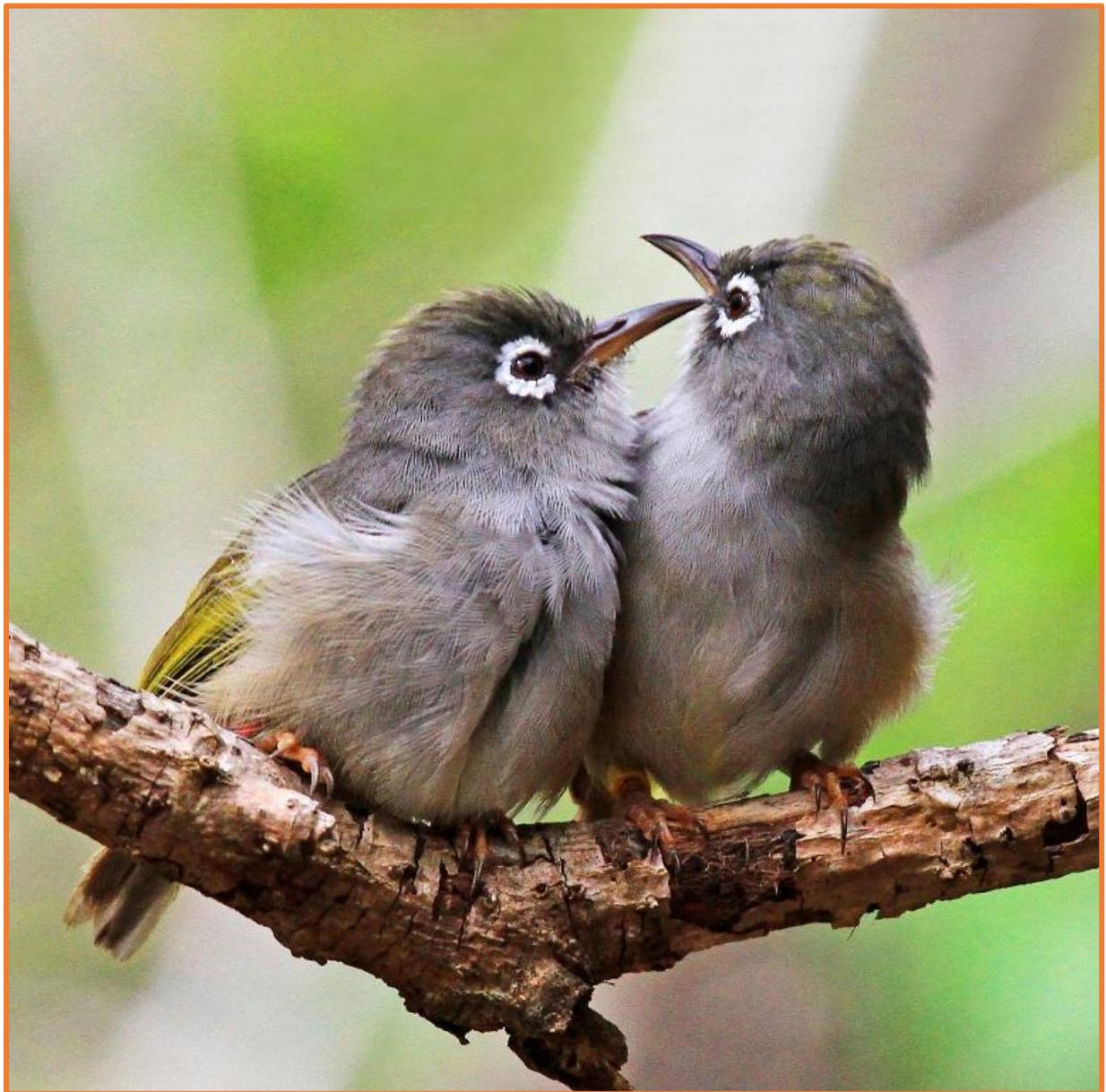


# Conservation plan for the Mauritius olive white-eye (*Zosterops chloronothos*)



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## Abbreviations and acronyms

BF	Brise Fer
BO	Bel Ombre
BRGNP	Black River Gorges National Park
CPSG	Conservation Planning Specialist Group (of IUCN SSC)
CZ	Chester Zoo
EFR	Ebony Forest reserve
ha	Hectare(s)
IAA	Ile aux Aigrettes
IUCN	International Union for Conservation of Nature
MAIFS	Ministry of Agro Industry and Food Security
MWF	Mauritian Wildlife Foundation
NPCS	National Parks and Conservation Service
OWE	Mauritius Olive white-eye
PAN	Protected Area Network
PANES	Protected Area Network Expansion Strategy
SSC	Species Survival Commission (of IUCN)
VDL	Vallée de l'est



