Workshop Report: a conservation breeding programme for plains-wanderers

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Cover photo © David Parker, Senior Threatened Species Officer, Office of Environment and Heritage (NSW). Male plains-wanderer (*Pedionomus torquatus*) with chicks in grassland habitat.

A contribution of the IUCN SSC Conservation Breeding Specialist Group

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Content

Summary

The plains-wanderer has recently been up-listed to Critically Endangered on the Australian list of threatened species. Since 2001, overall declines of 93-95% have been recorded at key sites in New South Wales and Victoria. There are estimated to be 250-1000 birds remaining in the wild, a record low for the species.

Ongoing loss of good habitat to agriculture and grazing regimes that do not promote optimal plains-wanderer habitat are considered the principle causes of the long-term decline. There remains uncertainty about the nature and role of other factors in the recent losses.

A national Recovery Plan is currently being developed for the plains-wanderer. The objectives of the Recovery Plan are to (1) reverse the long-term population trend of decline and increase the numbers of plains-wanderers to a level where there is a viable, wild breeding population, even in poor breeding years; and (2) maintain key plains-wanderer habitat in a condition that maximises survival and reproductive success, and provides refugia during periods of extreme environmental fluctuation.

The draft Recovery Plan identifies the need to investigate a captive breeding programme as a high priority action.

Agreed priority goals for 2015-2016

Goal 1: Gain approvals and collect 12 birds (adults and juveniles) from the wild for captive husbandry research & development.

Goal 2: Take the plains-wanderer conservation project through the formal NSW Government process to gain approval, priority status and funding support.

Goal 3. Clarify and pursue options through Government for prioritising and resourcing Plains Wanderer actions in Victoria.

Goal 4. Canvas interest and secure support from potential program partners.

Goal 5. Establish MOUs and other relevant and required agreements between governments and participating institutions.

Goal 6. Complete a captive management plan and husbandry manual to support agreed program goals.

Goal 7. Review the outcomes of 2 and 3 and, if favourable, pursue next steps in construction, founder collection, and release site preparation.

On August 11, 2015, 17 people from 9 organisations met in Canberra for 3 days to discuss the proposition of establishing a captive population to support plains-wanderer recovery efforts. The workshop, which was organised by the Office of Environment and Heritage, NSW, was hosted by the Department of Environment in Canberra and facilitated by the IUCN SSC Conservation Breeding Specialist Group.

Using the *IUCN SSC Guidelines on the Use of* Ex situ *Management in Conservation* as a framework for discussion, participants agreed that a captive population of plains-wanderers could support species recovery by:

1) Providing 15-20 years of respite from the species' currently high risk of extinction, buying time for understanding and implementing appropriate site management.
2) Generating birds for release:
    - to develop appropriate releases methods for the species that result in high establishment success;

- to test alternative site management approaches and confirm appropriate regimes for plains-wanderers;
- to boost wild numbers, reducing small population risks and kick-starting recovery.

In terms of conservation impact, these applications were considered by participants to be:

a) of critical importance to the immediate security of the species and
b) likely to increase significantly the chances of successful recovery following implementation of *in situ* management actions.

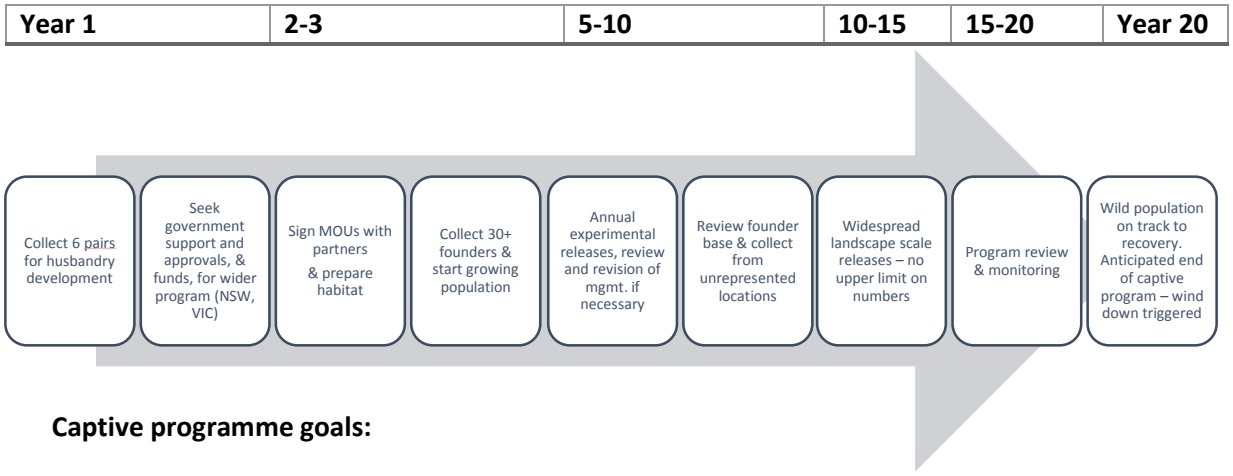
The estimated cost of the entire project (wild and captive components) over a 20-year period was 20 million dollars, half of which was identified for the captive component.

Participants agreed that urgent steps should be taken to prepare the ground for a carefully targeted and time-limited conservation breeding programme, able to be implemented immediately should funding be secured for the wider recovery programme.

Outputs from the workshop included a draft 20-year time-line for recovery-integrated deployment of a captive programme; draft captive programme goals and husbandry protocols; draft field research priorities and success indicators for the species' strongholds in New South Wales and Victoria; and priority goals, actions and responsibilities for the next 12 months.

A husbandry sub-group was established to help coordinate, document and communicate developments in this area as they occur. A funding sub-group was established to progress discussions of potential funding sources and to ensure a coordinated approach to those sources. These groups will communicate with the wider programme through Matt Cameron (OEH), the project coordinator.

Figure 1. Projected time-line for integration of the captive programme with the wider recovery effort.



Captive programme goals:

- Begin with at least 30 effective founders and supplement 1-2 founders per generation (4-5 years).
- Establish 3-4 "population centres" able to house at least 20 birds each, plus several supporting "satellite" facilities.
- Grow the captive population rapidly, to at least 100 birds.
- Generate 30-90 birds annually for release, more where possible.
- Maintain at least 90% wild source gene diversity in the captive population, minimise average inbreeding coefficient and maximise genotype diversity of release birds.
- Standardise disease risk management.

List of recommended actions

Progress with the following draft action plan will be reported quarterly to the wider group by the project coordinator, Matt Cameron. See page 28, *Action Plan for 2015-2016,* for further details about timelines and responsibilities.

Goal 1	*Collect 6.6 birds (3.3 adults; 3.3 young) from the wild for husbandry research & development.*
Action 1	NSW. Develop ethics and licensing approvals plus any other relevant approvals and protocols with respect to: wild collection (e.g. required sex ratio/disease risk management) and to transporting birds interstate.
Action 2	Victoria. Zoos Vic and Parks Vic to develop a Translocation Plan permitting collection from the wild and future releases of captive-bred young. Establish wild collection requirements and approvals for capture and for transporting birds interstate.
Action 3	Develop capture, transport and captive disease risk management protocols. Prepare aviaries and put in place requirements for initial care and husbandry at both Taronga Zoo and Featherdale Wildlife Park.
Action 4	Establish a Husbandry Group to ensure coordination and communication of husbandry-related activities.
Action 5	Collect 12 birds (adults and juveniles) from the wild.
GOAL 2.	*Take the plains-wanderer conservation project through the formal NSW Government process to gain approval, priority status and funding support.*
Action 5	As required.
GOAL 3.	*Clarify and pursue options through Government for prioritising and resourcing Plains Wanderer conservation actions in Victoria.*
Action 6	Establish relevant contacts and take action as required.
GOAL 4.	*Canvas interest and secure support from potential programme partners.*
Action 7	Develop potential funding model.
Action 8	Draft text on the plains-wanderer situation and proposed plan of action to ensure appropriate framing of any approaches to potential partners (need to make sure people know what is being asked of them and understand that things will only happen if the project gets the necessary support).
Action 9	Use text described above in any approach by ZAA to its members.
Action 10	Discuss plains-wanderer situation & plan with institutions potentially able to provide climatically suitable facilities or other resources. Gauge potential for participation and report back to the Coordinator.
GOAL 5.	*Establish MOUs and other relevant and required agreements between governments and participating institutions.*
Action 15	Develop appropriate government/zoo MOU using previous examples as a starting point (ZAA has some examples).
Action 16	Develop other MOUs/agreements as needed.
GOAL 6.	*Draft a captive management plan and husbandry guidelines to support agreed program goals.*
Action 17	Develop initial draft of husbandry guidelines.
Action 18	Develop draft captive management plan in ZAA-compliant format and in line with agreed programme goals.
GOAL 7.	*Review the outcomes of 2 and 3 and, if favourable, pursue next steps towards facility construction and founder collection, and next steps in preparing wild sites to receive birds.*
Action 19	Review and communicate outcomes and agree next steps.

