

PLATYPUS FORUM

Hobart, Tasmania

3-4 September 2009

Platypus Partnership Program



**Primary Industries,
Parks, Water and
Environment**



PROGRAM – DAY 1

Time	Presenter	Title
08:45		Tea & coffee
09:00	Platypus Partnership Program	Welcome, logistics etc
09:15	Sarah Munks	1999 platypus workshop – 10 years on
09:30	Tom Grant	Plenary address: The platypus – a species of least concern?
10:20		Morning tea
	Mucormycosis and Reproduction	
10:50	Joanne Connolly	Mucormycosis of the platypus in Tasmania – early investigations
11:10	James Macgregor	Preliminary investigation into the distribution and physical characteristics of the platypus (<i>Ornithorhynchus anatinus</i>), and the prevalence of mucormycosis, in northwest Tasmania
11:30	Josh Griffiths	Distribution, prevalence and persistence of mucormycosis in Tasmanian platypuses: a contemporary perspective
11:50	Frank Grutzner	Establishing genetic tools to study monotreme reproduction and <i>Mucor</i> disease
12:10	Gemma Morrow	Novel methods used to study echidna reproduction: how these techniques could be applicable to studies on platypus reproduction
12:30		Lunch
	Ecology	
13:30	Steffen Kolomyjec	Climatic constraints on the distribution of the platypus (<i>Ornithorhynchus anatinus</i>)
13:50	Rachelle Olsson Herrin	Distribution and individual characteristics of the platypus in the Plenty River, southeast Tasmania
14:10	Nick Gust	Platypus abundance and demographics in Tasmania : quantifying natural variability and investigating mucormycosis impacts
14:30	Sarah Munks	Management of platypus habitat in production forests in Tasmania
14:50	Rodney Armistead	Impacts of drought, fire and urbanization on the distribution and abundance of platypus in Victoria
15:10		Afternoon tea
	Genetics and Captive Breeding	
15:40	Amelia Swan	Phylogeography of the Tasmanian and Australian mainland platypus populations employing mitochondrial DNA
16:00	Elise Furlan	Levels of genetic variability in the platypus, <i>Ornithorhynchus anatinus</i> , and consequences for conservation
16:20	Mette Lillie	Characterisation of MHC-linked microsatellite markers in the platypus (<i>Ornithorhynchus anatinus</i>)
16:40	Jessica Thomas	Reproduction and longevity of captive platypus at Healesville Sanctuary
17:00	Nigel Forteach	Observations on platypuses in captivity with particular reference to stress indicators
17:20	Platypus Partnership Program	Wrap-up, outline tomorrow's discussion, dinner plan

PROGRAM – DAY 2

Time	Presenter	Title
08:30		Tea & coffee
08:45	Group discussion	
10:45		Morning tea
11:15	Group discussion	
1:00		Lunch
2:00	Group discussion if necessary	
4ish		Pack-up & depart

1999 platypus workshop – 10 years on

Sarah Munks

Forest Practices Authority, Hobart, Tasmania.

The Tasmanian platypus stands out from the crowd. It is bigger than and, at a sub-specific level, is genetically different to its mainland counterpart. It also provides a unique opportunity to profile the behaviour and ecology of platypuses prior to the introduction of foxes into the Australian landscape. Its vulnerability to introduced disease and, like all platypuses, its dependence on both healthy aquatic and riparian habitats provides us with numerous challenges.

This was the conclusion from papers presented at a meeting of platypus researchers held in Tasmania in 1999. The talks presented at the workshop covered the upsurge in studies of platypus biology in Tasmania which started in the mid-80's with the disease work of Munday, Obendorf and Connolly. Although progress had been made in the understanding of many aspects of the ecology and biology of Tasmanian platypuses, it was clear that there was still a dearth of basic information. The 1999 meeting resulted in a number of recommendations for ongoing work including monitoring of the spread of the disease, mucormycosis, studies of the island populations, ongoing studies of basic biology, and work on the impact of road-kills due to culvert avoidance on platypus populations.

Despite ongoing resourcing issues the momentum of research efforts has been maintained in the last 10 years and a number of studies have addressed, in part, the 1999 recommendations. There is a need to keep the research and monitoring effort going into the future, particularly in light of the recent introduction of the red fox to the state and the uncertainty surrounding the impacts of climate change.

The platypus – a species of least concern?

