurable under farm conditions in a reliable manner (Rousing et al. 2001). A method for assessing animal welfare in an in-door sow herd with loose pregnant sows has been developed (Bonde et al. 2000).

It is in general acknowledged that a major reason for differences in the level of animal health and welfare between livestock farms is due to differences in the management. The daily management routines including health surveillance are very important. Organic pig production is a relatively new production and the systems are changing rapidly. As a consequence most stockmen are inexperienced and need to develop suitable management routines. A concept for operational management for inexperienced farmers or for farmer with present management problems has been developed and is called a Systematic Operation Programme (SOP). SOP's have been developed for areas such as calf rearing (Sørensen et al. 1985), mastitis control (Enevoldsen et al. 1987) and mink production (Møller et al. 1997). In this concept all daily actions are described. Each action is based on a certain observation or criteria. A SOP is organised in action plans such as a plan for feeding, reproduction, hygiene actions and disease prevention and surveillance. The time needed by the farmer for operational management is optimised between different type of actions. A SOP gives the farmer a chance for a good start or a restart in situations with problems with diseases, zoonoses or animal welfare.

Management strategies need to be based on relevant knowledge and experiences. The following sources need to be considered:

- Scientific literature
- Expert opinion studies
- Surveys
- Experiments

A cheap and fast source of information is the published scientific literature on risk factors and effects of the disease in question and further effects of specific options for prevention and treatment. A major problem with this source in relation to organic pig production is that published research results based on relevant organic conditions are scarce.

In situations with little published knowledge it is often valuable to consider expert opinion studies. There is increasing interest among epidemiologists for using expert opinions in a systematic manner for quantification of parameters which are difficult to estimate directly from empirical data. Expert panels have been used for quantifying risk factors for contagious diseases such as swine fever and foot and mouth disease (Horst, 1998) as well as for bovine respiratory disease (van der Fels-Klerx et al., 2000). A possible application for expert opinion studies is evaluation of the relevance of various alternative control options and control strategies applied in a livestock herd (Sørensen et al. 2000).

Field studies or surveys based on cross sectional data (often questionnaires) are a typical source of information in veterinary epidemiology. Almost all information on health and welfare problems in organic pig production is derived from field studies. Field studies have the advantage that you obtain data from the animal population in question. A problem in relation to organic pig production is that there are so few organic pig producers that it is difficult to make a survey which can provide you with a satisfactory number of observations (farms). For some management aspects it may be possible also to include conventional out-door sow production systems to obtain a sufficient number of farms.

Questions relevant for management strategies can be examined in classical experiments, which can be conducted on private farms, on research stations or in laboratories. For clarification of many questions related to management it is important to do experiments on farms in order to obtain relevant management conditions (Sørensen & Hindhede 1997). However, experiments with infectious diseases, parasites and zoonoses can often not be done on private farms, and it can therefore be necessary to use research stations for specific research questions.

5. Objectives and expected achievements

Parasites are unavoidable in organic pig production but need to be controlled at an acceptable level. In order to develop non-medical strategies for controlling parasites in organic pig production it is urgent to obtain specific answers to some of the most frequent questions from organic farmers and practising veterinarians: When and to which extent do piglets obtain helminth infections from the environment? How long time should the pastures remain free of pigs before the infectivity is so low that pigs can return? What is the effect of ploughing the pasture? These questions will be addressed in WP1.

Risk factors for parasites, diseases, zoonoses and welfare problems can be identified based on existing knowledge. However we need to quantify these risks and further to identify critical control points for on-farm use in order to establish a monitoring system for controlling these risks at farm level. Researchers, advisors and experienced farmers have important knowledge on operational management. This knowledge can be systematised and described in systematic operation programmes and can be elicited in an expert opinion study. However, before a systematic operation programme is proven useful for organic pig farmers it needs to be evaluated for on farm use. These tasks are carried out in WP2.

Wild rodents such as rats will always be present in organic pig production. However, since rats are assumed to be an important risk factor for diseases and zoonoses, it is necessary to develop efficient rodent control strategies for organic pig production without use of rodenticides. Knowledge on pest supporting factors in Danish out door pig production systems is lacking, and a survey identifying these factors is therefore a necessary part of developing such strategies. This work will be carried out in WP3.

Existing knowledge combined with results obtained in WP1 and WP 3 provide a basis for relevant management strategies for organic pig production developed in WP2.

Valuable knowledge relevant for this project will be produced in other national and international projects. To promote efficient communication for the benefit of this project a scientific workshop will be organised focussing on diseases, zoonoses and welfare problems in organic pig production. The workshop will be organised ultimo 2002. This task will be carried out in WP4.

The project is expected to produce:

- Strategies for non-medical parasite control in piglets
- Hazard analysis and critical control points for measuring risks for leg problems and weaning diarrhoea, *Salmonella* and animal welfare problems
- Effective rodent management strategies
- Systematic operation programmes for preventing and treating leg problems in sows, weaning diarrhoea, *Salmonella* and animal welfare problems

6. Description of workpackages including methods

Table 1: Workpackage list

WP No	WP title	Responsible participant	Budget	Start	End	Deliverable, No
1	Non-medical parasite control in piglets	AR	850.000 kr.	May 2001	July 2004	D1-D4
2	Development of a HACCP and systematic operation programme for control of diseases, zoonoses and animal welfare problems	JTS	925.000 kr.	Jan 2002	Sept 2004	D5-D10
3	Development of strategies for pest management	HL	500.000 kr.	June 2001	May 2004	D11-D13
4	Project co-ordination and organisation of an international workshop	JTS	225.000 kr	May 2001	Dec 2004	D14
Total			2.500.000 kr.			