Introduction

The plains-wanderer has recently been up-listed to Critically Endangered on the Australian list of threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Since 2001, overall declines of 93-95% have been recorded at key sites in New South Wales and Victoria. There are estimated to be 250-1000 birds remaining in the wild, a record low for the species.

Ongoing loss of good habitat to agriculture and grazing regimes that do not promote optimal plains-wanderer habitat are considered the principle causes of the long-term decline. There remains uncertainty about the nature and role of other factors in the recent losses.

The overall goals of the recovery plan are to: 1) reverse the long-term population trend of decline and increase the numbers of plains-wanderers to a level where there is a viable, wild breeding population, even in poor breeding years; and 2) maintain key plains-wanderer habitat in a condition that maximises survival and reproductive success, and provides refugia during periods of extreme environmental fluctuation.

On 11 August 2015, 17 people from 9 organisations met in Canberra for 3 days to discuss the proposition of establishing a captive population to support plains-wanderer recovery efforts. The workshop, which was organised by the Office of Environment and Heritage, NSW (OEH), was hosted by the Department of Environment in Canberra and facilitated by the IUCN SSC Conservation Breeding Specialist Group (CBSG).

The aims of the workshop were to agree on:

- The recovery goals of the proposed captive population.
- The "size and shape" of a captive population that would be capable of achieving these goals
- The risks and challenges to setting up and managing a population with these characteristics.
- The infrastructure, husbandry and programme management protocols, and commitment from potential partners needed to manage these risks and meet these challenges.
- The likely costs involved in establishing and managing such a project.
- The next steps in the project.
- A set of ideas about further research needed to improve understanding of the factors that contributed to recent declines of the species in the wild.

Workshop process

Matt Cameron of the Office of Environment and Heritage welcomed participants to the workshop and Ashley Leedman gave an Acknowledgement of Country. Participants introduced themselves, their affiliation and their involvement with plains-wanderers.

Scene-setting presentations

Scene-setting presentations were given to bring participants to a shared understanding of the plains-wanderer situation, and to the proposed approach to its recovery.

Caroline Lees: CBSG One Plan Approach and the IUCN SSC Guidelines on the Use of *Ex Situ* Management in Conservation

David Parker and David Baker-Gabb: Plains-wanderer Status Review – species biology, review of past and present distribution, details of recent decline, conservation action and recovery planning to date.

Ashley Leedman: Recovery Plan and National Status update – update on progress of the draft recovery plan and outcomes of the re-assessment of the species' listing status.

Paul Andrew: Captive breeding - history and potential. Past attempts at captive management of this and similar species, identified challenges and constraints.

Plains-wanderer recovery needs and potential roles for a captive programme

Using the draft recovery plan and the experts in the room, participants listed the known and hypothesised threats to plains-wanderer populations. Against each threat they listed actions recommended to restore, conserve or increase the resilience of plains-wanderers in the face of that threat. This analysis included describing research needed to further understand the nature of the threats to the species and its likely response to recommended interventions. Following this, participants discussed the ways in which captive breeding could support the proposed activities. The results of this discussion are summarised in Table 1. Priority applications of the proposed captive programme were agreed to be:

- Insurance: preventing extinction and "buying time" (15-20 years) for the species while best practice *in situ* management is tested, agreed and implemented.
- Immediate generation of a harvest for release:
    - to provide birds on the ground for testing site treatments towards a better understanding of best practice site management/restoration;
    - to increase the resilience and recovery capacity of wild populations.
- As a lower priority, participants discussed the potential application of display birds at targeted locations to help engage particular audiences with the issues impacting plains-wanderer conservation.

Captive programme design and preliminary population models

The characteristics of and risks to small captive populations were presented and illustrated using preliminary population models. The models presented also provided some initial scoping of the dimensions of a programme required to meet the recovery goals identified. Further details are provided on Page 14.

Working groups

Two working groups were formed: one to consider how and when captive birds would be used in the recovery programme and the other to consider the husbandry and management of a captive programme able to meet those needs. Working groups were tasked as follows:

Working Group 1: Using Captive Birds in Recovery

Specifically: what do we need from the captive programme? Where do we need to have birds? When? Why? What kinds of birds (age, sex, experience)? What outcomes do we expect to get from this application and how will this be measured? What are the triggers for winding down the captive programme? What are the preferred options for wind-down?

Challenges:

Assume that a thriving captive population exists and is available to you. Discuss and agree what you would do with it and why; record your discussions. Then:

- DRAFT a time-line for the use of the captive population in recovery, with accompanying detail.
- Document the other on-ground actions that would need to be taken to support this application and add these to the time-line.

Working Group 2: Husbandry, Health, Facility and Programme Design.

Specifically: what do we need to build, how would we manage health and nutrition, how would we cater for the seasonal and throughout-life needs of the birds, how would we establish reliable, consistent breeding at the rates required, how should we optimise genetic and demographic health and how would we manage zero or negative growth, should this be required in future?

Challenges:

With the expertise in the room and the available supporting materials:

- DRAFT a husbandry manual (sample template provided).
- Include a calendar of husbandry/management activities.
- Outline population-level genetic and demographic management needs.
- Cost the delivery of a captive programme ($$ range per unit per annum).

Each working group spent the rest of the afternoon of DAY 1 developing a work-plan for completing the identified tasks. DAY 2 was spent working on the assigned tasks with scheduled sessions for the groups to report to each other on progress.

Final session (DAY 3)

On DAY 3 the products from the two working groups were summarised. Participants discussed the outcomes and agreed a series of goals and actions aimed at moving the project along over the coming months. Gaining funding support from the NSW Office of Environment and Heritage is key to progressing the work agreed and this is the immediate focus.

To generate a report from the workshop the following editorial team was agreed:

- Matt Cameron (OEH)
- Caroline Lees (CBSG)
- Graeme Phipps (Independent)
- Phil Ainsley (Zoos South Australia)
- Ashley Leedman (Commonwealth Dept. Environment)

Paul Andrew, Taronga Zoo and David Parker, OEH, were assigned responsibility for leading the development of a ZAA-compliant Captive Management Plan for the programme, and with convening a husbandry group for the purpose of maintaining contact with participants around the development and implementation of captive management protocols.

A funding group to explore and coordinate funding approaches was established (Matt Cameron, Glen Holland, Ashley Leedman).

Quarterly progress reports are to be circulated by the overall coordinator of the project, Matt Cameron, Office of Environment and Heritage.

Finally, Matt Cameron thanked participants for their work and closed the meeting.

IUCN SSC Guidelines on the Use of *Ex situ* Management for Conservation

Caroline Lees, IUCN SSC CBSG

Ex situ management has been used in many situations to deliver conservation benefit for threatened species. However, *ex situ* management can be a difficult and expensive intervention. Its inclusion in recovery programmes should be carefully evaluated and planned as part of an integrated conservation strategy.

The recent revision of the IUCN SSC's *Guidelines on the Use of* Ex situ *Management for Conservation* identifies the following steps as critical to ensuring optimal integration of *ex situ* programmes into species recovery:

1. Identify and agree the species' recovery needs.
2. Identify and agree the ways in which *ex situ* management could provide benefits.
3. Determine and agree the characteristics and dimensions of a programme able to provide those benefits.
4. Agree whether it is a) achievable and b) affordable.
5. Evaluate and agree whether it is the best of the options available.
6. If it is, agree how and when it will be delivered and by whom.

These steps essentially separate the question of whether *ex situ* management will be of value to a project into two threads: one which considers the potential impact on species conservation of *ex situ* management intervention and another which considers the likelihood of delivering that impact given the biological, practical and resource constraints involved (see Figure 3.)

This approach provided the framework for the plains-wanderer workshop:

1) Working Group 1 addressed the question of conservation impact.
2) Working Group 2 addressed the question of feasibility.
3) The combined groups weighed the results against the alternatives and agreed next steps.

