



Tasmania

DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Tasmanian Devil Facial Tumour Disease (DFTD)

DISEASE MANAGEMENT STRATEGY

FEBRUARY 2005

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INTRODUCTION

Tasmania's wild Tasmanian devil population is being severely affected by the devil facial tumour disease (DFTD).

DFTD has now been recorded across the eastern half of Tasmania and as far west as Cradle Valley. To December 2004, it had been found over 65 per cent of the State and is almost certainly present in a larger area. A third to half the wild devil population in the State 10 years ago is likely to have been lost. The short and medium term effects of DFTD are severe; the long term effects are not known at this stage.

So far, the disease has only been recorded in wild Tasmanian devils.

DFTD appears to be an entirely new wildlife disease and presents new and daunting challenges to wildlife biologists, epidemiologists, veterinary pathologists and wildlife managers.

Whilst knowledge of the disease is improving as a result of intensive mapping and monitoring of the wild population and diagnostic research and investigations, its cause and mode of transmission and ultimate potential impact remain uncertain

The Tasmanian Government has provided a three-year funding package of over \$1.8 million for the response to the disease. Other staff resources are also being devoted to the disease response. The Australian Government has provided special funding to monitor the disease in Tasmania's World Heritage Area and a further \$2 million over two years has been pledged by the Australian Government to assist research into DFTD.

The response to the disease is being coordinated by the Department of Primary Industries, Water and Environment. A steering group comprising representatives from key stakeholders has been established and is being supported by a multi-discipline project team. The response is being undertaken in three parts – mapping and monitoring of the wild population to look at disease spread and effects, diagnostic research and investigations to describe the disease and the development of management strategies to minimise effects of the disease on the species.

This Disease Management Strategy has been developed in the light of the current knowledge of the disease. It adopts an adaptive management approach and will be refined as knowledge and understanding of the disease improves. The strategy draws together the resources of the Department of Primary Industries, Water and Environment and the Parks and Wildlife Service of the Department of Tourism, Parks, Heritage and the Arts together with a number of local and interstate businesses and institutions and key stakeholders.

EXECUTIVE SUMMARY

The Tasmanian devil facial tumour disease (DFTD) Disease Management Strategy has been developed in the light of current and emerging knowledge and understanding of the disease and will be refined and adapted as knowledge and understanding of the disease improves.

The strategy is based on best practice disease management principles and risk minimisation and adopts a precautionary approach to the disease. It is comprised of five key elements –

- 1) Ongoing field mapping and monitoring of the disease and diagnostic research and investigations;
- 2) The isolation of devils in quarantined insurance populations;
- 3) Field trials to test the effectiveness of isolation and disease suppression techniques in maintaining and restoring devil populations and limiting the apparent spread of the disease;
- 4) Ongoing work to maintain the biosecurity and genetic diversity of captive devils held by wildlife parks in Tasmania; and
- 5) Improved management of captive devils held by interstate wildlife parks to maximise breeding success.

Field mapping and monitoring of the disease and diagnostic research and investigations during 2004 has made considerable progress in understanding the impact of DFTD on the wild devil population and in identifying the disease, its cause and means of transmission. Much work however remains to be done to understand the disease's behaviour and transmission dynamics to enable the implementation of effective management strategies and the development of a diagnostic test and possibly a vaccine.

The isolation of devils in quarantined insurance populations is considered an essential step if DFTD continues its apparent spread westward across Tasmania. Whilst it is not yet certain that the disease will reach the high density devil population on the far north-west or devils in more isolated parts of the west coast, a precautionary decision has been taken to remove devils now from areas in which the disease has not been recorded, and place them in isolated quarantine facilities within Tasmania. Final evaluation of potential sites including the existing wildlife quarantine site at Tarooma, other urban sites, Maria Island and other offshore island is underway.

Whilst discussions with the national zoological industry body, the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA) have produced in-principle agreement on the establishment of an insurance population in zoos on the mainland, the Government has received expert veterinary advice that devils should not be transferred interstate until knowledge and understanding of the disease improves.

The important diagnostic finding that the devil tumours are identical regardless of the sex and area of origin of the animals has led to the hypothesis that the tumour may be passed directly from animal to animal by implantation of the cell line during fighting and biting. Based on this information, field trials are being developed to test the effectiveness of trapping and removal of diseased devils.

Field trials are proposed in sites in eastern Tasmania including the Forestier and Tasman Peninsulars. Trials of these techniques are also being considered as a management tool for limited the spread of the disease into areas in which the disease has not been recorded to date including Narawntapu National Park near Port Sorell.

Devils held in captivity in Tasmania's wildlife parks represent a potentially important reservoir of disease-free animals. The devil disease project team has been working in partnership with Tasmania's wildlife parks for some time in an endeavour to maintain the apparent disease-free status of the Tasmanian captive devil population.

Enclosure biosecurity has been recognised as important in minimising the risk of interaction between captive and wild devils, and best practice veterinary and husbandry protocols are in place to maintain the apparent disease-free status of the captive devils. Protocols have also been developed to enable limited transfer of devils between Tasmania's wildlife parks to maintain breeding lines and genetic diversity.

A productive partnership has been established with ARAZPA to ensure that the breeding potential of devils currently held by Australian wildlife parks and zoos is maximised through a co-operative Species Management Plan. Whilst a significant proportion of devils held in other States are post-breeding age, there is potential for greater breeding success amongst the younger devils. The Tasmanian devil studbook managed by Healesville Wildlife Sanctuary in Victoria will be an important tool in assisting to implement this strategy.