Table 2: Description of workpackages

WP1: Non-medical parasite control in piglets	
Workpackage number	1
Start date or starting event	May 2001
Responsible person	Allan Roepstorff
Contributing persons	Stig M. Thamsborg, Ph.D. student
Person-months:	Scientific: 18 Technical: 4
Objectives	
<ul style="list-style-type: none"> • To describe the parasite transmission rates to piglets born on naturally contaminated farrowing pastures • To measure the long-term infectivity of naturally contaminated pastures • To compare the long-term infectivity of continuous pastures and ploughed/new grass pastures 	
Description of work	
<ol style="list-style-type: none"> 1. <i>Parasites in piglets on contaminated farrowing pastures.</i> Six farrowing pastures will be contaminated with helminth eggs (<i>Ascaris suum</i>, <i>Oesophagostomum dentatum</i>) by infected pigs in due time before 6 sows farrow on the pastures in the summer time. The piglets will be followed parasitologically, and one piglet from each litter will be removed with approx. 2 weeks intervals for necropsy and estimation of helminth worm burdens and liver lesions. The pasture contamination will be measured by analyses of soil and grass samples for infective parasite stages. 2. <i>Long-term infectivity on naturally contaminated pastures.</i> After removal of the last piglets from the above-mentioned farrowing pens, 6 groups of helminth-free tracer pigs (having adapted to the outdoor environment beforehand) will be exposed to the pastures for 4 days and subsequently moved to clean pens for further 10 days before they are necropsied. The pigs will be examined for numbers of intestinal helminths and liver white spots to estimate the transmission rate (numbers of established worms per unit of time). Soil and grass samples will be analysed for infective stages for comparisons with the pig data. This tracer study will be repeated twice yearly (autumn and spring) for the following two year in order to estimate the long-term infectivity of the naturally contaminated pastures. 3. <i>Comparison of long-term infectivity of continuous grass and on ploughed/new grass.</i> The above mentioned 6 pastures will either be 3 maintained as continuous paddocks (the grass cut twice a year) and 3 pastures that will be ploughed the first autumn, followed by the establishment of new grass (the grass will subsequently be cut twice a year). Hereby the effect of ploughing on long-term pasture infectivity can be estimated. 	
Deliverables	
<p>D1 International journal paper on neonatal helminth infections</p> <p>D2 Informative publication on neonatal helminth infections</p> <p>D3 International journal paper on long-term helminth infectivity of continuous and ploughed pastures</p> <p>D4 Informative publication with recommendations for organic farmers on pasture management in non-medical control of helminth infections</p>	
Milestones	
<p>M1 Experiment on helminth infections in piglets on contaminated pastures completed (Dec. 2001)</p> <p>M2 Experiment on long-term survival of infective helminth stages on continuous and ploughed pastures completed (Dec. 2003)</p>	

WP2: Development of a HACCP and systematic operation programme for control of diseases, zoonoses and animal welfare problems

Workpackage number:	2
Start date or starting event:	Jan. 2002
Responsible person:	Jan Tind Sørensen
Contributing persons:	Marianne Bonde, Mette Giersing
Person-months:	16 scientific and 5 technical

Objectives

To develop a method for risk analysis and documentation for selected diseases, animal welfare problems and *Salmonella* at herd level

To develop systematic operation programmes for control of selected diseases and *Salmonella*

Description of work

4. *Development of a protocol for critical control points for leg problems in sows and weaning diarrhoea in piglets..* Hazards for leg problems in sows, weaning diarrhoea, *Salmonella* and welfare problems are identified. Critical control points are identified. A protocol for monitoring CCP's on the farm is described. A protocol for monitoring animal production, leg problems and weaning diarrhoea, *Salmonella* and animal welfare is described.
5. *Development of a systematic operation programme (SOP).* A preliminary organisation of a SOP is described in a set of action plans. An expert panel consisting of 1 or 2 experienced pig producers, experienced advisors and researcher are established. All experts remain anonymous and their answers are known only by the involved researchers. The SOP prototype is developed by 3-4 consecutive questionnaires mailed out to the expert panel. Each questionnaire is based on the results from the previous questionnaire.
6. *Application of a CCP-protocol and a systematic operation programme on organic pig farms.* The monitor protocol, the animal response protocol and the SOP-prototype are applied on 6-8 organic pig production systems during one year. Health, animal welfare and level of *Salmonella* are also recorded.
7. *Evaluation of a CCP report as a decision support system.* Reports documenting risks for diseases, welfare problems and zoonoses as well as records on disease, *Salmonella* level and animal welfare are produced for each farm and is discussed with the farmer.
8. *Evaluation of a SOP as a decision support system.* The farmers are interviewed on their experience using SOP's and their expectation for using a SOP as a decision support tool. The SOP is revised based on the evaluation and the final version is formulated in an Internet version

Deliverables

- D5. A report on risks of leg problems, weaning diarrhoea, *Salmonella* during one year
- D6. A report on welfare problems on 6-8 organic pig farms during a year
- D7. A scientific journal paper on the relationship between diseases, animal behaviour problems, and production at sow level
- D8. A report on a HACCP for leg problems, weaning diarrhoea, *Salmonella*, and animal welfare problems on an organic pig farm.
- D9. A report on how the farmers have perceived a SOP as a management tool.
- D10. A Systematic operation programmes is described on the Internet including a procedure for how to apply the programme.

Milestones

M3. A CCP monitor protocol is available (Nov 2002).

M4. A prototype of CCP report focussing on risks for leg problems, weaning diarrhoea, *Salmonella*, and animal welfare problems is available (Jan. 2004).

M5. An evaluation of the HACCP-report as a decision support tool (Sept 2004).

M6. A final version of a SOP-manual is completed on paper (Oct. 2004).

WP3: Development of strategies for pest management in selected production systems

Workpackage number	3
Start date or starting event	June 2001
Responsible person	Herwig Leirs
Contributing persons	Jens Lodal, Jørgen Brøchner Jespersen
Person-months:	5,5 scientific 3,5 technical

Objectives

To identify efficient pest and vector control strategies, suitable for organic pig production systems.

