Australian Government
Department of Agriculture

Integrating science and management of free-ranging swine diseases

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Introduction

- Interface between science and management

- How is science (research) being utilised to inform policy for managing diseases in free ranging swine
  - Types of research being done?
  - What sort of information is most useful for disease management?
  - Impacts of research on intervention and mitigation?
  - Has policy contributed to or hindered management of disease risk?
  - Does management of disease in free ranging swine fit into One Health?
  - How do we make information available to stakeholders?

- Literature review. Australia, USA, Brazil, Spain

Context

- Government
- Veterinarian/epidemiologist
- Researcher (emergency and foreign animal diseases)
- Extensive policy experience

Not:

- Wildlife biologist
- Wild pig expert
- Vertebrate pest manger

Overview

- Disease and wild pigs
- Other impacts
- Key drivers for investing in research
- Major research areas that inform management practices
- Case studies
- Community engagement - sociological research
- Discussion – draw it together

Terminology: wild boar; feral pigs; free-ranging swine; wild hogs....

  - For the purposes of this presentation the term *"wild pigs"* will be used

Disease issues in wild pigs

- Role in disease epidemiology: hosts (natural or spillover), vectors and reservoirs
- Significant livestock diseases
  - FMD, CSF, ASF, Aujeszky's disease, bTB, etc.
- Zoonotic diseases
  - trichinellosis, brucellosis, Japanese encephalitis, Q fever, leptospirosis, etc
- Transmission of disease to other wildlife
  - bTB, AJD, trichinellosis

Wild pigs do not respect country or state borders and can spread disease between contiguous territories

NSW GOVERNMENT Department of Primary Industries

FACTSHEET

Zoonotic disease risk – feral pigs

Dr Amanda Lee, Pig Health Coordinator, Menangle

Diseases naturally transmitted from animals to people are called 'zoonoses' (plural of 'zoonosis'). People in direct contact with animals or animal products are most at risk of contracting a zoonotic disease.

In Australia, feral pigs can carry a number of infectious zoonotic diseases including brucellosis, leptospirosis and Q fever.

Brucellosis

Brucella suis is the bacterium responsible for brucellosis in pigs and can cause human brucellosis. Swine brucellosis is usually an infection of feral pigs in northern NSW and Queensland, but people can become infected through exposure to infected animals or their tissues/fluids. Infected boars may develop swollen testicles (see photo below). Pigs may become lame with swollen joints and/or develop signs of incoordination and hind leg paralysis. Pigs may show no

People usually become exposed by contact with bacteria-contaminated fluid from infected animals through abraded skin, through mucous membranes or by ingestion of uncooked or unpasteurised animal products. *Brucella suis* can also be transmitted in aerosols. The process of slaughtering and butchering animals, particularly feral pigs, presents a risk of infection but this may be reduced through the use of protective clothing and good personal hygiene.

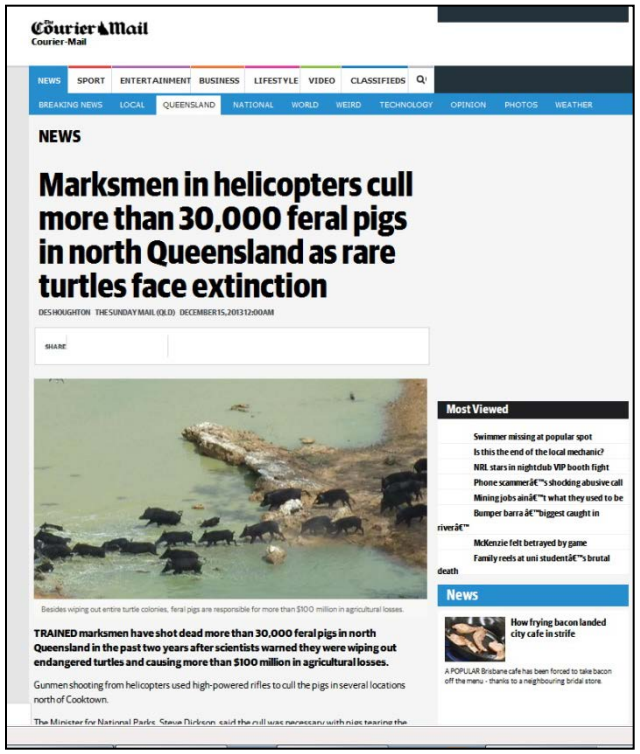
Human brucellosis typically presents with acute, non-specific influenza-like symptoms including intermittent fever, sweating, lethargy, loss of appetite, headaches, joint pain, chills, muscle aches, and back pain. The onset of clinical signs usually occurs 5 to 60 days after exposure, but occasionally not until several months later. Typically symptoms last for 2 to 4 weeks and are followed by a spontaneous recovery. However, some infected people may develop an

