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Strategy for managing wildlife disease *in the* Tasmanian Wilderness World Heritage Area

DRAFT

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Overview of the Strategy

Wildlife disease has affected biodiversity, ecosystem integrity, human and livestock health, and economies around the world on an ascending scale in recent times. In the first six months of 2003, diseases reservoired in wildlife were second only to war in claiming attention and causing expenditure by governments around the world (Environment Canada 2004). The island State of Tasmania has not escaped this threat with the recent emergence of several significant diseases such as Devil Facial Tumour Disease (DFTD) and Chytridiomycosis that threaten the Tasmanian devil and native frogs respectively.

The Tasmanian Wilderness World Heritage Area (TWWHA) plays a significant role in the conservation of Tasmania's wildlife including those of world heritage significance. This strategy provides a framework for considering wildlife disease threats to the TWWHA by identifying and prioritising those threats and recommending priority actions for threat mitigation. Current TWWHA disease threats are prioritised within the strategy using standard risk analysis frameworks. The highest priority diseases identified for management in the TWWHA are Chytridiomycosis, DFTD, and Psittacine Circoviral Disease (PCD) affecting Orange-bellied Parrots. Mucormycosis in platypuses is also prioritised as more research is needed to adequately assess risk. This strategy also addresses wildlife disease threats to the health of visitors and people who work within the TWWHA.

The overarching goal of this strategy is to protect biodiversity and human health within the TWWHA by minimising the impact of wildlife disease.

A number of strategic actions are developed within the framework of six goals:

- Prevention of emerging disease
- Early detection of new disease
- Rapid response to new disease
- Managing existing disease
- Education and training
- Communication

Strategic actions address these goals by focussing on appropriate passive and targeted strategic surveillance, reporting, research, and disease management.

Contents

Introduction

1.1 Need for a TWWHA wildlife disease strategy.

The TWWHA is very important for the conservation of Tasmania's wildlife biodiversity (Driessen and Mallick 2003, Mallick and Driessen 2005). It is a large area (1.38 million hectares) of reserved land containing relatively undisturbed ecosystems where natural processes continue to occur largely free from disturbances associated with European settlement. Whilst the undisturbed state, rugged topography and harsh climate provides some inherent protection to its wildlife, the TWWHA is contiguous with the rest of Tasmania and therefore vulnerable to external influences on wildlife health including disease. The recent emergence and spread of several significant diseases in Tasmania highlights this vulnerability.

Disease in wildlife populations is recognised as a key threatening process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and under the Tasmania's Nature Conservation Strategy 2002-2006 (DPIW 2006a). The TWWHA Management Plan 1999 (DPIW 1999), a statutory document provided for under the Tasmanian *National Parks and Reserve Land Management Act 2002* also recognises the potential risk to wildlife and humans from disease. A management prescription of the TWWHA Management Plan is to record and monitor wildlife parasites and diseases with emphasis on human pathogens.

Until recently there has been limited management of wildlife disease in the TWWHA. The emergence and threat posed by significant diseases such as DFTD and Chytridiomycosis have highlighted the need for a strategic approach to wildlife disease management in the area to minimise the impact of wildlife disease on biodiversity and on human health.

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1.2 State, national and international context

This strategy supports various state and national legislative obligations and agreements.
It supports objectives outlined in the Tasmanian Wilderness World Heritage Area Management Plan 1999 (DPIW 1999) to record and monitor wildlife diseases thereby contributing to the protection and conservation of wildlife and ecological processes. Tasmanian state wildlife biosecurity and quarantine measures are regulated by the *Animal Health Act 1995* and the *Nature Conservation Act 2002*. Quarantine Tasmania operates within the above legislature regulating wildlife movement across state and national borders. The Tasmanian Biosecurity Strategy 2006 (DPIW 2006b) incorporates objectives and aims to reduce the risk of wildlife disease entry into Tasmania to very low levels.

Quarantine and biosecurity measures nationally are regulated by the *Environment Protection and Biodiversity Conservation Act 1999* and the *Quarantine Act 1908*. Quarantine and biosecurity strategies are discussed more fully below in Section 2.1.

As a member of the World Organisation for Animal Health (OIE), Australia has international obligations to assist in the notification and control of animal diseases. The OIE is recognised as a reference organisation by the World Trade Organisation.

1.3 The scope of the strategy

The scope of this strategy is to encompass disease issues affecting or potentially affecting native wildlife occurring in the TWWHA. Effectively this means vertebrate wildlife, as knowledge of disease issues in Tasmania's invertebrate fauna is extremely limited. However a disease threat to any species of wildlife would be addressed within the context of this strategy.

The scope of the strategy also includes introduced wildlife where they are hosts to or have potential to


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host diseases that effect native wildlife in the TWWHA. Currently 25 species of introduced vertebrate animals are known to occur within the TWWHA (Driessen and Mallick 2003). Introduced foxes may also inhabit the TWWHA (Saunders et al. 2006).

1.4 Wildlife disease definition and current intelligence

Disease is defined in this strategy as any process that interferes with or modifies the performance of an animal's normal functions. Causes of disease include infectious agents (virus, bacteria, fungus or parasite), chemical or biological toxins, genetic or physiological causes, or physical causes (trauma, heat or cold) (Environment Canada 2004). Most diseases covered within this strategy have an infectious origin. Wildlife diseases that impact biodiversity, conservation and human health have been targeted. The strategy does not aim to prevent or manage all wildlife diseases as some are an integral component to natural ecosystems.

There have been few wildlife health studies targeting the TWWHA conducted to date. A number of wildlife disease monitoring studies have included the TWWHA and the known status of disease occurrence within the TWWHA has been collated in Table 1. Data has been obtained from The Animal Health Laboratory (AHL) Launceston (from the Laboratory Information Management System), the Animal Health and Welfare Branch (AHWB) Department of Primary Industries and Water (DPIW), contracted private veterinarians (Appendix 2), and published research. The inventory is by no means exhaustive and should be modified as new (or endemic) diseases are identified over time. The list forms the baseline for an adaptable disease management framework. For example a shift in the host / pathogen / environment dynamics can result in a low priority endemic disease occurring as an epidemic with high mortalities.

1.5 Effects of wildlife disease on biodiversity and the environment, human and livestock health, and its economic implications

Biodiversity and the Environment

Wildlife disease usually is a positive stabilising influence on ecological processes, dynamics and integrity. Parasitic, pathogenic and commensal fauna associated with wildlife play their role in natural processes and should be conserved within a healthy ecosystem. Disease incidence and prevalence relate to dynamic associations among the host, the agent of disease, and the environment.

Changes or disturbance in the environment can alter ecosystem processes and allow the expression or intrusion of significant wildlife diseases (Gillin et al. 2002). Factors such as climate change and anthropogenic environmental impacts have the potential to alter habitat considerably, directly affecting wildlife and their pathogens. Climate change may affect disease expression by altering habitat or by causing physiological changes within the host. Climate change is also likely to affect vectors such as mosquitos, ticks and snails, contributing to the transmission of wildlife disease (Environment Canada 2004). Anthropogenic impacts such as introduced species of unknown disease status, habitat loss, fragmentation and degradation occurring outside the protected TWWHA have potential to lead to disease emergence. Diseases emerging outside the TWWHA have implications for wildlife within the TWWHA due to the contiguous habitat and lack of a physical border.

Wildlife disease incursions or mitigation measures also have the potential to alter ecosystem dynamics and biodiversity. For example, Devil Facial Tumour Disease spread across mainland Tasmania and the associated decline in devil populations is creating an ecological niche that could be filled by introduced animals such as the cat and fox (DPIW 2006c), threatening other native fauna. Disease mitigation measures such as translocation of healthy wild devils to form insurance populations has potential to alter predator-prey dynamics in source or destination ecosystems. Wildlife disease incursions into populations of threatened species can be catastrophic and contribute to further decline and perhaps extinction.

