SWIFFT State Wide Integrated Flora and Fauna Teams

SWIFFT Video conference notes 27 January 2011

Amphibian Ecology

SWIFFT meeting notes are a summary of the video conference and not intended to be a definitive record of presentations made and issues discussed.

Quick take home messages from this video conference or read through the speaker summaries.

1. The conservation biology of the Southern Toadlet *Pseudophryne semimarmorata* in south-west Victoria -Yoni Tiljak – Honours at LaTrobe University, Victoria, Australia.
2. Growling Grass Frog Dams to Habitat project - Gary Peterson, Department of Sustainability & Environment.
3. Amphibian conservation- Gerry Marantelli, Amphibian Research Centre.
4. Chytridiomycosis: A fatal disease of amphibians - Dr Alex Hyatt, Australian Biosecurity Microscopy Group, CSIRO, Australian Animal Health Laboratory (AAHL), Geelong, Victoria, Australia.
5. Hybrid Zones in Frogs: Evolutionary Biology and Significance for Conservation - Murray Littlejohn, Department of Zoology, University of Melbourne.

KEY POINTS SUMMARY

The Southern Toadlet has undergone a severe decline in the last 40 years in south-west Victoria and more research is required to understand the species ecology and the extent of the decline.

Raising awareness of the Southern Toadlet and risks associated with the spread of Chytrid fungus is needed to assist in conservation of this species

The project to enhance farm dams for the Growling Grass Frog commenced in 2008/09.

Broad scale landscape enhancements and connectivity between dams, wetlands and streams is required for conservation of Growling Grass Frogs.

The Amphibian Research Centre was established in 1994 and undertakes captive breeding and conservation of about 50 species of frogs,

Some threats may not be lethal on their own but when combined they have the potential to kill individual frogs, the entire frog population and even cause species extinction.

Chytridiomycosis (Chytrid fungus) is an emerging infectious disease of amphibians caused by a fungus *Batrachochytrium dendrobatidis*.

The first video conference for 2011 focused on ***Amphibian Ecology***. A total of 77 participants were connected across 13 locations at Heywood, Horsham, Hamilton, Colac, Warrnambool, Ararat, Ballarat, Geelong, Traralgon, Tatura, Box Hill, Nicholson Street Melbourne and Mt Gambier South Australia.

Those attending included participants from;

Educational: LaTrobe University.

Local Government: City of Manningham, City of Greater Geelong, City of Ballarat.

Field Naturalist Clubs: Ararat, Ballarat, Geelong, Hamilton, Portland and Traralgon.

Community Conservation Groups: Ararat Land Care, ANGAIR, Ballarat Environment Network Barwon Coast Committee, Brolga Recovery Group, Geelong Environment Council, Basalt to Bay Landcare.

Conservation Organisations: Central Highlands Water, Vic Roads, Trust for Nature, Windamarra Aboriginal Corp., Parks Victoria, VicRoads, Dept. Catchment Management Authorities (Glenelg Hopkins, Corangamite – Water Watch), DSE/DPI biodiversity staff across south-west Victoria, Box Hill, Nicholson Street Melbourne.

SPEAKER SUMMARIES

The conservation biology of the Southern Toadlet *Pseudophryne semimarmorata* in south-west Victoria - *Yoni Tiljak – Completed her Honours at LaTrobe University, Victoria, Australia*

Southern Toadlet overview

The Southern Toadlet is a very small ground dwelling frog growing to about 30 cm. Males create burrows in areas that will flood after rain from which they call, usually from late March to early May. The call is very similar to the Brown Toadlet also known as Bibron's Toadlet or *Pseudophryne bibronii*. The best way these two species can be identified from each other is by capturing the frog and looking at the belly markings, the Southern Toadlet having an orange or yellow mottled band on its underside.

The Southern Toadlet can live for at least 10 years and has a very small home range of about 5 metres from the breeding site. Yoni explained that the Southern Toadlet was once widespread in south- west Victoria but over the last 40 years there has been a severe decline in the population, whereas two other species of smooth frogs (*Geocrinia victoriana* and *G. laevis*) which utilise the same habitat, are in the same area with similar breeding characteristics of laying eggs on dry land which flood after rain do not appear to have experienced the same level of decline.

Project summary

The project was aimed at determining the current status of the Southern Toadlet in south-west Victoria by:

- Determining the past and present distribution of the Southern Toadlet in south-west Victoria
- Identifying habitat and microhabitat characteristics that influenced the past and present distributions, breeding and survival habitats.
- Determining whether disease (chytrid fungus) may have caused the decline.

Yoni surveyed 17 historic Southern Toadlet breeding sites, 13 sites were in the Corangamite Catchment, south of Camperdown to the coast and 4 in the Grampians, north of the Moora

Moora Reservoir. Sites were visited on at least 3 separate occasions and species identified using call recordings and individuals captured for identification. Measurements were taken, swabs for chytrid fungus were taken and temperature and humidity of the site were recorded.

Eight species of frogs were detected across all the study sites but adult Southern Toadlets were only found at two sites; Philip Island Track in the Grampians and Loch Ard Gorge site near Port Campbell.

Six weeks after the breeding season Yoni conducted a tadpole present/absence survey at each of the 17 sites. It was found that 7 of the 17 sites had no water. At the remaining 10 sites a survey of tadpoles was conducted. Overall there were very few tadpoles found of any species despite the presence of calling males at many of the sites. No Southern Toadlet tadpoles were found. Tadpoles were identified using Tadpoles of South-eastern Australia (Anstis 2002). Swabs were taken to see if chytrid fungus was present.