# The olive white-eye conservation plan

## Scope

The focus of concern is the Critically Endangered Mauritius olive white-eye *Zosterops chloronothos* (OWE), considered the rarest terrestrial breeding bird in Mauritius. It is a small passerine with a relatively fast life history. Although once widespread across Mauritius the species has declined due to a mix of threats including habitat loss, and introduction of non-native predators (including rats and monkeys). Currently the wild population is highly fragmented in small pockets of remnant forest with a last 'stronghold' in the Combo region of the Black River Gorges National Park (BRGNP) and a heavily managed, translocated population on Ile aux Aigrettes (IAA). Additional smaller fragmented populations also survive in other areas such as Vallee des Couleurs, Bassin Blanc, Grand Bassin, Pigeon Wood and the Bel Ombre Uppers.

This document details the planning process and product for a 3-year conservation plan contributing to a 2040 vision.



## The Olive white-eye

### Species overview

The Mauritius olive white-eye (*Zosterops chloronothos*) is the only Mauritian endemic terrestrial bird still listed as Critically Endangered by the IUCN Red List due to its small and declining population (IUCN, 2017).

The olive white-eye is a small, elusive passerine with no sexual dimorphism. However, males can be identified by their vocalisations (Horne, 1987). They form monogamous pairs and are highly territorial defending territories of around 0.5 ha (Maggs, 2016). They are found in both native and exotic forest and scrub where nectariferous plants are abundant (Safford and Hawkins, 2013). The OWE is primarily nectarivorous but will also feed on invertebrates and fruit with their long bills enabling foraging and probing in foliage as well as flowers.



### Olive white-eye conservation history

The olive white-eye has experienced an island wide decline thought to be primarily due to habitat loss and degradation, and nest predation by invasive rat species (Nichols et al., 2005a). Historical range is believed to have been more widespread with birds distributed throughout the island. By 1975 the population was estimated to be restricted to the south-west of Mauritius, and number approximately 340-350 pairs (Cheke, 1987). By 1993 the species had declined to an estimated 200 pairs (Safford and Hawkins, 2013) and surveys in 2001 and 2012 recorded a continued decline to 250 and then 150-200 birds, respectively (MWF, 2013). By 2012 the species is thought to have been primarily restricted to an area of less than 25km<sup>2</sup> in the BRGNP (Nichols et al., 2004) having experienced a range contraction of 50% in just 25 years (MWF, 2013). Nest predation by rats is thought to contribute to continued low productivity in the remnant population (Nichols et al., 2005b, 2005a, 2004).

In 2005 the MWF initiated a recovery project in response to the continued population decline. There were three primary aims of this project:

1. Establish a secure sub-population by marooning birds on Ile aux Aigrettes island Nature Reserve.
2. Monitor the remnant sub-population in the Combo region of the BRGNP to better understand the species' behaviour and breeding biology.
3. Determine how to protect the species in their source population.

From 2005 to 2009, nests in the forest at Combo were harvested by MWF for hand rearing and fledglings were subsequently released on IAA. Seventy-three eggs were harvested in total. Egg fertility was 90%, and 41 chicks were successfully hand reared for release on to IAA. In total, 38 birds were released on IAA between 2006 and 2010 and the population is now (June 2023) estimated to number 57 individuals.



Marooning (introduction of a population to an island that is not subject to threats experienced on the mainland) the OWE on IAA has allowed close monitoring of the species. The population has thrived in the absence of most mammalian predators found on the mainland and has also benefited from continuous habitat restoration efforts and the provision of supplemental food.

Since releases were completed, the work done by MWF on IAA has consisted of both monitoring and management of the OWE. The aim of monitoring has been to track the status of the population and to increase knowledge of OWE breeding, feeding and territoriality.

Experimentation regarding supplementary feeding of the OWE on IAA has provided valuable insights, such as that:

- Supplemental food cannot be provided to the adult population in one location due to intraspecific aggression. The application and design of specially designed feeding stations has allowed the development of optimal food delivery strategies for the OWE. The placement of feeding stations can be used to manipulate the distribution of the population.
- Sugar water was found to be a suitable replacement to nectar solution; providing a low cost (both financially and in terms of human resource) feeding alternative (Ferrière et al., 2021).

The remnant population at Combo is estimated to be made up of 30 pairs/breeding territories, distributed across the protected forest (territories exist within an area of approximately 200 ha) and a small area of tea plantations (approximately 50 ha) in the region.