Table 1. Wildlife disease threats to TWWHA

Disease name	Pathogen	Pathogen Type	Zoonotic Potential	Present / absent in TWWHA	DEH Threat Abatement Plan	Tasmanian notifiable diseases (Appendix 1) List A	List B	Overall risk estimation (Appendix 3)
Amphibian Chytridiomycosis	Batrachochytrium dendrobatidis	fungus		Present	Yes (DEH 2006b)			Extreme
Devil Facial Tumour Disease	Infectious neoplastic cell line	neoplastic cells		Present			Yes	High
Psittacine Circoviral Disease (Beak and Feather)	Psittacine circovirus	virus		Present	Yes (DEH 2005)			High
Avian Psittacosis (Chlamydiosis)	Chlamydiophila psittaci	bacteria	Yes	Present			Yes	Moderate
Salmonellosis	Salmonella enteritica - many serotypes	bacteria	Yes	Present			Yes	Moderate
Sarcoptic Mange	Sarcoptes scabei	parasite	Yes	Present				Moderate
Toxoplasmosis	Toxoplasma gondii	protozoa	Yes	Present				Moderate
Tuberculosis (pinniped)	Mycobacterium pinnipedii	bacteria	Yes	Present		Yes		Moderate
Avian Influenza	H5N1 avian influenza	virus	Yes	Absent / exotic		Yes		Very low
Avian Poxvirus	Avian poxvirus	virus	Currently no	Uncertain				Very low
Giardiasis	Giardia	protozoa	Yes	Present				Very low
Trichinellosis	Trichinella pseudospiralis	parasite		Present		Yes		Very low
Hydatidiasis	Echinococcus granulosus	parasite	Yes	Moderately unlikely to enter			Yes	Negligible
Toxicoses	Persistent Organic Pollutants / heavy metals / fuels etc.	toxins		Present				Varies with toxin
Bat Lyssavirus infection	Australian bat lyssa virus	virus	Yes	Uncertain		Yes		Unknown
Liver Fluke	Metazoan parasite	parasite		Present				Unknown
Platypus Mucormycosis	Mucor amphibiorum	fungus		Unconfirmed				Unknown
Rabbit Haemorrhagic Disease	Rabbit haemorrhagic disease virus	virus		Present				Unknown
Wobbly Possum Disease	Wobbly possum disease virus	virus		Unconfirmed				Unknown

Human Health

Effective wildlife disease management strategies are crucial for managing human and livestock health nationally and globally. Approximately 70% of significant new or emerging diseases affecting humans and economies worldwide are believed to have a wild animal source (Environment Canada 2004). Several zoonotic diseases with potential to cause human morbidity and even mortality occur or potentially occur within the TWWHA including Pinniped Tuberculosis, Avian Chlamydiosis, Bat Lyssa Virus infection, Toxoplasmosis and Sarcoptic Mange. Avian Influenza (AI, highly pathogenic strains are currently exotic) has been identified as a low-level overall threat in this Strategy (Table 1), however human and poultry industry ramifications of entry and establishment would be considerable.

Food safety may be an issue for those consuming diseased wallabies, rabbits and ducks hunted within the TWWHA (animals are hunted in the Central Plateau Conservation Area and at Ducks Farm Cove). Diseases such as Salmonellosis, Trichinellosis or a toxicosis are important concerns in this context.

Livestock Health

A disease incursion in waterfowl such as Avian Influenza or Newcastle Disease has potential to threaten the poultry industry. Tasmanian endemic Trichinellosis has not been shown to date to affect pigs (Obendorf et al. 1990, Henry 1989) however an incursion into the commercial pig industry could have serious consequences.

Economic implications

Nature-based tourism and recreational hunting could sustain economic loss in the event of a significant wildlife disease incident. The TWWHA's reputation as a pristine environment could be affected. Potentially, a large economic impact could ensue following a food safety or commercial livestock disease incursion from a wildlife source. A significant disease incursion would incur costs associated with an appropriate response from AUSVETPLAN, conservation programs, and threatened species recovery programs.

1.6 Adaptive, strategic surveillance and management into the future

The ongoing threat of new and emerging diseases, the dynamic relationship between host, pathogen and the environment in endemic disease, and ongoing research highlight the requirement of this strategy to be reviewed and adapted as information and priorities change. Whilst disease surveillance can be undertaken by a range of wildlife health managers and researchers, there is a need for a veterinary officer to collate data, prioritise disease intelligence, adapt strategies to changing dynamics, and effect management guidelines.


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2 Goals

The overarching goal of this strategy is to protect biodiversity and human health within the TWWHA by minimising the impact of wildlife disease. The following six goals and their associated actions are needed to achieve the overarching goal:

1. Prevention of emerging disease
2. Early detection of new disease
3. Rapid response to new disease
4. Managing existing disease
5. Education and training
6. Communication

The success of actions to achieve the goals relates to the following principles and constraints:

- development of achievable actions within an adaptive strategy based on scientific principle;
- mitigation of any negative impacts of management actions themselves;
- re-evaluation of strategy success;
- budget constraints;
- practical constraints of working in remote / inaccessible parts of the TWWHA; and
- ethical constraints of survey / monitoring and management techniques;

2.1 Prevention of emerging disease

Emerging diseases are diseases which are either newly recognised or were previously recognised by science and have increased in prevalence or geographic range (Williams et al. 2002). It is a requirement under the *Animal Health Act 1995* to report any suspicion of a notifiable disease. The Office of the Chief Veterinary Officer, DPIW manages two lists of animal notifiable diseases that include emerging diseases. List A diseases are exotic –there are no known cases in Tasmania. List B diseases are endemic – known to occur in Tasmania or on the Australian mainland and some form of monitoring or control is required. For web links to current notifiable disease lists see Appendix 1.

Prevention of emerging disease in free-living wildlife populations is generally much easier to achieve than control or eradication of an established disease. This highlights the need for effective surveillance and mitigation of risk pathways (transmission routes) for the entry and spread of disease. Natural wildlife migration could result in the introduction of emerging disease to Tasmania and mitigation of this relatively low risk pathway would prove difficult. Movement of infected wildlife through trade and travel is the most likely mode of spread for many wildlife pathogens (Morell 1999), and this risk can be estimated through surveys for disease prevalence and an understanding of wildlife movements. Given the artificial boundary between the TWWHA and the rest of Tasmania, the prevention of disease introduction needs to begin at national and state borders.

Biosecurity policy at both national and Tasmanian level is defined by its Appropriate Level of Protection (ALOP). Each World Trade Organisation member country determines its own ALOP. The ALOP at both national and Tasmanian level is set at a "very low level of risk". The ALOP is applied through the setting of sanitary and phytosanitary measures on imports (DPIW 2006d). This strict policy supports this goal of the strategy by aiming to reduce the risk of wildlife disease entry to very low levels.

Nationally the *EPBC Act 1999* controls the international movement of wildlife and wildlife specimens. Permits are required under the *EPBC Act 1999* to import or export *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) listed specimens, or other species of animal or plant listed as suitable. The Australian Quarantine and Inspection Service (AQIS) under the Quarantine Act 1908 applies quarantine regulations to all animals imported to Australia to reduce the risk of disease introduction, and some animals are not permitted to enter if the risk is considered too great.

In Tasmania, the Tasmanian Biosecurity Strategy (DPIW 2006b) provides the Tasmanian Government's policy framework to protect industries, the environment

and public health and safety from the negative impacts of pests, diseases and weeds. It proposes 11 outcomes to be addressed through 58 actions to ensure an optimal and complete biosecurity system for Tasmania. The TWWHA strategy operates within the overarching structure of the Tasmanian Biosecurity Strategy, and shares many of its principles: the use of a risk analysis framework, quarantine, animal disease surveillance through contracted veterinarians, emergency preparedness, training, education and communication. Biosecurity activities in Tasmania are largely the responsibility of Quarantine Tasmania however other government agencies, the private sector and the general public all have important roles to play in protecting the State's values.

The *Animal Health Act 1995* is the principal animal disease control legislation in Tasmania. The Animal Health and Welfare Branch of DPIW currently assess wildlife importation case by case and use pre-import health screening when deemed necessary. The *Nature Conservation Act 2002* also has provisions, managed by the Wildlife Management Branch of DPIW, for controlling the import of wildlife into Tasmania in relation to the conservation and protection of the State's wildlife. Some animals of unknown disease status imported for the pet industry eg. spiders, can enter under the current permit system.

2.2 Early detection of new disease

Early detection of new disease by passive and active surveillance is essential so that a rapid response can be instigated to reduce the likelihood of diseases of significance becoming established. Surveillance for TWWHA new wildlife disease events should occur within the TWWHA when possible, but monitoring across Tasmania is also important. The remote / inaccessible nature of most of the TWWHA presents logistical constraints to surveillance and limits the number of observation opportunities.