Tom Grant

School of Biological, Earth and Environmental Sciences, University of NSW.

The current conservation status given to the platypus by the IUCN is “least concern”. With the exception of South Australia, where it is listed as “endangered” and almost certainly no longer occurs in the Mount Lofty Ranges and Adelaide Hills, the platypus is not listed as threatened on schedules of state or commonwealth legislation. This paper considers the current distribution and abundance of the platypus, the criteria for listing of threatened species, threats to the conservation of the platypus and the consequences of its not being a listed species.

Mucormycosis of the platypus in Tasmania – early investigations

Joanne H. Connolly^{1,2}, David L. Obendorf³, Richard J. Whittington⁴,

Paul J. Canfield⁵ and Mark S. Nowakowski⁶

¹EH Graham Centre for Agricultural Innovation, Charles Sturt University, Wagga Wagga, NSW.

²School of Animal and Veterinary Sciences, Charles Sturt University, Wagga Wagga, NSW.

³7 Bonnington Rd, West Hobart, TAS, 7000; School of Medicine, University of Tasmania, Hobart, Tasmania.

⁴Faculty of Veterinary Science, University of Sydney, Camden, NSW.

⁵Faculty of Veterinary Science, University of Sydney, NSW.

⁶16 Rose Lane, Launceston, Tasmania.

Many microorganisms and parasites have been reported from the platypus, but most infections are subclinical. *Mucor amphibiorum*, a fungus initially isolated from frogs and toads, is the only disease agent known to cause significant morbidity and mortality in the free-living platypus (*Ornithorhynchus anatinus*) in Tasmania. Mucormycosis in platypuses causes a granulomatous dermatitis that may progress to disseminated disease and death. We discuss the findings of a twelve month investigation into mucormycosis which began in 1994 (Connolly *et al.* 1998).

The distribution of affected animals was determined from questionnaires, databases, literature, a mark-recapture study and a necropsy study. Platypuses with mucormycosis were located in Brumby's Creek, Liffey River, Supply River, South Esk River, Meander River, and Macquarie River.

Seventeen of 60 platypuses captured (28%) during this Tasmanian study had mucormycosis. Eleven adult males, five adult females and one juvenile female were affected. The prevalence at Brumby's Creek was 33% (12/36) and from Liffey River was 66% (2/3). During the study two of 25 necropsied platypus had mucormycosis; possibly an underestimation due to difficulty in obtaining dead platypuses. No disease seasonality was observed. Body condition was variable, but affected males were larger than non-affected ones. Hindlimbs and tails were most commonly affected, followed by front feet, trunk, head and bill. Skin lesions included nodules, plaques, abscesses and ulcers. Histologically, granulomatous or pyogranulomatous lesions were seen. T cells were the predominant infiltrating lymphoid cell, commonly present with neutrophils, epithelioid cells and giant cells. Affected platypuses were anaemic, lymphopenic, with lowered cholesterol and calcium and higher globulin and potassium concentrations. Platypuses with mucormycosis had significantly higher concentrations of serum antibody against the fungus, as determined by ELISA.

All 13 isolates of *Mucor amphibiorum* cultured from platypus skin lesions were of the positive mating type. An isolate was found sensitive to amphotericin B, but resistant to itraconazole and fluconazole. No *M. amphibiorum* was cultured from intact platypus skin (n=8), platypus faeces (n=40) or environmental samples (n=14). *Mucor circinelloides*, *M. saturninus* or *M. hiemalis* were commonly isolated from soil or faecal samples (platypus and frog). The role of other aquatic animals, such as fish, frogs and invertebrates in Tasmanian freshwater ecosystems, as potential carriers of *M. amphibiorum* and sources for platypus infection is yet to be adequately investigated. An ELISA serological survey of platypuses and a diagnostic PCR test for other carriers are required. To date an environmental niche has not been identified for *M. amphibiorum*.

Preliminary investigation into the distribution and physical characteristics of the platypus (*Ornithorhynchus anatinus*), and the prevalence of mucormycosis, in northwest Tasmania

James Macgregor

Wynyard Veterinary Clinic, Tasmania and Murdoch University, Western Australia.

A study was performed to investigate the distribution and prevalence of mucormycosis in the platypus (*Ornithorhynchus anatinus*) in northwest Tasmania and to gather information on the distribution and physical characteristics of the platypus in this area. These aims were achieved by the capture, examination and release of 44 wild platypuses in the Inglis, Emu and Black-Detention catchments, and the examination of 3 platypuses presented to a local veterinary clinic, between December 2007 and August 2008.