Detailed monitoring of the OWE in Combo was initiated in 2005 by MWF coinciding with the harvests and continued until the 2018/2019 breeding season; monitoring focussed on the breeding productivity of pairs located in Combo forest and the nearby tea plantation. The population was not monitored by MWF in 2019/2020, then low intensity monitoring was conducted by MWF in 2020/2021 to assess the occupation of suspected territories in the forest and tea plantations. In 2022/2023 Ebony Forest staff monitored the territories in the tea plantation in order to harvest eggs for hand-rearing and release at Ebony Forest. No monitoring was done in 2021/2022 by MWF, instead mist netting in the tea plantation to capture un-ringed birds for ringing was prioritised.

Monitoring of the OWE in Combo identified rats as a major limiting factor. The Combo population has benefitted from various short term rat control experiments, though none have been applied long term. Rat control experiments confirmed that small-scale rat management is effective at reducing the impact of rats (Maggs et al., 2015) but identified that there is a need for large-scale rat management to ensure OWE population long-term persistence (Maggs, 2016).

### Current conservation activities

There are now three key organisations actively involved with OWE conservation in Mauritius. The MWF has been the lead organisation managing OWE in Mauritius until very recently. Working with permission from National Parks and Conservation Service (NPCS) they have been monitoring and, at times, managing the OWE population at Combo, managing the translocated population on IAA and undertaking periodic country-wide surveys.

The NPCS is currently investing in the establishment of a rat-controlled area of 10 ha. to help safeguard the OWE in the Combo forest.

Ebony Forest Reserve (EFR) has been acquiring and developing its internal conservation management skills and, in 2022/23, hand-reared and released its first cohort of OWE into the surrounding forest. A total of 42 nests were found in the Combo tea fields and one-third of nests (n=14) were harvested



resulting in 24 eggs and two chicks. Egg fertility was low at 58%. A total of 6 OWE fledglings were released in Ebony Forest Reserve.

## Rationale

Uncertainty exists as to the actual wild status of the OWE in Mauritius (population size, distribution, genetic health), though all three organisations recognise the need for action to prevent further decline. All three organisations also recognise that they are undertaking complimentary, though often discrete work for the species. Each feels the need to invest in efforts in recovery of the species, whilst appreciating that they each have other equally valid calls on their finite resources. There is an appreciation between the organisations that a lack of inter-organisational coordination and communication exists and that this is not helpful for their work.



All partners share a common objective of reducing the extinction risk of OWEs, and all see growing population size and numbers of sub-populations as a powerful way to improve the species' resilience. Equally all share a concern about the current genetic consequences of previous declines and the impacts on future management. Other values expressed by one or more partners include the cost of



OWE management; the benefits of OWE recovery on wider ecosystem restoration; and synergies for other threatened species from efforts focussed on OWE.

Each organisation brings a diverse set of skills and knowledge, and each brings different yet complimentary options for OWE recovery. **The two fundamental concerns that these leading organisations want to address, are how best to:**

1. **Prioritise where and when specific OWE management actions occur and by whom; and**
2. **Coordinate OWE recovery decision making and shared management.**



## Results and recommendations

### Vision (by 2040)

*“We are proud that the Mauritius olive white-eye is thriving”*

Progress towards this vision will be measured through monitoring of the following indicators:

“We”	“Olive white-eye is thriving”
Defined as:	
<ul style="list-style-type: none"> <li>● Effective collaboration between organisations</li> <li>● Higher levels of joint work/ decision-making and inter-organisation exchange of knowledge and skills</li> <li>● Species downlisted in IUCN Red List with co-authors from all institutions</li> </ul>	<ul style="list-style-type: none"> <li>● Population distribution/density increased</li> <li>● Downlisting to Endangered and moving towards Vulnerable</li> <li>● Genetically viable populations</li> </ul>
Measured by:	
<ul style="list-style-type: none"> <li>● Jointly authored publications/reports</li> <li>● Internal reports/updates (monthly/quarterly/annual) shared between organisations</li> <li>● Skills/training exchange</li> <li>● Central information storage/sharing, including studbook accessible to all organisations</li> <li>● Notes of meetings of annual review of progress towards species action plan/strategy and for regular meetings.</li> <li>● Annual review to check using resources available most effectively and efficiently</li> <li>● Exchange of birds between sites</li> <li>● Bringing others onboard more effectively (stakeholder, landowners, companies etc)</li> </ul>	<ul style="list-style-type: none"> <li>● No. sub-populations (n=4)</li> <li>● ‘Global’ population to have increased</li> <li>● At least 450 birds (need to revisit this in time as our understanding of what is there now improves and what it will take to go further)</li> <li>● Population distribution/density assessed through surveys, territory mapping, census etc</li> <li>● Population genetic analysis</li> </ul>



## Goals

Based on the priority threat categories identified prior to the workshop it was agreed that achievement of the following eight goals in the next three years will alleviate those threats in order to work towards achieving the long-term vision.