1. ONGOING FIELD MAPPING AND MONITORING AND DIAGNOSTIC RESEARCH AND INVESTIGATIONS

Field Mapping and Monitoring

Field mapping and monitoring and intensive diagnostic research and investigations into the Tasmanian devil facial tumour disease (DFTD) will continue to be a priority and to provide vital input into the development of management strategies as knowledge and understanding of the disease improves.

Mapping and monitoring is being undertaken across the State and DFTD has now been recorded across the eastern half of Tasmania and as far west as Cradle Valley. DFTD has recently been confirmed at Fentonbury and Adamsfield in the south, and immediately north of Eaglehawk Neck.

To December 2004, the disease had been recorded over 65 per cent of the State and is almost certainly present in a larger area. A third to a half of the wild devils present in the State 10 years ago are likely to have been lost.

A previously medium-density devil population affected by DFTD, and suitable for regular study, has been located at Bronte Park in the central highlands. A recent apparent change in the disease status of the devil population in the Fentonbury area has provided the opportunity to study disease arrival and progression in this area.

Field mapping and monitoring has confirmed that the short and medium term effects of DFTD on devil populations are severe. Long term monitoring at replicated sites will be essential to assess whether these effects remain, or whether populations can recover. Monitoring will also help reveal how DFTD is transmitted through a wild population and help guide disease management strategies.

Diagnostic Research and Investigations

An intensive diagnostic research and investigation effort is underway at the Mt Pleasant Laboratories near Launceston assisted by work at a number of interstate institutions.

Whole blood and sera samples have been taken from devils across the State and this data is now being analysed. A number of investigations to identify possible applications for established diagnostic tests have been undertaken and are continuing.

Key outcomes include the development of an effective field sampling unit, documented anaesthesia monitoring, establishment of a sample bank for devil tissue and the development of a number of blood and biochemical reference values for devils.

Work on a case definition of DFTD has included histopathological, cytogenetic and transmission electron microscope analysis. The use of immunohistochemistry has shown that the most consistent tumour type isolated appears to be of a neuroendocrine origin.

Ground-breaking cytogenetics work has established the normal Tasmanian Devil karyotype and the chromosome rearrangements of the tumour, leading to the hypothesis that DFTD may be directly passed from animal to animal by implantation of the cell line during fighting and biting. Further testing of this hypothesis is planned.

The process of aetiological identification (identifying the cause of DFDT) has been progressed by histopathological, immunohistochemical and cytogenetic examination of the tumour. The results of transmission electron microscopy of tumour tissue for the presence of virus particles has so far been negative but work will continue to categorically rule out viral involvement.

A tissue culture laboratory was established in July 2004 and cultures made of tumour cells. Additional techniques will be employed in the next stage of aetiological investigation. A pilot trial to test samples for the presence of a range of toxins is proposed and may lead to a much larger project.

2. ESTABLISHMENT OF QUARANTINED INSURANCE POPULATIONS

Background

The establishment of “insurance populations” of devils, sourced from apparently disease-free¹ areas of Tasmania, has been identified as an important management response to the devil facial tumour disease (DFTD). It is considered to be an important precautionary measure to maintain a healthy population of Tasmanian devils in the event that the disease continues its apparent spread westward into areas in which the disease has not been recorded to date.

The triggers that necessitate this immediate management action are the widespread distribution of DFTD throughout the state, severe population crashes of devil numbers, and evidence suggesting the disease is contagious. By removing juvenile devils from currently “clear” areas of the wild and translocating them into captivity, it is hoped to secure a disease-free population of new founder animals.

Ongoing discussions with the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA) has led to in-principle agreement to establish an insurance population of devils at selected captive institutes on the mainland. It has been agreed that support from member zoos could be provided subject to the approval of the respective regulatory wildlife authorities.

A risk-reduction document was prepared by DPIWE outlining quarantine and husbandry protocols to limit potential transmission of DFTD in captivity and circulated to key staff of the potential institutes and the respective Chief Veterinary Officer (CVO) for each state. The Tasmanian Chief Veterinary Officer has also been consulted. His advice, together with that of veterinary pathologists at the Mt Pleasant Laboratories, is that in light of the currently limited knowledge of DFTD, devils proposed for transfer interstate should undergo a Pre-Export Quarantine (PEQ) period prior to any movement of animals out of Tasmania (see attachment).

The following two prerequisites for holding and establishing devil insurance populations have been identified:

- 1) the site is located in a disease-free area; and
- 2) no other devils occur in that area.

Suitable locations that would meet PEQ requirements for temporary housing of captive insurance populations of devils are urban areas and off-shore islands. Potential sites for the holding facilities include the existing wildlife quarantine centre at Tarooma, other secure urban sites and islands off the Tasmanian mainland including Maria Island.

Objectives

The ultimate objective of the insurance population strategy is to ensure a genetically diverse, healthy captive devil population as a backup against possible future extinction in the wild.

¹ Without a diagnostic test, animals are closely inspected for visible signs of DFTD and any possible lesions are sampled and cleared by the veterinary/diagnostic team.

In addition to providing a necessary genetic enhancement to ensure the current captive population remains viable, establishment of insurance populations could provide a valuable source of animals for reintroduction to the wild in the event that a vaccine becomes available or in areas of the State that can be kept disease-free.