Mean bodyweights of live adult female and male platypuses were 1.3 ± 0.1 kg (n=24) and 2.1 ± 0.2 kg (n=15) respectively. Male platypuses aged 0-6 months were found to have a lower weight in relation to local mean adult weight than platypuses previously studied in New South Wales. Platypuses aged 0-6 months were not observed until April. Evidence was found of platypus activity and platypus burrowing in altered habitats in agricultural areas.

No cases of mucormycosis were conclusively diagnosed. One platypus with signs consistent with those previously described in cases of mucormycosis was captured in the Emu River catchment. However, laboratory tests did not confirm this diagnosis. Two platypuses from the Inglis catchment area were found to have signs that were very similar to those previously described in cases of mucormycosis. However, infectious agents other than *Mucor amphibiorum* but consistent with the lesions observed were found in samples taken from these platypuses. This suggests that caution should be exercised when diagnosing mucormycosis based on clinical findings alone and raises the possibility that some cases may have been incorrectly diagnosed. Patches of hair loss and mild skin inflammation on the dorsal tail were observed in three platypuses in the Inglis catchment, but the cause was not determined.

Distribution, prevalence and persistence of mucormycosis in Tasmanian platypuses: a contemporary perspective

Nick Gust¹, Josh Griffiths¹, Michael Driessen¹, Annie Philips¹,

Niall Stewart² and Dominic Geraghty³

¹Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania.

²Menzies Research Institute, University of Tasmania, Hobart, Tasmania.

³School of Human Life Sciences, University of Tasmania, Launceston, Tasmania.

While the fungal disease mucormycosis has infected Tasmanian platypuses for nearly three decades, its impacts remain largely unknown. This study documents the spatial and temporal distribution of mucormycosis in Tasmanian platypuses as a baseline for assessing its impacts. Over 1,800 platypus capture and observation records were collated and mapped, and indicate that between 1982 and 2007, mucormycosis infected platypuses were present in at least 11, and potentially 22 of Tasmania's 48 river catchments. During 2008-09, live-trapping surveys were undertaken to determine the spread, prevalence and persistence of the disease. Surveys of 75 rivers and creeks across 18 catchments captured 167 individuals and an additional 12 platypuses were obtained from the public. Only seven of the 179 sampled animals were ulcerated with clinical signs of mucormycosis. All infected individuals were obtained from catchments with prior histories of disease, where platypuses have persisted despite mucormycosis being present for up to 20 years. Detection probabilities were calculated to estimate the probability that the other surveyed catchments are currently disease free. Detection probabilities were generally high (>0.75) per catchment, indicating sampling effort was adequate to reliably detect diseased animals at historically reported prevalence, (which averaged 0.295 from surveys undertaken between 1994 and 2000). Mean disease prevalence in affected catchments sampled during the present study declined to 0.071. This significant four-fold reduction in prevalence makes disease detection more challenging and increased sample sizes are required to confidently assert that some catchments are currently disease free. Reduced disease prevalence suggests mucormycosis is exerting less impact on Tasmanian platypuses now than it was in the mid to late 1990's, however the individual consequences of infection are poorly understood and require further investigation.

Establishing genetic tools to study monotreme reproduction and *Mucor* disease

Frank Grutzner

School of Molecular and Biomedical Science, University of Adelaide, South Australia

The platypus genome project provides a huge resource for research on monotremes. It also allows much quicker development of genetic tools that can be used in combination with field-based work to better understand for example monotreme ecology, population biology and reproduction. From our own work, which is focussed on understanding function and organisation of the complex sex chromosomes of platypus and echidna we try to develop tools that can be used to better understand monotreme reproduction, population genetics and diseases like mucor disease. I will discuss how our work on monotreme Y chromosomes allows us to identify new genes that could be involved in sex determination in monotremes and how this led to the establishment of a simple PCR test to determine the genetic sex in echidnas. We also investigate the genes of the inflammatory pathway in platypus to establish a tissue culture based assay that could allow us to test if cells from different populations of platypus react differently when exposed to a disease challenge like *Mucor amphibiorum*. Expression analysis of genes in ulcerated tissue will also give us insights into the type of response and the pathways that are involved in the development of this potentially lethal disease in platypus.