Passive surveillance involves opportunistic monitoring of wildlife by people 'in the field' for any morbidity or mortality event. It relies on field personnel to report unusual wildlife disease events to an appropriate governmental or non-governmental wildlife health body. Information needs then to be delivered to Wildlife Health / Veterinary Officers within the Biodiversity Conservation and Animal Health and Welfare Branches of DPIW respectively (Table 2). The information can then be assessed and prioritised and an appropriate response delivered. Priority will be given to notifiable diseases, mass mortalities, zoonoses, diseases that may impact on primary production, and mortality or morbidity events affecting threatened species. Because of the wide range of field personnel involved, the success of passive surveillance relies on educating stakeholders in how to recognise and report wildlife morbidity and mortality events.

Active surveillance for early detection of new disease involves targeted monitoring of a species where potential for a priority new disease incursion exists. The risk assessment process within this strategy has one exotic disease (Avian Influenza) in the list of diseases with potential to impact biodiversity within the TWWHA, and impact human and livestock health and the economy outside the TWWHA (Table 1). Surveillance should focus on priority species at sites where wildlife congregation occurs, high use areas such as visitors centres, research sites, or at captive wildlife facilities.

Active surveillance was conducted for avian influenza by DPIW between 2005 and 2007 in waterfowl, non-migratory shore-birds and shearwaters in southeastern and northern Tasmania. A low prevalence of low pathogenic influenza A virus was demonstrated in waterfowl tested. Past exposure of waterfowl to influenza A virus is also evidenced by approximately one quarter testing seropositive (DPIW 2007a). Active surveillance for existing disease is covered in Section 2.4 below.


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Table 2. Passive surveillance reporting structure

Field personnel who are likely to first encounter wildlife morbidity / mortality	Contact personnel who are likely to be informed of wildlife disease events	All morbidity / mortality events to be reported directly or via personnel listed to:
University researchers Government biologists Rangers and field staff (Parks and Wildlife), and wildlife rangers (DPIW) Council workers Government field officers Recreational park users (bushwalkers, field naturalists etc) Recreational fishers General public driving (road kill) Recreational shooters or commercial shooters in forestry areas Wildlife tourism operators Wildlife parks Landholders Landcare / bushcare personnel	Governmental veterinarians (Wildlife Health Officer within the Biodiversity Conservation Branch, Veterinary Officers within the Animal Health and Welfare Branch, Veterinarians within the Animal Health Laboratory, DPIW) Non-governmental veterinarians (private practitioners including vets contracted by DPIW for wildlife surveillance, see Appendix 2) RSPCA Tasmania Wildlife carers Animal control officers Police Animal Welfare Officer (University of Tasmania) Council bushland and reserve managers / contractors Environment Division, for reported fish kills (Department of Tourism, Arts and the Environment)	Wildlife Health Officer, Biodiversity Conservation Branch DPIW AND/OR Veterinary Officers within Animal Health and Welfare Branch DPIW

2.3 Rapid response to new disease

New diseases need to be rapidly assessed in consultation with The Chief Veterinary Officer. Notifiable diseases are risk assessed and an appropriate response is made under nationally agreed processes eg. AUSVETPLAN (DPIW 2005, Animal Health Australia 2002). The response to the more serious List A exotic diseases (Appendix 1) should be rapid and usually involves an eradication policy – movement controls, vaccination, or slaughter and disposal of whole groups with compensation paid to the owner.

Other new diseases require rapid risk assessment and prioritisation by a veterinary officer within the Biodiversity Conservation Branch and the Chief Veterinary Officer. Priority diseases require the rapid development of management strategies as diseases are difficult to eradicate once established.

2.4 Managing existing disease

A number of wildlife diseases known to occur in Tasmania including the TWWHA have been collated and listed Table 1. Each disease has been subjected to a risk assessment (Appendix 3) to obtain an Overall Risk Assessment (risk of entry, establishment and spread combined with consequence to biodiversity and conservation values). Three diseases scored extreme or high in the Overall Risk Assessment - Chytridiomycosis, Devil Facial Tumour Disease, and Psittacine Circoviral (Beak and Feather) Disease (Table 1). These diseases have been described in some detail in Appendix 4 as they are a priority for active surveillance and managerial actions in this strategy. Platypus Mucormycosis has also been included as additional research is needed to determine the risk of this disease to platypus.

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The *EPBC Act 1999* recognises only two wildlife diseases as key threatening processes and mitigates the impacts of these processes through threat abatement plans (DEH 2005, DEH 2006b). Both of the listed wildlife diseases are priority diseases within this strategy and both occur in the TWWHA - Chytridiomycosis and Psittacine Circoviral Disease.

Wildlife disease management options include disease prevention, control, eradication, and non-intervention. Options for disease prevention are discussed above in Section 2.1. Options for control or eradication of existing disease include (Wobeser 2002):

- surveillance and reporting;
- the use of disinfectants / pesticides (local scale use);
- biosecurity generally is important to reduce anthropogenic spread of disease;
- removal of pathogens (eg. toxin remediation);
- treatment of individual animals (eg. chemotherapy in small populations of high conservation value);
- vaccination;
- altering host distribution (fencing, use of repellents etc);
- selective culling, general population reduction (best results when focussed), eradication of a population;
- habitat modification (reducing exposure to pathogens); and
- restriction of wildlife translocation.

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2.5 Education and training

Stakeholders require education and training to achieve the above goals and to ensure adequate disease identification and reporting. Personnel will require training to deliver actions listed in Section 3. Education and enforcement of described biosecurity measures at the TWWHA and state borders is essential.

2.6 Communication

Good communication among personnel from DPIW (Veterinary Officers from Biodiversity Conservation and Animal Health and Welfare Branches, Wildlife Management Branch), the Animal Health Laboratories Launceston, the Australian Wildlife Health Network (AWHN), Tasmania Parks and Wildlife, Quarantine Services Branch, Biosecurity Tasmania, Forestry Tasmania, Hydro Tasmania and nature-based tourism operators, is essential to effectively implement the actions of this strategy. Communication among stakeholders allows for wildlife disease intelligence to quickly reach appropriate DPIW personnel. Wildlife disease data needs to be collated, stored, analysed and actions and disease information disseminated.

In addition all stakeholders including the Tasmanian general public and tourists, need to be informed of the potential impacts of wildlife health issues on biodiversity, human and livestock health, the environment and the economy. The public may need to be informed quickly and responsibly in response to some new or emerging disease issues.

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3 Action plans

The actions listed below address the objectives of the six goals. Most actions have been written for priority wildlife health issues identified by the risk assessment process in Appendix 3. The risk assessment process assesses the likely consequence of wildlife disease to TWWHA biodiversity and conservation values. The process provides a ranking of disease threats to determine priorities for management actions within the strategy. High priority diseases identified by the risk assessment are then described in detail in Appendix 4.

The actions describe and prioritise research projects, monitoring and surveillance, and management guidelines in relation to wildlife disease in the TWWHA. Actions outlined will need to be reassessed temporally as part of adaptive management to reflect new research and developments. Research priorities and managerial actions should be based on rigorous scientific principles.

Each action has been allocated a category to reflect its priority based on risk assessment and contribution to the overarching goal of the strategy:

Priority 1a: Extreme risk, urgent action required.
Priority 1b: Actions that can be easily implemented without significant additional funding.
Priority 2: High risk, action required.
Priority 3: Moderate to low risk, watching brief required.

3.1 Prevention of emerging disease

Action 3.1.1: Report Notifiable List A diseases eg. Avian Influenza to the Emergency Disease Hotline (1800 675 888) (Priority 1a).

Action 3.1.2: Review the current permit system for control of wildlife movement into Tasmania and ensure that biosecurity and quarantine adequately prevents disease threats to biodiversity. Develop and regularly update disease risk assessments (in conjunction with the Wildlife Management Branch animal import assessment group) for wildlife with unknown disease status commonly requested for import into Tasmania (Priority 3).

Action 3.1.3: Develop island biosecurity protocols in collaboration with the Parks and Wildlife Service to reduce the risk of disease introduction to target off-shore islands and possibly disease-free reserves within mainland Tasmania (Priority 1a).