Chytrid fungus

Part of Yoni's project was to determine if Chytrid fungus could be impacting on the current distribution of the Southern Toadlet. Chytrid fungus has been identified as a major threat to frog populations worldwide. It has caused decline and extinctions of many frog species. Chytrid attacks keratin which is found in the mouth parts of tadpoles and the skin of adult frogs. It prevents tadpoles from feeding and prevents the uptake of moisture and oxygen from the skin of adult frogs effectively dehydrating the frog. Chytrid fungus is spread by the movement of infected frogs and also in water so it is important to take care to sterilize equipment which is being moved from one wetland to another.

Chytrid testing was conducted at 11 sites which contained adequate numbers of tadpoles and frogs. Chytrid fungus was detected at four sites. Chytrid fungus was not found at the two Southern Toadlet sites. Habitat characteristics of soil, water, pH, salinity and vegetation were measured. No significant relationships were detected between presence of the Southern Toadlet and the two species of smooth frogs *Geocrinia victoriana* and *G. laevis* and any measured habitat factors although field observations indicate that within shared sites the different species have preferences for different vegetation types, with the Southern Toadlet preferring more open habitats.

Climatic influence on breeding success

Yoni looked at how climatic changes may have impacted on the success of the Southern Toadlet's breeding season. Males start calling after the first autumn rains and stop calling when nights get below 10^0 C. By looking at climatic records Yoni found there have been a number of years in which the arrival of autumn rains has been late and night-time temperatures have dropped below 10^0 C. Under these conditions the success of the breeding season would have been limited. Ideal conditions are when the autumn rains commence in Mid-March and the night-time temperatures remain above 10^0 C from March until May.

Threats

Yoni used a case study example of the Loch Ard Gorge population to show how precarious sites such as this are to human disturbance from factors such as development (damage to vegetation and water regimes), fire management and spread of Chytrid fungus into the area from foot traffic.

Conclusions

- The Southern Toadlet has undergone a severe decline in the last 40 years in south-west Victoria and more research is required to understand the species ecology and the extent of the decline.
- Comparing populations in south-west Victoria with population around Melbourne which have been monitored for at least 10 years may help increase understanding of threats to this species.
- Raising awareness of the Southern Toadlet and risks associated with the spread of Chytrid fungus is needed to assist in conservation of this species in south-west Victoria.

Key Points from questions

- Salinity levels at sites varied from high to low salinity but did not appear to be an influence on the presence of Chytrid fungus.
- An education program which could be rolled out to schools in the area advising of the conservation needs of the Southern Toadlet would be beneficial (this is beyond Yoni's role and more suited to organisations such as DSE or Greening Australia).
- Yoni will be providing management advice to Parks Victoria ranger staff regarding protection at the two sites where Southern Toadlet was found.
- The DPI Weed Stop program could be an effective avenue to increase awareness of risks associated with the spread of Chytrid fungus.
- The spread of Chytrid fungus on footwear is of concern particularly when people are moving between wetlands e.g. duck hunting. Signage at highly sensitive sites may be an option to advise people to ensure footwear and equipment is properly disinfected.
- David Pace from Torquay Primary School has a strong interest in frogs and may know of other Southern Toadlet populations.
- Much of the knowledge regarding distribution of the Southern Toadlet in south-west Victoria dates back to Murray Littlejohn's work in the 1960's.
- In recent years there have been a number of consultants undertaking surveys associated with major projects which are directed to survey for the Southern Toadlet at the appropriate times but no detections have been made.

- Comments from Traralgon suggest more information is required for that part of the state as well.
- Breeding sites are very small and can be only 5 metres in radius and there is little movement from these sites.
- More research is required to understand the characteristics of sites before the possibility of establishing new safe sites can be undertaken, although the concept has merit.
- A protocol to limit the spread of Chytrid fungus by people working in wetlands would be a good initiative.

Growling Grass Frog Dams to Habitat project - *Gary Peterson, Department of Sustainability & Environment, Victoria.*

Gary provided a brief outline of the project which stemmed from previous survey work by Michael Smith at Arthur Rylah Institute, in which he found the Growling Grass Frog occupied some farm dams but not others. Vegetation around dams was found to be an important factor. In the context of the drought and the endangered conservation status of this species the project to enhance farm dams for the Growling Grass Frog was commenced in 2008/09 and will eventually include all of Victoria and south-eastern South Australia. At present the project is focusing on a number of population clusters in south-west Victoria in which every dam within 1.5 km of a cluster is surveyed. Surveys are regularly carried over a three-year period to measure the difference between where enhancement works have been carried out and those with no enhancement.

Enhancement works

Fencing a quarter of the farm dam and reinstating with aquatic vegetation and artificial terrestrial habitat such as logs, railway sleepers etc.

Most of the enhancement works are now completed and the project is now at the beginning of the three-year monitoring phase. Once the results are finalised it is hoped a standard design for enhancement can be formulated so it can be implemented as a program via CMA's, Greening Australia, and Trust for Nature etc.

Key points

Gary made the point that we need to be also looking at broad scale landscape enhancements and connectivity between dams, wetlands and streams.

Increased rainfall in 2010 has had a positive effect on increased records as Growling Grass Frogs have dispersed but hopefully without spreading Chytrid fungus.