Description of work

9. *Identification of pest-supporting factors.* A broad analysis of outdoor pig systems is made in order to find out which internal or external system characteristics can be related to the occurrence of pest problems. Data will be collected through questionnaires which, after a pilot trial, will be sent to a large set of private farmers, such that a reply of about 100 farms is obtained (also conventional outdoor pig farms will be included to ensure a sufficiently high number of respondents; the pest problems in both types of farms should be similar, but they are more difficult to control in organic systems since one wants to avoid pesticides). The questionnaire will focus on the presence of pests, the use of pest control, characteristics of the management system and the surrounding environment. At this stage, a broad definition of “pests” is used including rodents, predators and arthropod pests.
10. *Ecology of the pest problem.* Selected systems with a reported high occurrence of pest problems and a high relevance for organic pig farming will be investigated in detail to document the nature of the pest problem, particularly rodents, more precisely and to define the key factors which may be limiting for the size of the pest population (food availability, shelter availability, possibilities for recolonisation). Data will be collected through the use of standard population ecological techniques in sites with an existing pest problem (capture-recapture studies to assess survival and recruitment and radiotelemetry to investigate the movements of the rodents in relation to the areas occupied by the pigs).
11. *Identification of pest control tools.* Based on the identified major problems, a number of appropriate pest control tools will be selected. The control methods will focus on exclusion (keeping pests away from the sensitive areas or from their key resources), deterring or repelling, biological control and control with traps.

The results will be regularly shared with the other project partners, in order to be included in the tools developed in WP2.

Deliverables

- D11. A list of factors which are known to increase pest problems in open air pig farms, to be incorporated in risk analysis and decision support systems.
- D12. An annotated list of non-pesticide-based pest control tools for use in outdoor pig systems.
- D13. An international journal paper on the ecology of wild rodents in outdoor pig farm systems.

Milestones

- M7. Questionnaire results analysed. (Nov. 2001)
- M8. Ecological fieldwork finalised (Feb. 2004)
- M9. Potential control techniques listed (May 2004)

WP4: Project co-ordination and organisation of an international workshop

Workpackage number: 4
Start date or starting event: May 2001
Responsible person: Jan Tind Sørensen
Contributing persons:
Person-months: 3 scientific

Objectives

To organise an international workshop on management for control of diseases, zoonoses and welfare problems in organic pig production and to co-ordinate the project

Description of work

12. *Organisation of a scientific workshop.* Active groups in the field of research in management tools for controlling diseases, zoonoses and welfare problems in organic pig production are invited for a two day workshop in Denmark for sharing current results and experiences on management tools. The workshop is to be held ultimo 2002. Results presented and a summary of the discussion will be published in a report which will be made available for an international audience.
13. *Co-ordination.* Co-ordination of the whole project is included in WP4 and includes a project meeting two times a year (in total 6 meetings).

Deliverables

D14. A workshop report

Milestones

M10. A scientific workshop (Dec. 2002).

7. Implementation and time schedule

Table 3: Deliverables list

De-liverable, No	Deliverable title	Delivery date	Nature
1	International journal paper on neonatal helminth infections	June 30 2002	Paper
2	National publication on neonatal helminth infections	Aug. 31 2002	Publication
3	International journal paper on long-term helminth infectivity of continuous and ploughed pastures	April 30 2004	Paper
4	A national publication with recommendations on pasture management in non-medical control of helminth infections	Feb 28 2004	Publication
5	A national publication on risks of diseases, zoonoses and welfare problems estimated on 6-8 organic pig farms during a year	June 2004	Publication
6	A report on welfare problems on 6-8 organic pig farms during a year	June 2004	Publication
7	An international journal paper on the relationship between diseases, animal behaviour problems, and production at sow level	May 2004	Paper
8	A report on HACCP for leg problems, weaning diarrhoea, Salmonella, and animal welfare problems on an organic farm	Aug 2004	Publication
9	A national report on how the farmers have perceived a SOP as a management tool	Sep. 2004	Publication
10	A Systematic operation programmes is described on paper and on the Internet, including a procedure of how to apply the programmes	Dec. 2004	Internet tool
11	A national report on factors which are known to increase pest problems in out-door pig farms, to be incorporated in risk analysis and decision support systems.	Feb 28 2004	Publication
12	A national report of non-pesticide-based pest control tools for use in outdoor pig production systems.	May 31 2004	Publication
13	An international journal paper on the ecology of wild rodents in organic pig farm systems	May 31 2004	Paper
14	A scientific workshop	Jan. 2003	Publication

8. Collaborative partners

The project will be carried out in close co-ordination with the development project: *New organic pig production systems integrated in crop rotation focussing on a low environmental impacts and consumer acceptance 2001-2004* (Project leader John E. Hermansen). Our research project (WP2 and WP3) will use the private organic pig farms also used by the development project. Recording schemes will be co-ordinated for the benefit of both projects.

The project will collaborate with the parallel DARCOF project *Resource use, environmental impact and economy in organic pig production* (Project leader John E. Hermansen). The recordings to monitor production in the two projects will be co-ordinated and used in both projects. The two projects will use the same private organic pig farms. The project will also collaborate with the parallel DARCOF project: *Pig feeding under organic farming conditions with emphasis on nutrients, utilization, product quality and health* (Project leader Viggo Danielsen).

The project will collaborate with the DARCOF project *Improvement of animal health and welfare in organic dairy production with special focus on calves* (project leader Mette Vaarst) on identification of conceptual issues in relation to definition of animal welfare problems in organic livestock production.

KVL participates in the DARCOF project *Organic production of steers and use of bioactive forages in livestock (PROSBIO)* (project leader Stig M. Thamsborg). Our project and PROSBIO (together with a DARCOF Ph.D. co-financing scholarship) organise and finance a Ph.D. project entitled *Management practices and bioactive forages in the control of parasite infections in organic swine production systems*.

There will be regular contact in WP3 with the Danish Environmental Protection Agency's Rat Consultants in order to extract information from the rat control reporting system which they manage and to discuss the acceptability of the suggested methods for rodent control. The two Rat Consultants are senior officers who supervise the rat control organisation in Denmark.