Timing and Methods

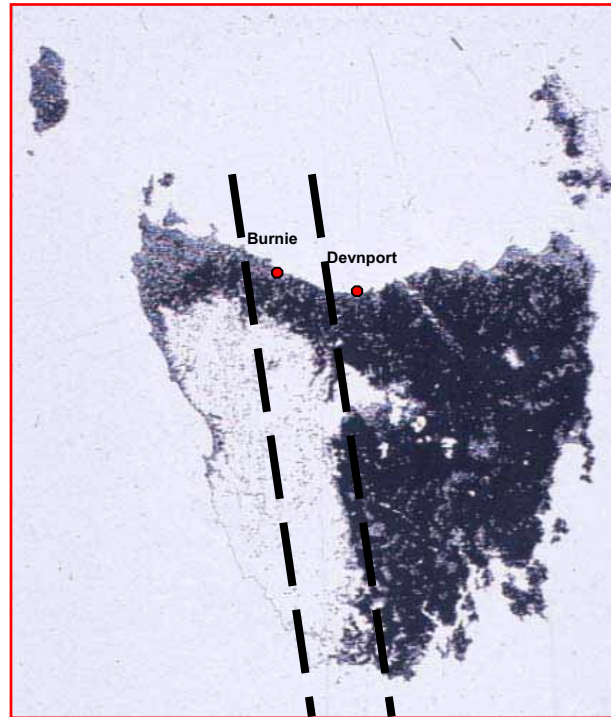
There is a very restricted time-frame within which devils can be sourced from the wild for insurance populations due to the risk of the disease spreading and the need to collect juvenile devils from the wild in the immediate weaning period (February-March 2005). DFTD mainly affects adult devils (2 year olds +), therefore, 'targeting' recently-weaned animals living in apparently 'clear' areas prior to dispersal represents the safest option for risk management. These young devils will have had less contact with conspecifics (members of the same species) and will be removed prior to dispersal into or from the source area.

The DFTD monitoring teams have been conducting trapping surveys to identify potentially suitable locations for removal of wild juvenile devils from the population. Whilst the disease covers an estimated 65 percent of the State, there remain a number of areas of the State in which devil populations have not yet shown physical signs of DFTD. Diagnostic research and monitoring records strongly indicate that DFTD is an infectious disease, therefore, targeting suitable 'clear' locations of the state as soon as possible is important prior to any signs of the disease becoming evident in the area.

To reduce the risk of DFTD transmission to the captive devil population, following a period of at least 12 months pre-export quarantine (PEQ), it is proposed that the young founders be exported only to mainland institutes not holding any other devils. DFTD is a high risk disease - being fatal and probably infectious - without any diagnostic test at present. PEQ is a necessary consideration because of the limited current knowledge and understanding of the nature or spread of the disease.

Source Locations

Wild founder stock are to be sourced from regions of the State that represent different genetic provenances to maximise the genetic diversity of captive insurance stock. To date, two genetic management units have been identified, eastern Tasmania and the north-west (see Map 1, below). Genetic research has shown an evolutionally-significant variation in devils between eastern and western Tasmania, resulting from a natural topographical buffer to gene flow relating to unsuitable habitat. It is therefore also important to source devils of western provenance to represent the natural genetic population structure.

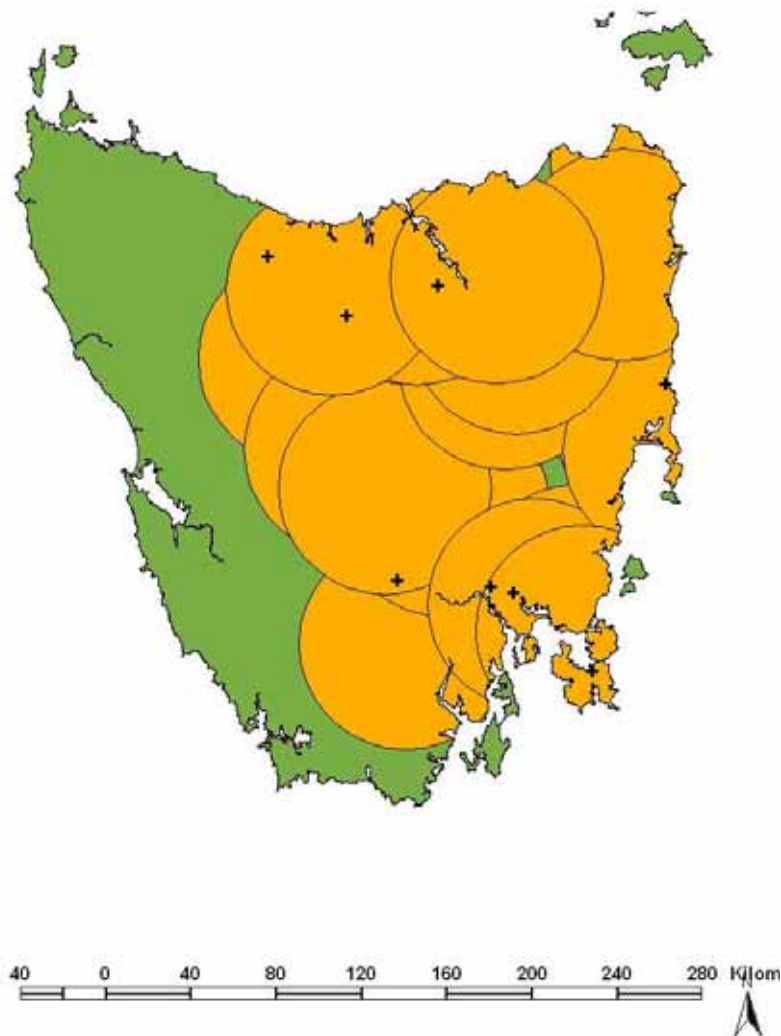


Map 1: Genetic population management units of Tasmanian devils (Jones et al. 2004) overlaid on environmental domain model for devils (Jones and Rose 1996). The dashed lines show the zone which acts as a filter to gene flow and relates to unsuitable habitat and associated low densities of devils.