As an interim guide to landholders a fact sheet is available See fact sheet 2008

http://www.ccma.vic.gov.au/admin/file/content2/c7/growling+grass+frog+dams+to+habitat+fact+sheet_1299728942037.pdf

Growling Grass Frog habitat preferences and enhancement progress report 2009 D. Bryant 2009.

http://www.ccmaknowledgebase.vic.gov.au/resources/Growling_Grass_Frog_habitat_pref.pdf

Contact: Gary Peterson 03 55619915 or David Bryant 03 94508617

Amphibian conservation - *Gerry Marantelli – Amphibian Research Centre*

Gerry said the Amphibian Research Centre was established in 1994 and undertakes captive breeding and conservation of about 50 species of frogs, including 12 threatened species. The centre operates out of modified shipping containers which have been set up for breeding and rearing of tadpoles. Research is undertaken at the site and some of the projects are aimed at putting frogs back into the wild.

Captive breeding facilities at the Amphibian Research Centre

Threats to frogs in Victoria

Gerry felt the following issues are a combination of past and current threats.

He also stressed that we need to consider the cumulative impact of threats which often mean a frog can face several threatening processes at the same time. Some threats may not be lethal on their own but when combined they have the potential to kill individual frogs, the entire frog population and even cause species extinction.

Climate change – these are broad scale changes to cycles and landscapes that frogs have adapted to cope with.

Droughts are longer and more severe - habitat may remain unsuitable for breeding beyond the likely life expectancy of frogs.

Catastrophic events – fire, floods, seasons more unpredictable, extreme and unfavorable for breeding.

Fragmented habitats are changing – species have nowhere to go.

Invasion of new frogs and other species into areas which were previously beyond their range, e.g. the Dwarf Tree Frog.

Release of threatened species back into the wild when conditions recover from a catastrophic event such as a fire or a prolonged drought.

Gerry spoke about how climate issues threatened the survival of one species that was only known from one location in Victoria. The habitat had become dry for a number of consecutive years beyond the life expectancy of the frogs breeding capacity. When conditions became suitable, captive bred frogs were release. Recent extreme rains caused severe flooding which may have also caused damage by washing the frogs away; these are examples of how climate change can increase the severity of events.

Introduced species – fish

- Trout and Mosquito fish are predators of tadpoles and reduced or eliminate tadpole survival.
- Introduced fish such as trout are present in areas where frogs have no adaptation to presence of fish – the frogs become easy prey.

Release of developed Spotted Tree Frogs as a release of tadpoles would be predated upon by trout.

Human water storage has changed the landscape and the nature of aquatic systems favouring fish – permanent dams have replaced ephemeral water bodies.

Introduced species - plants - e.g. willow and blackberry

- Encroaching on habitat and reducing stream basking sites.
- Blocking drainage and seepage lines and disrupting water flow.

Introduced species – mammals – e.g. Cattle, deer, pigs, brumby and foxes.

- Trampling and damaging breeding habitat –wallows, siltation downstream.
- Predation on large ground dwelling species

Agricultural and other chemicals

- Mortality associated with use – e.g. glyphosate.
- Developmental damage due to low exposure at environmental levels.
- Deformities.
- Behavioural changes – e.g. escape response of tadpoles reduced.
- Sterilisation and reduced fitness on exposure.
- Sex changes and reduced fertility e.g. atrazine.

Habitat degradation - Gerry felt all of the above threats are forms of degradation of habitat.

- Clearing of riparian vegetation reduces habitat.
- Changing water regimes (controlled flooding, dams etc. which do not correspond to natural breeding cycles and development of tadpoles).
- Fragmentation of habitats and encroachment of development and increasing habitat edges/margins.
- Isolation of populations into smaller discreet areas.

Amphibian Chytrid Fungus

This is an exotic pathogen which has caused a major decline in Australian frogs over recent decades and resulted in extinction of some species in Australia but not yet in Victoria. Gerry referred to species such as such as the Spotted Tree Frog, Alpine Tree Frog and the Baw Baw Frog which had sudden and massive declines in their populations and have never recovered to previous levels. Chytrid Fungus still persists in the environment with varying levels of impact on a range of species over different landscapes.

Chytrid Fungus;

- Directly affects a number of species resulting in major mortality.
- Increases stress on species that are infected which impacts on their resilience to withstand a range of threats.
- Contributes to seasonal or event driven mortality in some species.

Gerry spoke about methods which have been developed to maximize survival of releases into the wild by releasing tadpoles into artificial systems which allow for development without being infected by Chytrid Fungus. When the tadpole has completed metamorphosis, it can then climb out into the natural system. This increases its chances of survival by reducing impacts from Chytrid Fungus in the tadpole phase.

Gerry stressed the above issues need to be looked at as a combination of impacts rather than as an isolated impact.

Mobile breeding facilities

Gerry spoke about self-contained frog breeding containers which are being used by a number of organizations to breed frogs for release into the wild. Gerry felt that whilst it is good to be able to undertake artificial breeding and release, we need to come to grips with ensuring the natural systems are managed to support wild populations. There is also an ongoing need to better understand what is happening with frog populations and their response to changing conditions.

Key points from questions

Use of chemical sprays for locusts could disrupt the food chain for frogs. Generally, frog populations in the agricultural setting where locusts are a problem have a boom and bust population cycle influenced by prevailing conditions. The danger is that frog populations may be impacted upon at a time when they are already low because of drought. It is important that the use of chemicals is not ongoing and there is opportunity for frog populations to rebound when conditions become suitable. In summary, more work is required to determine the impacts of agricultural chemicals on the food chain and frogs in particular.