Budget

Danish Centre for Experimental Parasitology, RVAU	2001	2002	2003	2004
Months (scientific)	3	6	6	3
Months (technical)	2	1	1	0
Salary (scientific)	77	159	163	84
Salary (technical)	44	23	23	0
Operation – equipment	0	0	0	
Operation – other	59	33	33	10
Overhead	36	43	44	19
Total	216	258	263	113

Danish Pest Infestation Laboratory	2001	2002	2003	2004
Months (scientific)	1.5	2	1	1
Months (technical)	0.5	1.5	1.5	0
Salary (scientific)	51	69	35	35
Salary (technical)	10	32	32	
Operation – equipment	0	0	0	
Operation – other	59	82	42	
Overhead	12	20	14	7
Total	132	203	123	42

Danish Institute of Agricultural Sciences	2001	2002	2003	2004
Months (scientific)		8	7	4
Months (technical)		2	3	0
Salary (scientific)		272	241	147
Salary (technical)		45	69	0
Operation – equipment		0	0	0
Operation – other		70	90	25
Overhead		77	80	34
Total		464	480	206

9. References

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Appendix: CV's of central persons, and description of role, qualifications, capacity and experience of each participant including maximum 5 relevant papers (max. 5 pages).

ProjektII8: Management in relation to health and food safety in organic pig production

Appendix: CV's for central persons in the project

Curriculum vitae for Jan Tind Sørensen (Born April 1957)

Education:

- 1981: M.Sc. in Animal Science at Royal Veterinary and Agricultural University Copenhagen
- 1985: 6 month at Edinburgh University, UK
- 1988: Ph.D. in Animal Science at Royal Veterinary and Agricultural University Copenhagen
- 1989: 4 month at University of Minnesota USA

Positions:

- 1981: Research Assistant at Danish Institute of Animal Science
- 1984: Ph.D.-student at Royal Veterinary and Agricultural University Copenhagen
- 1987: Research Assistant at Danish Institute of Animal Science
- 1992: Senior Research Scientist at Danish Institute of Animal Science (DIAS)
- 1997: Head of Research Unit : *Welfare Assessment, Health Management and Animal Health Economics* at the Department of Animal Health and Welfare. Danish Institute of Agricultural Sciences

Field:

- Development of systems orientated research methods
- Development of systems orientated management strategies in livestock production systems
- Methods for animal health economics
- Development of computer models for herd health management and animal health economics
- Methods for welfare assessments at herd level
- On-farm experiments on complex problems integrating production, welfare and health issues

Occupation:

- Project leader for three major multiinstitutional research projects during 1993-97.
- Currently project leader for three major research projects
- Currently advisor for four Ph.D.-students at RVAU.
- Scientific reviewer for four international scientific journals
- National co-ordinator for Study Commission on Management and Health in EAAP

Publications

Has published research results since 1982 in terms of 227 titles, including 34 papers in international scientific journals with a peer review procedure.

Recent publications

- Dohoo, I.R. & Sørensen, J.T. 2000. Monitoring and analysis of health and production at farm level. Proceedings from the 5th International Livestock Farming Systems Symposium in Posieux Switzerland 19-20 August 1999. EAAP Publication No 97, 14-27.
- Sørensen, J.T. (ed.) 1997. Livestock farming systems - More than food production Proceedings of the fourth international livestock farming symposium. EAAP Publication No 89. Wageningen Pers Wageningen The Netherlands 367 pp
- Sørensen, J.T. 1998. Modelling and simulation in applied livestock production science. In: (ed. Peart, R.M. & Curry, R.B.): Agricultural Systems Modelling and Simulation. Marcel Dekker Inc. New York USA 475-494.
- Sørensen, J.T. & Sandøe P. (Ed.) 2001. Assessment of Animal Welfare at Farm or Group Level. Acta Agriculturae Scandinavica Section A Animal Science Supplementum XX (in press)
- Sørensen, J.T, Sandøe P. & Halberg H. 2001. Animal welfare as one among several values to be considered at farm level: The idea of an ethical account for livestock farming. Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum XX (in press).

Curriculum Vitae - Allan Roepstorff

Date of birth: 16 August 1950

Qualifications: M.Sc., Ph.D.

Present position: Deputy Director (since 1993, Acting Director Oct.1999-June 2000), Senior Research Fellow, Danish Centre for Experimental Parasitology (DCEP), The Royal Veterinary and Agricultural University (KVL), 3 Ridebanevej, DK-1870 Frederiksberg C, Denmark

Research experience:

Worked as a Research Scientist at the Danish Asthma-Allergy Association, 1980-81, and The National Committee for Pig Breeding, Health and Production, 1981-83. Ph.D.scholarship (swine helminths) at Department of Clinical Studies and Department of Veterinary Microbiology, KVL, 1983-1985. Post-doctoral Fellow (swine helminths) at Dept. Veterinary Microbiology, KVL, 1985-89. Post-doctoral Fellow at Dept. Veterinary Microbiology 1990 (fish parasites) and 1990-91 (organic swine), and at The Technical University of Denmark 1990-91 (fish parasites). Senior Research Scholarship at Dept. Veterinary Microbiology (swine helminths) 1991-1994. Deputy Director of Danish Centre for Experimental Parasitology 1993-, and Acting Director, Oct.1999-June 2000. Main research interests: helminth (*Ascaris*, *Oesophagostomum*, *Trichuris*) and coccidia infections of swine, epidemiology, transmission, outdoor/organic production systems, host-parasite relationships. Daily head of the *Ascaris/Trichuris* research group.

Teaching:

Participating in teaching of veterinary students, B.Sc.and M.Sc. students. Supervision 1994-2000: 7 MSc students, and 7PhD students.

Publications:

Author and co-author of 53 publications in international peer reviewed journals, 3 publications in Danish journal with referees, 27 books, theses, scientific reports, 19 informative publications for farmers, and 65 abstracted congress presentations.