- Significantly reduce predation and competition of all life-stages of OWE to increase recruitment and survival.
- Establish a system for screening and response to disease in order to minimise impacts on OWE recovery.
- Understand the genetics, demographics, health and distribution and movements of the OWE population (island-wide) to be better able to make evidence-based management decisions.
- Ensure the OWE population on IAA is genetically healthy to secure its long-term viability.
- Establish a viable population of OWE at Ebony Forest to capture existing genetic material.
- Mitigate threats to improve the security of existing naturally occurring fragmented 'sub-populations' of OWE.
- Initiate reintroduction of a new/reinforcement of an existing subpopulation within appropriate OWE habitat to improve viability of global population and move towards downlisting.
- Reduce invasive and increase endemic/native plants in order to improve food sources, territories and habitats for OWE.

Each of these goals can be achieved or contributed to in a number of ways. Given the range of organisations represented at the meeting and their respective expertise and specific locations of work, the following strategies or approaches were developed to demonstrate the different ways in which these goals could be achieved (Table 1)



Table 1 Strategies devised in 2023 to achieve the goals of the conservation plan.

GOAL 1:	Significantly reduce predation and competition of all life-stages of OWE to increase recruitment and survival							2023 Priority	2024 onwards
<b>Threat group</b>	Invasive vertebrate species								
<b>Strategies</b>	Continue capture of monkeys at BF, EF, BO, VDL at current levels							✓	
	Advocate for national monkey control policy								✓
	Maintain NPCS crow campaign focused on OWE priority sites							✓	
	Lobby for implementation of eradication proposal for crows (submitted)								✓
	Develop and implement optimised Good Nature trapping strategy (based on research/ trials at EF and BF)							✓	
<b>GOAL 2:</b>	<b>Establish a system for screening and response to disease in order to minimise impacts on OWE recovery</b>								
<b>Threat group</b>	Invasive vertebrate species								
<b>Strategies</b>	Improve testing of animal imports to include more ecologically-relevant diseases of potential threat to OWE								✓
	Vet services and International Zoo Vet Group to receive duplicate samples for OWE (histopathology and disease screening)							✓	
<b>GOAL 3:</b>	<b>Understand the genetics, demographics, health and distribution and movements of the OWE population (island-wide) to be better able to make evidence-based management decisions</b>								
<b>Threat group</b>	Intrinsic threats								
<b>Strategies</b>	Complete OWE survey with system in place for replication every 10yrs								✓
	Undertake targeted demographic study of Combo and the tea fields and determine if/ over what timeframes it should be replicated							✓	
	Establish and implement a system for genetic and health screening for OWE beginning with existing managed sites.							✓	
<b>GOAL 4:</b>	<b>Ensure the OWE population on IAA is genetically healthy to secure its long-term viability</b>								
<b>Threat group</b>	Intrinsic threats								
<b>Strategies</b>	If early indicators of the genetic study from OWE genetic research suggest a need for further introduction of genetic diversity, a decision will be made and implemented to incorporate the new genetic diversity into the population.								✓
	Determine likelihood of achieving carrying capacity on IAA in order to inform the extent of harvesting, management etc. that might be required and to predict future trajectories.							✓	
	Develop population model to determine offtake possible to avoid negatively impacting the population on IAA.							✓	



<b>GOAL 5:</b>	<b>Establish a viable population of OWE at Ebony Forest to capture existing genetic material</b>								
<b>Threat group</b>	Intrinsic threats								
<b>Strategies</b>	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals surviving and breeding							✓	
<b>GOAL 6:</b>	<b>Mitigate threats to improve the security of existing naturally occurring fragmented 'sub-populations' of OWE</b>								
<b>Threat group</b>	Habitat - Destruction and fragmentation								
<b>Strategies</b>	Identify significant (size and genetically based) population/sites for protection following results of the OWE survey (use feedback from PAN project on habitat-positive landowners to inform decision as to where to target efforts)								✓
	Determine simple, effective actions to mitigate threats to these significant populations (e.g. landowner engagement, closing paths, promoting planting of nectar-provisioning plants etc.)								✓
<b>GOAL 7:</b>	<b>Initiate reintroduction of a new/reinforcement of an existing subpopulation within appropriate OWE habitat to improve viability of global population and move towards downlisting.</b>								
<b>Threat group</b>	Habitat - Destruction and fragmentation								
<b>Strategies</b>	Post-OWE survey an evaluation of site selection completed to identify how best to promote population growth								✓
	Begin work to reintroduce/reinforce a population in a prioritised area								
<b>GOAL 8:</b>	<b>Reduce invasive plants and increase endemic/native plants in order to improve food sources, territories and habitats for OWE.</b>								
<b>Threat group</b>	Habitat - Quality								
<b>Strategies</b>	Ongoing habitat restoration as part of wider organisational objectives for NPCS and EF							✓	✓
	Develop weeding and planting strategies to minimise negative short-term impacts on OWE							✓	
	Assess additional OWE areas for habitat improvement considering options to achieve multi-species gains								