Action 3.1.4: Investigate the processes that result in the accidental introduction of frogs and potentially new pathogens into Tasmania from northern Australia on fresh produce (eg from banana farms). Once understood, develop preventative measures that can be instigated and incorporated into this strategy (Priority 2).

3.2 Detection of new disease

Action 3.2.1: Report Notifiable List A diseases to the Emergency Disease Hotline (1800 675 888) (Priority 1a).

Action 3.2.2: Develop protocols where feasible for passive monitoring by field personnel (Table 2). May include requiring general wildlife health assessments (observing and recording unusual posture, behaviour, lesions, other signs morbidity or mortality) in permits issued to researchers, shooters, recreational fishers, wildlife tourism operators etc. (Priority 1b).

Action 3.2.3 Distribute the Wildlife Health Investigation Manual (DPIW 2007b) to selected field personnel including rangers (Table 2) to assist with assessment and recording of wildlife health events. Distribute 'First Response to Sick or Injured Tasmanian Wildlife' (DPIW 2007b) cards more widely to field personnel (Priority 1b).

Action 3.2.4: Collaborate with researchers engaged in wildlife research programs to encourage them to collect additional relevant samples for disease assessment from captured wildlife (Priority 1b).

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Action 3.2.5: Perform ongoing risk assessments for any exotic or Australian mainland disease with potential to impact TWWHA wildlife to incorporate into this adaptive strategy. Develop active surveillance programs where risk is high or extreme (Priority 2).

3.3 Rapid response to new disease

Action 3.3.1: The Office of the Chief Veterinary Officer and the Animal Health and Welfare Branch DPIW to assess the importance of a new disease, and develop and implement an appropriate method for managing the disease in a wild animal population (AUSVETPLAN - DPIW 2005, Animal Health Australia 2002) (Priority 1a).

Action 3.3.2: New diseases which are not managed under AUSVETPLAN should be risk assessed, prioritised and managerial actions developed for high priority diseases (Priority 1a).

3.4 Managing existing disease

Action 3.4.1: Report Notifiable List B diseases to the Emergency Disease Hotline (1800 675 888) (Priority 1a).

Chytridiomycosis

Action 3.4.2: Develop an adaptive Chytridiomycosis Management Plan incorporating the Actions below (Priority 1a).

Action 3.4.3: Define chytrid free areas and categorise into priority zones for targeted management strategies (Priority 1a).

Action 3.4.4: Facilitate research into the likely mechanisms involved in the spread of chytrid. This should involve assessing the use of water, machinery and equipment by land managers such as Hydro Tasmania, Forestry Tasmania, and Parks and Wildlife Service (Priority 1a).

Action 3.4.5: Develop and implement Tasmanian hygiene guidelines (including washdown guidelines for equipment) standardised across industries to control transmission of water, soil and amphibians from infected to uninfected sites. These strategies can be refined as research proceeds (Priority 1a).

Action 3.4.6: Test and trial a disinfectant for field use that is effective against chytrid fungus, mucor fungus and phytophthora. The disinfectant should be safe for use in the environment (Priority 1a).

Action 3.4.7: Develop disease and frog monitoring program to measure the success of control measures. Re-evaluate management strategies post-monitoring (Priority 1a).

Action 3.4.8: Facilitate research into sensitivity of Tasmanian frogs to chytrid fungus (Priority 1a).

Action 3.4.9: Facilitate research into detecting chytrid in water samples. This might include the use of filtration and keratin baits (Priority 2).

Action 3.4.10: Facilitate research into the potential for high-level management of priority zones (Priority 3).

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Action 3.4.11: Circulate chytrid fungus distribution data to all land management agencies (Priority 2).

Action 3.4.12: Educate TWWHA visitors in how to minimise disease introduction (Priority 1a).

Action 3.4.13: Educate public, particularly fresh food retailers (importers of produce from interstate or overseas), about the possibility of introducing amphibian disease to native populations from "banana box frogs". Instigate a program for collecting "banana box frogs", swabbing to monitor for disease and humane frog euthanasia (Priority 2).

Devil Facial Tumour Disease

Action 3.4.14: Continue camera monitoring and road-kill surveys of Tasmanian devils in and around the TWWHA for DFTD within the context of the DFTD program. A formal volunteer road-kill survey program is currently being instigated by the Tasmanian devil team (Priority 2).

Action 3.4.15: Consider (in collaboration with the Tasmanian devil team) undertaking higher intensity trapping and sampling in areas where DFTD has been identified by camera monitoring and road-kill surveys. Trapping within the TWWHA where devils occur in low density could provide valuable density vs. disease transmission rate information. Sampling would provide material used for genetic and immunological studies of southwest populations (Priority 3).

Action 3.4.16: Consider creating a DFTD-free (and general disease-free) reserve within the Southwest Conservation Area by establishing a devil proof double fence from Birchs Inlet to the coast. Establish strict biosecurity guidelines for all reserve users (Priority 1a).

Psittacine Circoviral Disease

Action 3.4.17: Build a new aviary at the Taroona captive Orange-bellied Parrot facility with a separate quarantine facility incorporating best practice disease control design measures (DEH 2006a) (Priority 1b). This action is currently being funded by the Australian government and undertaken by DPIW in association with the OBP Captive Management Group.

Action 3.4.18: Incorporate biosecurity and disease monitoring measures outlined in the OBP captive population disease outbreak response Action Plan (DPIW 2006e) (Priority 1a).

Action 3.4.19: Provide all staff involved with captive OBP management with training in best practice biosecurity and disease monitoring measures. Ensure sufficient staff numbers to adequately address biosecurity and husbandry issues (Priority 1a).

Action 3.4.20: Incorporate feeding practices to meet nutritional needs based on expert advice (Priority 1b).

Action 3.4.21: Maintain current system of assessing and when necessary increasing (by addition of suitable wild birds) genetic diversity of captive stock to enhance disease resistance (Priority 1b). This action is currently being undertaken by OBP Captive Management Group.

Action 3.4.22: Continue monitoring wild populations for PCD, herpesvirus and other priority diseases (Priority 1b). This action is currently being funded and undertaken by the Threatened Species Section, DPIW.


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Mucormycosis in platypus

Action 3.4.23: Establish a program to provide early detection of the disease in and around the TWWHA (Priority 1a).

Action 3.4.24: Investigate / monitor the effect of Mucormycosis on infected platypus populations to determine the level of threat to the status of platypus in Tasmania (Priority 1a).

Action 3.4.25: Collaborate with Tasmanian devil team to report platypus observations as well as devils as part of the devil road-kill volunteer monitoring program (Priority 1b).

Action 3.4.26: Compile and analyse research and monitoring data. With increased knowledge develop disease management actions and include in this adaptive strategy (Priority 2).

3.5 Education and training

Action 3.5.1: Ensure field workers, scientists, rangers and all personnel involved in the implementation of actions are appropriately educated and trained (Priority 1a).

Action 3.5.2: Educate all stakeholders listed in Table 2 of the strategy and the general public in how to recognise and report wildlife morbidity or mortality events. Such a broad scale education program may involve television or newspaper adds, leaflets to be sent to relevant institutions, notices with permits etc (Priority 1a).

Action 3.5.3: Promote research of priority projects and secure funding from relevant universities / organisations / government (Priority 1b).

3.6 Communication

Action 3.6.1: A veterinary officer within DPIW should act as a conduit for the passage of information among stakeholders. The veterinary officer should receive, collate, analyse, prioritise and record wildlife disease data, develop and conduct management actions, and facilitate information dissemination (Priority 1b).

Action 3.6.2: Collaborate with the DPIW Corporate Marketing Unit to develop a communication strategy to best inform the public of wildlife disease issues (Priority 1a).

3.7 Evaluation and funding

Action 3.7.1: Review the strategy for managing wildlife disease in the Tasmanian Wilderness World Heritage Area in two years or when necessary (Priority 1a).

Action 3.7.2: Evaluate the success of actions annually – ensure each action has been implemented and assess outcomes (Priority 1b).

Action 3.7.3: Secure funding from appropriate institutions or stakeholders to achieve listed actions (Priority 1a).