Contact: Gerry Marantelli, http://frogs.org.au/

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Chytridiomycosis - A fatal disease of amphibians *- Dr Alex Hyatt, Australian Biosecurity Microscopy Group, CSIRO, Australian Animal Health Laboratory (AAHL), Geelong, Victoria, Australia.*

Alex said much of the work on response to the decline of amphibians in Australia and around the world commenced in the mid to late 1990's. Through collaboration with scientists in the USA and Australia a project was begun to identify what the major drivers for the decline in frogs were and see if an infectious agent was involved. Once it was determined to be an infectious agent the development diagnostic measures and development of management protocols followed.

Chytridiomycosis (Chytrid fungus) is an emerging infectious disease of amphibians caused by a fungus *Batrachochytrium dendrobatidis* (*Bd*).

It is recently discovered and detected over an increasing geographic range. It is a highly virulent fungal pathogen of amphibians capable at the minimum of causing sporadic deaths in some populations, and 100% mortality in other populations.

Overview

Alex provided an overview of the insidious nature of the disease and the infectious agent *Batrachochytrium dendrobatidis* (*Bd*)

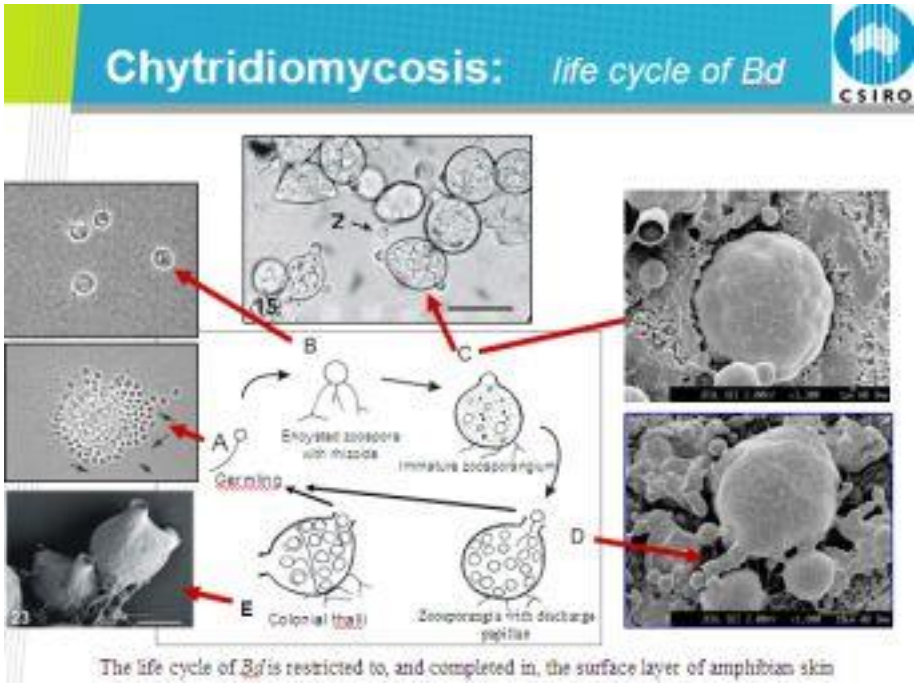
- A broad range of amphibian species can be infected both in the wild and captive populations.
- Transmission is via a zoospore that requires water as a medium.
- If the zoospore is dehydrated the disease will be killed.
- It appears to move naturally through the environment at a rate unaffected by human activity (approximately 100 km/yr).
- Once in an area it can survive in the environment for months or years even without the amphibian host. It also has the potential to kill of the amphibian host even when they are in low numbers which means it is capable of driving an amphibian population to extinction. Alex said this was very unusual for an infectious agent and means it can multiply without amphibians but exactly how is unknown at this time.
- Tadpoles are readily infected – mostly around the keratin in the mouth parts. If the tadpole survives to metamorphosis the fungus spreads to skin.

- The life cycle of (*Bd*) is restricted to and completed in the surface layer of the amphibian skin. Death is caused by an imbalance in the ionic and osmotic balance leading to an increase in calcium ions which impacts on the heart, causing fits and slowly kills the frog.
- Some species of frogs have more resilience to the disease than others.
- (*Bd*) is known to replicate more effectively at low temperatures. It is also thought the immunity of the frog is reduced at low temperatures which could possibly lead to a higher infection rate but the correlation between these factors has not been fully proven at this time.
- There are cases where some species have recovered from infection but Alex thought this was more of an exception than the norm.

Batrachochytrium dendrobatidis (Bd) is a very significant pathogen and one of the most infectious agents in the word.

Life cycle'

Alex showed a detailed diagram of the life cycle of the infectious agent Batrachochytrium dendrobatidis and microscopic images showing zoospores which send out rhizoids for feeding. He showed images from a cryo-scanning electron micrograph of zoosporangium which develops discharge papillae that release zoospores; this cycle takes place within the skin of the frog.