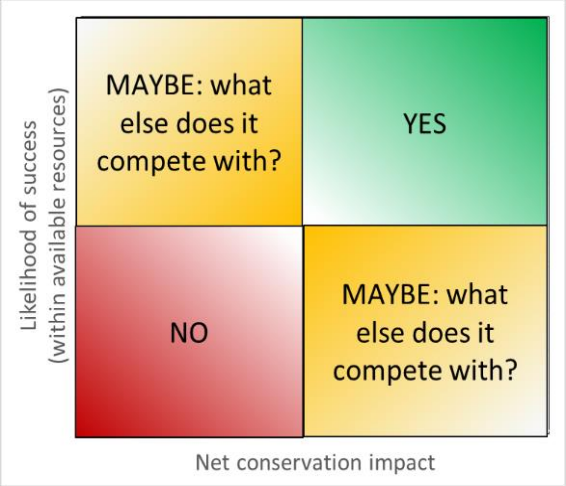


Figure 3. Illustration of how the *ex situ* guidelines can help groups agree on whether *ex situ* management will be a valuable conservation intervention.

Potential Role for *Ex situ* Management in Plains-wanderer Recovery

At the time of the workshop the plains-wanderer Recovery Plan was in draft form. Using the information in the draft document and the expertise and perspectives in the room, participants listed relevant threats, proposed strategies for mitigating those threats, and identified routes through which *ex situ* management could support mitigation measures. The results of these discussions are summarised in Table 1.

Table 1: Threats, threat-directed actions and proposed supporting roles for a captive programme.

Threats	Proposed actions and strategies	Role for a captive program	Notes.
Lack of community awareness of species needs	Communication and awareness raising of issues and required action for key audiences.	Displaying birds as ambassadors for a threatened community. Locate exhibits in key areas to maximise impact on key audiences.	Need to scope this in detail. Key audiences may not visit zoos or be influenced by exhibits. Lower priority focus for *ex situ* work.
Climate change	Identify and target more climate-resilient areas for reintroduction and assisted colonisation (e.g. wetter parts of the current distribution)	Generate a harvest for release to targeted sites.	Short-term strategy for use until wild population can reliably generate sufficient numbers.
Inappropriate grazing management (in both wet and dry seasons and including impact of rabbits)	Facilitate grazing management and monitor impact. Also, research food availability issues related to grazing, season and fire.	Secure a well-managed, resilient captive population to buy time for the species (15-20 years) while *in situ* management measures are trialled, validated and widely implemented. In the short-term, use birds released from captivity to test various *in situ* treatments.	Research required to establish evidence of best practice.
Inappropriate burning regimes (Victoria)	Training to ensure implementation of appropriate regimes (Victoria)		Prioritised as the two main functions of the proposed captive program for plains-wanderers.
Standing water in paddocks	Alter topography to redress problems caused by levees (Victoria)		
Feral predators	Develop, implement and monitor feral predator management.		
Quail hunting	Implement exclusion zones in key plains-wanderer habitat.		
Wild fire	Implement wild fire mitigation measures and rapid response to fire events.		
Prolonged drought	Implement good grazing management.		
Habitat loss	Implement incentive programs and land acquisition programs towards improved habitat and tree management.	Reward good grassland practice with plains-wanderer releases from captivity?	For later consideration.
Lack of knowledge of distribution (Qld & SA)	Research distribution and abundance.	None identified	
Small population related risks	Research meta-population dynamics of remaining wild populations.	Create a captive population of sufficient size to ensure resilience to small population issues. Use releases from captivity to build resilience in wild populations.	

The potential roles for *ex situ* intervention were prioritised as follows:

- Insurance: preventing extinction and "buying time" (15-20 years) for the species while best practice *in situ* management is established and implemented.
- Immediate generation of a harvest for release:
    - to provide birds on the ground for testing site treatments towards a better understanding of best practice site management/restoration
    - to increase the resilience and recovery capacity of wild populations.
- As a lower priority, participants discussed the potential application of display birds at targeted locations to help engage particular audiences with the issues around plains-wanderer conservation.

These findings were carried through to the working groups for development.

Captive Programme Design and Preliminary Population Models

Caroline Lees, IUCN SSC CBSG

Introduction

A population's extinction risk depends on both deterministic (e.g. natural selection, harvesting) and stochastic (e.g. environmental, demographic and genetic) processes (see Schaffer, 1987). The influence of the latter increases as population size declines, potentially accelerating extinction processes initiated by deterministic factors. Captive populations are almost always small and therefore at risk to stochastic events. In addition, in programmes spanning multiple generations, conservation value can be eroded by inadvertent genetic selection for the captive environment. These factors need to be assessed and accounted for in the design and execution of conservation breeding programmes. In preparation for the plains-wanderer workshop, preliminary population viability analysis (PVA) models were built in PMx (Ballou, *et al*, 2013) and in VORTEX (Lacy *et al*., 2009), to help participants think about these issues. The results described here were presented on Day 1 of the workshop and helped to inform the draft programme framework described in this report.

It should be noted that these models are based on only a small amount of plains-wanderer-specific data, supplemented by expert opinion and data from potentially appropriate analogue species. As more information on the captive performance of plains-wanderers becomes available these models should be revised and estimates and projections reviewed in accordance with standard programme management practice.

Conservation breeding programmes

The following text provides a brief summary of the information, analyses and thinking that informed the basic captive program framework agreed by workshop participants. For further information on the ideas presented here and on the design and management of conservation breeding programmes in general, see Ballou *et al*., 2010.

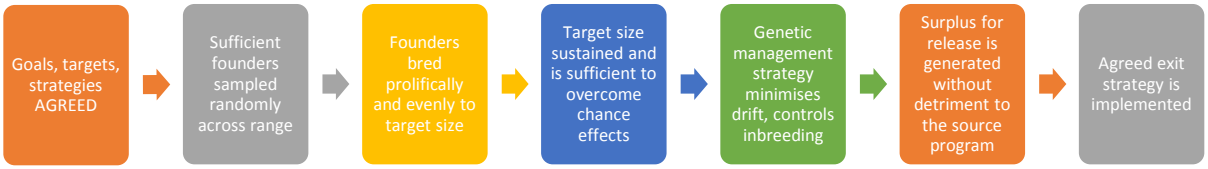


Figure 4. Steps and activities involved in a typical breed-for-release programme.

Conservation breeding programmes are designed and managed to meet the needs of a specific recovery or conservation programme. The steps and activities involved in a typical breed-for-release programme (such as that proposed here for plains-wanderers) are summarised in Figure 4. Each of these steps is associated with one or more planning tools and with specific targets against which success can be evaluated.

Agreeing a purpose, goals and targets for a programme often involves trade-offs between competing needs. Measures that will help increase the health and productivity of the captive population may have a detrimental impact on remaining wild stocks and decisions in this area require careful consideration. Population models can help by allowing decision-makers to explore the potential relative impact of a range of alternative strategies or actions on a population, based on a "best guess" of relevant population dynamics.

Population models

Two sets of captive population models were built in advance of the workshop:

- A deterministic model (in PMx) which allows users to calculate the expected decline in gene diversity over time, given a set of user-defined starting parameters (starting population size and gene diversity; effective population size; generation time, maximum growth rate, maximum allowable population size (carrying capacity – K) and programme length). Results are shown in Table 3.
- A stochastic model (in VORTEX) which simulates the same dynamics considered in the PMx model but which in addition allows the incorporation of risks related to environmental, demographic and genetic uncertainty in the population. This allows the user to simulate a "best guess" of both the most likely average performance of a population under a particular management scenario but also the uncertainty around this result. Note that the model developed was optimistic in assuming no catastrophes and no environmental variation (that is, it assumed that management would ensure no year-to-year variation in underlying birth and death rates). It was pessimistic in assuming only one breeding attempt each year for females. The resulting baseline model carried an extinction risk over the 25 year period considered of zero (1000 iterations), a deterministic growth rate of r=0.425 and a stochastic one of r=0.357. Generation time was approximately 4 years.

Few data are available on the biology and population dynamics of plains-wanderers. The input parameters for these models were drawn from a small number of references provided by workshop participants. In the absence of species-specific information on age-specific mortality, data from a captive population of black-and-white stilts were used as a potentially reasonable, large sample alternative (Hibbard, pers. comm.). These data were reviewed, supplemented and corrected by other workshop participants but in particular David Baker-Gabb. Though these models are very rough, they represented a reasonable "best guess" among experts at the start of the workshop and were used to help participants begin to gain a sense of the likely scale of captive operation required to achieve the desired recovery outcomes.

Programme dimensions and key questions

The following areas were considered.

- How many founders?
- How big a population?
- How many "engines"?
- How long until capacity is reached?
- How much harvest can be expected?