Other impacts

- **Agricultural**
  - Crop damage
  - Predation on young stock (esp lambs)
  - Infrastructure damage (fencing etc)
  - Soil erosion
  - Damage to native vegetation and pastures

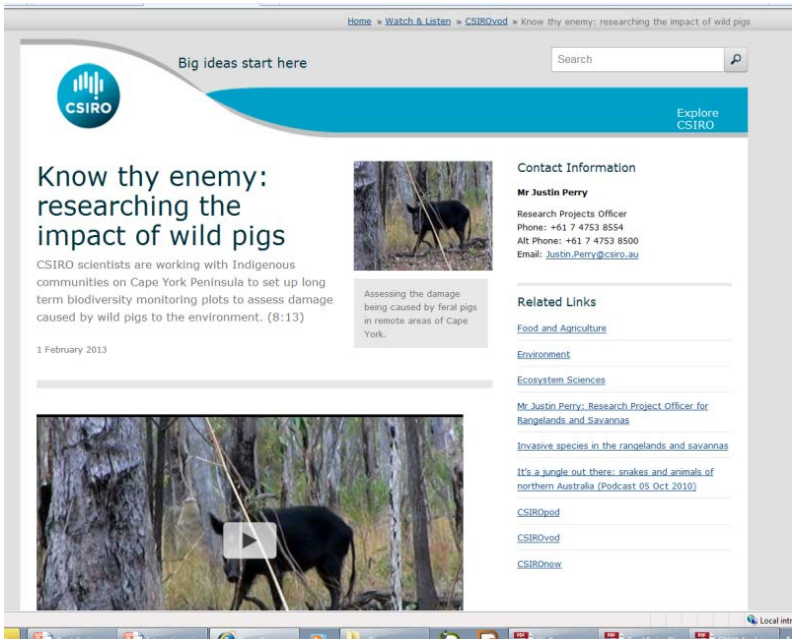
- **Environmental**
  - Habitat changes
  - Predation on native wildlife
  - Potential competition for food

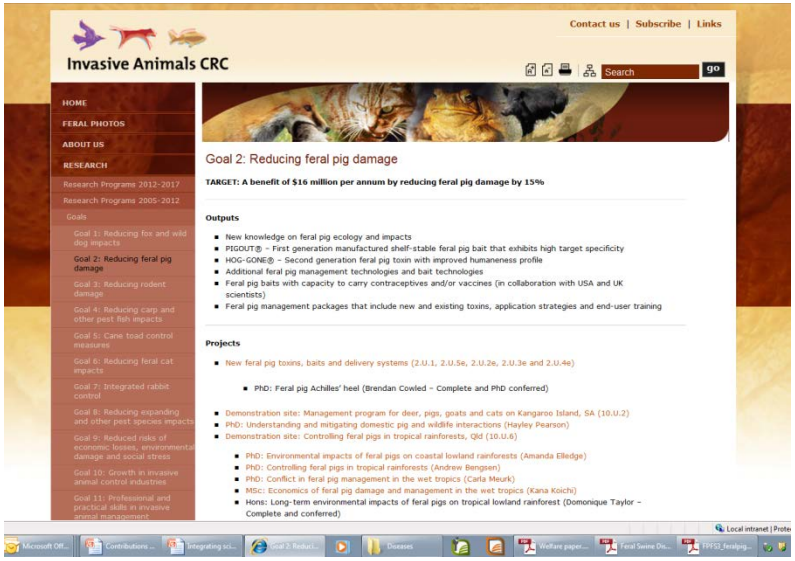
- *But* wild pigs also considered a <u>resource</u> – commercial harvesting, recreational hunting, conservation value (wild boar)