Nick Gust

Abbreviations and Glossary

Abbreviations

AHL	Animal Health Laboratory
AHWB	Animal Health and Welfare Branch
AI	Avian Influenza
ALOP	Appropriate Level of Protection
AQIS	Australian Quarantine and Inspection Service
AWHN	Australian Wildlife Health Network
BCB	Biodiversity Conservation Branch
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COS	Consequence of Spread
CPCA	Central Plateau Conservation Area
CVO	Chief Veterinary Officer
DEH	Department of the Environment and Heritage (now Department of the Environment, Water, Heritage and the Arts)
DEWR	Department of Environment and Water Resources
DFTD	Devil Facial Tumour Disease
DPIW	Department of Primary Industries and Water
ELISA	Enzyme-linked immunosorbent assay
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
HA	Haemagglutinin
HI	Haemagglutination inhibition
IRA	Import Risk Analysis
LIMS	Laboratory Information Management System
MHC	Major Histocompatability Complex
OBP	Orange-bellied Parrot
OIE	World Organisation for Animal Health
PCD	Psittacine Circoviral Disease
PCR	Polymerase Chain Reaction
POEn	Probability of Entry
POEs	Probability of Establishment
POS	Probability of Spread
PWS	Parks and Wildlife Service
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SPS	Sanitary and phytosanitary
TWWHA	Tasmanian Wilderness World Heritage Area
WMB	Wildlife Management Branch
WTO	World Trade Organisation

Glossary

Emerging disease	Diseases which are either newly recognised or were previously recognised by science and have increased in prevalence or geographic range
AUSVETPLAN	Australian Veterinary Emergency Plan. A series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident
Biosecurity	The protection of people, animals and ecological systems against disease and other biological threats
Disinfectant	A chemical used to destroy disease agents outside a living animal
Enzyme-linked immunosorbent assay	A serological test designed to detect and measure the presence of antibody or antigen in a sample
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission
Haemagglutination	Agglutination of red blood cells by a specific antibody or other substance
Introduced animal	Non-native species which can establish self-sustaining populations in the wild
Native wildlife	Animals that are indigenous to Australia
Monitoring	Routine collection of data for assessing the health status of a population
Morbidity	Sickness or diseased state
Mortality	Death
Polymerase chain reaction	A method of amplifying and analysing DNA sequences that can be used to detect the presence of virus DNA or mRNA (using reverse transcriptase, or RT-PCR)
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time
Quarantine	Place of isolation where animals of unknown health status can be maintained and subjected to health checks for a period of time before being introduced to the recipient population
Surveillance	A systematic program of investigation designed to establish the presence, extent of, or absence of a disease, or of infection or contamination with the causative organism
Vaccination	Inoculation of healthy individuals with weakened or attenuated strains of disease-causing agents to provide protection from disease
Zoonotic disease	Diseases that can be passed from animals to humans

Appendix 1 Notifiable diseases

Diseases notifiable to DPIW, Tasmania under the *Animal Health Act 1995* – for latest list see **http://www.dpiw.tas.gov.au/inter.nsf/WebPages/CPAS-5QZ2AP?open**

List A diseases are exotic –there are no known cases in Tasmania.
List B diseases are endemic –known to occur in Tasmania or on the Australian mainland and some form of monitoring or control is required.

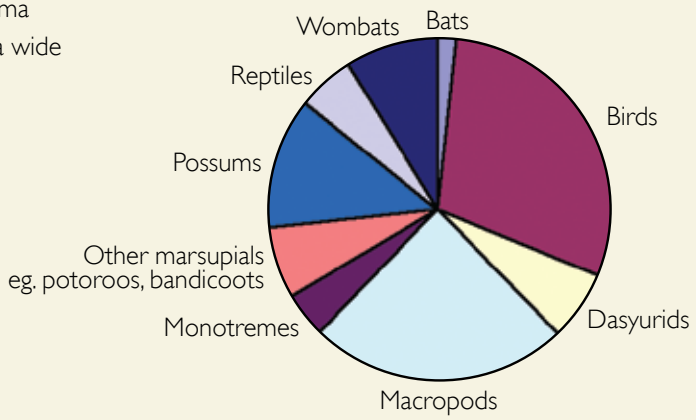
Diseases notifiable to the OIE (World Organisation for Animal Health) – for latest list see **http://www.oie.int/eng/maladies/en_classification2007.htm?e1d7**

Appendix 2 Wildlife disease records from contracted veterinarians

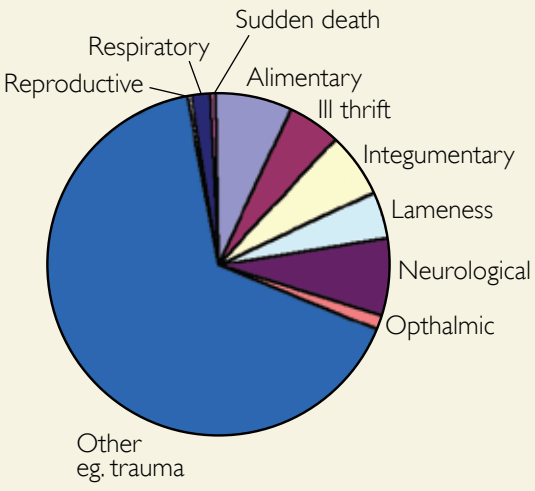
The Animal Health and Welfare Branch DPIW contracts a number of veterinary practices across Tasmania to investigate and treat sick and injured wildlife. Contracted veterinarians therefore are very important in passive wildlife disease surveillance – providing opportunities for early detection of new disease and also for monitoring existing disease. Data collected from contracted veterinarians provide useful temporal comparisons of syndromes and species affected. Whilst birds and macropods represent the majority of wildlife cases investigated, a wide range of species are presented to contracted veterinarians (Figure 1). In addition, whilst cases such as trauma represent the majority of wildlife investigated, a wide range of syndromes are assessed (Figure 1).

Figure 1. Wildlife diseases cases (n=568) recorded by contracted veterinarians January 2006– September 2007 shown by species and syndrome

Wildlife diseases by species



Wildlife diseases by syndrome



Appendix 3 Risk assessment for disease in wildlife

Risk to biodiversity and conservation

Risk analyses have become an essential tool for government primary industry departments worldwide in managing the risks of importing and/or spreading animal diseases in commodities. The Import Risk Analysis (IRA) framework is used by Biosecurity Australia (2007) to assess the potential risks of allowing entry of biological material from outside Australia and the movement of material across State borders.

The IRA framework is modified in this strategy to assess the likely consequence of wildlife disease to biodiversity and conservation values. This transparent risk assessment process utilises current scientific knowledge, providing a ranking of disease threats to determine priorities for management actions within the strategy. Using a risk analysis framework for wildlife disease threats facilitates an integration of wildlife disease management with Tasmanian and national biosecurity strategies for managing introduced animals and agricultural pests. The approach uses a series of probabilities (or likelihoods) for key events in a pathway for entry and spread of a disease to an area or population. The events typically considered in the risk analysis of a wildlife disease threat include:

1. Probability of Entry (POEn): the probability (divided into six levels, negligible to extreme) that a disease agent will enter a specified area/population. Pathways of entry may be specified at this step;
2. Probability of Establishment (POEs): the probability (negligible to extreme) that the disease will establish within an area/population;
3. Probability of Spread (POS): the probability (negligible to extreme) that the disease will spread away from its point/population of initial establishment.
4. The Consequences of Spread (COS) are the potential impacts of a wildlife disease on the biodiversity and conservation values of the TWWHA, including six qualitative levels of consequence from negligible to extreme (Table 5). The COS is estimated based on previous experience elsewhere in Australia or overseas. Estimates of COS consider the number of susceptible native species (threatened and non-threatened), and the level of impacts (entire species, local populations, individuals).

The pathway for entry of a disease threat to a specified area/population such as the TWWHA can occur at a range of geographical scales with associated steps for entry, establishment and spread. Avian Influenza is the only exotic disease included, but additional exotic diseases could be incorporated into the risk analysis where necessary using the existing framework.

Risk analysis includes the following steps:

1. Using Table 3, combine the POEn with the POEs to obtain a Probability of Entry and Establishment (POEE);
2. Using Table 3, combine the POEE with the POS to obtain the composite Probability of Entry, Establishment and Spread (PEES);
3. Use Table 5 for a description of the measure of the COS.
4. Using Table 4, combine the PEES with the COS to obtain the Overall Risk Assessment (Table 6).