## Goals to actions

The 8 priority goals identified above and the different approaches for achieving them will contribute to the long term aims of this conservation plan, however more immediate actions need to be identified to deliver measurable progress towards the ultimate vision of a thriving OWE population in Mauritius. The specific recommended actions, with responsible parties, are detailed in Appendix C.

*GOAL 1: Significantly reduce predation and competition of all life-stages of OWE to increase recruitment and survival.*

Three key action areas emerged for this goal, each of which was targeted to a specific vertebrate predator group – crows, monkeys and rats.

The Government of Mauritius has an on-going crow control campaign and all stakeholders committed to supporting this by sharing observations with relevant authorities and continuing to lobby for support of the programme. Similarly, all participants committed to continuing to monitor and report monkey sightings to relevant authorities.

Rat control is a priority for all stakeholders and development of ‘mainland islands’ in potential OWE habitat is widely considered to be the optimal approach. Participants are committed to documenting and sharing research on the establishment and optimisation of trapping grids with Goodnature traps, as well as trials of other new and emerging technologies.

*GOAL 2: Establish a system for screening and response to disease in order to minimise impacts on OWE recovery.*

Future disease outbreaks were considered to be a potential threat to the OWE on Mauritius and the group felt that current disease screening at entry points is focussed on the potential impact on poultry and other species vital to the economy. A need to better understand the potential diseases that may affect wild species was identified.

*GOAL 3: Understand the genetics, demographics, health and distribution and movements of the OWE population (island-wide) to be better able to make evidence-based management decisions.*

Despite a long history of monitoring and management of the OWE there are still significant gaps in knowledge of the status of the current population. A need for a concerted capture and ringing effort was identified for populations on the mainland to better understand their demographic characteristics (sex ratio, recruitment etc) and the need for collection of blood samples for genetic analysis was agreed.

Due to the number of sites and organisations involved in monitoring and managing OWE populations, a priority is to establish a system for sharing information on all the populations being monitored.

*GOAL 4: Ensure the OWE population on IAA is genetically healthy to secure its long-term viability.*

The population of OWE on IAA is undoubtedly vital and played a significant role in securing the persistence of the species in the early years of the programme. However, IAA is a closed population and with little to no immigration or emigration. The group expressed concerns about the genetic health and viability of this population, calling for genetic and demographic studies of this population.

*GOAL 5: Establish a viable population of OWE at Ebony Forest to capture existing genetic material.*

EFR are in a position where they can now support a wild population of OWE. These birds will be harvested as eggs/chicks from populations on the mainland that are not currently receiving any protection from predators, and if necessary from the IAA population. A series of annual releases will be conducted until a wild population of >30 birds is established.



*GOAL 6: Mitigate threats to improve the security of existing naturally occurring fragmented 'sub-populations' of OWE.*

Participants agreed to continue current activities to improve habitat quality for the OWE and to engage with other landowners/managers in the region to do the same.

*GOAL 7: Initiate reintroduction of a new/reinforcement of an existing subpopulation within appropriate OWE habitat to improve viability of the global population and move towards downlisting.* Management of existing predator grids (for example in EFR and Brise Fer) will continue to enable future releases.

Before populations can be established in completely new sites, participants agreed that another island-wide survey was needed to better understand the status of OWE across Mauritius. Results of this survey will provide valuable information regarding species distribution and habitat requirements.

*GOAL 8: Reduce invasive plants and increase endemic/native in order to improve food sources, territories and habitats for OWE.*

Current weeding and planting regimes to continue at key sites and development of a strategy will be promoted to guide management of other potential OWE sites.



## Strategy governance

Oversight of the OWE Conservation Plan will be achieved through establishment of the following organisational structure (Figure 1).