Novel methods used to study echidna reproduction: how these techniques could be applicable to studies on platypus reproduction

Gemma Morrow and Stewart C. Nicol

School of Zoology, University of Tasmania, Hobart

There is surprisingly little field based data on the reproductive biology of the two Australian monotremes, the echidna and the platypus. Over the last three years we have developed a number of techniques for the non-invasive study of echidna reproductive biology, some of which should be transferrable to studies on platypus.

We have been able to take samples from the female reproductive tract using a DNA collection brush. Recovered epithelial cells provide information on the oestrous cycle, while the presence of sperm and its condition can show whether the female has mated and how recently this has occurred.

Using ultrasound we have been able to follow the annual recrudescence of the testes and venom gland in male echidnas, and with the help of an expert ultrasonographer, observe an egg in the uterus of a pregnant female.

Climatic constraints on the distribution of the platypus (*Ornithorhynchus anatinus*)

Stephen H. Kolomyjec, Jennifer G. Parsons, Christopher Johnson and David Blair

School of Marine and Tropical Biology, James Cook University, Queensland

Understanding the factors influencing the distribution of a species is necessary for informed management and conservation planning. Current distribution estimates of the platypus are based solely on sightings and capture data from researchers; little is known about the environmental determinants of that distribution. It is our goal to fill this gap in knowledge and provide a better understanding of platypus distribution.

Using a large data set of sighting records (n=4,315) we have generated a predictive climatic model to examine range limiting environmental factors. In doing so, we have also produced a new distribution map for the platypus.

We found that the factors contributing most to the locations of suitable platypus habitat were the amount of precipitation in the driest quarter and the temperature during the hottest quarter. That an amphibious mammal requires a certain amount of water in its habitat comes as no surprise, particularly when many fluvial systems in Australia are seasonally ephemeral. It is also vindicating to see that temperature is an important factor as it has been one the primary factors hypothesized in regards to the northern limit of the platypus distribution by researchers for decades.

Our predictive models also support the observations of regions lacking in platypuses, which create distribution gaps in north Queensland. The gaps are on a scale that may warrant the future resurrection of regional sub-species nomenclature, particularly when combined with other empirical data on northern Queensland platypuses.

Distribution and individual characteristics of the platypus (*Ornithorhynchus anatinus*) in the Plenty River, southeast Tasmania

Rachelle Olsson Herrin

University of Lund, Sweden and University of Tasmania, Hobart, Australia

Very little is known of platypus ecology and how threatening processes affect the state of populations. It is therefore important to gain a better understanding of how characteristics vary between different populations to be able to predict the effects of disturbance. The main aim of this study was to investigate the characteristics of platypus (*Ornithorhynchus anatinus*) in the Plenty River catchment in southeast Tasmania.

Distribution of platypus and habitat characteristics associated with platypus occurrence within the catchment was determined through a field-based survey, a sighting survey and anecdotal evidence. Morphological, behavioural and genetic traits of the population were also investigated during the field survey. In addition, Plenty River population characteristics were compared to another population in the South Esk River in northeast Tasmania.

Platypus were found in all parts of the Plenty River catchment, but in much lower numbers in the upper and mid-catchment compared to the lower catchment. This could be related to differences in habitat characteristics, but other factors such as disturbance from anthropogenic activities could also be influencing the observed distribution pattern. A similar trend in distribution was seen in the South Esk River population, indicating that it is not a catchment-specific characteristic. However, comparisons of other characteristics of the two catchments imply that it is important to apply catchment-specific measures in management and conservation.

The Plenty River platypus is morphologically similar to other Tasmanian populations, but larger than its mainland counterpart. It displays highly diurnal activity patterns and a great deal of movement on land which is in line with previous observations of Tasmanian platypuses in contrast to mainland populations. Diet composition is largely consistent with previous studies, although it varies temporally and spatially which supports the hypothesis that the platypus is an opportunistic feeder. A preliminary genetic study shows that different parts of the catchment might support different populations, but further research is needed to substantiate these findings.