Disease Zoning and Risk Reduction

Map 2 depicts areas of Tasmania that have been assigned as disease risk zones. This information is based on current knowledge of confirmed cases of DFTD from field monitoring, roadkills and other cases. The map indicates that a large portion of the north and northeastern part of the state is considered to be a risk zone, whereas the far southern and western extremes are at lower level risk. It is important to note that the map is not yet complete although north-western surveys have so far found no evidence of disease. There are large areas of the state yet to be sampled, including areas in the vicinity of known risk zones.

DFTD Zones



Map 2: Disease risk zones for DFTD.

The orange zone is considered to be high risk based on confirmed incidents of the disease, mainly in the north and northeast of the State. No disease has yet been recorded in the west of the State - green zone. The location of wildlife parks (8) are marked as crosses.

Note: this map is not yet complete, and will be updated with further records as information from fieldwork and laboratory analyses comes to hand.

High-risk areas are depicted by shaded circles representing a 50 km radius around each point location, that being approximately twice the maximum known home range for the Tasmanian devil (based on radiotracking surveys). For devils living within this radius, there is a reasonable chance that their home range will contact that of the diseased devil.

As a precaution, devils for insurance purposes will be sourced where possible from areas of the state located outside risk zones *i.e.* within the green area. Where this is not possible, as in the case of devils

of eastern provenance, devils will be sourced from lower risk zones (>25km from nearest confirmed case) where landscape features appear to restrict devil movement and only after intensive trapping has been conducted.

Recent trapping effort indicates Narawntapu National Park is a potentially suitable area from which to source devils as it has a medium-high density of devils, a relatively long-term monitoring history and no present evidence of DFTD. Narawntapu is also physically suited as a source area, being bounded on three sides (to the north, east and west) by substantial bodies of water, and to the south by fairly unsuitable devil habitat. These physical features of the landscape may play a role in the apparent absence of the disease in the area to date.

It is desirable to collect founders from at least one other eastern provenance area due to the limited genetic diversity of devils in any single location. There are very few other potentially unaffected areas of the state. The Southport area contains low-medium densities of devils and is being investigated as a second location. The site is located in the far south of the State in a presumed “clean” area, falling outside the known disease risk zone (Map 2) and >50km from the nearest confirmed case.

Age, Number and Sex of Founder Animals

A maximum of 13 (4 male; 9 female) juvenile devils would be removed from Narawntapu national Park and possibly the Southport area to represent the eastern genetic provenance insurance unit. A similar number and sex ratio of devils would be removed from several locations along the west coast to maximise genetic diversity from that area. The total maximum number of juveniles removed would be 25 individuals.

Research has shown that due to the naturally low genetic diversity of Tasmanian devils, only a relatively low number of founder animals are required to represent the natural diversity of the species. Population genetic research suggests that 25 individuals collected from a range of locations will be appropriate to establish and maintain a captive population long term. Removal of this low number of devils would have no effect on the remaining population, particularly because juveniles are the age class that suffers the highest natural mortality, due to predation and particularly events during dispersal.

Pre-Intake Trapping

Prior to removal of any young, focal areas will be extensively monitored to ensure the most up-to-date disease status of the population. The sites will be trapped for twice the usual duration, and the surrounding location also thoroughly targeted to provide a high level of confidence that no individuals with signs of DFTD have been located in that area. Veterinarians from the diagnostic team are available to check any uncertain cases.

Recent trapping at Narawntapu has recorded over 100 individual devils, with no signs of DFTD. The Southport area is a medium-low density population and therefore is unlikely to yield such high numbers of individuals. Fewer individuals (approx. 5 juveniles) will be sourced from this location to minimise potential associated risk.

Health Check

All devils for intake from the wild will be rigorously vetted prior to removal into captivity. Each animal will undergo a full examination by DPIWE diagnostic team and veterinarians. The health check includes a thorough physical inspection and blood sampling under anaesthesia, conducted under specific protocols and collection procedures. Each devil will be microchipped for individual identification, treated for parasite control and as a precautionary measure given a dose of antibiotics.

Temporary Holding Facilities

Devils will be temporarily housed on site in demountable holding pens constructed at Narawntapu National Park and Southport. The pens will be constructed following the standard approved for housing other captive devils. This housing is suitable for holding the juveniles for up to two months, while construction of the PEQ facilities is completed.

Pre Export Quarantine - Proposed Location and Facilities

To satisfy the criteria for Pre Export Quarantine (PEQ), holding facilities must be established in disease-free areas of the state, without any existing devil populations *i.e.* urban areas and off-shore islands. The proposed sites for holding facilities are the DPIWE wildlife and quarantine site at Tarooma, other secure urban sites and islands off mainland Tasmania including Maria Island. Devils originating from the western and eastern provenance areas would be housed and managed separately at the respective sites.

The Tarooma quarantine site is currently housing a control group of west coast devils, and further development of the site could readily progress. A potentially suitable site for temporary enclosures has been located in a semi-secluded, accessible location of Maria Island, adjacent to existing facilities.

The holding pens at Tarooma are double security fenced, located within a compound of approximately 3000m² inside the existing secured DPIWE research site perimeter. The cyclone fence outside the enclosures extends beneath the ground to a depth that prevents any animals that might escape their pens from digging out of the compound.

A development plan for the devil compound and additional enclosures at Tarooma has already been prepared. The construction plan includes animal pens, a maintenance and storage area and a wash bay. Documentation on husbandry and hygiene protocols and disease risk-reduction practices is followed to ensure best-practice animal management. Development of an appropriate site on Maria Island and/or at other urban/island sites for temporary housing of devils would follow the plan for the Tarooma facility, with some minor modifications.