How many founders?

25-50 founders sampled from across the species range is generally considered to provide a sufficient sample of allelic diversity (see Ballou *et al*. 2010). Founders do not need to be taken all at once – they can be added to the population later but there are costs and benefits to be considered in terms of practical captive management, impact on the wild population (which may differ temporally) and costs to the project.

All models assume a founder base of 30 effective founders – that is, 30 relatively unrelated birds that contribute offspring. In the models no founders are added after the start of the programme.

How big a population?

Because of the probabilistic nature of genetic inheritance, retaining a sufficient amount of the genetic diversity captured in the founding event over the length of the programme requires that each founder produces multiple offspring – each additional offspring increases the chance of capturing a full complement of that founder's unique traits. Once the population has grown into all of the space available, further crashes or "bottlenecks" need to be avoided as during these events further gene diversity is lost. Even with these measure in place, chance dictates that rarer alleles will be lost occasionally (drift) – the frequency of loss increasing as (effective) population size decreases. PMx models were used to explore the ability of populations of 50, 75 and 100 birds, to retain 90% of wild source gene diversity, for a period of 25 years. The results are shown in Table 3. As illustrated, only extending carrying capacity to 100 or extending generation length to 8 years succeeded in maintaining gene diversity above the 90% threshold for the 25 year period. The latter was considered too high risk by workshop participants. Adding founders during the programme was not considered but would be expected to be highly successful in sustaining elevated levels of gene diversity. Results from the equivalent VORTEX models are consistent with these results (see Table 2.)

Table 2. VORTEX model projections of gene diversity after 25 years, starting with 30 founders and for carrying capacities of 50, 75 and 100.

Founders=30; K varied; No catastrophes	Gene diversity @ 25 years (1000 model iterations)
K=50	**86%**
K=75	**88%**
K=100	**91%**

How many “engines”?

Experience has shown that in general, captive facilities managing larger numbers of programme birds enjoy greater overall success than those managing just a small number. There are four likely contributors to this observed effect:

1) Biology: for some species the presence of larger numbers and/or the greater choice of potential mates or allies can lead to better breeding performance.

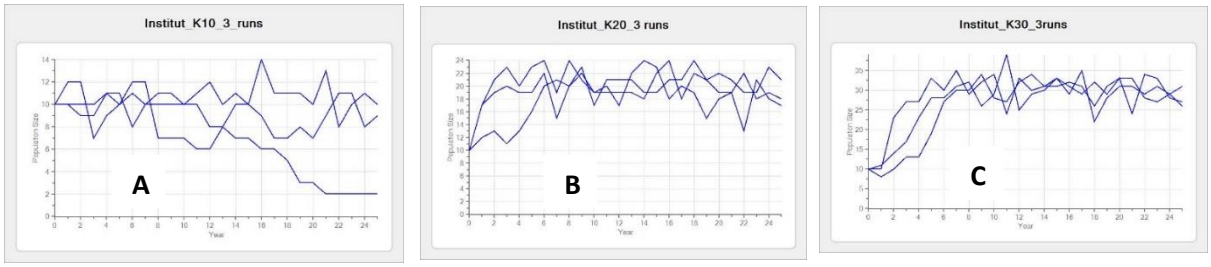
2) Husbandry: holding more birds accelerates and sustains learning and experience. Also in some cases allows economies of scale to justify facility enhancements.

3) Demographic stochasticity: chance dictates that smaller groups are more prone to extremes: extreme birth or death rates; sex-ratio skews; high impact catastrophes. As a result they are more prone to population crashes (or explosions) and will have a greater need for regular transfers in and out.

4) Transfer inertia: to recover from crashes or booms, to avoid inbreeding and to maintain required operational sex-ratios, institutions with smaller holdings will need to move or exchange birds with other institutions more frequently. This involves planning, permits, paperwork, logistics and settling and introducing birds. These all provide opportunities for error, delay and accident.

It makes sense to design a programme from the outset to be underpinned by a number of larger facilities – “engines”, to provide a level of stability and reliable production. VORTEX models were used to explore the relationship between institutional carrying capacity and demographic “stability”. Note that these models explore only the demographic stochasticity aspect of stability and so are likely to underestimate total effects. Institutional carrying capacities of 10, 20 and 30 were considered. The results for 3 runs of each model are shown in Figure 5. As can be seen, holdings of only 10 birds perform less predictably and show steeper declines than those for 20 or 30. Inbreeding is a significant influence and can be managed by inter-institutional exchanges but for reasons outlined above this does not represent a complete solution. Housing a significant proportion of the proposed population in facilities accommodating at least 20 birds and as a precaution closer to 30 (to allow for the effects not reflected here) would be expected to increase overall programme stability.

Figure 5. VORTEX modelled illustration of the relationship between institutional capacity and demographic stability of the breeding unit. Each graph represents a different carrying capacity (A:K=10, B:K=20 and C:K=30). Each line represents a potential trajectory for that breeding unit given its carrying capacity. All other population characteristics are the same.



How long until capacity is reached?

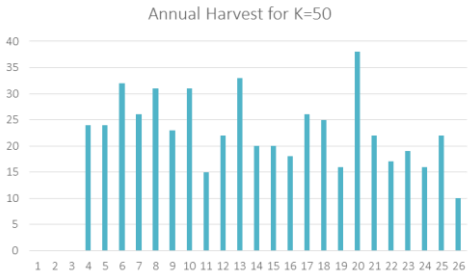
This will depend on how much capacity is provided, how many founders are brought in, and on the population growth rate achieved. Assuming 30 founders and an average annual growth rate of r=0.35, time to capacity could be as short as 2, 3 and 4 years, for capacities of 50, 75 and 100 respectively, though the uncertainty in the system could extend this and harvesting models suggested average times of around 5, 6 and 7 years respectively.

Note however that model estimates of reproductive success in captivity are deliberately precautionary due to the many unknown quantities in this project. Under the right husbandry regimes (which might include double-clutching and hand-raising) the biology of the bird would allow for greater productivity and shorter times to capacity.

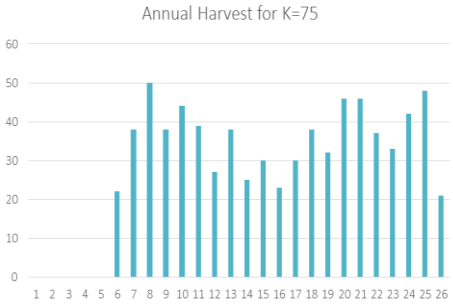
How much harvest can be expected?

The volatile biology of the bird in combination with chance factors would predict that even under consistent husbandry and management, the number of birds available for harvest each year (defined in the models as the number of birds over and above programme carrying capacity at the end of each year) will vary. It can be helpful to get a general sense of this variability both to manage expectations and to help in release programme design. Some preliminary illustrations of likely variability are shown below.

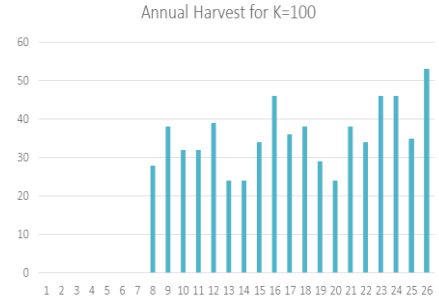
Figures 6. The number of birds available for harvest in each year of the programme, for one model iteration, and for carrying capacities of 50, 75 and 100.



a) K=50: mean harvest > yr 3 = 23 birds; range of harvest = 10 – 38 birds



b) K=75: mean harvest > yr 3 = 32 birds; range of harvest = 20 – 50 birds



c) K=100: mean harvest > yr 3 = 29 birds; range of harvest = 23 – 52 birds

Table 3: Summary of PMx analysis results.