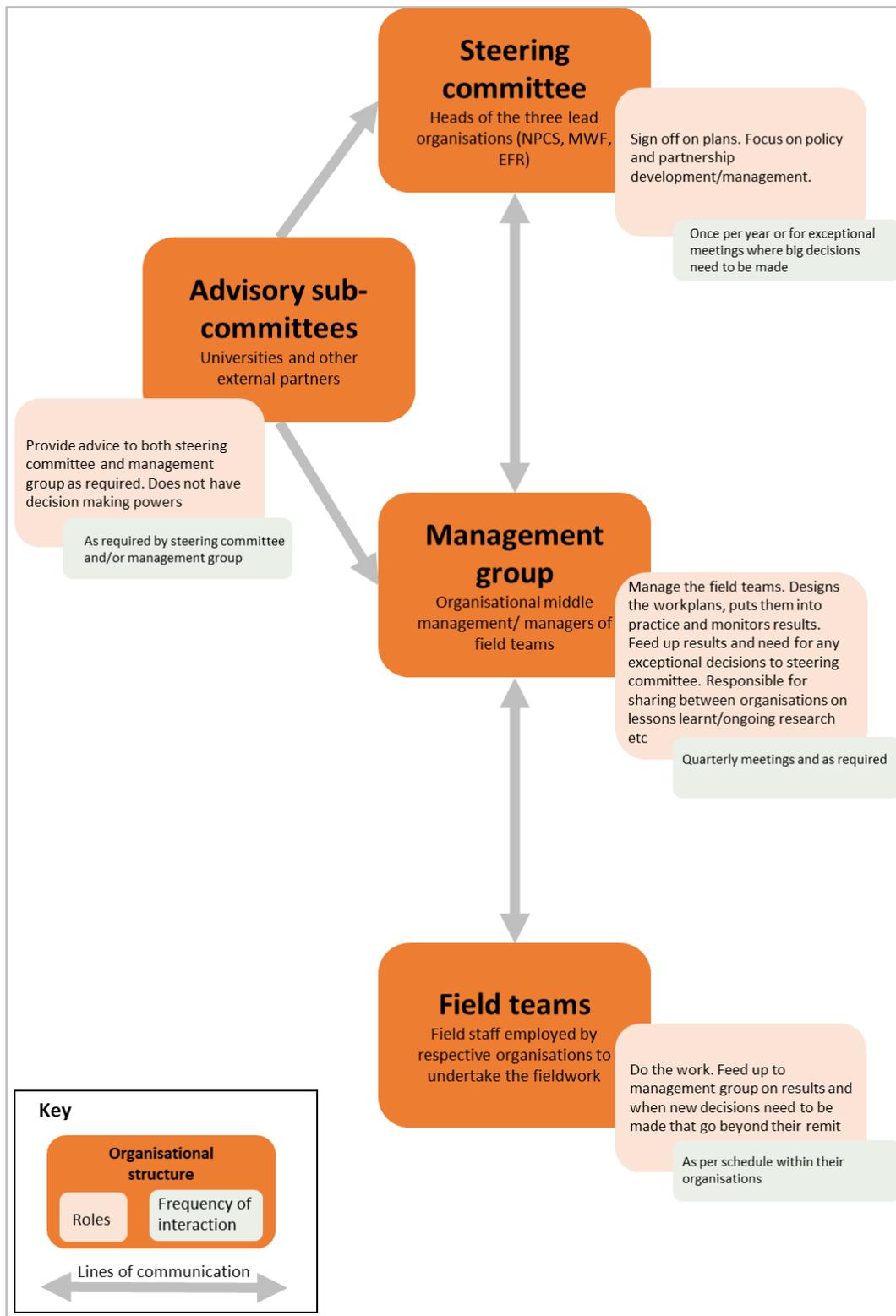


Figure 1 Governance structure of the OWE conservation plan oversight.



# The conservation planning process

## Planning process

This plan was developed in a collaborative process according to the Species Conservation Planning Principles and Steps (CPSG, 2020). The process was designed and facilitated by the Conservation Planning Specialist Group (CPSG) (part of the International Union for Conservation of Nature-IUCN-Species Survival Commission- SSC) in collaboration with a cross-stakeholder Organising Team (OT).

## Principles and steps of process

The following seven principles are the core values on which the collaborative process is centred, in order to stimulate shared ambition and resources:

- Plan to act
- Promote inclusive participation
- Use sound science
- Ensure good design and neutral facilitation
- Reach decisions through consensus
- Generate and share products quickly
- Adapt to changing circumstances

By following a set of agreed steps, effective planning can be achieved by ensuring that any plan produced will be implementable and robustly supported by all involved in the process.

## Development process

A number of preparatory meetings were held online prior to a multi-day workshop in Mauritius, followed by additional online calls to finalise the plan (see Appendix A).

All members of the OT were invited to attend each of these meetings and additional experts and advisors were invited when deemed necessary by the OT.