Table 3. Matrix for combining descriptive likelihoods

Likelihood 1	Likelihood 2					
	Extreme	**High**	**Moderate**	**Low**	**Very Low**	**Negligible**
Extreme	extreme					
High	high	high				
Moderate	moderate	moderate	Low			
Low	low	low	Low	low		
Very Low	very low	very low	very low	very low	very low	
Negligible	negligible	negligible	Negligible	negligible	negligible	Negligible

Table 4. Risk estimation matrix

Probability of entry, establishment and spread	COS					
	Negligible	**Very low**	**Low**	**Moderate**	**High**	**Extreme**
Extreme	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible	Very Low	Low	Moderate	High	Extreme
Moderate	Negligible	Negligible	Very Low	Low	Moderate	High
Low	Negligible	Negligible	Negligible	Very Low	Low	Moderate
Very Low	Negligible	Negligible	Negligible	Negligible	Very Low	Low
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Very Low

Table 5. Consequences to TWWHA biodiversity and conservation values.

Consequences to biodiversity and conservation values	
Extreme	The impact of a wildlife disease is likely to be **extreme**, including: A significant impact on **more than one** non-threatened species such that the species are likely to become threatened, AND/OR The conservation status of **more than one** threatened species would be **worsened**.
High	The impact of a wildlife disease is likely to be **highly significant**, including: A significant impact on **one** non-threatened species such that the species is likely to become threatened, OR A significant impact on **more than one** non-threatened species but without the species necessarily becoming threatened, OR The conservation status of **a single** threatened species would be **worsened**;
Moderate	The impact of a wildlife disease is likely to be **significant**, including: Local population impacts on **one or more** non-threatened species, with **more than one population** per species effected, AND/OR Local population impacts on **one threatened species**,
Low	The impact of a wildlife disease is likely to be **minor**, including: Local population impact on **one or more** non-threatened species, with a **single population** per species effected.
Very low	The impact of a wildlife disease is **unlikely to be recognised** at the population level for any species; however the disease may impact on **individual animals**.
Negligible	The impact of a wildlife disease is **unlikely to be significant for populations or individuals**.

Table 6. Summary of TWWHA risk assessments

Wildlife disease	POEE #	POS #	PEES #	Consequence to biodiversity and conservation	Overall risk estimation
Amphibian Chytridiomycosis	Extreme	High	High	Extreme	Extreme
Devil Facial Tumour Disease	Extreme	Extreme	Extreme	High	High
Psittacine Circoviral Disease (Beak and Feather)	Extreme	Extreme	Extreme	High	High
Avian Chlamydiosis	Extreme	Extreme	Extreme	Moderate	Moderate
Salmonellosis	Extreme	Extreme	Extreme	Moderate	Moderate
Sarcoptic Mange	Extreme	Extreme	Extreme	Moderate	Moderate
Toxoplasmosis	Extreme	Extreme	Extreme	Moderate	Moderate
Tuberculosis (pinniped)	Extreme	Extreme	Extreme	Moderate	Moderate
Avian Influenza	Low	Extreme	Low	Moderate	Very low
Avian Poxvirus	Very low	High	Very low	High	Very low
Giardiasis	Extreme	Extreme	Extreme	Very low	Very low
Trichinellosis	Extreme	Extreme	Extreme	Very low	Very low
Hydatidiasis	Low	Moderate	Low/very Low	Very low	Negligible
Toxicoses	Extreme	Varies with toxin	Varies with toxin	Varies with toxin	Varies with toxin
Bat Lyssavirus infection	Extreme	Extreme	Extreme	No data	Unknown
Liver Fluke	Extreme	Unknown	Unknown	Unknown	Unknown
Platypus Mucormycosis	Extreme	High	High	Unknown	Unknown
Rabbit Haemorrhagic Disease	Extreme	Extreme	Extreme	No data	Unknown
Wobbly Possum Disease	Unconfirmed	Extreme	Unknown	No data	Unknown

POEE = Probability of Entry and Establishment,
POS = Probability of Spread,
PEES = Probability of Entry, Establishment and Spread

Table 7. Summary of overall disease risk assessment in relation to biodiversity and conservation values, and human health in the TWWHA

Wildlife disease	Overall risk estimation	Known and potential impacts	Potential pathway of entry into the TWWHA	Likely areas of disease persistence in the TWWHA
Amphibian Chytridiomycosis	Extreme	B.dendrobatidis has been linked to the decline, range contraction and extinction of amphibian species throughout the world. The TWWHA provides suitable conditions for spread and establishment of this disease so multiple species extinction and range contraction is a real risk.	From infected areas immediately outside the boundaries of the TWWHA as well as from limited infected sites within the TWWHA. Could enter on wet / muddy vehicles, helicopters, equipment, boots, camping equipment or in water used for bushfire operations etc or via transfer of frogs, tadpoles or aquatic plants or 'natural' transmission between frogs / tadpoles.	Favourable conditions (cool to moderate and moist climate) prevailing through the region. Currently borders TWWHA and occurs in 2 disturbed locations in the TWWHA (Strathgorden and McPartlans Pass) (Pauza pers. comm.).
Devil Facial Tumour Disease	High	Significant declines in Tasmanian devil populations have occurred (Hawkins et al. 2006). Local extinctions in wild populations or total species extinction in wild populations could occur.	Direct horizontal transmission between devils thought to occur during feeding or mating episodes. Does not appear to be transmitted vertically. Could enter in neoplastic tissue transferred by people trapping / researching.	Has been recorded in several locations within the TWWHA (eg Cradle Mountain, near Lake St Clair and Strathgordon), although significant parts of the TWWHA are currently thought to be free of the disease. Three factors may limit transmission rate / prevalence within the TWWHA – low devil densities (limited evidence does not support this to date), bio-geographical barriers, unique MHC genes (not confirmed in south-western devils) may confer immunity (not confirmed).
Psittacine Circoviral Disease (Beak and Feather)	High	Progressive morbidity and mortality in affected individuals. Others become immune. An outbreak could threaten the wild orange-bellied parrot population.	Low level disease and immunity already present in wild population. Captive population has higher level of immunity and these fledglings will supplement wild population.	Melaleuca and Birches inlet. Disease may be expressed in adverse environmental conditions.
Avian Chlamydiosis	Moderate	Morbidity and mortality. Even low prevalence among breeding birds has potential to impact population. Zoonotic.	Via released captive OBP's. Via interactions with other psittacines.	Melaleuca and Birches inlet.
Salmonellosis	Moderate	Macropods, wombats. Different forms of disease. Primary or secondary infection. Can result group mortality. Humans may contract disease via ingestion (food poisoning) or direct contact with infected wildlife.	Endemic in TWWHA.	Endemic in TWWHA. Disease events relate to host and environmental stress factors.
Sarcoptic Mange	Moderate	Sporadic, can cause significant morbidity and mortality in wombats and may have a substantial effect on local abundance, may threaten remnant populations (Martin et al. 1998). May be zoonotic.	Common in the TWWHA throughout the range of the common wombat.	Common in the TWWHA throughout the range of the common wombat.