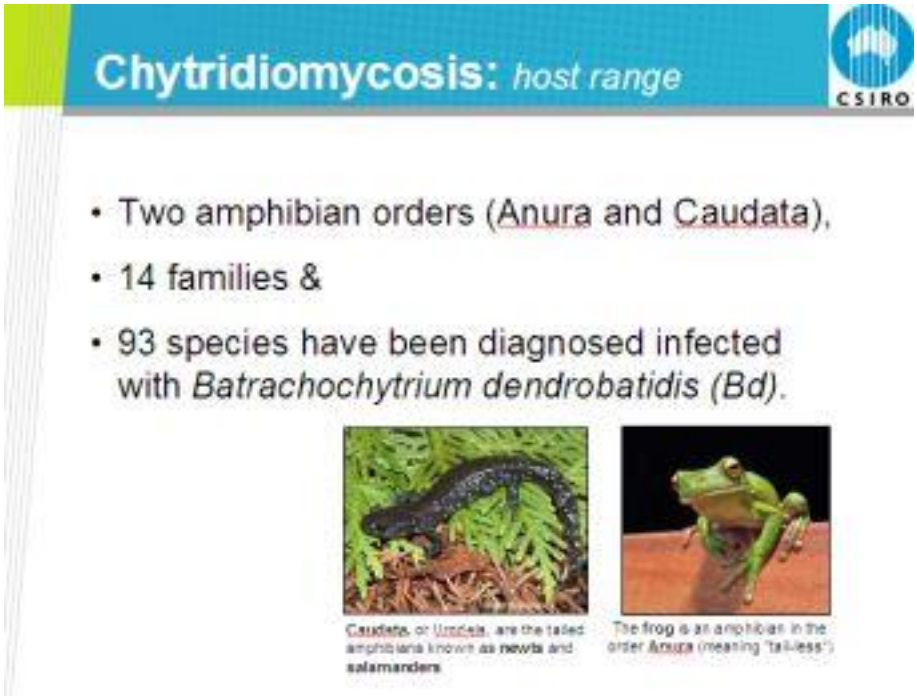


Distribution of *Batrachochytrium dendrobatidis* (Bd)

Bd is not native to Australia, It is thought that it may have arrived in southeast Queensland in the mid-1970s on imported specimens of the African clawed frog, Xenopus laevis. Earliest record in Australia is December 1978 in the Conondale Ranges, west of Brisbane.

It is now found in six continents; Africa, South America, Central America, North America, Europe, Australia, and Oceania (NZ). The earliest record is from North America in Rana pipiens collected in 1974.

There is some evidence that in certain areas of the word *Bd*. exists in endemic forms and frogs in those areas do not become ill or die e.g. Japan, but if they are exposed to the form of *Bd.* that is currently being spread around the world there is a detrimental impact on those frogs.



Actions for management of Chytridiomycosis (Chytrid fungus)

Alex spoke about the declaration of *Batrachochytrium dendrobatidis* as Key Threatening Process to Australian Frogs in 2002 under the EBBC Act. Subsequently a Threat Abatement Plan was developed by the Commonwealth Government in 2006. This paved the way for funding of surveys on Bd. and research to understand the pathogenic nature of the agent.

A working group was formed to report to the World Organization of Animal Health (OIE - Office of International Epizootics) http://www.oie.int/ out of Paris which covers animal health worldwide. A major objective is to limit the spread of infectious agents throughout the world so when there is an outbreak in a country or zone it can be reported and protocols followed. A chapter has been written specifically about Chytridiomycosis for the OIE and will be available soon.

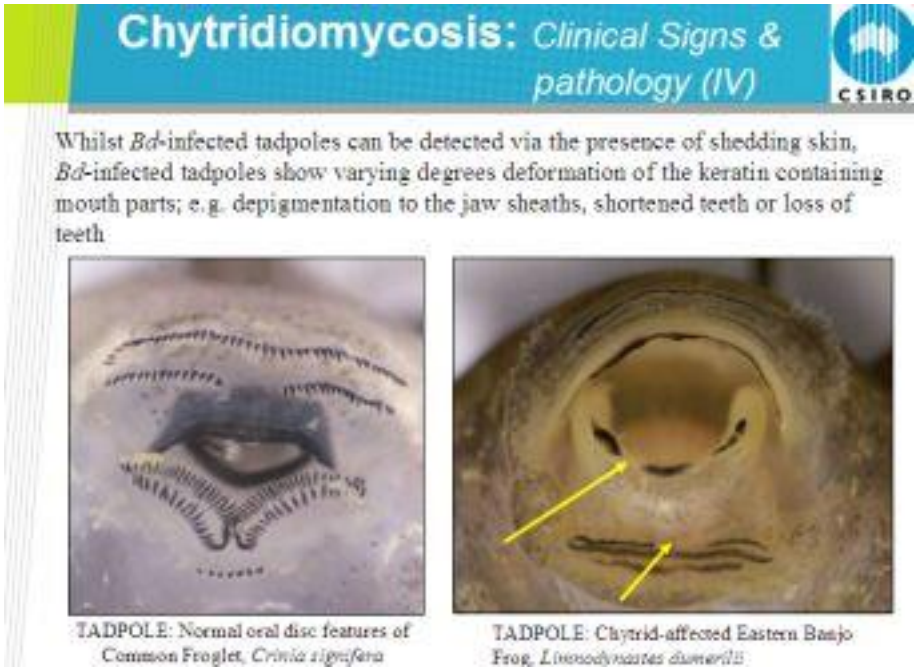
Signs of infection in frogs - Behavioural

- failure to seek shelter.
- reluctance to flee.
- sitting with hind legs held away from the body.
- fitting when handled *loss of ability to turn itself upright when turned over.