Some recent publications:

- Roepstorff, A., Murrell, K.D. 1997. Transmission dynamics of helminth parasites of pigs on continuous pasture: *Ascaris suum* and *Trichuris suis*. International Journal for Parasitology, 27: 563-572.
- Roepstorff, A., Nansen, P. 1998. Epidemiology, Diagnosis and Control of Helminth Parasites of Swine. FAO Animal Health Manual 3. Food and Agriculture Organization of the United Nations, Rome, Italy, 161 pp.
- Thamsborg, S.M., A.Roepstorff & M.Larsen (1999): Integrated and biological control of parasites in organic and conventional production systems. Veterinary Parasitology, 84, 169-186.
- Larsen, M.N. & A.Roepstorff (1999): Seasonal variation in development and survival of *Ascaris suum* and *Trichuris suis* eggs on pastures. Parasitology, 119, 209-220.
- Nansen, P. & A.Roepstorff (1999): Parasitic helminths of the pig: factors influencing transmission and infection levels. International Journal for Parasitology, 29, 877-891.
- Mejer, H., S.Wendt, L.E.Thomsen, A.Roepstorff & O.Hindsbo (2000): Nose-rings and transmission of helminth parasites in outdoor pigs. Acta Veterinaria Scandinavica, 41, 153-165.
- Roepstorff, A., K.D.Murrell, J.Boes & S.Petkevi_ius: Ecological influences on transmission rates of *Ascaris suum* in pigs on pastures. Veterinary Parasitology (submitted)

Curriculum vitae: Herwig Leirs

Place and date of birth : Turnhout (Belgium), 22 May 1963
Professional address : Head of Mammal Department, Danish Pest Infestation Laboratory
Skovbrynet 14, DK-2800 Lyngby, Denmark
e-mail: h.leirs@ssl.dk ; fax : +45 45931155
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Universiteit Antwerpen (RUCA), Department of Biology
Groenenborgerlaan 171, B-2020 Antwerpen, Belgium

HL graduated as a PhD from the university of Antwerp (Belgium) in 1992 with a thesis on population ecology of African *Mastomys* rats and its implications for pest control. Since 1985, he has been involved in biology, (applied) ecology and integrated pest management research of rodents.

Until 1996, he worked as a researcher at the University of Antwerp. In December 1996, he was appointed Head of the Mammal Department at the Danish Pest Infestation Laboratory. Since October 1999, he is also a part-time professor at the University of Antwerp. He is co-ordinator, participant or advisor for several research projects focusing on ecology, biodiversity, zoonosis epidemiology and pest control of rodents, several of them with international funding. He acted as a WHO rodent-expert at several instances, among others during the Ebola/Marburg virus outbreaks in Central Africa. He has been an expert or reviewer for several international organisations. He is fluent in Dutch, English, Danish, French, and, to a lesser extent, German; he understands Swedish and Norwegian, can communicate in Kiswahili and has notions of Russian.

He has published one monograph, one edited book, one congress proceedings and about 50 papers on rodent biology in international scientific journals or refereed books, apart from a number of reports with more limited distribution. He is Associate Editor of *Mammalia* and acts regularly as a referee for several other international scientific journals. He has participated in many international meetings (about 75 lectures or posters), several times as convenor of symposia, and he has been chairman of one international workshop on rodent biology and member of the scientific or organising committee for several others. He has supervised a number of M.Sc.- and Ph.D.-students.

Five selected publications:

- LEIRS, H., N.C.STENSETH, J.D.NICHOLS, J.E.HINES, R.VERHAGEN & W.N.VERHEYEN. 1997. Seasonality and non-linear density-dependence in the dynamics of african *Mastomys* rats. Nature, 389:176-180.
- LEIRS, H. & E.SCHOCKAERT (EDS.). 1997. Rodent Biology and Integrated Pest Management in Africa. Proceedings of the International Workshop held in Morogoro (Tanzania, 21-25 October 1996). Belgian Journal of Zoology, 127 (suppl.):180 pp.
- LEIRS, H., J.MILLS, J.W.KREBS, J.E.CHILDS, DUDU AKAIBE, N.WOOLLEN, G.E.LUDWIG, C.J.PETERS, T.G.KSIAZEK. 1999. Search for the Ebola-reservoir in Kikwit: reflections on the vertebrate collection. Journal of Infectious Diseases, 179 (Suppl 1):S155-63.
- SINGLETON, G., L.HINDS, H.LEIRS & ZHANG ZHIBIN (Eds.). 1999. Ecologically-based management of rodent pests. ACIAR, Canberra, 490 pp. [ISBN 1 86320 256 0].
- ASIKAINEN, K., T.HÄNNINEN, H.HENTTONEN, J.NIEMIMAA, J.LAAKKONEN, H.K.ANDERSEN, N.BILLE, H.LEIRS, A.VAHERI & 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.

Curriculum vitae for Anne Mette Giersing Linder (prev. Hagelsø)

Born June 3rd 1943

Education:

1979: M.Sc. in Zoology (spec. Ethology), Copenhagen University
1998 Ph.D. Royal Veterinary and Agricultural University, Copenhagen

Employment:

Research Assistant, Danish Institute of Animal Science (DIAS)
1995-98 Guest researcher at Swedish University of Agricultural Sciences, Dept. of Food Science
1999- Senior Research Advisor, DIAS, Dept. Animal Health and Welfare

Research activity:

Applied behaviour research in primarily pigs: Social behaviour of slaughter pigs, including studies on aggression and rank order; sow-piglet interaction in relation to piglet crushing and weaning procedures; the effects of social factors on the development of boar taint; animal-man relationships in relation to fear of humans and handling of pigs.

Analysis and dissemination activity:

Advising, lecturing and teaching, as well as examination within a broad field of pig and animal behaviour. From 1986 to 1989 member of the Willeberg-committee, from 1990 to 1991 and 1993 to 1995 scientific secretary to the Ethical Council Concerning Animals. Member of the Council from 1995 to 1998. Member of project committees for governmental research programmes from 1989 to 1995. Member of an interdisciplinary group to report on pig housing from 1990 to 1993 (Skt. Antonius prize 1994). Member of the Ministry of Justice Working Group concerning the outdoor keeping of pigs 2000- , and participant in the Knowledge Synthesis concerning organic pig farming 2000.