Platypus abundance and demographics in Tasmania – quantifying natural variability and investigating mucormycosis impacts

Nick Gust and Josh Griffiths

Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania

Quantifying the magnitude and scale of variability in ecological systems is critical to understanding how they may operate and helps interpret their changes in response to disturbances or anthropogenic influences. Here we investigate important spatial scales of variability in the relative abundance, body size, sex ratios and age structures of Tasmanian platypuses using two years of trapping data. Specifically we investigate the influences of spatial variability at two scales; amongst catchments and within catchments. During 2008-9 more than 10,000 hours of live trapping surveys were conducted across 75 streams in 18 catchments. Three sizes of fyke nets were set and a total of 195 platypuses were sampled across seven stream orders. Carefully documented sampling effort and methodology enabled systematic investigation of the influences of scale, netting methodology and seasonal influences. Catch per unit effort (CPUE) was used as a proxy for relative abundance. Results are compared across catchments of differing mucormycosis disease history to investigate the potential population level impacts of the disease. The results of preliminary analyses are presented.

Management of platypus habitat in production forests in Tasmania

Sarah Munks

Forest Practices Authority, Hobart, Tasmania.

Platypuses are frequently recorded in forested areas, including those subject to forestry activities. Actual data on the effects of forestry on the platypus are few. However, a number of reviews have suggested that poorly managed forestry operations may have an adverse impact on the platypus. The main environmental effects attributed to forestry operations are those that result in damage to stream banks and reduction in the abundance and diversity of prey species. Current management actions to minimise the direct and indirect effects of forestry activities on platypus and their habitat include streamside reserves and dispersing harvesting coupes.

The results of two studies that provide some information on the effects of forestry activities on the platypus in Tasmanian river systems will be presented. The first examined the occurrence of platypus in the upper catchment of the South Esk River and the impact of past forestry activities. This study found a trend toward a higher number of platypuses in headwater streams with relatively undisturbed catchments compared to headwater streams which had been disturbed by forestry operations. This was related to differences in the 'in-stream' and riparian characteristics of the disturbed streams compared to undisturbed streams. The second study involved the use of a model of the platypus population in northeast Tasmania to explore the sensitivity of the platypus to different forest management scenarios. The results indicated that the platypus is sensitive to differences between forest management scenarios. The sensitivity of the model, however, indicated the need for more data on population size, distribution within a river system and response to habitat disturbance.

Impacts of drought, fire and urbanization on the distribution and abundance of platypus in Victoria

Rodney Armistead¹, Paul Mitrovski¹ and Andrew R. Weeks^{1,2}

¹CESAR Consultants, North Melbourne, Victoria.

²Centre for Environmental Stress and Adaptation Research, University of Melbourne, Victoria.

Since 2007 CESAR Consultants have undertaken mark, release and recapture platypus surveys in the majority of Melbourne's metropolitan catchments and waterways for Melbourne Water's Urban Platypus Program. Similar surveys have also been undertaken in the MacKenzie River that flows through the Grampian Ranges National Park in the north east of Victoria. These surveys have been undertaken to evaluate the distribution and abundance of platypus in these catchments. Drought, fire, urbanization and predation pose serious threats to platypus and have severely impacted parts of these catchments. Here we will talk about these issues in relation to results from surveys, including the affects of the recent black Saturday fires in Victoria.

Phylogeography of the Tasmanian and Australian mainland platypus populations employing mitochondrial DNA

¹Amelia Swan, ²Emily Miller, ¹Chandramaya Siska Damayanti, ³Stephen Kolomyjec, ⁴Elise Furlan, ⁵Tom Grant, ³David Blair, ¹Chris Moran, ⁴Andrew Weeks, ⁶Nick Gust and ¹Jaime Gongora

¹Centre for Advanced Technologies in Animal Genetics and Reproduction, Faculty of Veterinary Science, University of Sydney, NSW.

²Faculty of Veterinary Science, University of Sydney, NSW.

³School of Marine and Tropical Biology, James Cook University, Queensland.

⁴Bio21 Institute, University of Melbourne, Victoria.

⁵School of Biological, Earth and Environmental Sciences, University of New South Wales, NSW.

⁶Biodiversity Conservation Branch, Department of Primary Industries, Parks, Water and Environment, Tasmania.