Signs of infection in frogs – visual

- shedding layers of skin from the feet and other areas
- limbs with a reddened appearance
- slight roughening of the surface with minute skin tags
- occasional small ulcers or haemorrhage

Signs of infection Tadpoles - the mouthparts of tadpoles can be viewed with a magnifying glass. Infected tadpoles have fewer and degraded pigment markings around the mouth.



Infection rates 2011

State/Territory	Species	Infected	Percent
ACT	18	1	5.6%
NSW	85	20	23.5%
NT	48	0	0.0%
Qld	125	21	16.8%
SA	27	4	14.8%
Tas	11	2	18.2%
Vic	33	3	9.1%
WA	77	12	15.6%
Total species	219	49	22.4%

If a frog or tadpole is suspected of being infected there a number of properly validated scientific diagnostic assays which can be carried out but these should be done by a quality assured program under OIE and Australian veterinary Science protocols.

Types of assays

- Histochemical techniques, Conventional IPX (*Bd*) or IPX + keratin stain (*Bd*)
- Electron microscopy
- Molecular diagnostics (and sampling) protocols
- Real time imaging/disease consultation
- TaqMan is the assay of choice

Sampling can be carried out using a clean swab from the frog or sitting the frog in a bath of water which can be filtered and sent for analysis. The costs of analysing samples are $40 but becomes cheaper with more samples. Contact Alex for details

More information on sampling from Amphibian Disease Home Page:

Alex said this project was supported by funding from Integrated Research Challenges in Environmental Biology (IRCEB) Grant IBN-9977063 from the National Science Foundation, USA. He acknowledged those people who provided valuable input to the success of the project.

Contact Alex Hyatt, Australian Biosecurity Microscopy Group, CSIRO, Australian Animal Health Laboratory (AAHL), Geelong, Victoria, Australia

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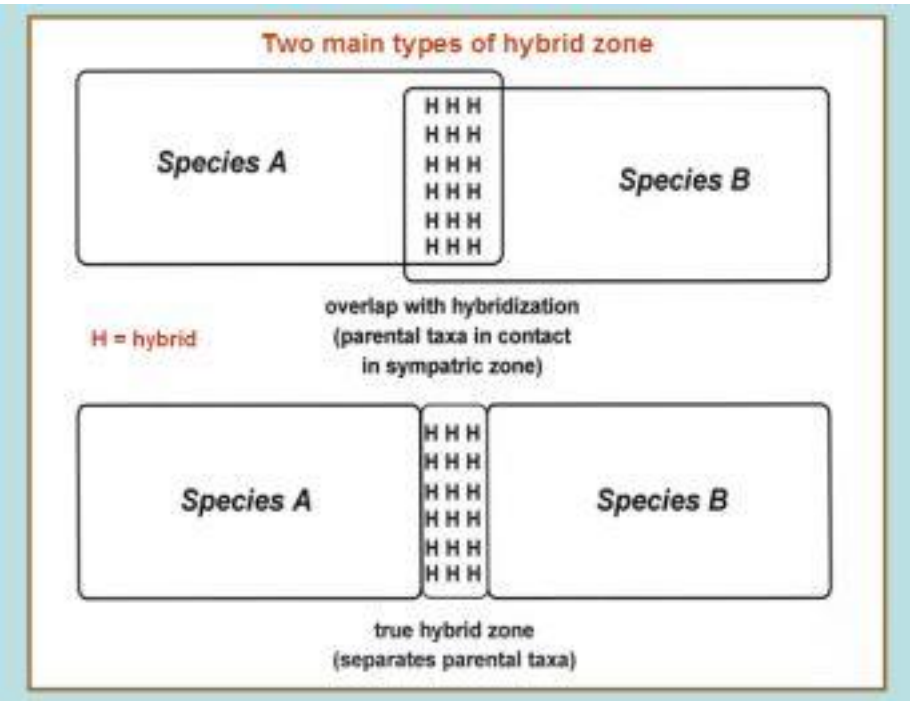
Hybrid Zones in Frogs: Evolutionary Biology and Significance for Conservation - *Murray Littlejohn, Department of Zoology, University of Melbourne*

Murray introduced his talk by defining natural hybridisation as the interbreeding of individuals from two populations (parental: P1, P2) which are distinguishable on the basis of one or more genetically determined characters.

He said Hybrid zones are a linear spatial interaction marking the interbreeding between individuals from genetically divergent populations that results in progeny recognisably different from both parents (= hybrids)

Types of Hybrid Zones

1. A hybrid zone where there is an overlap of two parental species or taxa with hybrids produced in the zone of overlap. The parental taxa are able to interact and are in contact and sympatry
2. A hybrid zone where the two parental species don't overlap and there is a belt of hybrids which separate them so they don't interact directly.



Categories of hybrid zone

Transient Hybrid zones - they can lead to the extinction of one of the interacting taxa or the two interacting taxa can become one. Or natural selection can favour the development of reproductive isolation so hybrids are no longer produced and each species mate within those species.