Parameter	Baseline	Tests	% Gene Diversity at 25 yrs	90% retained for?
Generation Length	4.5	4.5	85.3	14yrs
		6	88.4	20yrs
		8	**90.8**	28yrs
Maximum Lambda	1.26	1.26	85.3	14yrs
		1.5	85.8	15yrs
		1.75	85.9	15yrs
Current N	30	20	82.7	8yrs
		30	85.3	14yrs
		40	86.5	17yrs
Ne/N	0.3	0.2	79.3	8yrs
		0.3	85.3	14yrs
		0.4	88.4	20yrs
Current gene diversity	0.983	0.975	82.7	8yrs
		0.983	85.3	14yrs
		0.988	86.5	17yrs
Maximum allowable N	75	50	84.9	14yrs
		75	85.3	14yrs
		100	**90.1**	26yrs

Table 7. Summary of baseline VORTEX parameters

Vortex Parameter	Captive population estimate	Explanatory notes
# of populations	1	-
Inbreeding depression included?	YES - LEs 3.14	Default value based on a study of 40 captive populations (Ralls et al., 1988)
Concordance of environmental variation (EV) and reproduction	NO	Assumes good years for reproduction are not coupled to good years for survival.
EV correlation among populations	N/A	-
Breeding system	Polyandrous (modelled as short-term monogamous as precautionary values assume only 1 clutch per year)	-
Age of first reproduction (♂ / ♀)	1 (both sexes)	Based on field and captive observation (Baker-Gabb pers. comm.)
Maximum age of reproduction	15	Estimate for wild birds was 12 and under the favourable conditions provided captive birds may be expected to breed for longer. However, note that with the mortality schedule used few birds will reach this age.
Annual % adult females breeding	(((40+(10*(Y>2)))+(10*(Y>4)))+(10*(Y>6)))	Conservative estimate - assumes that young birds will breed less well (40% likelihood at age < 3years) than older ones (60% likelihood at age>6yrs).
Density dependent reproduction?	None	Not expected to occur.

Vortex Parameter	Captive population estimate	Explanatory notes
% males in breeding pool	100%	Females breed with at least one male each year.
Maximum number of broods per year	1	Conservative estimate; females can have 2-3 (Baker-Gabb, pers. comm.)
Litter size	1=5%; 2 = 10%; 3=50%; 4=10%; 5=5%.	Based on data and expert opinion (Baker-Gabb)
Offspring sex ratio	50/50	In absence of evidence to the contrary.
EV in breeding and mortality (measured as standard deviation around mean of binomial distribution from which values are sampled)	0% of mean value (mild EV)	Assumes standardisation of husbandry and management will remove year-to-year variation in average birth and death rates.
% annual mortality (♀)		Taken from Back-winged Stilt Studbook (Wilson, 2008)
0-1 years	40%	
1+ years	10%	
% annual mortality (♂)		
0-1 years	40%	
1+ years	10%	
Initial population size	30 (10 and 20 also tested)	Based on expected need for at least 30 effective founders.
Carrying capacity (K)	75 (50 and 100 also tested)	

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Notes from Working Group 1: Using Captive Birds in Recovery

Paul Andrew, Mark Antos, Joss Bentley, Matt Cameron, Dan Harley, David Hunter, Ashley Leedman, Damon Oliver, David Parker.

Specifically: what do we need from the captive programme? Where do we need to have birds? When? Why? What kinds of birds (age, sex, experience)? What outcomes do we expect to get from this application and how will this be measured? What are the triggers for winding down the captive programme? What are the preferred options for wind-down?

Challenges:

Assume that a thriving captive population exists and is available to you. Discuss and agree what you would do with it and why; record your discussions. Then:

- DRAFT a time-line for the use of the captive population in recovery, with accompanying detail.
- Document the other on-ground actions that would need to be taken to support this application and add these to the time-line.

Priority applications

Maintenance of good habitat structure over an area or areas of sufficient size was emphasised as key to plains-wanderer recovery and ongoing conservation. It is possible that the implementation of *in situ* management towards this end will on its own result in sufficient natural recovery. However, based on current knowledge of the wild population this outcome is highly uncertain. Establishing a captive population and using this to boost wild numbers in the short-term was considered by all to be a strategy that would increase the likelihood of success and reduce uncertainty, thereby increasing the value of any investment in site management.

Though participants agreed that much is known about what constitutes ideal habitat for plains-wanderers, this has not been experimentally tested and there remain areas of uncertainty, particularly in regards to establishing and maintaining suitable habitat for the species other than through grazing. Participants discussed this and prioritised targets for testing that would enhance the ability of managers to create optimal conditions *in situ*.

Importantly it was agreed that any release of captive birds to experimental plots should contribute both to improving knowledge and to increasing the resilience of the wild population. In line with this it was agreed that all releases should be to good quality habitat, to the extent that this is known.

The following research priorities were identified:

NSW Research

Research questions needing captive birds:

- threshold effect
- predation effect

Threshold effect (DRAFT)

The objective is to determine if the small size of populations is inhibiting recovery. This will be investigated by supplementing small populations and comparing their response (survival/rate of change in population) against small populations that have not been supplemented. Three replicates are recommended (i.e., six sites comprising three supplementation sites and three control sites). A site comprises around 600-ha of primary habitat in good condition containing a small number of birds (e.g., n=10). Approximately 30 birds would be added to each of the supplementation sites (total 90 birds).

Treatments	Supplementation	No Supplementation
Replicates	3 sites with 10 birds, 600-ha of primary habitat in good condition	3 sites with 10 birds, 600-ha of primary habitat in good condition
No. birds required	30 birds per site = 90 birds	0
Monitor	Survival & rate of population change	
Total birds needed = 90		

Predation and threshold

The above experiment could be modified to also investigate the effect of predation through the addition of fox control. The treatment s would then become (1) no supplementation and fox control, (2) supplementation and fox control, (3) supplementation and no fox control, and (4) no supplementation and no fox control. Three replicate are recommended, requiring 12 experimental sites. Six sites require supplementation with approximately 30 birds, requiring 180 birds in total.

Treatments	No supplementation with fox control	Supplementation and fox control	Supplementation and no fox control	No supplementation, no fox control
Replicates	3	3	3	3
	Total birds needed = 180			

Victoria Research

Considering only public land in the first instance there are two areas: Patho Plains with relatively stable conditions into which around 100 birds could be released, and Avoca, with variable conditions into which 200 birds could be released (300 release birds in total).

Potential treatments to be tested:

- Unoccupied/good quality
- Fire
- Good with grazing/slashing
- Good with very high quality patches

- Suggested releases would be of 2 males per female. Potential carrying capacity is expected to be 1 bird per 10 hectares but recommended release density is 1 per 20 hectares. Preferred release season is spring but anytime works. Foxes are not a focus in Victoria.
- Success indicators would relate to site fidelity, survival and reproduction. Re-release would be recommended if a site become empty after 12 months.

Surplus birds

- Participants agreed that there are enough areas into which birds could be released to accommodate any number of release birds, in any year of the programme. However, should the number of birds available for release greatly exceed the number needed for direct recovery actions, small numbers of birds might be made available for advocacy display or ex-situ research for pesticide trials.

Timeline for use of captive birds in recovery

Based on the needs identified, on the administrative requirements of the potential programme, and on feedback from the captive working group, the following time-line for application of captive bred birds in recovery was developed.

Timeline

Year 1-3:

- Seek government support and approvals. Collect a small number of wild birds to confirm husbandry protocols. Six pairs to be distributed between two institutions, noting that a pair is already in captivity but they may be too old for breeding (necessitating 12 birds from wild).
- Secure funding for longer-term project (*ex situ* and *in situ*).

Year 2-3:

- Collect additional birds to expand the founder population (from NSW and Victoria initially and later from SA and Qld)
- Review adequacy of founder population (ideally 30-50 birds).

Years 4-5

- Grow the captive population.

Years 1-5:

- Prepare and maintain suitable habitat conditions at release sites.

Years 5-10:

- Undertake experimental releases to develop release protocols and refine habitat management techniques.

Years 10-20:

- Widespread landscape scale releases (unlimited number of birds)

Year 15:

- Review programme.
- Landscape scale monitoring.

Year 20:

- Landscape scale monitoring.
- End of captive programme.

Though ideally the impact of removal of wild birds on source populations would be closely monitored this may not be possible with existing survey techniques due to the diffuse nature of the collecting that will occur.

Measuring post-release success

As an important precursor to considering the application of captive birds to the recovery programme the group considered what "success" would look like. The results are described below:

Assumptions:

- That birds are released only into suitable habitat that is below carrying capacity;
- Release sites comprise approximately 100 hectares of suitable habitat, not necessarily in a contiguous block but functionally linked;
- Need for comparative analysis of soft release versus hard release, measuring survival and dispersal;
- Soft release will perform at roughly 10% above hard release.

Hard release expectations (criteria for success):

- 30% survival after three months (measures to be taken on a sub-set of birds with GPS transmitters);
- 70% of surviving birds established a stable home range within three months (approximately 10 hectares).
- 70% of surviving birds remain in core release area after three months (within 10km of release site)
    - Pairing: within 12 months 50% of surviving birds paired (and pairing combinations include captive x captive; captive male x wild female; captive female x wild male);
    - 50% of paired birds successfully produced young;
    - Condition measure – recaptures fall within weight range of wild birds (but recapturing not a priority measure).