The platypus (*Ornithorhynchus anatinus*) is a monotreme endemic to Australia. It is distributed in streams and rivers of the southern and eastern Australian mainland and Tasmania. The platypus as a representative of monotremes has been used as a model for comparative genomic analyses providing interesting insights into the evolution of vertebrates. Besides these important contributions, understanding of the genetic diversity and phylogeography of the species is very limited. Here we analyse the phylogenetic relationships of platypuses from New South Wales, Australian Capital Territory, Queensland, Victoria and Tasmania using mitochondrial DNA control region sequences. Preliminary analyses show that platypuses from Tasmania cluster in a separate clade from those of continental origin. Within continental Australia, the phylogeographic structure appears to be relatively weak. To further understand the phylogeographic relationships of this species, more than 300 samples are being analysed. This information, in addition to current microsatellite studies will contribute to the assessment of the level of genetic differentiation and population structure of the platypus, assisting molecular ecology studies and conservation plans.

Levels of genetic variability in the platypus, *Ornithorhynchus anatinus*, and consequences for conservation

¹Elise Furlan, ¹Paul Umina, ¹Rodney Armistead, ¹Paul Mitrovski, ²Nick Gust,

²Josh Griffiths and ¹Andrew Weeks

¹Centre for Environmental Stress and Adaptation Research, Departments of Genetics and Zoology, The University of Melbourne, Victoria.

²Department of Primary Industries, Parks, Water and Environment, Resource Management & Conservation Division, Tasmania.

The platypus, *Ornithorhynchus anatinus* is a unique, iconic mammal endemic to Australia. Despite being listed as 'common' throughout its range, platypus abundance is poorly understood. Dependence on aquatic habitats in drought affected Australia renders this species potentially vulnerable to a variety of processes including climate change and habitat loss. To assist with understanding population processes, 13 microsatellite loci were isolated and optimised for amplification. Characterisation of 180 individuals from Tasmania and Victoria revealed all loci to be polymorphic (3-24 alleles per locus). Observed heterozygosities ranged from 0.445 – 0.610. Large genetic differences were evident between Tasmanian and Victorian *O. anatinus*. The long-term isolation of Tasmanian individuals from their mainland counterparts is likely to have contributed to the high levels of genetic differentiation observed. Within Tasmania, high levels of allelic diversity were detected with genetic differentiation identified among some populations. Similar levels of allelic diversity were found within Victorian platypuses along with significant genetic differentiation among populations. These microsatellite loci will facilitate research into the population genetics of *O. anatinus* throughout its Australian range and assist with species management and conservation efforts.

Characterisation of MHC-linked microsatellite markers in the platypus (*Ornithorhynchus anatinus*)

Mette Lillie¹, Nick Gust² and Kathy Belov¹

¹Faculty of Veterinary Science, University of Sydney

²Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania

The Major Histocompatibility Complex is a multigene family that plays a vital role in the innate and adaptive immune response of jawed vertebrates, as an interface between the immune system and infectious agents. Variation in these antigen-binding sites provides a repertoire of MHC molecules with different pathogen specificity, effectively protecting the host against diverse pathogens. By measuring the genetic diversity of MHC of platypus populations we can evaluate the immunological fitness and adaptability of vulnerable populations to a changing environment. Microsatellite markers located in close proximity to MHC loci presents a simple, inexpensive and high throughput method of inferring genetic diversity at the MHC due to tight linkage with specific MHC alleles.

The platypus (*Ornithorhynchus anatinus*) faces an uncertain future from the impacts climate change, habitat degradation and the infectious disease, mucormycosis. The selective maintenance of MHC alleles is thought to vary between populations of platypuses. Therefore, characterisation of MHC diversity can allow current conservation efforts to infer the inherent evolutionary potential and immunological fitness of each surveyed population and assist in conservation management. I will discuss the design, development and optimisation of three Class II and one Class I-linked microsatellite markers in the platypus, and their implementation in the typing of more than 80 platypuses.

Reproduction and longevity of captive platypus at Healesville Sanctuary

Jessica Thomas, Ian Elton and Paula Watson

Healesville Sanctuary, Victoria

The platypus was first introduced into captivity in 1933. They have been a difficult species to keep as the cause of death for many captive platypuses has been recorded as 'unknown'. Veterinarians and keepers have speculated that these deaths were due to stress associated with captivity. There has also been limited success breeding the platypus, despite attempts made by several institutions. Stress and unsuitable facilities may have been factors inhibiting their reproduction. Only two captive institutions have produced healthy young that have survived into adulthood (n=11). Healesville Sanctuary has bred platypus five times in 75 years, with four successes occurring in the past 10 years. This achievement has been attributed to advances in enclosure design, husbandry protocols and new research objectives. At Healesville Sanctuary, the breeding facility consists of a large swimming area, natural earthen burrows, intensive behavioural monitoring and a 'hands off' approach. The behavioural monitoring allows us to predict key events during the breeding season and remotely monitor platypus health and stress levels. We are also investigating the relationship between food consumption, activity levels and behaviour. We plan to continue to develop expertise in the captive management of platypus by further refining our husbandry, veterinary and captive breeding protocols. Given the difficulty of keeping and breeding platypus in captivity, it is important that we strive to implement a successful captive breeding program for platypus now, so that if the time comes, we will be able to instigate a successful recovery program.