Selected publications:

- Giersing Hagelsø, M. & Studnitz, M., 1996. Characterization and measurement of aggressive behaviour. Conference on Welfare of Domestic Animals, Tune, Denmark, 24-26 Jan. 1994.
Acta Agric. Scand. Section A Animal Science 0(SUPPL. 27):56-60.
- Sandøe, P, Giersing, M. & Jeppesen, L.L., 1996. 'Concluding remarks and perspectives' from Conference on Welfare of Domestic Animals, Tune, Denmark, 24-26 Jan.
Acta Agric. Scand. Section A Animal Science 0 (SUPPL.27): 109-115.
- Giersing, M. & Andersson, A., 1998. How does former acquaintance affect aggressive behaviour in repeatedly mixed pigs?
Appl. Anim. Behav. Sci. 59:297-306.
- Pedersen, L.J., Studnitz, M., Jensen, K.J. & Giersing, A.M. 1998. Suckling behaviour of piglets in relation to accessibility to the sow and the presence of foreign litters.
Appl. Anim. Behav. Sci. 58:267-279.
- Giersing, M., Lundström, K. & Andersson, A. 2000. Social effects on boar taint: Significance for the production of entire male pigs (*Sus scrofa*).
J. Anim. Sci. 78:296-305.

Curriculum vitae: Marianne Kjær Bonde

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Research profile

Development of methods for the assessment of animal welfare in commercial herds, including development and evaluation of relevant behavioural, and health related indicators. The aim of my Ph.D. project is to develop and evaluate behavioural, and health related welfare indicators, which can form part of welfare assessment systems in commercial pig production with loose housed dry sows.

Education and employment

DVM (1992). Veterinary officer within the meat and food inspection sectors (1992-1997). M.Sc. in Applied Animal Behaviour and Animal Welfare, University of Edinburgh (1997). Research assistant at the Danish Institute of Agricultural Sciences, Department of Animal Health and Welfare (1998–1999). Research fellow at the Royal Veterinary and Agricultural University, Department of Animal Science and Animal Health, from Oct. 1st 1999.

Current projects (main activities)

Development and evaluation of animal welfare indicators and evaluation of a welfare assessment system in commercial animal production (1998-2002).
Health, welfare, and production in multi-site pig production systems (1997-1999).

Five selected publications

- Bonde, M., Rousing, T. & Sørensen, J.T., 2000. Indicators for the assessment of animal welfare in a sow herd with loose housed dry sows.
Book of Abstracts of the 51st Annual Meeting of the European Association for Animal Production, The Hague, The Netherlands, p. 187.
- Bonde, M., Rousing, T. & Sørensen, J.T., 1999. Repeatability and inter-rater agreement of behaviour tests on piglets on commercial farms.
Proceedings of the 33rd International Congress of the International Society for Applied Ethology (eds. Bøe, K.E., Bakken, M. & Braastad, B.O.), 17-21 August 1999, Lillehammer, Norway, p. 124.
- Bonde, M., Rousing, T. & Sørensen, J.T. 2001. The welfare assessment report. Overview, documentation and evaluation.
Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum (in press).
- Rousing, T., Bonde, M. & Sørensen, J.T., 2000. Indicators for the assessment of animal welfare in a dairy cattle herd with a cubicle housing system. In: Improving health and welfare in animal production (eds. Blokhuis, H.J., Ekkel, E.D. & Wechsler, B.).
EAAP Publication No. 102, 37-44.
- Rousing, T., Bonde, M. & Sørensen, J.T. 2001. How to aggregate welfare indicators into an operational welfare assessment system: a bottom up approach. I:
Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum (in press).

Appendix: CV's for central persons in the project

Curriculum vitae for Jan Tind Sørensen (Born April 1957)

Education:

- 1981: M.Sc. in Animal Science at Royal Veterinary and Agricultural University Copenhagen
- 1985: 6 month at Edinburgh University, UK
- 1988: Ph.D. in Animal Science at Royal Veterinary and Agricultural University Copenhagen
- 1989: 4 month at University of Minnesota USA

Positions:

- 1981: Research Assistant at Danish Institute of Animal Science
- 1984: Ph.D.-student at Royal Veterinary and Agricultural University Copenhagen
- 1987: Research Assistant at Danish Institute of Animal Science
- 1992: Senior Research Scientist at Danish Institute of Animal Science (DIAS)
- 1997: Head of Research Unit : *Welfare Assessment, Health Management and Animal Health Economics* at the Department of Animal Health and Welfare. Danish Institute of Agricultural Sciences

Field:

- Development of systems orientated research methods
- Development of systems orientated management strategies in livestock production systems
- Methods for animal health economics
- Development of computer models for herd health management and animal health economics
- Methods for welfare assessments at herd level
- On-farm experiments on complex problems integrating production, welfare and health issues

Occupation:

- Project leader for three major multiinstitutional research projects during 1993-97.
- Currently project leader for three major research projects
- Currently advisor for four Ph.D.-students at RVAU.
- Scientific reviewer for four international scientific journals
- National co-ordinator for Study Commission on Management and Health in EAAP

Publications

Has published research results since 1982 in terms of 227 titles, including 34 papers in international scientific journals with a peer review procedure.

Recent publications

- Dohoo, I.R. & Sørensen, J.T. 2000. Monitoring and analysis of health and production at farm level. Proceedings from the 5th International Livestock Farming Systems Symposium in Posieux Switzerland 19-20 August 1999. EAAP Publication No 97, 14-27.
- Sørensen, J.T. (ed.) 1997. Livestock farming systems - More than food production Proceedings of the fourth international livestock farming symposium. EAAP Publication No 89. Wageningen Pers Wageningen The Netherlands 367 pp
- Sørensen, J.T. 1998. Modelling and simulation in applied livestock production science. In: (ed. Peart, R.M. & Curry, R.B.): Agricultural Systems Modelling and Simulation. Marcel Dekker Inc. New York USA 475-494.
- Sørensen, J.T. & Sandøe P. (Ed.) 2001. Assessment of Animal Welfare at Farm or Group Level. Acta Agriculturae Scandinavica Section A Animal Science Supplementum XX (in press)
- Sørensen, J.T, Sandøe P. & Halberg H. 2001. Animal welfare as one among several values to be considered at farm level: The idea of an ethical account for livestock farming. Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum XX (in press).