Only female devils would be housed on Maria Island or on other off-shore islands as an additional risk management precaution to guard against the chance of any escape and establishment of a devil population in the wild. The male devils (4) from eastern provenance locations would be maintained at a separate facility in a suitable location within Tasmania.

Risk Minimisation Practices

Devils trapped for insurance populations will be recently-weaned animals sourced from “disease-free” areas of the wild during the upcoming weaning period (Feb-Mar 2005). Monitoring has shown DFTD usually affects adult devils (2 year olds +), and diagnostic research suggests that the disease may be spread by physical contact between individuals. As a risk minimisation strategy, removal of juveniles reduces the risk of infectious disease because young devils have considerably less contact with conspecifics and will be removed prior to their dispersal into or from the source area.

As with other mammal species, devils have been shown to have female philopatric systems, which means that females remain near their natal area and male juveniles disperse. Current trapping in Narawntapu National Park and in the Southport area indicates that while nearly all females are still lactating, weaning has begun in several individual mothers.

The widespread occurrence of DFTD in the eastern area of the State presents a low possibility that a few young males present in clean areas may have dispersed in from a nearby diseased area by the time trapping of founders commences. As a further risk reduction practice, males will be removed from the most distant locations and the smaller *i.e.* younger individuals will be selected.

In addition, the number of males collected will be kept to the minimum sex skew acceptable for effective population management.

There is as yet no diagnostic test available to detect DFTD, and visual inspection is not always reliable, with an unknown latent period between contracting the disease and onset of obvious lesions. A minimum 12-month period of Pre-Export Quarantine (PEQ) is considered a prudent measure to reduce the risk of DFTD transmission to the captive devil population. DFTD is a unique disease with no diagnostic test or vaccine at the present time, and there is no understanding of its cause, transmission, lag time or potential of the disease to affect other species. Fortunately, DFTD is already isolated in Tasmania, providing a unique opportunity to contain the disease until further knowledge is available.

Juvenile devils housed in quarantine facilities would be maintained under close observation and undergo routine health monitoring by DPIWE diagnostic team. In any suspected cases of DFTD, the animal will be removed from the facilities to the Mount Pleasant Laboratories for further clinical testing.

Devils would be released from PEQ to mainland facilities only when more definitive information on the transmission route and details of the disease or a diagnostic test becomes available. A quarantine time-frame of at least 12 months is proposed, because devils do not usually express the disease until they are adults *ie.* two years old. The juvenile founder devils will not reach breeding age until 2006, and therefore, as adults, they will still then be of maximum value in the establishment of a mainland breeding program for the insurance group.

Devils clearing PEQ and exported to captive institutes outside of Tasmania would be managed under a specific code of risk minimisation practices that has been developed by DPIWE in consultation with the State Chief Veterinary Officer and other expert animal health authorities. The insurance animals would be housed at mainland ARAZPA institutes under a partnership agreement as part of a formal Species Management Plan.

3. FIELD TRIALS: ASSESSING MANAGEMENT OPTIONS FOR WILD POPULATIONS

Options for isolating disease-free, wild populations

The focus in 2004 was to assess the disease status of areas that are or could be effectively isolated from the immigration of diseased devils. These included the introduced, feral devil population on Badger Island in the Furneaux Group, and the Forestier and Tasman Peninsulas. DFTD was confirmed in these areas as detailed below.

- **Badger Island, Furneaux Group:** This feral population has been isolated on Badger Island probably since its introduction in around 1996. A field trip in May 2004 found an unusual age structure (no older males) in this small population, indicative of a diseased population. While no diseased devils were trapped, a devil with typical DFTD-like tumours (diagnosis not confirmed with pathology) was observed.
- **Forestier Peninsula:** This population could be effectively isolated from “mainland” Tasmania using a combination of fencing and grid mesh to discourage devil movement across the Denison Canal bridge at Dunalley. A trapping trip in June 2004 revealed one devil (61 trapped) with tumours. A small number of diseased animals have since been recorded. The age structure on the peninsula is indicative of a non-diseased population (good representation of older age classes) suggesting that the disease has been expressed here only recently.

Field trials to assess the effectiveness of disease suppression as a management tool

The most effective management tool currently available to mitigate the population impacts of DFTD is to reduce the amount of time that infected devils are in the population and in contact with healthy devils, by trapping and removing (“trap and remove”) diseased devils.

Results of diagnostic work at Mount Pleasant laboratories has shown that the cytogenetics of all devil tumours are identical, irrespective of location. This has led to the hypothesis that the tumours may be transmitted directly between devils through transfer of tumour cells during biting. If this is the case, removal of infected devils may reduce the chance of infection of new individuals and decrease the prevalence of the disease in the population. Vaccination may be a disease management option in the future.

A characteristic of devil populations up to eight years after the disease has first arrived is the lack of older age classes. Devils live up to six years in the wild. Females would normally breed four times (at 2, 3, 4, and 5 years of age). Prime breeding males are 4-5 year olds. In post-disease populations, there are very few devils more than two years of age and none older than three. Most devils appear to contract the cancer soon after reaching adulthood as a two year old. Reproductive failure in these diseased two year old females appears to be quite high. This population age structure could have serious implications for the long-term extinction risk of wild devils.

Removal of diseased devils from wild populations should decrease disease prevalence and allow more devils to survive into their third year or even longer. These animals might then breed two or three times, with the increased output of juveniles aiding population recovery.

There are three situations in which this technique for disease suppression could be applied: to enhance devil populations in a local area which is currently diseased, to suppress or even eradicate the disease in an isolated area such as the Forestier and Tasman Peninsulas, and to protect currently disease free areas such as Narawntapu National Park and parts of north-west and western Tasmania.