Observations on platypuses in captivity with particular reference to stress indicators

Nigel Forteath, Yolande Szefky and Nick Jones

Platypus House, Beauty Point, Tasmania

Much has been said regarding the difficulties of keeping platypuses in captivity but observations on the behaviour of animals in the captive environment are seldom reported. This presentation will report on the behaviour of five platypuses, two males and three females: one male is housed with one female and the other male with the remaining two females. Although it has been reported in the wild that platypuses share burrows, we have been surprised by their intimacy in the burrow; animals are observed sleeping between or over the top of one another. Likewise, males may share food with a female. Prenuptial behaviour commences two months before actual mating with tail grasping and rolling taking place both night and day. Coitus occurs many times between October and December. During these months paired platypuses sleep for no more than two or three hours each day. Males are most intolerant of each other. A male entering an area previously occupied by another male will attempt to remove faeces left by the previous occupant, scrapping them into the water. Dominance behaviour has become apparent in the area occupied by three animals. Newly captured animals become stressed and may spend several days immersed except for quick visits to the surface for oxygen. However, platypus keepers can recognize several other indicators of stress which if not acted upon immediately may result in the death of the animal. Recently we have noticed that porphyrin may obscure the white eye patches. The possibility of porphyrin being an indicator of stress or some other physiological disturbance is discussed.

Workshop questions

Many thanks to those who responded to the two questions below:

Q1. What are the key threats to conservation of Tasmanian platypuses in the next 25 years?

Q2. What are the most important research questions that, if answered, would best direct conservation efforts for Tasmanian platypuses?

We have received responses to these questions from 12 participants, and have compiled a list of key threatening processes and research questions for your consideration before the meeting. Participants who responded have helped inform the process and determine the direction and productivity of workshop discussions. If you have not responded to these questions and don't see your 'issues' already reflected in the tables, please send us your responses ASAP so we can incorporate them in the list before the workshop.

We look forward to seeing you this week in Hobart (Sept 3rd and 4th).

Best wishes,
The Platypus Partnership People.

Table 1. Respondent's perception of the key threatening processes for Tasmanian platypuses.

Identified key threatening processes	Number of responses
General habitat degradation	9
Introduced species/ predators	7
Disease	6
Climate change	5
Forestry	5
Agriculture	4
Water abstraction	4
Genetic diversity	3
Pollution	3
Fishing	2
Roadkill	1
Devil's advocate: none known	1

Table 2. Respondent’s specific research questions for Tasmanian platypuses, that if answered, would best inform conservation efforts.

(Note: obvious duplicates have been removed, in the workshop we will shortlist the most important ones, focus and reword them as necessary).