## Preparatory meeting - SWOT analysis

Participants were asked to conduct a SWOT analysis on the OWE recovery programme to date. The objective of this exercise was not to assess the efficacy of the institutions/individuals involved, but simply to assess the range of work conducted to-date to help understand what has worked well and where there are key areas to improve.

Results of the identified Strengths and Weaknesses are identified below, and the Opportunities and Threats were categorised according to the PESTLE framework to help structure consideration of various external factors (Table 2). PESTLE analysis is a tool that helps understand and categorize external factors under the following themes: Political, Economic, Social, Technological, Legal, and Environmental (Abbas, 2023).



## Strengths

- Staff and organisations.
  - *Highly skilled and motivated staff with a range of relevant experience (field, hand-rearing and release).*
  - *Organisations have a clear direction with strong leadership and clear roles within.*
  - *Consensus across organisations that conservation action is needed.*
- Data.
  - *Detailed long-term datasets (life histories, re-sightings, breeding productivity, feeding observations).*
  - *Good ringing data for IAA and Combo.*
- Species knowledge.
  - *Extensive monitoring and management work resulting in detailed species knowledge.*
- Site Management.
  - *Long-term programme on IAA with relevant management rights resulting in well-studied population with detailed ringing records.*
  - *Habitat management and predator grids on a number of mainland sites.*
- Long term funders.
- Annual planning and review meetings.
- Scientific guidance from partners, other institutions, advisors and collaborators (Chester Zoo, Zoological Society of London etc).

## Weaknesses

- Staff and organisation.
  - *High staff turnover.*
  - *Lack of inter-organisation communication channels.*
- Species knowledge.
  - *Lack of consensus on population trends.*
  - *No up-to-date national passerine survey therefore limited knowledge of the population outside of sites managed by participants.*
- Data.
  - *Record keeping on hand-rearing can be improved.*
  - *No open access data sharing between organisations.*
- Habitat and sites.
  - *Unsuccessful release of Mauritius fodies on Round Island meant OWE were never attempted.*
  - *Limited suitable predator-controlled habitat for future releases.*
- Delays in taking certain actions.
- Limited hand-rearing facilities.



Table 2 Opportunities and Threats to the OWE recovery programme structured into PEST(L)E criteria. NB, no legal items were identified so this section has been omitted from the PESTLE.

	Opportunities	Threats
<b>Political</b>	<ul style="list-style-type: none"> <li>Through good collaboration with government there are opportunities to positively influence policy alignment and reporting to international conventions (30/30 objective, NBSAPs, NIASSAP, INDC targets, Paris agreement, CBD etc)</li> </ul>	<ul style="list-style-type: none"> <li>Change in political will/government priorities</li> <li>Perspective of Government of Mauritius and Private sector</li> </ul>
<b>Economic</b>	<ul style="list-style-type: none"> <li>Collaborations with companies/ private sector to finance project</li> <li>Global move in commercial sector for companies to be more environmentally-aware</li> </ul>	<ul style="list-style-type: none"> <li>Donor fatigue</li> <li>Funders work on short cycles</li> <li>Changing priorities of funders (e.g. HSBC)</li> <li>Reduction or diversion of funding and technical help from local and external funders</li> </ul>
<b>Social</b>	<ul style="list-style-type: none"> <li>Inter-organisation collaboration</li> <li>Growing awareness/force from within the commercial sector</li> <li>Working together locally and building local capacity</li> <li>Public attitude shift in favour of nature</li> <li>More people wanting to spend time outdoors</li> <li>Schools more involved and interested in including environmental awareness within the curriculum (in recent years it has been included at end of primary)</li> </ul>	<ul style="list-style-type: none"> <li>Organisations competing for same/limited resources (i.e. funding)</li> <li>Lack of consensus among stakeholders</li> <li>Lack of public understanding/appreciation of nature</li> <li>Personality clashes</li> <li>Inaction from stakeholders</li> </ul>
<b>Technology (Science)</b>	<ul style="list-style-type: none"> <li>Greater scientific work to improve knowledge and management</li> <li>Increase research done on the species to further our knowledge with existing and new research partners</li> </ul>	
<b>Environmental</b>	<ul style="list-style-type: none"> <li>Surveys to confirm population status and trends</li> <li>Already know where OWE are at risk already</li> <li>Habitat restoration and management, especially island restoration for passerines and others (OWE is a flagship)</li> <li>Efficiency of predator grids if sufficiently resourced</li> </ul>	<ul style="list-style-type: none"> <li>Current and new invasive predators – rats, crows, monkeys</li> <li>Invasive diseases</li> <li>Predator grids are resource intensive to create and maintain (staff time, financial outlay)</li> <li>Habitat loss and degradation (including from urban development) – reduces quality of habitat for existing populations and limits options for future releases.</li> <li>Decreased OWE fertility</li> <li>Climate change</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>Excellent conservation track record</li> <li>Collaboration with more external partners e.g. zoos, to build local capacity</li> <li>Sharing knowledge and data</li> </ul>	<ul style="list-style-type: none"> <li>Long term programme planning vs short-term funding commitments</li> <li>Foreign direct investment and big local money for grey projects</li> <li>Staff loss</li> </ul>