Notes from Working Group 2: Husbandry, Health, Facility and Programme Design

Carolyn Hogg (facilitator), Glenn Holland, Debbie Rudd (recorder), Graham Phipps, Nick Atchison, Richard Matkovics, David Baker-Gabb, Phil Ainsley (computer notes)

Specifically: what do we need to build, how would we manage health and nutrition, how would we cater for the seasonal and throughout-life needs of the birds, how would we establish reliable, consistent breeding at the rates required, how should we optimise genetic and demographic health and how would we manage zero or negative growth, should this be required in future?

Challenges:

With the expertise in the room and the available supporting materials:

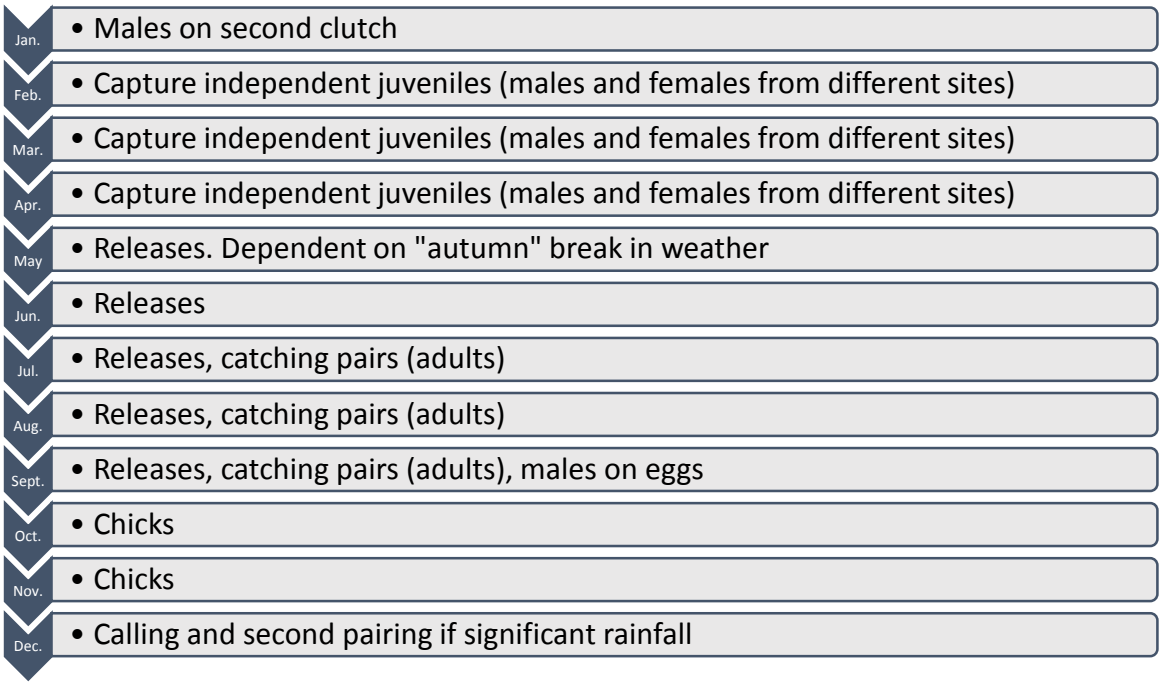
- DRAFT a husbandry manual (sample template provided)
- Include a calendar of husbandry/management activities (format suggested overleaf)
- Outline population-level genetic and demographic management needs
- Cost the delivery of a captive programme ($$ range per unit per annum)

Husbandry

Guidelines need to written which include the following as a minimum.

1) Aviary design (spatial distribution) and how many aviaries to start with
2) Capture and acclimatisation *ex situ*
3) Breeding management
4) Juvenile housing
5) Disease management
6) Dietary needs
7) Release (timing, requirements for pre-conditioning, soft release etc)
8) Costing

Calendar of husbandry and management activities



Potential role of private aviculture

Private aviculture has both space and expertise to contribute. It was agreed that in the first instance core breeding facilities would be either public zoos and/or purpose-built facilities. Potential use of private aviculturists as a second-wave of satellite facilities discussed but not resolved. Disease risk management was considered an issue and it was suggested that private facilities could hold birds that were part of the programme but not destined for release, if needed. This will require further discussion in the context of programme design and in consultation with permitting agencies.

Population-level management needs

Participants put together the following list of issues to be agreed or addressed either during the meeting or later, during programme development and delivery:

- Recommend two intakes of founders into facilities, first to test success of initial aviary design. Bring in smaller cohort of perhaps 10 (5 males & 5 females) initially and then do a second intake once facilities are established, husbandry protocols are refined and breeding/staffing/management is going well.
- Concern around fatigue (institutional) within programme. This could be addressed by ensuring the option of wild release to alleviate holding pressure from an early stage within the programme.
- Discussion around practicality of field sampling/collecting. Need to consider *in situ* situation at time of collection. Similarly need to account for approval stages (permits etc.).
- The initial sample of founders would need to be spread between at least two institutions to safeguard against a catastrophic event occurring at one holding site.
- Species appears to be easy to breed from an aviculturist perspective but problems may arise as a result of attempts to breed for a conservation/recovery perspective.

- Ideally founders would be collected from across the species' range. It may not be possible to get birds out of Queensland, however will be able to deliver birds into Queensland. Should be able to get birds out of South Australia.
- Capture and transport: it is essential that an experienced aviculturist is present to assist and provide advice at point of collection of wild birds.
- Full post-capture veterinary screening should follow all captures: parasitology, faecal, blood and feather.
- Material should also be collected for any future genetic analyses.
- The initial focus of the breeding programme would be on parent-raised birds, however the potential for hand-raising birds for release should be tested and evaluated because of the potential of this technique to dramatically increase productivity.
- Crèche juveniles for 10 months in groups, but with the option retained to remove females if dominance or aggression is observed in the crèche group.
- Need to consider pre-conditioning requirements for release birds.
- Agreements need to be organised that make clear the ownership of programme birds and the respective responsibilities of project collaborators. Agreement will include:
    - Milestones
    - Funding (and breakdown/assignment against milestones)
    - Reporting requirements
    - Post-release monitoring requirements
- Holders of birds will be expected to follow a Captive Management Plan (CMP) and Annual Review and Recommendations (ARR).
- An exit strategy and appropriate triggers for this should be agreed and incorporated into the Captive Management Plan.

Cost estimates

- 100 birds to be held across 4 institutions (12 pair per institution)
- This will require 14 aviaries per institution (includes holding aviaries for animals produced)
- Initial set up cost for aviaries of $84,000 per institution
- Annual cost of maintain birds (all inclusive) is $5,000 per bird, or $125,000 per annum for 25 birds

Summary

- $2.5 million per institution for management for 20 year programme
- $0.1 million for infrastructure
- $2.6 million per institution
- **$10.4 million is total cost captive programme over 20 years.**

Action Plan for 2015-2016

The following aspects of the proposed project were finalised and agreed on Day 3 of the workshop, and a series of actions was proposed and agreed for the 2015-2016 period.

Overall recovery strategy

The overall focus of recovery is to establish a proportion of current plains-wanderer habitat under permanently enhanced management, to support the wild population through extended periods of unfavourable climatic conditions that result in numbers falling to dangerously low levels.

This will involve two broad areas of work:

1) *In situ*: confirming the characteristics of "enhanced management" experimentally and implementing the results at prioritised sites.
2) *Ex situ*: securing the species against extinction for 15-20 years and providing a reliable source of release birds to advance growth and resilience in the wild population and to provide for robust testing of field treatments.

[Note that potentially occupied habitat for the species in NSW is estimated to be able to support 3200 birds and in Victoria an additional 1500 birds or so. The species may currently number fewer than 250 individuals.]

Key attributes of the proposed strategy

- The captive programme is considered an essential short-term measure for ensuring long-term viability of plains-wanderers in the wild.
- The captive programme is a finite component of the strategy. It will run for a defined period of time and then wind down. It is not expected to support the wild programme indefinitely, or beyond the envisaged 15-20 year programme period.
- To allow for sustained, continuous breeding in captivity whilst avoiding over-crowding, releases will be annual and ongoing, regardless of seasonal conditions. There will always be places suitable for release and potential sites will be identified ahead of time to provide for this.
- The strategy's success will be reliant on the ability of land managers to maintain good habitat and commit adequate resources to this end.
- The program will occur within a learning/adaptive management framework which will add value to the project and provide information for future management of the spp.