Key drivers for investment in research

- Agricultural damage
- Environmental impacts
- Disease management (FADs/endemic/zoonoses)





Policy perspective

- Address producer/environmental/community concerns
- Science-based strategies and programs
  - Address identified priorities
- Measures are effective and cost-effective
- Balancing/managing different perspectives
- Coordinated responses/collaboration involving multiple stakeholders – partnership approaches

Major research areas (brief)

1. Ecological studies (population studies, home ranges, habitat usage)
   - Understand basic biology, interactions with other wildlife and livestock

2. Measuring agricultural damage/environmental impacts
   - Justify investment in control programs

3. Population control techniques (baiting - toxins and bait technology, trapping, fertility control, etc)
   - More effective and cost-effective techniques, humane, targeted
   - Strategic control, integrated management
   - Reduce wild pig damage

4. Disease management (surveillance, epidemiological studies, interaction with other species, modelling studies, vaccines)
   - Manage disease risks, reduce transmission, eradicate disease, control disease in specific contexts

Research may be general (basic) or directed (address specific need)

Example of directed research: population control

Pest Animal Control CRC

REPORT FOR THE AUSTRALIAN GOVERNMENT DEPARTMENT OF THE ENVIRONMENT AND HERITAGE

A project that investigates current options for managing feral pigs in Australia and assesses the need for the development of more effective and humane techniques and strategies.

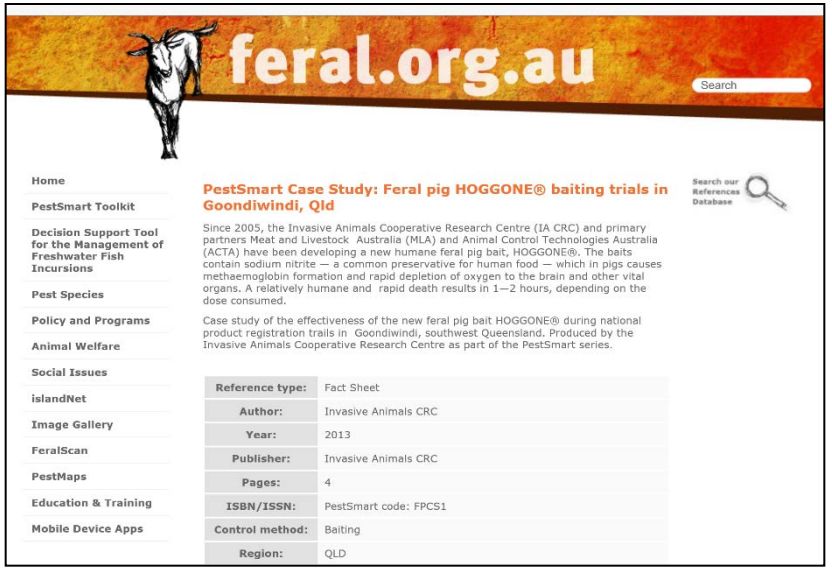
Stage 3 Report.
Review the humaneness of the options identified in stage 1.
Identify and prioritise gaps in the existing knowledge concerning the humaneness of the options and provide recommendations for future research activity.

Published November 2004.