Table 7 continues over the page

Wildlife disease	Overall risk estimation	Known and potential impacts	Potential pathway of entry into the TWWHA	Likely areas of disease persistence in the TWWHA
Toxoplasmosis	Unknown	Morbidity or mortalities to mass morbidity or mortalities associated with multiple exposure factors. Bandicoots particularly susceptible. Some humans susceptible.	Via feral cats throughout the TWWHA.	General areas – disease expression relates to weather stress and nutritional factors.
Tuberculosis (pinniped)	Moderate	Morbidity and possibly mortality in affected seal colonies. Humans in close contact with wild pinnipeds at risk.	Transmission from close contact in colonies or during haul out. Wide-ranging foraging trips may assist with inter-colony transmission. More data needed.	Maatsuyker Island Group as there is a New Zealand fur seal colony, and other pinnipeds haul out here.
Avian Influenza	Very low	Sudden onset (>10% of a flock) morbidity or mortality. Mass mortality. Almost any bird species may be affected. Threatened species at risk. Terrestrial and marine mammals including humans may be affected (DPIW 2007b).	Via migratory waterfowl (ducks, geese and swans).	The virus survives best in moist, cool conditions. It can survive for several days in faeces and lake water (DPIW 2007b). Migratory waterfowl could introduce AI to other bird species via direct contact, faeces or waterbodies.
Avian Poxvirus	Very low	Avian Poxvirus infection on Albatross Island has contributed to reduced Shy Albatross breeding success (as low as 10% in some colonies in some years) (Woods 2004).	Via humans transferring virus or vectors from Albatross Is. Via rare interactions between birds from different colonies.	Shy albatross colonies at Pedra Branca and Mewstone.
Giardiasis	Very low	Morbidity in effected marsupials. Morbidity in humans from infected faeces.	Present in macropods.	In marsupial habitat throughout the TWWHA.
Trichinellosis	Very low	Morbidity and in some cases mortality via muscle cysts in infected animals.	Likely endemic in devils and quolls throughout the TWWHA.	Present in devils from Cradle Mountain region. Devils, quolls and possibly pademelons and Brushtail possums infected via sylvatic cycle.
Hydatidiasis	Negligible	Affects macropods and livestock on mainland Australia. Can cause death in infected humans.	Via imported infected dog or fox in Central Plateau Conservation Area via infected dog or fox/sheep life cycle on farmland in Lakes area.	Unlikely to persist as no known macropod or feral animal reservoir in Tasmania.
Toxicoses	Uncertain / variable	Biomagnification, bioaccumulation, variety of health effects. Generally localised.	Mining operations, hydroelectric activities, WHA infrastructure and associated persistent organic pollutants / heavy metals / fuel spills etc.	Macquarie Harbour, Gordon Dam / River, TWWHA infrastructure (State of the Environment webpage).
Bat Lyssavirus infection	Unknown	Not known to occur in Tasmania (DPIW unpubl. data). In mainland Australia can cause morbidity and mortality in bats and humans. Caused two human deaths on the Australian mainland. Exposed bats may be asymptomatic.	Into Tasmania from mainland Australia island-hopping across Bass Strait or stowing in shipping containers. Into TWWHA as bats move on foraging trips or sub-adult dispersion.	Disease could persist in bat colonies in TWWHA.

Wildlife disease	Overall risk estimation	Known and potential impacts	Potential pathway of entry into the TWWHA	Likely areas of disease persistence in the TWWHA
Liver Fluke	Unknown	Occasional mass mortality macropods. Macropods may act in environmental contamination for domestic ruminant infection (Obendorf 1983).	Infected macropods where snail intermediate hosts are present.	Central Plateau Conservation Area, possibly Walls of Jerusalem (Driessen pers. comm.). Occurs in outbreaks in favourable weather conditions.
Platypus Mucormycosis	Unknown	Morbidity and potentially high mortality often affecting multiple platypuses sharing the same catchment.	No definitive records to date within the TWWHA. Known to occur in catchments shared with northern TWWHA. Transmission may occur within shared water bodies or between water bodies with general platypus movement / dispersion.	Water systems throughout the TWWHA.
Rabbit Haemorrhagic Disease	Unknown	Mass mortality rabbits. Usually adults in warmer summer months. Occasionally winter mortalities.	Contact among rabbits.	In warmer lowland areas where rabbits are detected.
Wobbly Possum Disease	Unknown	Morbidity progresses to mortality. Occurs in New Zealand Brushtail possums.	Unknown in TWWHA.	Unknown.

Risk to human and livestock health

Whilst half of the wildlife disease threats to the TWWHA identified in this strategy have zoonotic potential (Table 1), a full risk assessment process has not been undertaken to assess risk to human or livestock health. The likelihood of recreational or management personnel contracting a zoonotic disease is very low as most listed zoonotic diseases require close contact with diseased wildlife or infected animal faeces. Whilst human contact with animal faeces could occur, the likelihood of a healthy person contracting the faecally transmitted diseases giardiasis, hydatid disease or toxoplasmosis is very low. Toxoplasmosis in this context carries a slightly higher risk – though human infection could result from cat faeces ingestion by an immunosuppressed person or a non-immune pregnant women (the foetus is at risk).

Wildlife researchers should be aware of potential zoonoses and should take adequate precautions to prevent infection. The likelihood of livestock contracting disease from wildlife within the TWWHA is remote.

Appendix 4 High priority diseases identified by the Risk Assessment

Three diseases scored extreme or high in the Overall Risk Assessment - Chytridiomycosis, Devil Facial Tumour Disease, and Psittacine Circoviral Disease (Table 1). These diseases have been described in some detail below and have been prioritised in managerial actions within the strategy. Platypus Mucormycosis has been included as additional research is needed to obtain an Overall Risk Assessment.

Amphibian Chytridiomycosis

Chytridiomycosis is an emerging infectious disease caused by the pathogen *Batrachochytrium dendrobatidis* that has been linked to the decline and extinction of amphibian species throughout the world. In 2004 Chytridiomycosis was first detected in Tasmania and subsequently found throughout a range of urban and rural habitats in eastern and northern Tasmania (Obendorf 2006). In 2005 a survey of chytrid in the TWWHA commenced to determine if the disease had spread to this high conservation area (Pauza pers. comm.). In particular there were concerns about the status of the Tasmanian Tree Frog, which is largely restricted to the TWWHA, because of anecdotal reports of population declines. The TWWHA is also important for the conservation of two other Tasmanian endemic frog species; the Moss Froglet which is restricted the TWWHA and the Tasmanian Froglet. *B. dendrobatidis* was detected at 16 of the 62 sites surveyed in western Tasmania and was found to cause oral Chytridiomycosis in tadpoles of all species assessed which were the Tasmanian Tree Frog, the Brown Tree Frog, the Tasmanian Froglet, and the Common Froglet. The presence of *B.dendrobatidis* was strongly associated with high use gravel roads and low elevation. The relationship between *B.dendrobatidis* and these risk factors suggest that some anthropogenic activities may facilitate the dissemination of the pathogen on a landscape scale. The spread of *B.dendrobatidis* into southwestern Tasmania would likely result in the establishment and persistence of the pathogen due to the optimal conditions for the persistence of *B.dendrobatidis* (cool to moderate and moist climate) prevailing through the region.

Managing chytridiomycosis in and around the TWWHA

Disease eradication is not possible due to widespread disease prevalence across most of Tasmania and prevailing favourable conditions throughout the State. Therefore the key objective for managing chytridiomycosis is to control the spread of the disease into uninfected areas. Targeted eradication of the disease in strategic areas may be an option in the future after additional research to ensure efficacy and environmental safety.

Disease control within and around the TWWHA should target key land managers and stakeholders, namely Parks and Wildlife Service, Forestry Tasmania, Hydro Tasmania, nature-based tourism operators, and neighbouring private landholders. Control measures should aim to prevent pathogen transmission from multiple infected sites bordering the TWWHA to uninfected areas around and within the TWWHA. For effective control further research is needed into:

- the nature of anthropogenic chytrid transmission;
- environmentally safe fungal disinfection for vehicle and equipment washdown and for water disinfection and;
- the susceptibility of Tasmanian frog species to infection.

In addition ongoing chytrid monitoring is required to assess prevalence in association with the occurrence of frog species. Facilitation of control measures, and appropriate research and monitoring programs are consistent with objectives in the *Infection of Amphibians with Chytrid Fungus Resulting in Chytridiomycosis Threat Abatement Plan 2006* (DEH 2006b).

Devil Facial Tumour Disease

The tumours characteristic of the condition known as Devil Facial Tumour Disease were first observed in Tasmanian devils in northeastern Tasmanian in 1996. Spotlight surveys and trapping in long-standing affected areas indicate that the devil population has declined in these areas by up to 89% (McCallum et al. 2007). Ongoing monitoring of the disease indicates that DFTD is distributed across 59% of mainland Tasmania (McCallum et al. 2007) including areas within the TWWHA. Diseased devils have been found in the TWWHA at Strathgordon, near Lake St Clair and in the Cradle Mountain area. In addition disease has been confirmed at several sites on the periphery of the TWWHA (Hawkins et al. 2006). There is sufficient evidence to indicate that DFTD is a transmissible disease likely to continue spreading throughout Tasmania and the TWWHA though large areas within the TWWHA are currently thought to be disease free. In response to the impact of DFTD on free-living Tasmanian devils, the species has been listed as Endangered and Vulnerable under State and Commonwealth threatened species legislation respectively.