Key attributes of the captive programme

Agreeing the characteristics and dimensions of a recovery-directed captive programme involves trade-offs. Captive programmes aimed at insurance and wild release enjoy a higher likelihood of success where they have a solid founder base (at least 30-50 wild-caught individuals sampled from across the species' range) and are encouraged to grow to large numbers (at least several hundred) with close attention paid to maintaining genetic quality. However, depending on circumstances such programmes can be expensive, unsustainable and the founder harvest required can pose additional risks to wild populations. Based on preliminary modelling and discussion and agreement on trade-

offs, the following goals were agreed for the plains-wanderer programme (though these should be reviewed regularly as part of the programme management cycle).

1) **Secure a sufficient founder base.** Begin with at least 30 effective founders and supplement 1-2 founders per generation: ideally founders to be sampled from across the species' range, including Queensland and South Australia.
2) **Secure 3-4 population "engines".** Establish initially 3-4 "population centres" able to house at least 20 birds each. Identify several supporting "satellite" facilities that can come on-line at the same time.
3) **Grow rapidly to capacity.** Grow (evenly and rapidly from the available founders) and sustain the population at 100 adult birds minimum.
4) **Generate a harvest for release.** Generate 30-90 birds annually for release and more wherever possible: the biology of the species is naturally volatile and its productivity in captivity relatively untested, hence the large range estimated at present (based on preliminary population models). Husbandry techniques such as double-clutching and artificial rearing could potentially elevate and help stabilise the numbers produced but the suitability of birds generated in this way is yet to be tested (i.e. their ability to survive and breed in the wild). Pre-release holding will be required.
5) **Protect the source population when harvesting.** Each year, harvest all birds suitable for release (definition of suitable to be agreed and tested) that are not required to secure the genetic and demographic integrity and potential of the captive source population.
6) **Maintain within carrying capacity.** Unless disease or other potential risks to the wild population suggest otherwise, release will be the primary means through which the captive population is maintained within available carrying capacity.
7) **Manage to genetic targets.** Maintain at least 90% wild source gene diversity[1] in the captive population and minimise average inbreeding coefficient of release birds. Where it does not cause damage to other priorities, split and re-pair breeding birds to increase the diversity of genotypes released.
8) **Implement disease risk management.** Agree and standardise screening and disease risk management across the programme from the outset.
9) **Agree an exit strategy.** This should be done before the programme begins. It should include both the triggers for winding down the captive programme and the strategies by which the population will be dispersed, reduced or sustained once the programme ends. Though the details of this were not addressed, the need was acknowledged and it was agreed that the relevant details would be included in the proposed Memoranda of Understanding.

Next steps

It was agreed that the immediate next step is to bring a small number of birds into captivity and work with them to establish husbandry protocols (including disease risk management). Taronga Zoo and Featherdale Wildlife Park were identified as the initial locations for this. Where possible, blood

[1] Standard approaches employ pedigree inference to estimate relationships and gene diversity in managed populations. In some cases it can be useful to support this approach with information derived from molecular analyses (e.g. quantifying founder relationships, characterising spatial gene diversity patterns, clarifying parentage). Working groups differed in their conclusions about how much added value this would bring in this particular case, and whether that added value would outweigh the associated costs in dollars, time, extra administration and, potentially, in delayed decisions. Both groups were agreed that appropriate samples should be taken and centrally stored so that this option is not ruled out, and to facilitate future studies not necessarily related directly to the specifics of this project.

and feather samples should be collected at this point and stored appropriately for future use in genetic studies[1].

Several institutions were flagged as potential holders of the proposed "population centres". Some were represented at the meeting and others are to be contacted to assess their interest and potential capacity. The initial list proposed included: Zoos Victoria Werribee Open Range Zoo, Taronga Western Plains Zoo, Zoos SA (Monarto Zoo), Priam Psittaculture, Darling Downs Zoo and Halls Gap. In addition it was agreed that consideration should be given to involving other potential stakeholders with the potential to effectively contribute to the programme.

Formation of a captive group

Paul Andrew, Taronga Zoo and David Parker, OEH, were assigned responsibility for leading the development of a ZAA-compliant Captive Management Plan for the programme, and with convening a husbandry group for the purpose of maintaining contact with participants around the development and implementation of captive management protocols.

Captive programme costs

Costs for the captive programme could vary greatly depending on where facilities are located and how birds are managed. The initial estimate over 20 years was 10.4 million dollars. This is in-line with the cost of other recovery-directed captive programmes. It was agreed that some examples of these would be a helpful addition to any funding proposals.

Funding model

There are various components to the programme proposed and each component could potentially draw from a different subset of funding sources. It was agreed that a funding model should be developed along these lines and Matt Cameron, Glen Holland and Ashley Leedman agreed to pursue this. Initial discussions produced the following ideas:

- **Captive Programme:** Zoos & their donor network, NSW Saving Our Species Programme, Commonwealth Threatened Species Strategy via Threatened Species Commissioner;
- **Release Monitoring:** NSW Office of Environment and Heritage, Victorian Department of Environment, Land, Water and Planning;
- **Habitat Restoration:** NSW Saving Our Species Programme NSW National Parks and Wildlife Service, Commonwealth Threatened Species Strategy via Threatened Species Commissioner; Vic – Parks Victoria; Trust for Nature.

List of recommended actions

Progress with the following draft action plan will be reported quarterly to the wider group by the project coordinator, Matt Cameron.

Goal 1	*Collect 5.5 birds (3.3 adults; 2.2 young) from the wild for husbandry research & development.*		
	Details	**Responsibility**	**Time-line**
Action 1	NSW. Develop ethics and licensing approvals plus any other relevant approvals and protocols with respect to: wild collection (e.g. required sex ratio/disease risk management) and to transporting birds interstate.	OEH (D. Parker)	ASAP
Action 2	Victoria. Zoos Vic and Parks Vic to develop a Translocation Plan permitting collection from the wild and future releases of captive-bred young. Establish wild collection requirements and approvals for capture and for transporting birds interstate.	Zoos Vic (G. Holland and D. Harley) and Parks Victoria (M. Antos).	ASAP
Action 3	Develop capture, transport and captive disease risk management protocols. Prepare aviaries and put in place requirements for initial care and husbandry at both Taronga Zoo and Featherdale Wildlife Park.	Taronga Zoo (P. Andrew & R. Matkovics); Featherdale Wildlife Park (N. Atchison) with others as required.	ASAP
Action 4	Establish a Husbandry Group to ensure coordination and communication of husbandry-related activities.	P. Andrew & D. Parker to set up. Initial group to include: D. Parker, R. Matkovics, G. Holland, G. Phipps, N. Atchison, P. Ainsley and others as required.	ASAP
Action 5	Collect 12 birds (adults and juveniles) from the wild.	D. Parker & R. Matkovics with others as required	ASAP
GOAL 2.	*Take the plan for plains-wanderers through the formal NSW Government process to gain approval, priority status and funding support.*		
	Details	**Responsibility**	**Time-line**
Action 5	As required.	OEH (M. Cameron, D. Parker)	By April 2016
GOAL 3.	*Clarify and pursue options through Government for prioritising and resourcing Plains Wanderer conservation action in Victoria.*		
	Details	**Responsibility**	**Time-line**

Action 6	Establish relevant contacts and take action as required.	M. Cameron, D. Baker-Gabb, G. Holland, D. Harley with others as required.	By August 2016.
GOAL 4.	*Canvas interest and secure support from potential programme partners.*		
	Details	**Responsibility**	**Time-line**
Action 7	Develop potential funding model.	OEH (M. Cameron) with Glen Holland (Zos Vic) & Ashley Leedman (Commonwealth)	By February 2016
Action 8	Draft text on the plains-wanderer situation and proposed plan of action to ensure appropriate framing of any approaches to potential partners (need to make sure people know what is being asked of them and understand that things will only happen if the project gets the necessary support etc etc).	OEH (M. Cameron) with others as required.	By December 2015
Action 9	Use text described above in any approach by ZAA to its members.	OEH (M. Cameron), ZAA (C. Hogg).	By February - October 2016
Action 10	Discuss plains-wanderer situation & plan with institutions potentially able to provide climatically suitable facilities or other resources. Gauge potential for participation and report back to the Coordinator.	G. Phipps, P. Andrew, P. Ainsley, D. Harley & G. Holland,	By November 2015
GOAL 5.	*Establish MOUs and other relevant and required agreements between governments and participating institutions.*		
	Details	**Responsibility**	**Time-line**
Action 15	Develop appropriate government – zoo MOU using previous examples as a starting point.	ZAA (C. Hogg); OEH (M. Cameron)	By August 2016
Action 16	Develop other MOUs/agreements as needed.	OEH (M. Cameron)	By August 2016
GOAL 6.	*Draft a captive management plan and husbandry guidelines to support agreed programme goals.*		
	Details	**Responsibility**	**Time-line**
Action 17	Develop initial draft of husbandry guidelines.	G. Phipps with husbandry sub-group and others as required.	By December 2015
Action 18	Develop draft captive management plan in ZAA-compliant format and in line with agreed programme goals.	P. Andrew with others as required.	By August 2016

GOAL 7.	*Review the outcomes of 2 and 3 and, if favourable, pursue next steps towards facility construction and founder collection, and next steps in preparing wild sites to receive birds.*		
	Details	**Responsibility**	**Time-line**
Action 19	Review and communicate outcomes and agree next steps.	OEH (M. Cameron) and others as needed.	August 2016

Appendix I: Workshop Programme

11-13 August, 2015

Commonwealth Department of the Environment,
5th Floor, 51a Allara Street,
Canberra.