Curriculum Vitae - Allan Roepstorff

Date of birth: 16 August 1950
Qualifications: M.Sc., Ph.D.
Present position: Deputy Director (since 1993, Acting Director Oct.1999-June 2000), Senior Research Fellow, Danish Centre for Experimental Parasitology (DCEP), The Royal Veterinary and Agricultural University (KVL), 3 Ridebanevej, DK-1870 Frederiksberg C, Denmark

Research experience:

Worked as a Research Scientist at the Danish Asthma-Allergy Assosiation,1980-81, and The National Committee for Pig Breeding, Health and Production, 1981-83. Ph.D.scholarship (swine helminths) at Department of Clinical Studies and Department of Veterinary Microbiology, KVL, 1983-1985. Post-doctoral Fellow (swine helminths) at Dept. Veterinary Microbiology, KVL, 1985-89. Post-doctoral Fellow at Dept. Veterinary Microbiology 1990 (fish parasites) and 1990-91 (organic swine), and at The Technical University of Denmark 1990-91 (fish parasites). Senior Research Scholarship at Dept. Veterinary Microbiology (swine helminths) 1991-1994. Deputy Director of Danish Centre for Experimental Parasitology 1993-, and Acting Director, Oct.1999-June 2000. Main research interests: helminth (*Ascaris*, *Oesophagostomum*, *Trichuris*) and coccidia infections of swine, epidemiology, transmission, outdoor/organic production systems, host-parasite relationships. Daily head of the *Ascaris/Trichuris* research group.

Teaching:

Participating in teaching of veterinary students, B.Sc.and M.Sc. students. Supervision 1994-2000: 7 MSc students, and 7PhD students.

Publications:

Author and co-author of 53 publications in international peer reviewed journals, 3 publications in Danish journal with referees, 27 books, theses, scientific reports, 19 informative publications for farmers, and 65 abstracted congress presentations.

Some recent publications:

- Roepstorff, A., Murrell, K.D. 1997. Transmission dynamics of helminth parasites of pigs on continuous pasture: *Ascaris suum* and *Trichuris suis*.
International Journal for Parasitology, 27: 563-572.
- Roepstorff, A., Nansen, P. 1998. Epidemiology, Diagnosis and Control of Helminth Parasites of Swine. FAO Animal Health Manual 3. Food and Agriculture Organization of the United Nations, Rome, Italy, 161 pp.
- Thamsborg, S.M., A.Roepstorff & M.Larsen (1999): Integrated and biological control of parasites in organic and conventional production systems.
Veterinary Parasitology, 84, 169-186.
- Larsen, M.N. & A.Roepstorff (1999): Seasonal variation in development and survival of *Ascaris suum* and *Trichuris suis* eggs on pastures.
Parasitology, 119, 209-220.
- Nansen, P. & A.Roepstorff (1999): Parasitic helminths of the pig: factors influencing transmission and infection levels.
International Journal for Parasitology, 29, 877-891.
- Mejer, H., S.Wendt, L.E.Thomsen, A.Roepstorff & O.Hindsbo (2000): Nose-rings and transmission of helminth parasites in outdoor pigs.
Acta Veterinaria Scandinavica, 41, 153-165.
- Roepstorff, A., K.D.Murrell, J.Boes & S.Petkevicius: Ecological influences on transmission rates of *Ascaris suum* in pigs on pastures.
Veterinary Parasitology (submitted)

Curriculum vitae: Herwig Leirs

Place and date of birth : Turnhout (Belgium), 22 May 1963
Professional address : - Head of Mammal Department, Danish Pest Infestation Laboratory
Skovbrynet 14, DK-2800 Lyngby, Denmark
e-mail: h.leirs@ssl.dk ; fax : +45 45931155
phone:+45 45878055; GSM-phone: +45 21231651
- Universiteit Antwerpen (RUCA), Department of Biology
Groenenborgerlaan 171, B-2020 Antwerpen, Belgium

HL graduated as a PhD from the university of Antwerp (Belgium) in 1992 with a thesis on population ecology of African *Mastomys* rats and its implications for pest control. Since 1985, he has been involved in biology, (applied) ecology and integrated pest management research of rodents.

Until 1996, he worked as a researcher at the University of Antwerp. In December 1996, he was appointed Head of the Mammal Department at the Danish Pest Infestation Laboratory. Since October 1999, he is also a part-time professor at the University of Antwerp. He is co-ordinator, participant or advisor for several research projects focusing on ecology, biodiversity, zoonosis epidemiology and pest control of rodents, several of them with international funding. He acted as a WHO rodent-expert at several instances, among others during the Ebola/Marburg virus outbreaks in Central Africa. He has been an expert or reviewer for several international organisations. He is fluent in Dutch, English, Danish, French, and, to a lesser extent, German; he understands Swedish and Norwegian, can communicate in Kiswahili and has notions of Russian.

He has published one monograph, one edited book, one congress proceedings and about 50 papers on rodent biology in international scientific journals or refereed books, apart from a number of reports with more limited distribution. He is Associate Editor of *Mammalia* and acts regularly as a referee for several other international scientific journals. He has participated in many international meetings (about 75 lectures or posters), several times as convenor of symposia, and he has been chairman of one international workshop on rodent biology and member of the scientific or organising committee for several others. He has supervised a number of M.Sc.- and Ph.D.-students.

Five selected publications:

- LEIRS, H., N.C.STENSETH, J.D.NICHOLS, J.E.HINES, R.VERHAGEN & W.N.VERHEYEN. 1997. Seasonality and non-linear density-dependence in the dynamics of african *Mastomys* rats. Nature, 389:176-180.
- LEIRS, H. & E.SCHOCKAERT (EDS.). 1997. Rodent Biology and Integrated Pest Management in Africa. Proceedings of the International Workshop held in Morogoro (Tanzania, 21-25 October 1996). Belgian Journal of Zoology, 127 (suppl.):180 pp.
- LEIRS, H., J.MILLS, J.W.KREBS, J.E.CHILDS, DUDU AKAIBE, N.WOOLLEN, G.E.LUDWIG, C.J.PETERS, T.G.KSIAZEK. 1999. Search for the Ebola-reservoir in Kikwit: reflections on the vertebrate collection. Journal of Infectious Diseases, 179 (Suppl 1):S155-63.
- SINGLETON, G., L.HINDS, H.LEIRS & ZHANG ZHIBIN (Eds.). 1999. Ecologically-based management of rodent pests. ACIAR, Canberra, 490 pp. [ISBN 1 86320 256 0].
- ASIKAINEN, K., T.HÄNNINEN, H.HENTTONEN, J.NIEMIMAA, J.LAAKKONEN, H.K.ANDERSEN, N.BILLE, H.LEIRS, A.VAHERI & 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.