Q	Initial Research Questions	Categories
1	Are there any reliable indicators of stress in the platypus e.g. production of profuse amounts of porphyrin in their Harderian gland secretions?	Captive breeding
2	Should we continue efforts to breed platypuses in captivity – just in case?	Captive breeding
3	How much prime platypus habitat will be lost, and how much degraded by climate change in the next 25yrs?	Climate change
4	How will the distribution and abundance of platypuses in Tasmania be affected by climate change?	Climate change
5	How will invertebrate productivity be affected by climate change?	Climate change
6	How will distribution and abundance of invert prey alter with climate change?	Climate change
7	How will freshwater ecosystem productivity alter with climate change?	Climate change
8	What are the consequences of mucormycosis infection for mortality and reproduction?	Disease
9	What are the mechanisms of disease transmission for mucormycosis?	Disease
10	Is there evidence for resilience to mucormycosis infection in long term infected populations?	Disease
11	What factors make individuals more susceptible to mucormycosis?	Disease
12	Is <i>Mucor amphibiorum</i> really introduced or endemic?	Disease
13	Do current low levels of prevalence compared to past high prevalence represent a variably aggressive new disease or a natural sink/source cycle?	Disease
14	What is the disease associated morbidity rate? Can this be measured? Is the disease a natural process within the population dynamic?	Disease
15	Can the R0 be defined for mucormycosis? And if so what is it?	Disease
16	What other factors (genetic diversity, immune status, age, sex, weight, reproductive status, co-existing diseases/pathogens, nutritional status etc) effect the disease morbidity and/or mortality rate? Can these be controlled? What actions should be taken to control these?	Disease
17	Can individuals develop immunity and increase survival in populations infected with <i>M. amphibiorum</i> ?	Disease
18	Can novel techniques be developed to reliably quantify platypus abundance?	Ecology
19	How do platypuses utilise habitat at specific times (such as shortly after emergence, at different ages and during the breeding season) and what are their movements over periods of years?	Ecology
20	Research into population dynamics	Ecology
21	Is there a direct relationship between the abundance of food and platypus abundance?	Ecology
22	Is there any correlation between platypus population abundance and presence of certain food items?	Ecology
23	How do Tasmanian platypuses respond to disturbances to their home ranges?	Ecology
24	What are the causes and frequency of platypus mortality and how does this change over 25yrs?	Ecology

25	How do the reproductive outputs of platypus populations compare to richness of habitat (defined by food abundance)?	Ecology
26	How are platypus distributed within catchments?	Ecology
27	Which factors determine timing, frequency and outcomes of reproduction?	Ecology
28	Can a critical population threshold be broadly defined? What action should be taken if abundance falls below this threshold?	Ecology
29	How do we make better estimates of abundance in different types of water bodies with differing ease of trapping with gill/fyke nets and/or observation?	Ecology
30	How can platypus populations be reliably and cost-effectively monitored through time?	Ecology
31	What are the key features of platypus habitat particularly in relation to riparian vegetation requirements?	Ecology
32	How much genetic diversity exists within and between catchments?	Genetics
33	Is Taxonomic revision justified? Are Tas platypus the same species? Subspecies?	Genetics
34	How does habitat fragmentation effect local population survival and genetic diversity?	Genetics
35	How does genetic diversity of Tasmanian and mainland populations compare?	Genetics
36	What impact will foxes have on platypus mortality and behaviour?	Introduced predators
37	What are the likely future state of rivers in Tasmania?	Land management
38	How significant is the impact of forestry and where are its impacts most evident?	Land management
39	Can we develop better farming/forestry/urban practices to minimise impacts on flow regimes & platy habitat?	Land management
40	What are the impacts of various land management practices (e.g. forestry, agriculture) on platypus populations, and how do they compare?	Land management
41	Are suitable communication policies and procedures in place to ensure knowledge transfer between relevant stakeholders?	Management

CONFIRMED DELEGATE LIST

FIRST NAME	SURNAME	AFFILIATION
Rodney	Armistead	CESAR
Warwick	Brennan	DPIW
Ray	Brereton	Hydro
Joanne	Connolly	Charles Sturt Uni
Xianlan	Cui	DPIW - Animal Health Laboratory
Peter	Davies	UTAS
Mike	Dreissen	DPIW
Nigel	Forteach	Platypus House
Elise	Furlan	CESAR
Rosemary	Gales	DPIW
Dom	Geraghty	UTAS
Tom	Grant	NSW Uni
Josh	Griffiths	DPIW
Tiggy	Grillo	Australian Wildlife Health Network
Frank	Grutzner	University of Adelaide
Nick	Gust	DPIW
Nick	Jones	Platypus House
Mandeep	Kaur	UTAS
Steffen	Kolomyjec	JCU
Mette	Lillie	Sydney Uni hons student
James	Macgregor	Wynyard Vet Clinic
Gemma	Morrow	UTAS
Sarah	Munks	DIER
Mark	Nowakowski	
Rachelle	Olsson Herrin	UTAS
Sarah	Peck	DPIW - Animal Health Laboratory
Annie	Philips	DPIW
David	Stevens	University of Adelaide
Niall	Stewart	UTAS
Amelia	Swan	Sydney Uni hons student
Yolanda	Szefky	Platypus House
Jessica	Thomas	Healesville Sanctuary
Andrew	Weeks	CESAR
Mary Lou	Conway	DPIW
Andrew	Baldwin	NRM North
Eddie	Tsyrlin	Melbourne Water