Background

The Plains Wanderer (*Pedionomus torquatus*) is an iconic Australian endemic that has declined dramatically over the past 15 years from approximately 3200 to 200 birds. Bold action is required to avoid extinction. The reasons for the decline are not known with certainty and therefore the success of recovery action taken solely in the wild cannot be assured at this time.

The Office of Environment and Heritage (OEH) and the Commonwealth Department of Environment (DOE) will hold a workshop in August 2015 to evaluate the potential of a captive breeding programme for the Plains-wanderer. Such an evaluation is expected to be an action in the developing National Recovery Plan. The assistance of the Conservation Breeding Specialist Group (CBSG) of the IUCN has been sought to assist in the design and delivery of this workshop.

By the end of this workshop we will have agreed:

- The recovery goals of the proposed captive population (*e.g. long-term insurance? Immediate and continual supplementation? Research? Advocacy? All of these?*).
- The "size and shape" of a captive population that would be capable of achieving these goals (*e.g. number of founders, growth rate, population size, harvest capability, extent of connectivity with wild population*).
- The risks and challenges to setting up and managing a population with these characteristics.
- The infrastructure, husbandry and programme management protocols, and commitment from potential partners needed to manage these risks and meet these challenges.
- The likely costs involved in establishing and managing such a project.
- The next steps in the project (assuming it is assessed to be feasible).
- A set of ideas about further research that needs to be done to better understand current wild declines.

For further information contact Matt Cameron: matt.cameron@environment.nsw.gov.au

Programme

Speakers are provisionally listed against topics in this draft – individuals mentioned will be contacted to confirm their availability and willingness to speak, and to confirm content and length etc.

DAY 1		
9.00am	**Welcome and introduction to the workshop**	Matt Cameron, NSW OEH
9.15am	**Participant introductions**	ALL
9.45am	**Scene setting presentations**	
	IUCN SSC Guidelines on the Use of *Ex Situ* Management in Conservation (10 mins)	Caroline Lees, IUCN SSC CBSG
	Plains Wanderer Status Review – species biology, review of past and present distribution, details of recent decline, conservation action and recovery planning to date. **(20mins)**	David Parker NSW OEH, David Baker-Gabb, Vic,
	Recovery Plan and National Status update – update on progress with the draft recovery plan and with revisions of the species' status. **(10 mins)**	Ashley Leedman, Commonwealth Department of Environment
	Captive breeding: history and potential (past attempts at captive management of this and similar species, identified challenges and constraints). **(20 mins)**	Paul Andrew (and others TBC)
11.00am	**COFFEE**	
11.15am	**What are the Plains Wander's recovery needs?** Participants will make a list of the action needed to restore, conserve or increase the resilience of the Plains Wanderer. This will include research aimed at further illuminating the nature of the threats to the species or its likely response to the activities recommended.	Plenary discussion
12.00pm	**Drafting captive programme goals:** what do we want a captive population to do for Plains Wanderer recovery and conservation?	Plenary discussion
1.00pm	**LUNCH**	
2.00pm	**Risks to small populations** and the implications for captive programme design – presentation of basic Plains Wanderer population models.	C. Lees
2.30pm	**Prioritisation:** of the captive roles identified, which are the most important to the recovery/conservation of the species? Which are the most urgent?	Plenary activity
3.00pm	**Working group formation:** Working groups are formed around: 1) husbandry, health & facility design; 2) integration with recovery & research; 3) governance, permitting, data and population-level management. Working groups are each assigned a central task and a set of associated questions.	Plenary
3.30pm	**TEA**	
3.45pm	**Working groups:** brainstorm issues around their central challenges (including what extra information is needed to move forward) and agree a work plan based on the time available.	Working groups

4.45pm	**Presentations:** working groups present their work to the wider group.	Plenary discussion
5.30pm	**End of DAY 1**	
DAY 2		
8.30am	**Re-cap and introduction to the day**	Plenary
9.00am	**Working groups resume.**	Working groups
10.30am	**COFFEE**	
10.45am	**Working groups resume.**	Working groups
12.00pm	**LUNCH**	
12.45pm	**Working group presentations.**	Plenary
1.30pm	**Working groups resume.**	Working groups
3.15pm	**TEA**	
3.30pm	**Working groups resume.**	Working groups
4.15pm	**Costing the programme:** a subset of participants assembles to develop costs. Other working groups finalise work for presentation on DAY 3.	Working Groups
5.15pm	**End of DAY 2**	
DAY 3		
9.00am	**Re-cap and introduction to the day.**	Plenary
9.15am	**Final working group presentations.**	
10.30am	**COFFEE**	
10.45am	**Discussion of conservation impact versus feasibility of proposed captive programme.**	Plenary
11.15am	**Next steps**	Plenary
11.45am	**Concluding remarks**	Plenary
12.00pm	**Meeting ends**	

Appendix II: Workshop Participants

Name	Email	Institution	Position
Phil Ainsley	painsley@zoossa.com.au	Zoos SA	Conservation Programmes Manager
Paul Andrew	pandrew@zoo.nsw.gov.au	Taronga Zoo	Curator
Mark Antos	mark.antos@parks.vic.gov.au	Parks Victoria	Environmental Scientist - Fauna
Nick Atchison	Nick_Atchison@featherdale.com.au	Featherdale Widlife Park	Curator of Birds
David Baker-Gabb	elanus@bigpond.com	Private	Private
Joss Bentley	joss.bentley@environment.nsw.gov.au	Office of Environment and Heritage (NSW)	Senior Threatened Species Officer, Ecosystems and Threatened Species.
Matt Cameron	matt.cameron@environment.nsw.gov.au	Office of Environment and Heritage (NSW)	Senior Team Leader, Ecosystems and Threatened Species, South West.
Dan Harley	dharley@zoo.org.au	Zoos Victoria	Threatened Species Biologist
Carolyn Hogg	carolyn@zooaquarium.org.au	Zoo and Aquarium Association	Manager Science and Policy
Glen Holland	gholland@zoo.org.au	Zoos Victoria	Manager, Healesville Sanctuary
Dave Hunter	david.hunter@environment.nsw.gov.au	Office of Environment and Heritage (NSW)	Senior Threatened Species Officer, Ecosystems and Threatened Species.
Caroline Lees	lees.caroline@gmail.com	IUCN SSC Conservation Breeding Specialist Group	Program Officer
Ashley Leedman	Ashley.Leedman@environment.gov.au	Dept of Environment (Commonwealth)	Assistant Director, Marine and Freshwater Species Conservation Section
Richard Matkovics	rmatkovics@zoo.nsw.gov.au	Taronga Zoo	Senior Keeper

Name	Email	Institution	Position
Damon Oliver	damon.oliver@environment.nsw.gov.au	Office of Environment and Heritage (NSW)	Senior Team Leader, Ecosystems and Threatened Species, South East.
David Parker	david.parker@environment.nsw.gov.au	Office of Environment and Heritage (NSW)	Senior Threatened Species Officer, Ecosystems and Threatened Species.
Graeme Phipps	graemephipps49@gmail.com	Independent aviculturist	-
Debbie Rudd	debbie.rudd@environment.gov.au	Dept of Environment (Commonwealth)	Marine and Freshwater Species Conservation Protected Species and Communities Branch
Ivan Lawler	Ivan.Lawler@environment.gov.au	Department of the Environment	Assistant Director, Marine and Freshwater Species Conservation Section (observer)