In 2005 and beyond, a series of field trials are proposed to test the effectiveness of removal of diseased devils though trapping in restoring population age structure and enhancing local recovery of population density. These proposed trials would be set up as adaptive management trials, in that they would be responsive to and refined as new information about the nature of the disease came out of the diagnostic program. Information about age-specific survival and reproduction collected during the trials will be used in population and epidemiological modelling to compare which is the best alternative management option. Diseased devils would be removed and taken to the Mount Pleasant Laboratories for study and/or euthanasia. Orphans would be hand-reared and retained for ongoing diagnostic monitoring.

There are several issues which these trials might address, including the degree of natural or artificial isolation required for the technique to be successful, and the amount of effort and cost required to achieve particular degrees of success. The remote cameras developed for the disease monitoring program can be used to assess what proportion of diseased devils have been missed by the trapping program.

Adaptive management trials to assess the effectiveness of removal of diseased devils for population recovery at sites with different degrees of isolation

The establishment of replicated, matched treatment and control sites in various parts of the State to evaluate the effectiveness of continued trapping and removal of diseased devils with different degrees of natural (bounded by water) or artificial (fencing) isolation is currently under consideration. Modelling and epidemiological advice is being sought on the framework for this experimental work. A minimum of five replicates in the form of matched control and treatment sites would probably be required to provide statistically-valid data. Such an exercise could be costly but could provide results of direct management value for the long-term. The potential benefits of this proposal and the possible timing of commencement will be considered in the context of the current and future knowledge and understanding of the disease.

In addition to these replicated sites, the Forestier and Tasman peninsula provide an opportunity to test whether disease suppression or eradication can be implemented in a large, isolated area in which the disease is present but not yet well established. This peninsula comprises 350 km² of land and a sizeable devil population. It is considered that this population could be isolated from mainland Tasmania by a suitable devil-proof grid, fencing and lighting on the Denison canal and bridge at Dunalley.

Adaptive management trials in northern Tasmania to contain the spread of the disease:

As noted above, DFTD has not been recorded to date within the Tasmanian devil population in the Narawntapu National Park and it appears that this population may be protected from the disease by the presence of waterbodies on three sides and unsuitable devil habitat to the south.

A proposal to run a broad-scale trapping line south of the national park is currently under consideration. A monitoring operation in the area in January 2005 identified potential sites for such a program.

Further to the west, several routes suitable for a broad-scale trapping program have been inspected and will continue to be evaluated. These routes provide suitable access and coincide with the tightest habitat restriction for devils between eastern and western Tasmania. If implemented, these operations would provide valuable information on future options for disease management in continuous wild populations.

Options for reducing other sources of mortality in wild populations that have been impacted by disease:

Mitigation of human-induced mortality (including roadkill, persecution and entrapment in council waste transfer facilities) may be important for in the long-term protection of the wild devil population. In 2004, strategies that could address these causes of mortality were addressed. The continued existence of diseased devil populations for three to eight years in the presence of these mortality factors suggests that these issues may not have the same tight time constraints and urgency but may nevertheless be important.

To date, presentations have been made to Parks and Wildlife Service staff to engage them in reducing roadkill in their local area by removing carcasses of roadkilled prey species from the road. The assistance of PWS personnel may also be sought to help identify locations of major roadkill blackspots which could be targeted for specific mitigation.

4. CURRENT CAPTIVE DEVIL POPULATIONS

A Tasmanian devil captive management program has been developed with the aim of preserving the health and genetic integrity of captive devils and helping to ensure that the species does not become extinct in the longer-term.

Effective captive management of Tasmanian devils (and other dasyurids - carnivorous marsupials) presents a greater challenge than many species, due to their somewhat unique life history and biology. Devils are relatively short-lived animals (< six years), do not breed until two years of age, become senescent after around four years old and can only rear one litter each year.

These factors coupled with a poor understanding of the species reproductive biology have resulted in limited ability to maintain captive stocks long-term and adequately represent genetic diversity.

To enable success of future captive management programs for devils there is a recognised need for a review of current practices and improved knowledge of the reproductive biology. In addition, because devils do not “fit” the typical profile for many species, standard management tools are less effective; therefore, it is important to identify parameters for long-term maintenance of captive populations, in the event that due to the disease, wild founder stock may no longer be available.

In association with the Australian Regional Association of Zoological Parks and Aquaria (ARAZPA), devil populations in Tasmania and interstate will be managed utilising a professional record keeping system and software designed specifically for zoo and wildlife industry by population biologists and geneticists. These tools assist in making management recommendations for movements and pairing of individuals to maximise genetic diversity. Cooperation between institutes will also assist in maximising genetic diversity in current stock and ensure founders are represented.

Dedicated species conservation effort requires integrated management of both wild and captive devil populations. There is a major opportunity for all Tasmanian wildlife parks and the mainland captive zoological industry to participate and play a role in working together towards conservation of the devil.

Biosecurity Measures

Due to a limited understanding of DFTD and in accordance with expert veterinary advice, as noted above, an embargo is in place on the export of devils out of the State as a precautionary measure. The purpose of the moratorium is to reduce the potential for infectious spread of the disease among captive devil populations, particularly those on the mainland, which have no risk of contracting the disease from wild animals. Protection of devils in zoos outside of Tasmania is especially important because these individuals could eventually be the only unaffected devils remaining and be crucial to the species' survival.