Australian Invasive Animal CRC program

- Aim: improved humaneness and selectivity of baiting programs for wild pigs

- Development of a new bait product for pig population reduction
  - Available toxins : animal welfare concerns, efficacy (dose dependant) , variable acceptance of baits by pigs, target specificity
  - Includes investigation of sodium nitrite as a toxic agent for baiting (efficacy, stability, formulation)
  - Bait substrates for improved palatability
  - new product HOGGONE



Disease management and wild pigs

Approaches:

1. Surveillance
2. Population reduction
3. Vaccination
4. Prevent contact between wild pigs and other species (e.g. buffer zones exclusion fencing)

- All measures have pros and cons in terms of effectiveness, costs, labour, availability or access, animal welfare, ecological effects (esp. potential for harm to non-target species)
  - Most appropriate approach may vary depending on policy context (political will, $$, stakeholder issues and community support)

- Define specific aim/s
  - Eradication
  - Reduced impacts on agriculture (livestock disease)
  - Reduced disease transmission

Case studies

1. Bovine tuberculosis: Spain

2. Classical swine fever: Australia

3. Brucellosis: United States

Bovine tuberculosis in Spain

References

- Vicente et al. 2006, Ballesteros et al. 2009,
- Gortazar et al. 2011, Boadella et al. 2012,
- Mentaberre et al. 2014

Veterinary Microbiology 151 (2011) 170–178

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Veterinary Microbiology

journal homepage: www.elsevier.com/locate/vetmic

Progress in the control of bovine tuberculosis in Spanish wildlife

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ARTICLE INFO

Keywords:

ABSTRACT

Despite the compulsory test and slaughter campaigns in cattle, bovine tuberculosis (bTB)

Policy context:

- Significant livestock producer in EU
- Regulatory control of bTB in cattle
- Wild boar recognised as reservoir of bTB in mediterranean ecosystems
- Understanding role of different host species in maintenace and transmission of infection essential to design effective bTB control measures to manage cattle disease

Approach

- Disease surveillance, epidemiological studies, genetic techniques, assessing control, vaccine technology

Findings

- Wildlife (including wild pigs) emerged as a significant reservoir in southern Spain in the early 2000's
  - Some studies showed prevalence in wild pigs up to 50%, and molecular studies showed isolates from wild pigs were similar to those in livestock in local areas
- Land management practices in the area had shifted towards the development of hunting estates with intensive management of particular game spp within confined areas
- Direct interactions between livestock and wildlife (camera traps) are rare
  - Indirect interactions are more likely to occur at water (compared to food stations or pasture); survival of mycobacteria may be enhanced near water
  - Can segregate cattle and wildlife at watering points using specific fence types
- Oral BCG vaccines may protect wild boar from infection
- Disease control is specific to the context
  - Research can help to guide the most appropriate management strategy for a particular context

CSF in northern Australia

References:

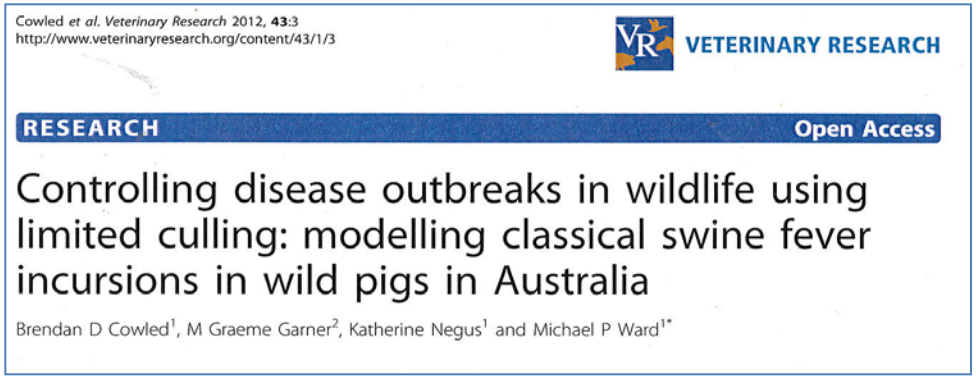
Cowled et al 2012, Leslie et al 2014

Policy context:

- Inform emergency animal disease policy and response plans to manage a CSF incursion in wild pigs