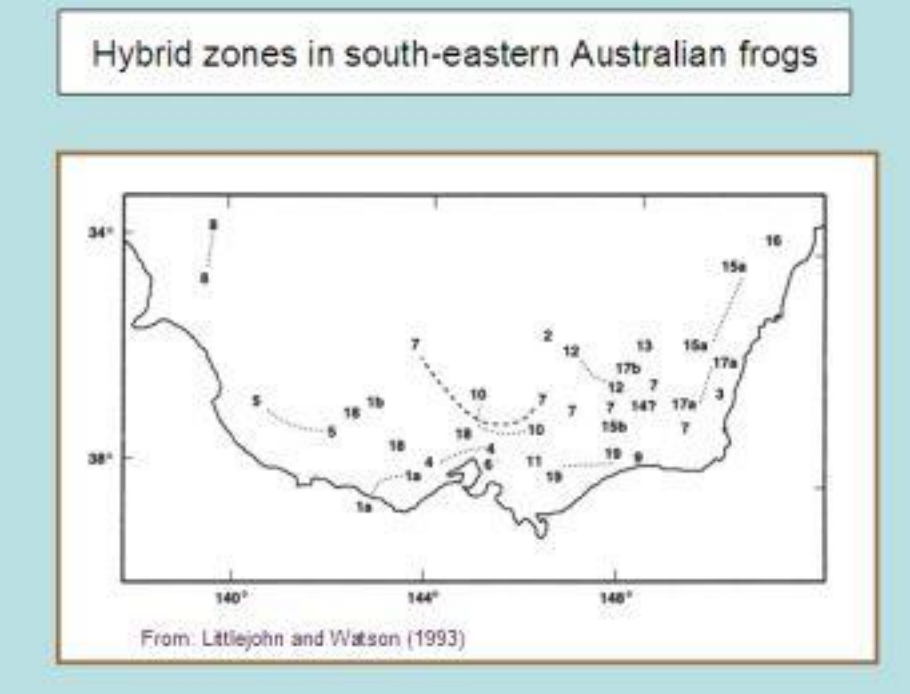
Hybrid inferiority – this refers to situations where there is continuous interaction between the parental species and the hybrids are so poorly adapted that they are eliminated before they reach maturity.

Hybrid superiority – where the hybrids do better than either of the parental species within a hybrid habitat.

For more information see; Hybrid zones in Australian frogs; their significance for conservation. M.J Littlejohn & G.F Watson. In; Herpetology in Australia: A diverse discipline. (eds) D. Lunney & D. Ayers (1993), Royal Zoological Society, New South Wales, Mosman; pp. 239-249.

Hybrid zones in Victoria

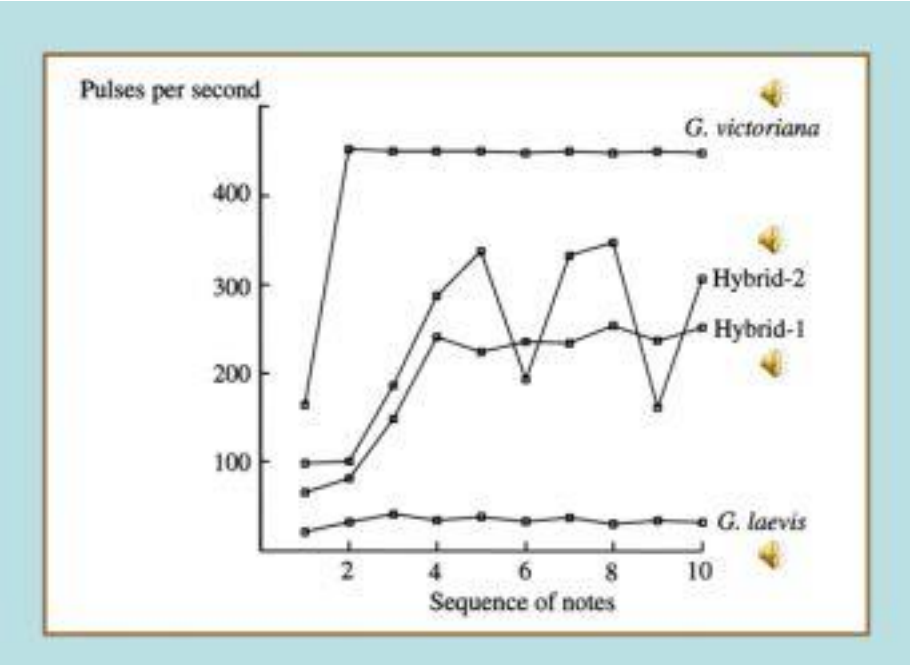
Murray showed a map of south-eastern Australia in which he identified 19 hybrid zones; these provide an important natural laboratory for wide ranging research into evolutionary processes.