Future export of devils sourced from the wild following a period of Pre-Export Quarantine (PEQ) is reliant on improved knowledge of DFTD or a diagnostic test to reduce risk of potential disease transfer. At this time, it may also become possible to lift the moratorium on movement of other devils between Tasmanian institutes and mainland Australia, or overseas.

Tasmanian Wildlife Parks

The Department of Primary Industries, Water and Environment has been working closely with Tasmanian wildlife park operators to keep them fully informed on DFTD issues and to assist them with monitoring and management of current captive devil populations. Industry-standard microchips have been provided to all operators to help individually identify their devils, record family histories and construct a state database for the species.

Assessment of the current captive devil stock has identified a need for the development of a management strategy to assist Tasmanian wildlife parks to a) maintain and manage their devils to sustainable levels, and b) ensure a genetically diverse and healthy population in the future.

Approximately 75 Tasmanian devils are currently held in the State's eight wildlife parks. An in-state captive management strategy will be developed in 2005 to assist in making pairing recommendations and ensure a good level of genetic diversity continues to be represented within these institutes. Effective breeding management of the existing stock is of particular importance, given the inability to freely import more founders from the wild due to the necessary constraints of disease management.

Two imminent requirements are the need to implement increased biosecurity measures and to assist park operators to manage their current stocks through permitting limited transfers between other wildlife parks in Tasmania. Because detailed information about DFTD and its transmission is not presently available, transfer of devils between captive institutions has been identified as a significant risk factor. Any devil movements will be restricted to necessity and assessed on a case-by-case basis. In the specific case of DFTD, devils kept in Tasmanian wildlife parks are considered to be at some risk because the establishments are located in areas of the state where free-ranging devil populations naturally occur. All the wildlife parks are located in areas of the state within confirmed disease zones (see Map 2). There have been no reports of disease within the parks.

The devil population currently held within Tasmanian wildlife parks represents a very important pool of animals and it is vital that their disease status remain uncompromised. Protection of these devils through improved biosecurity measures and guidance from disease experts is a principal aspect of the captive DFTD management strategy.

Biosecurity of Wildlife Parks

In response to the risk-assessment, a document was developed in association with the DFTD team's expert veterinary pathologist and Tasmania's Chief Veterinary Officer, entitled "Reducing the Potential for Transmission of Devil Facial Tumour Disease (DFTD) to Captive Tasmanian Devils".

The strategy follows principles of disease management outlined in the Australian Veterinary Emergency Plan (AUSVETPLAN) for Zoos, which is one of a series of national response plans that provide guidance toward implementation of most effective strategies toward containing and controlling emerging animal diseases.

The DFTD Risk Reduction document incorporates AUSVETPLAN principles of disease management and provides information on protocols and risk reduction techniques for wildlife park operators.

A map developed under quarantine principles reveals that most wildlife parks are within a High Level Disease Risk Zone (see Map 1). Park operators have been provided with a copy of the DFTD risk reduction document, and given additional information on biosecurity and updates on the disease.

Management of Stock and Genetics

There is a strong population skew evident between different Tasmanian institutes, with some establishments having relatively high numbers of devils and others having low numbers (or members of a single sex) due to natural attrition. While all institutes are located in the DFTD high risk zone, proposed devil movements between institutes will be assessed on a case-by-case basis to ensure that only necessary transfers take place.

Devils naturally have a very low genetic diversity, so it is imperative that genes from wild founders continue to be represented in captive stock. A number of parks have unrelated individuals and orphans *i.e.* wild founders of breeding age that are potentially very valuable animals. Collaboration between institutes is an important aspect of allowing interchange of stock for maintaining well-managed collections and a good level of genetic diversity.

At present there is a high level of risk associated with translocation of new devils from the wild into captivity as there is presently no diagnostic test - although the wild devils may not show external symptoms of DFTD, they could be carriers of the disease. In the future, with improved knowledge it may also be possible to integrate new founders into Tasmanian wildlife parks after a period of quarantine.

Mainland Wildlife Parks and Zoos

Mainland zoos now contain the only devils outside of Tasmania, with the last captive individual in a North America dying of old age earlier this year.

Approximately 80 devils are kept in Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA) member zoos and wildlife parks on mainland Australia. A minimal number of devils are held at independent captive establishments. ARAZPA has identified a need to import unrelated individuals into the captive devil population for future maintenance of genetic diversity.

In past years ARAZPA have been able to source devils from member institutes in Tasmania but this practice has ceased following the advent of DFTD and the necessary embargo on interstate devil movements. The dilemma of the current situation is that while there is currently only a limited understanding of the nature or spread of DFTD, it is considered a high risk disease - being fatal and probably infectious - without any diagnostic test at present. Therefore, safe integration of devils from Tasmania into the existing mainland population is not possible at this stage.

An alternative, safer strategy to introduction of devils into the current population is the isolation and separate management of any future imports as sub-populations, at institutes that destock beforehand and do not house any other devils. As knowledge about DFTD progresses, integrating sub-populations and utilising imported devils as breeding stock may become possible. Pending improved knowledge of the disease in the future, and following quarantine release of wild founders, members of the insurance group of devils may be able to be integrated to the current mainland population to boost genetic diversity.

The mainland captive devil population has been described by ARAZPA as “demographically extinct”, containing levels of genetic diversity too low to maintain the population in the medium to long-term. There are apparently only a few viable breeding pairs remaining in zoos. The devil studbook manager is presently putting together annual recommendations for the upcoming breeding season. In light of the uncertain quarantine period and moratorium on devil movement outside of Tasmania, it will be necessary to gain commitment from member organisations and the wider zoological community to focus on this species and maximise management of the current population.