Approach:

- Field collection of demographic and distribution data
- Spatio-temporal simulation modelling of outbreaks



Cowled *et al. Veterinary Research* 2012, **43**:3
http://www.veterinaryresearch.org/content/43/1/3

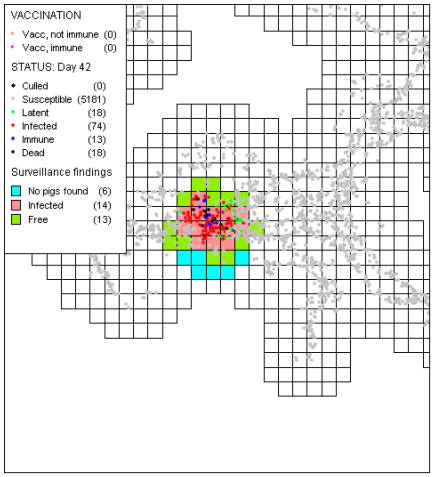
VETERINARY RESEARCH

RESEARCH Open Access

Controlling disease outbreaks in wildlife using limited culling: modelling classical swine fever incursions in wild pigs in Australia

Brendan D Cowled[1], M Graeme Garner[2], Katherine Negus[1] and Michael P Ward[1*]

Findings



- Surveillance
  - Strategies evaluated for effectiveness in delimiting the extent of infection
  - More groups needed to be sampled early in the outbreak to detect disease using simple random sampling
  - Radial and leapfrog sampling (using a grid approach) allowed faster delineation

- Control
  - Spatial structuring (contiguity) influenced model results
  - In northern Australian environment, disease spread was relatively slow along water courses with low incidence
  - Culling (aerial shooting) or vaccination were effective in containing outbreaks
  - May only be necessary to cull or vaccinate relatively small proportion of the population to eradicate disease

Brucella suis in USA

Acknowledgement: Dr Marta Guerra,
Centers for Disease Control and Prevention


Photo courtesy of Mark Krause USDA, VS

Policy Context

- Brucellosis present in feral swine populations (4-5 million)
- Reported in 39 states (Largest populations in California, Texas, Florida and Hawaii)
- Range in U.S. is increasing
- Pig hunting popular, carcases cross state lines
- Potential for increased contact between people and feral swine
- *A Growing Public Health Problem?*

Approach:

- Review reports, case data, clinical investigation

Findings

- Identify people at risk, exposure pathways
- Recommendations to prevent exposures
- Develop educational materials for target audience

5 Things You Can Do to Protect Yourself

1. Personal Protective Equipment (PPE) - Wear eye protection and rubber or latex gloves (disposable or reusable) and coveralls when handling carcasses
2. Avoid direct contact (bare skin) with fluid or organs from feral swine
3. Wash hands as soon as possible with soap and warm water for 20 seconds or more and dry hands with a clean cloth
4. Clean all tools and reusable gloves used in field dressing and butchering with a disinfectant—such as dilute bleach
5. Do not eat, drink or smoke in the field

Be Safe on Your Hunt Brochure

Community engagement

- Pest animals such as wild pigs inhabit both public and private lands

- Controlling wild pigs typically involves multiple groups and agencies (farmers, hunters, conservationists, commmercial operators, vertebrate pest agencies, environmental agencies, etc)

- Management of disease in wild pigs may also involve other stakeholders (hunters/ harvesters)
  - Different perspectives and priorities
  - These stakeholders may be in a position to contribute to disease management
  - They may also disrupt disease management if they have different objectives (e.g. commercial interest in maintaining a viable population)

- Effective community action is fundamental to most forms of invasive animal control.