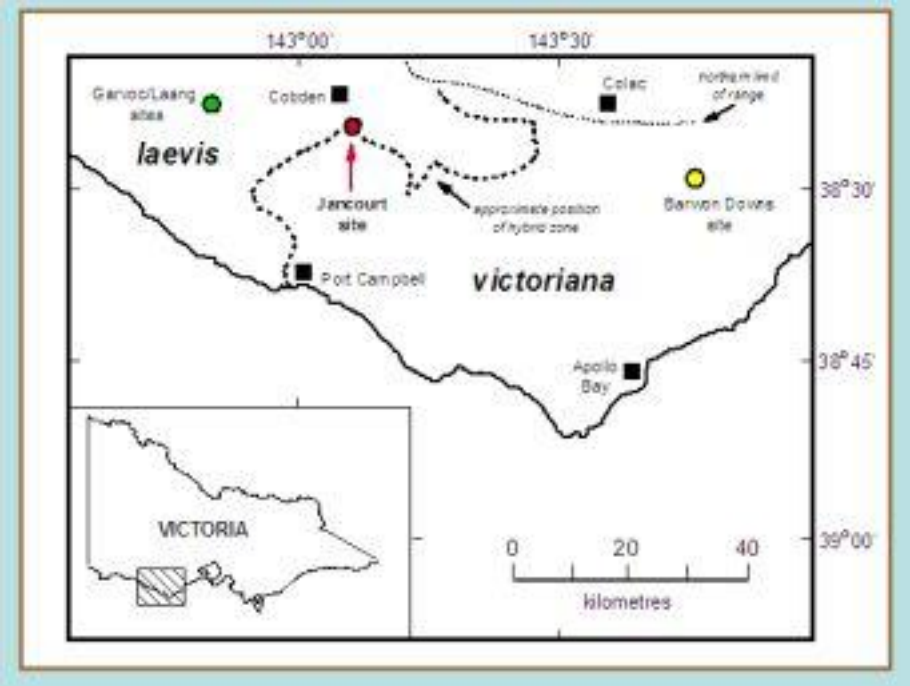
As an example, he spoke about the Smooth Frogs *Geocrinia laevis* and *Geocrinia victoriana* which are morphologically very similar with similar breeding seasons and life cycles. One of the main field identification methods is to compare the distinctive advertisement calls of the two species comprising an introductory note and a repeated note. Murray showed slides of audio spectrograms and oscillograms which depict the wave form and pulse rate of the frog calls which can be used as a diagnostic means of identifying the two species from each other and the presence of any hybrids.

As an example of how audio spectrograms and oscillograms can be analysed he showed a graph of the sequence of notes and the pulse rate for the two species of *Geocrinia* and also

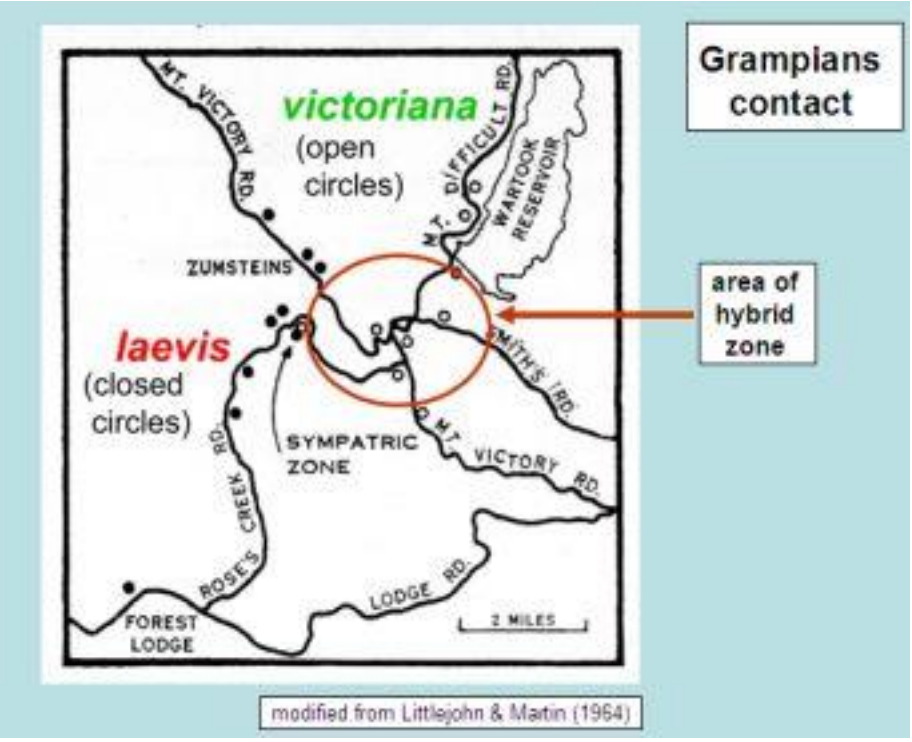
two hybrids. He also played sample calls from the four types of calls which demonstrated a different pulse rate and sequence of notes for the two parental species and the two types of hybrids.



With years of field work Murray and his co-researchers have been able to map the distribution of the two species of Geocrinia across south eastern Australia and Tasmania and identify two areas of contact between the species. One major area of contact is in south west Victoria and another area of lesser contact in the northern Grampians has been identified together with the presence of hybrids. Through years of study these hybrid zones have been mapped and in the area near Jancourt (south of Cobden) changes to the hybrid type has been studied along with changes to vegetation and habitat characteristics.



Hybrid zone near Jancourt



Hybrid zone - Grampians

Sites of special scientific interest

Murray spoke about the potential for recognising the evolutionary and scientific value of hybrid zones. He discussed the need to consider hybrid zones and problems associated in recognising hybrid zones for conservation purposes. This would include identifying and mapping hybrid zones and studying evolutionary changes. Murray referred to two documents which recognise the need to consider sites of evolutionary significance.

Standard Criteria for sites of biological significance, Victoria (DSE 2004)].

Sites of Special Interest document prepared by the Nature Conservancy Council (1991), United Kingdom, Joint Nature Conservation Committee.

Also

Natural Heritage Listing criteria

Key Points from questions

- There is now an opportunity to incorporate the use of GIS technology to improve mapping and overlay of data to look for correlations in hybrid zones.
- Construction of temporary refuges on some of the saline lakes may not necessarily be beneficial to some species of frogs as they have adapted to ephemeral water levels and where permanent water exists there is a possibility of fish being present that will predate on the frogs. (The answer may be a combination of ephemeral and separated permanent water bodies).

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See: swifft.net.au for more videoconference notes.