DPIWE and ARAZPA will develop a partnership agreement to establish a mainland insurance population as part of the management strategy for DFTD. This will involve the establishment of a captive management group with representatives from DPIWE and ARAZPA and other experts to create and formalise a Species Management Program. DPIWE and ARAZPA have already demonstrated a productive partnership in captive and wild management of the threatened orange-bellied parrot.

5. REFERENCES

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**DEVIL FACIAL TUMOUR DISEASE (DFTD)
ANIMAL HEALTH ISSUES ASSOCIATED WITH ESTABLISHING AN
INSURANCE POPULATION.**

**Rod Andrewartha
Chief Veterinary Officer, DPIWE**

January 2005

Situation

The current lack of information on the aetiology and epidemiology of DFTD means that it is not possible to predict its' effect on the long term survival of Tasmanian devils in the wild.

It has been proposed that a captive population of Tasmanian devils should be established to ensure the survival of the species.

The current apparently rapid decline in population and the short life expectancy of devils means that efforts to establish an insurance population need to commence before there is sufficient knowledge about the disease to be able to differentiate diseased/carrier animals from disease free animals.

Issues to be considered

An infectious agent (virus) has not been ruled out. Although to date no particles have been visualised on electron microscopy and a current hypothesis is that DFTD may be caused by a direct inoculation of the tumour cell line through bite wounds etc.

Affect on other species is unknown. There has been no evidence of DFTD in other species, nor any documented decline in the number of another native species that may be associated with the disease, however it remains a possibility that the disease may be transmissible to, and have an adverse effect on, other species.

DFTD is currently restricted to a group of islands (Tasmania and offshore islands). Note that this range is virtually the same geographic range of devils. Only approximately 75 devils are known to exist outside of Tasmania and these are in captivity.

There is no test available to detect DFTD. Information suggests that visual inspection may not be very sensitive as trapping has found rapid development of lesions in previously visually free animals.

Existing Captive Populations

Devils already in captivity in mainland states have no evidence of DFTD. The genetic diversity of this population is not large enough to maintain an isolated population for longer than about 5 years.

Devils held in captivity in Tasmania have not shown clinical disease although infection status is not known. All parks are within an area of possible infection. If DFTD can be spread by a transmissible agent then these animals may have been exposed to infection. Again there is insufficient animals in this class to maintain sufficient genetic diversity as a closed population.

Recommendations on existing captive populations

On current knowledge it is recommended that captive devils in Tasmanian collections are not introduced into mainland collections. The captive devils in Tasmania may have been exposed to the disease, especially if it is due to an infectious agent.

It is also recommended that wild caught devils are not introduced into Tasmanian or mainland collections as the DFTD status of captured wild devils can not be determined. If DFTD requires intimate contact to spread then captive populations in Tasmania may remain free.

Enhancing the genetic pool of captive devils

The lack of sufficient genetic diversity in captive populations means that some recruitment from the wild population is needed to establish an insurance population. Genetic differences between eastern and far western wild devil populations dictate that separate insurance populations of each group may need to be maintained.

To recruit from the wild it is necessary to collect animals from areas of lowest disease risk (ie areas where the disease has not been detected) and animals of lowest risk of exposure (young animals).

Animals recruited from the wild should not be mixed with existing captive populations (see previous section)

These animals then need to be kept in some form of isolation to

- a) minimise the risk of them being exposed to the disease,
- b) minimise the risk of them spreading the disease should they be infected.

6. A *Minimise the risk of exposure of the captive population*

As we do not know if DFTD is caused by an infectious agent, and if so whether this is aerosol spread or even vector borne, it is not possible to specify what the minimum requirements for isolation are. In this case a precautionary approach must be taken.

A precautionary approach dictates that the isolation should be in an area where there is no wild devil population, that people and fomites involved in management of the devils should either not come into contact with other devils, or should undergo cleaning and disinfection prior to handling this population.

Isolation of the population in a facility in an urban area where there is no devils, or in a devil free area such as a devil free offshore island, would be a preferred option.

Minimise the disease risk posed by the devils

The species range of DFTD is not known. As a precautionary approach it should be assumed that at least all dasyurids are potentially at risk.

Precautions will need to be taken to prevent escape of the animals and possible agent from the holding facility. Ideally the facility should be situated such that any inadvertent escape or discharge does not pose a risk.

Appropriate facility design and construction should prevent escape, while biosecurity procedures can be developed for decontamination of people, fomites and waste from the facility.

Isolation of the facility from devil and dasyurids populations as a further precaution against escapes, discharge of possible vectors is highly recommended.

As previously stated DFTD is currently isolated on an island (Tasmania). The risk of spread of the disease to other areas of Australia is virtually eliminated by not allowing any movement of devils to the mainland until more is known about the disease. Until either

- the mode of transmission is known, or
- a test is developed that can confirm an animal is free of the disease, or
- it is confirmed that the disease only affects Tasmanian devils,

a precautionary approach dictates that Tasmanian devils should not be moved to mainland Australia.

Recommendations

Based on current knowledge, the disease risk associated with recruitment of Tasmanian devils from the wild to establish an insurance population, would be minimised by establishing a captive colony or colonies in either an urban area or isolated devil free area of Tasmania, such as an offshore island.

These colonies should be separate from existing captive collections.

Recruitment into this population should be only juvenile animals to minimise the possible level of prior exposure.

Maintaining the devils in this facility until breeding age provides approximately 12 months in which the animals can be observed for signs of disease. Any animals developing signs suggestive of DFTD should be removed from the facility immediately.

Movement of devils to other facilities, including movement to other areas of Australia, can be reconsidered in light of advances in knowledge of the disease as the animals approach breeding age. (Devils captured in 2005 will be sexually mature by March 2006)