- <u>Research needs to address social as well as biological challenges</u>

Environmental Management (2011) 48:878–881
DOI 10.1007/s00267-011-9747-8

Integrating Ecological Knowledge, Public Perception and Urgency of Action into Invasive Species Management

Paul Caplat · Shaun R. Coutts

Received: 7 April 2011 / Accepted: 20 June 2011 / Published online: 24 September 2

Abstract Recently Prévot-Julliard and colleagues presented a concept paper on biological conservation strategies using exotic species as a case study. They emphasized the difficulty of integrating conservation into a broad pic-

Keyword
Australia

Environmental Management (2014) 53:429–440
DOI 10.1007/s00267-013-0180-z

Bridging Disciplines, Knowledge Systems and Cultures in Pest Management

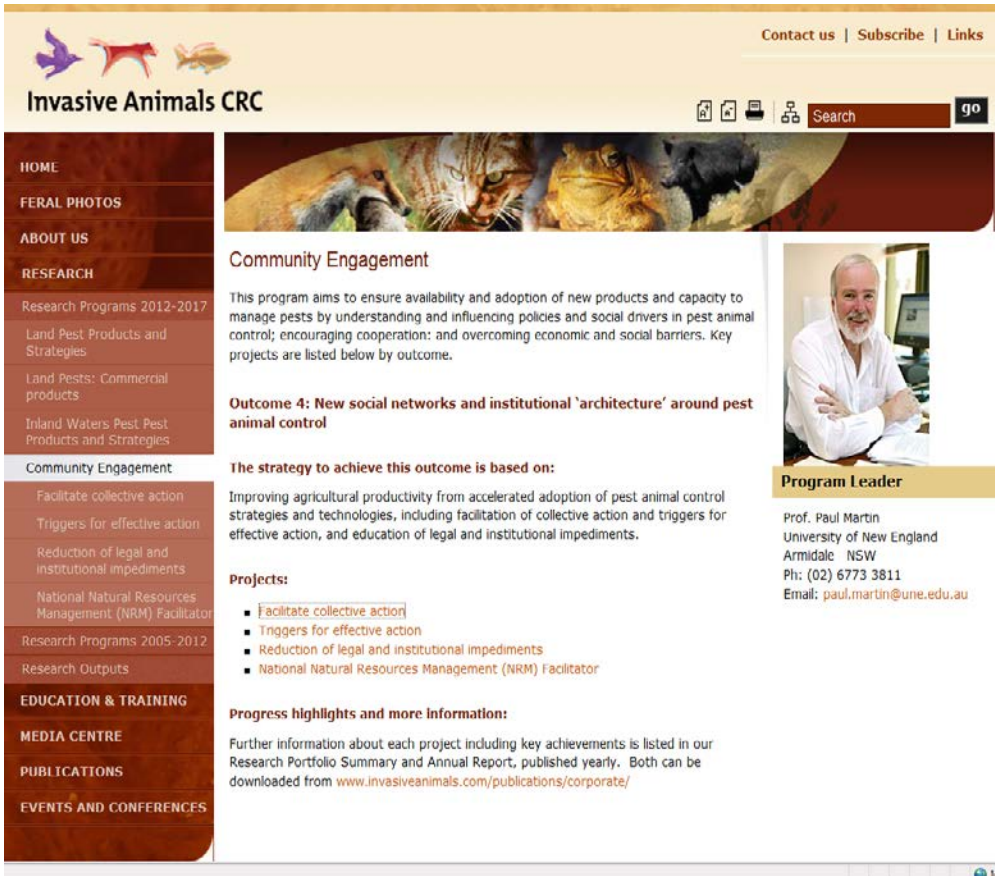
Will Allen · Shaun Ogilvie · Helen Blackie · Des Smith · Shona Sam · James Doherty · Don McKenzie · James Ataria · Lee Shapiro · Jamie MacKay · Elaine Murphy · Chris Jacobson · Charles Eason

Received: 22 January 2013 / Accepted: 30 September 2013 / Published online: 13 October 2013

Abstract The success of research in integrated environmental and natural resource management relies on the participation and involvement of different disciplines and stakeholders. This can be difficult to achieve in practice considering the different conversations that need to occur in an integrated research program. We then outline rubrics that list the criteria required in inter- and trans-disciplinary collaborations, along with examples of effective engagement