Curriculum vitae for Anne Mette Giersing Linder (prev. Hagelsø)

Born June 3rd 1943

Education:

1979: M.Sc. in Zoology (spec. Ethology), Copenhagen University
1998 Ph.D. Royal Veterinary and Agricultural University, Copenhagen

Employment:

1980 Research Assistant, Danish Institute of Animal Science (DIAS)
1995-98 Guest researcher at Swedish University of Agricultural Sciences, Dept. of Food Science
1999- Senior Research Advisor, DIAS, Dept. Animal Health and Welfare

Research activity:

Applied behaviour research in primarily pigs: Social behaviour of slaughter pigs, including studies on aggression and rank order; sow-piglet interaction in relation to piglet crushing and weaning procedures; the effects of social factors on the development of boar taint; animal-man relationships in relation to fear of humans and handling of pigs.

Analysis and dissemination activity:

Advising, lecturing and teaching, as well as examination within a broad field of pig and animal behaviour. From 1986 to 1989 member of the Willeberg-committee, from 1990 to 1991 and 1993 to 1995 scientific secretary to the Ethical Council Concerning Animals. Member of the Council from 1995 to 1998. Member of project committees for governmental research programmes from 1989 to 1995. Member of an interdisciplinary group to report on pig housing from 1990 to 1993 (Skt. Antonius prize 1994). Member of the Ministry of Justice Working Group concerning the outdoor keeping of pigs 2000- , and participant in the Knowledge Synthesis concerning organic pig farming 2000.

Selected publications:

- Giersing Hagelsø, M. & Studnitz, M., 1996. Characterization and measurement of aggressive behaviour. Conference on Welfare of Domestic Animals, Tune, Denmark, 24-26 Jan. 1994.
Acta Agric. Scand. Section A Animal Science 0(SUPPL. 27):56-60.
- Sandøe, P, Giersing, M. & Jeppesen, L.L., 1996. 'Concluding remarks and perspectives' from Conference on Welfare of Domestic Animals, Tune, Denmark, 24-26 Jan.
Acta Agric. Scand. Section A Animal Science 0 (SUPPL.27): 109-115.
- Giersing, M. & Andersson, A., 1998. How does former acquaintance affect aggressive behaviour in repeatedly mixed pigs?
Appl. Anim. Behav. Sci. 59:297-306.
- Pedersen, L.J., Studnitz, M., Jensen, K.J. & Giersing, A.M. 1998. Suckling behaviour of piglets in relation to accessibility to the sow and the presence of foreign litters.
Appl. Anim. Behav. Sci. 58:267-279.
- Giersing, M., Lundström, K. & Andersson, A. 2000. Social effects on boar taint: Significance for the production of entire male pigs (*Sus scrofa*).
J. Anim. Sci. 78:296-305

Curriculum vitae: Marianne Kjær Bonde

Graduate Research Fellow
Dept. of Animal Health and Welfare
Research Centre Foulum
P.O. Box 50, DK-8830 Tjele
Tlf:+45 89 99 13 47 - Fax:+45 89 99 15 00
E-mail:Marianne.Bonde@agrsci.dk

Research profile

Development of methods for the assessment of animal welfare in commercial herds, including development and evaluation of relevant behavioural, and health related indicators. The aim of my Ph.D. project is to develop and evaluate behavioural, and health related welfare indicators, which can form part of welfare assessment systems in commercial pig production with loose housed dry sows.

Education and employment

DVM (1992). Veterinary officer within the meat and food inspection sectors (1992-1997). M.Sc. in Applied Animal Behaviour and Animal Welfare, University of Edinburgh (1997). Research assistant at the Danish Institute of Agricultural Sciences, Department of Animal Health and Welfare (1998–1999). Research fellow at the Royal Veterinary and Agricultural University, Department of Animal Science and Animal Health, from Oct. 1st 1999.

Current projects (main activities)

- Development and evaluation of animal welfare indicators and evaluation of a welfare assessment system in commercial animal production (1998-2002).
- Health, welfare, and production in multi-site pig production systems (1997-1999).

Five selected publications

- Bonde, M., Rousing, T. & Sørensen, J.T., 2000. Indicators for the assessment of animal welfare in a sow herd with loose housed dry sows.
Book of Abstracts of the 51st Annual Meeting of the European Association for Animal Production, The Hague, The Netherlands, p. 187.
- Bonde, M., Rousing, T. & Sørensen, J.T., 1999. Repeatability and inter-rater agreement of behaviour tests on piglets on commercial farms.
Proceedings of the 33rd International Congress of the International Society for Applied Ethology (eds. Bøe, K.E., Bakken, M. & Braastad, B.O.), 17-21 August 1999, Lillehammer, Norway, p. 124.
- Bonde, M., Rousing, T. & Sørensen, J.T. 2001. The welfare assessment report. Overview, documentation and evaluation.
Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum (in press).
- Rousing, T., Bonde, M. & Sørensen, J.T., 2000. Indicators for the assessment of animal welfare in a dairy cattle herd with a cubicle housing system. In: Improving health and welfare in animal production (eds. Blokhuis, H.J., Eckel, E.D. & Wechsler, B.).
EAAP Publication No. 102, 37-44.
- Rousing, T, Bonde, M.& Sørensen, J.T. 2001. How to aggregate welfare indicators into an operational welfare assessment system: a bottom up approach. I:
Acta Agriculturae Scandinavica, Section A, Animal Science Supplementum (in press).