A program to protect the Tasmanian devil population from DFTD was initiated by DPIW in 2003 under the Tasmanian Devil Facial Tumour Disease Response Project Plan. The program has the following four components:

- monitoring of the wild population;
- diagnostic investigation into the disease;
- development of a captive devil management strategy and;
- development of a management strategy for wild populations.

Monitoring of the wild population

The aims of the DFTD monitoring program, which support the management efforts, include:

- documentation of the distribution of disease in Tasmania, including surveillance of disease-free sites for early detection of disease incursions and;
- ongoing monitoring of diseased areas temporally to describe and anticipate changes in disease distribution and devil demographics over time.

Surveys are being conducted using intensive live trapping, camera trapping and road-kill surveys. Limited intensive trapping in the TWWHA has resulted in poor capture rates presumably due to low densities. Trapping within the TWWHA requires increased sampling effort to detect disease prevalence with appropriate sensitivity among low-density devil populations. In addition the remote and inaccessible TWWHA has limited trapping opportunities.

Camera surveillance involves capturing close photographic images of wildlife to look for externally visible signs of disease. Lesions of interest can be used as a trigger for further investigation of the affected population by other methods. Statewide spotlight surveys have been carried out annually by the Wildlife Management Branch since 1975 (the survey range was expanded and the method standardised in 1985) in order to monitor a range of native wildlife populations (DPIW 1992). The spotlight surveys have been shown to provide an effective index of devil numbers to document widespread and significant declines in Tasmanian devils at a regional scale.

Diagnostic investigation into the disease

Diagnostic investigation into the disease includes developing a case definition, and researching the cytogenetics and immunology of affected and unaffected devils. Immunology and some diagnostic work are being undertaken at the University of Tasmania and the AHL.

Development of a captive devil management strategy

The aims of captive animal management include maintaining quarantine facilities for insurance populations and establishing a sustainable breeding population outside Tasmania.

Development of a management strategy for wild populations

Limiting geographic spread or suppressing the disease on a broad-scale are both unlikely to be feasible (Jones et al. 2007). In the short term, management options include; establishment of insurance populations (in captivity, within fenced areas on mainland Tasmania and / or on islands), and eradication or transmission reduction trials in areas

that can be isolated. The Forestier Peninsula program includes quarantine of the peninsula population by restricting the movement of devils and intensive trapping to remove affected animals.

The long-term options include the spontaneous or assisted evolution of resistance or development of a field-deliverable vaccine. These options may not be viable in the timeframe required.

Managing DFTD in the TWWHA

Managing DFTD within the TWWHA is largely dependent upon the above project plan which incorporates a number of existing researchers and managers. Actions within this strategy focus on coordinated disease management within the TWWHA specifically. The TWWHA may prove to be important in the long-term conservation of devils for the following reasons:

- Low devil densities may reduce disease transmission rates (though Hamede et al. (2008) suggests that transmission is frequency, rather than density, dependent), allowing more time for these populations to evolve disease resistance.
- Bio-geographical barriers may slow the progression of the disease 'front'.
- Some western devils may have MHC genes sufficiently different to eastern devils to provide DFTD immunity (unproven, research is currently underway).
- A proposed devil proof double fenced area within the Southwest Conservation Area has potential to maintain a wild disease free population which may differ genetically from populations within a similar proposed fenced area in the northwest of mainland Tasmania.

Save the Tasmanian Devil Program

Orange-bellied Parrot diseases – Psittacine Circoviral Disease, Avian Chlamydiosis, and nutritional issues

The Orange-bellied parrot is listed as Endangered under both Commonwealth and Tasmanian Threatened Species legislation as less than 150 individual birds remain in the wild. The species breeds only in southwestern Tasmania in the TWWHA during summer and flies to mainland Australia along the Victorian and South Australian coastline for winter foraging.

A captive breeding program for OBP's was established in Hobart in 1985 and at Healesville Sanctuary (Victoria) in 1994. In addition, two small breeding populations have been established, one at the Adelaide Zoo and a second in a private Melbourne holding. A reintroduction of captive-bred birds was trialed at Melaleuca in 1991 and 1993 and a reintroduction program commenced at Birches Inlet in 1994. Three hundred and thirty-four birds (Holdsworth pers. comm.) have been released at Birches Inlet to date. A disease incursion in captive or wild-bred populations has the potential to significantly impact the wild OBP population.

Psittacine Circoviral Disease

Psittacine Circoviral (Beak and Feather) Disease was clinically present in the captive population at Green Point north of Hobart between 1985 and 1989. PCD is widespread in wild psittacine populations in Australia (DEH 2005). Testing for PCD started in 1991-1992 after an adult was confirmed with the disease within the winter range. To date 270 wild juveniles and 120 captive birds have been tested for PCD antibodies (Haemagglutination-inhibition, HI) and antigen (Haemagglutination, HA). High PCD antibody levels within the captive population (56.7% of captive and 5.5% of wild birds have significant antibody levels) offers some protection to released birds. Levels of disease (0.08% of captive and 1.1% of wild birds have significant antigen levels) are very low in captive and wild populations (Holdsworth pers. comm.).

PCD is characterised by progressive symmetrical feather deformity and loss, beak deformities and eventual death. Susceptibility to develop clinical

disease rather than protective immunity varies with age, individuals, and environmental factors. In such a small population, the loss of even a few breeding birds can alter their viability.

Management within the TWWHA

As PCD is endemic in OBP's in the TWWHA, disease management should focus on maintaining healthy captive birds as the supplementary wild stock, and the continued monitoring of wild birds. The health of captive birds depends on excellent biosecurity and hygiene / husbandry (DPIW 2006e, DEH 2006a).

Other OBP disease issues

Young birds are also susceptible to infection with the bacteria *Chlamydia psittaci* (avian chlamydiosis) and infection has been identified as a cause of death in captive OBP's. The organism is shed in the faeces of infected birds, contaminating the environment and spreading by aerosol. Transmission to humans can cause severe respiratory disease.
The 2005-2006 mass chick mortality event at Taroona (originally viral aetiology was suspected) (DPIW 2006e) is now thought to have be caused by dietary mineral imbalance (Holdsworth pers. comm.). Ascaridiasis has also been identified as a recent significant cause of mortality in the captive population. In relation to all disease issues, excellent biosecurity, husbandry, disease monitoring and facility design (including quarantine) is critical for effective management (DPIW 2006e, DEH 2006a).

Platypus Mucormycosis

Mucor amphibiorum is considered to be an endemic Australian fungus. The fungus infects amphibians in Queensland, the Northern Territory and New South Wales, while in Tasmania the fungus is known to occur in free-living platypuses but to date has not been recorded in amphibians. Though the disease has been present in Tasmania for at least 25 years, the precise impact on platypus populations remains uncertain. Mucormycosis has now been detected in eleven catchments in northern Tasmania, and the distribution of the disease appears to be expanding. Infection with ***M. amphibiorum*** leads to severe granulomatous and often ulcerative dermatitis in the platypus. Morbidity and death is suspected to follow from secondary bacterial infection.

Monitoring and management in Tasmania including the TWWHA

There is a need for ongoing surveillance to monitor disease spread, and further research to assess the potential threat to areas of currently unknown disease status such as the TWWHA. Two short pilot studies have explored potential surveillance methods using public sightings at platypus observation points, and remote sensor cameras. Public sightings at Mount Field National Park were recorded over a two-year period. The continuous collection of data provides an opportunity for early detection of disease incursions. In addition it may be possible to detect severe declines in the number and activity of animals at monitored sites. In 2007 DPIW commenced a study to investigate / monitor the impact of Mucormycosis on Tasmanian platypus populations using a combination of community surveillance and targeted scientific investigation.

Management strategies will be developed as research and monitoring proceed. Generic disinfectant principles should, however, be used in the interim till increased knowledge allows for protocol refinement. Disinfection protocols for land managers in and around the TWWHA developed in this strategy aim to prevent the spread of three known problematic fungii in Tasmania – mucor, chytrid and phytophthera. Effective cleaning and disinfection of vehicles, equipment and personal items between sub-catchments may prove to be a logical approach to biosecurity.

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