Community engagement cont'd

- Australian Invasive Species CRC: Research theme focussed on community engagement
  - Collective action (enable and support community-led action)
  - Triggers for effective action (communication strategies to increase uptake of effective action by private citizens)
  - Reducing legal and institutional impediments (laws and policies, implementation and coordination)
  - Natural Resource Management Facilitator (bringing private and public land managers together to adopt best-practice pest management techniques)



Community engagement cont'd

- In addition to being a research target, the community can also be a source of data and samples for research e.g. recreational hunters and commercial harvesters

- Another example is 'citizen science' e.g. Feral Pig Scan program
  - The FeralPigScan project is part of the FeralScan Citizen Science program.
  - This project provides a unique partnership that brings government, research, industry, business and community together to address the national problem of feral and pest animal species.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Click on a marker to view its details.
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Northern Territory 4
Queensland 167
South Australia 7
Tasmania 0
Victoria 57
Western Australia 38
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Very high numbers seen
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Discussion

- Types of research being done
- What sort of information is most useful for disease management?
- Impacts of research on intervention and mitigation?
- Has policy contributed to or hindered management of disease risk?
- Does management of disease in free ranging swine fit into One Health?
- How do we make information available to stakeholders?

What sort of information is most useful for disease management?

- Population distribution/density data
- Ecological information (home ranges, movement patterns etc)
- Surveillance data
- Basic epidemiology: multiple host systems for shared diseases
- Description of the wild pig/livestock interface and risks (interactions)
- Data on efficacy of control measures
- New control tools (e.g. diagnostics, vaccines)

Impacts of research on intervention and mitigation?

- In some cases research findings are being incorporated in management strategies and plans e.g.
  - ecological data being used for setting priorities and control zones in contingency plans for managing exotic disease outbreaks
  - new bait technologies
  - public health guidelines

- In other cases despite considerable investment, findings yet to be taken up e.g.
  - vaccination for TB control in Europe
  - Regulatory approvals for new toxins can take considerable time

Has policy contributed to or hindered management of disease risk?

- Policy: course of action to implement an identified (government) objective

- Clearly a range of policies will influence effectiveness of programs even if (or especially where) they are not specifically targeted at wild pig control e.g.
  - Allocation of funds – investment in control
  - Animal 'ownership'
  - Access to land
  - Registration of chemicals

- Science policies: support to research that can improve disease management

Does management of disease in free ranging swine fit into One Health?

- Many of the important diseases of wild pigs also affect livestock, humans or wildlife

- Controlling disease in wild pigs has other impacts and flow-on effects

- Management of free-ranging swine diseases can improve the health of human, agricultural animals and wildlife as well as preserving biodiversity

How do we make information available to stakeholders?

- Being open to cooperate/collaborate with these communities/groups
- Documenting both successful and unsuccesful initiatives
- Seek feedback from stakeholders
- Community engagement should be a core component of the NFS program, (including communication strategy)
- Use of ‘Fact sheets’, WWW sites
- Involve stakeholder representatives in research planning

Conclusions

- Differing perspectives (disease vector, agricultural pest, environmental impacts, source of income, hunting resource) mean that managing wild pigs poses significant challenges for policy makers

- Science is an essential component for effectively managing diseases in wild pigs

- Research funding tends to be driven by need to manage:
  - agricultural damage
  - environmental impacts
  - disease management (FADs/endemic/zoonoses)

Conclusions cont'd

- From a policy context control of disease in wild pigs cannot be considered in isolation to their role in causing agricultural damage and environmental impacts (feral pigs vs wild boar?)

- Effective management of wild pigs, as with many pest species requires active research involving multi-disciplinary approach

- Controlling disease in wild pigs is specific to the context (disease/ecosystem)

- Research (surveillance and ecological studies) can help define risks and select most appropriate management option for specific situations

Conclusions cont'd

- New technologies may provide options for improved control e.g
  - fertility control, biological control, new toxins and delivery systems, oral vaccines

- Community engagement is increasingly being recognised as a key element of effective pest animal control
  - Social science methods
  - Uptake of best practice management options
  - Public-private partnerships
  - Engage stakeholder groups who may have competing interests

Association Inc. - Diseases of Feral Pigs in Australia - Windows Internet Explorer

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Association I...

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- In the Community
- Application form
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- General Info
  - NSW Public Land + Hunting (R License) information
  - + Busting the myth

Feral Pig Disease

- + Poisonous plants
- + Insurances
- Dog Registry
- Poachers Paradise

"SportDOG TEK 1.0 Tracking System with optional E-training supplied by Dogmaster".

Diseases of Feral Pigs in Australia

Acariasis.

This is a condition caused by biting lice, which are known to be carried by feral pigs. The lice will bite the human handler of their dead host, causing temporary irritation. Sarcoptic itch and acariasis, is a highly contagious infestation with Sarcoptes scabiei, a tiny, whitish-brown, eight-legged mite that burrows into the skin to lay its eggs. Burrowing, egg laying, and faeces deposition cause severe skin irritation, eruption, and itchy rash.

Brucellosis.

Brucellosis can occur in wild boar. The main point of infection from pigs is via their body fluids such as blood, urine and milk being inhaled or splashed in the eyes. Good personal hygiene and careful dressing of carcase are the best preventive measures.
Humans become infected by coming in contact with animals or animal products that are contaminated with the bacteria. In humans brucellosis can cause a range of symptoms that are similar to the flu and may include fever, sweats, headaches, back pains, and physical weakness. Severe infections of the central ne
also cause long-lasting or chronic

Fascioliasis.

A common disorder of feral pigs in
a flatworm called Fasciola hepatica
consumption and neither is the car
Liver flukes can also be found on w
invades the liver, bile passages ma
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ILLEGAL TRANSLOCATION AND GENETIC STRUCTURE OF FERAL PIGS IN WESTERN AUSTRALIA

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JORDAN O. HAMPTON, Veterinary and Biomedical Sciences, Murdoch University, South Street, Murdoch, Western Australia, 6150, Australia

Abstract: Unlike many regions in the world where wild pigs (*Sus scrofa*) are threatened, in Australia they are a significant invasive species. As such, the molecular ecology of feral pigs was investigated to understand their social and population genetic structure. Samples from 269 adult animals were collected over their distribution in southwestern Australia. Using 14 highly polymorphic microsatellite markers, we identified 7 inferred feral pig populations that had moderate heterozygosity (mean = 0.580) and displayed a high level of differentiation (mean R_{ST} = 0.180). In revealing the genetic structure of feral pigs, we detected anomalies in the putative origin of some individuals. Samples from these animals were collected from 2 main areas: recently colonized regions that were previously uninfested, and established feral pig populations, where animals from geographically isolated areas had been introduced. In the latter, these corresponded to areas that were in close proximity to public road access and towns. Given the large distances immigrants were found from their population of origin (from 50 to >400 km), the generally low levels of dispersal of southwest feral pigs, and the grouping and sex of these pigs, we suggest that these individuals have been deliberately and illegally translocated to supplement recreational hunting stocks. Additionally, we could not detect any genetic contribution in these feral pigs from domestic pig herds, suggesting that the deliberate release of domestic pigs to restock feral populations is relatively uncommon. Our molecular data allowed some inferences regarding the success or lack thereof of current management practices, and offered considerable insights into the dynamics of the feral pig populations and identification of "new" approaches that may allow for better control of this highly destructive species.

JOURNAL OF WILDLIFE MANAGEMENT 69(1):377–384; 2005

Key words: Australia, Bayesian assignment, dispersal, movement, deliberate introduction, feral boar, genetic diversity, microsatellites, *Sus scrofa*.

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  Ronda de Toledo s.n., 13005 Ciudad Real, Spain

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  Centers for Disease Control and Prevention

Thank you for your attention

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