### Preparatory meeting - Threat analysis

The organising team and additional contributors were asked to brainstorm current driving and restraining forces which support and threaten the OWE population respectively (detailed in Appendix B). The threats were then discussed and clarified in greater detail, before the group were guided through a threat prioritisation exercise. Of the 25 individual threats identified the following four areas emerged as being believed to pose the most significant threats to the OWE (Table 3).

Table 3 Key threat themes and details identified following forcefield analysis of the OWE population.

<b>Invasive vertebrate species (current &amp; future)</b>	
	Asian crows disturbing nesting birds and eating eggs and chicks
	Competition for food from introduced birds
	Monkeys predating all life stages
	Predation on eggs by introduced birds
	Rats predating on eggs and nestlings/ fledglings
	Introduced species bringing diseases (i.e. avian malaria)
<b>Habitat – Destruction and fragmentation</b>	
	Isolated populations in small pockets vulnerable to loss of that subpopulation
	Limited territories reducing opportunities for recruitment of new breeding pairs
	Reduction in forest cover
<b>Habitat - Quality</b>	
	Endemic nectar-producing plants becoming rarer
	Invasive plants reducing habitat quality
<b>Intrinsic threats</b>	
	Ageing population (knock-on effect on inbreeding)
	Gene flow between sub-populations becoming harder (potential inbreeding impacts)
	IAA reaching carrying capacity limiting further growth
	Limited pool of eggs to harvest from for management

(See Appendix B for full details of threat analysis and ranking)

### Workshop

The Organising Team and additional stakeholders came together in Mauritius on the 17<sup>th</sup>-19<sup>th</sup> April 2023 for a 3-day workshop hosted in Flic-en-Flac. One contributor from Chester Zoo joined remotely as they were unable to join in person.



Relevant timescales were discussed and agreed within the group to ensure that each were relevant and achievable. The vision (by 2040), goals (2023-26), indicators and actions (2023-24) were developed around the key threat areas identified in the preparatory meetings. Drafts of the vision and indicators were produced by the whole group on the opening day and gradually refined throughout the planning process.

### Vision (by 2040)

*“We are proud that the Mauritius olive white-eye is thriving”*

### Goals

Based on the threat categories identified prior to the workshop, participants split into working groups to propose goals which could alleviate those threats and be achievable within the short-term (next 3 years) these are detailed in Table 4. Given the range of organisations represented at the meeting and their respective expertise and specific locations of work, the working groups additionally brainstormed a number of alternative strategies or approaches which could be taken to achieve the goals (Table 1).

*Table 4 The eight goals created for the OWE conservation plan and the threats that they address (not presented in order of priority).*

Threat category	Goals
Invasive vertebrate species	<b>1</b> Significantly reduce predation and competition of all life-stages of OWE to increase recruitment and survival
	<b>2</b> Establish a system for screening and response to disease in order to minimise impacts on OWE recovery
Intrinsic threats	<b>3</b> Understand the genetics, demographics, health and distribution and movements of the OWE population (island-wide) to be better able to make evidence-based management decisions
	<b>4</b> Ensure the OWE population on IAA is genetically healthy to secure its long-term viability
	<b>5</b> Establish a viable population of OWE at Ebony Forest to capture existing genetic material
Habitat - Destruction and fragmentation	<b>6</b> Mitigate threats to improve the security of existing naturally occurring fragmented ‘sub-populations’ of OWE
	<b>7</b> Initiate reintroduction of a new/reinforcement of an existing subpopulation within appropriate OWE habitat to improve viability of global population and move towards downlisting.
Habitat - Quality	<b>8</b> Reduce invasive and increase endemic/native plants in order to improve food sources, territories and habitats for OWE.



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## Appendices

### Appendix A: Meeting dates and process

25/04/22	Discuss workshop process and stakeholders/participants (online)
22/02/23	Organising Team meeting (online)
09/03/23	SWOT analysis (online)
03/04/23	Threat analysis (online)
17-19/04/23	Workshop (hybrid)
14/06/23	Finalising vision and next steps (online)
17/07/23	Goals and Actions (online)
07/09/23	Draft review and discussion (online)



## Appendix B: Full forcefield and threat analysis process

Positive/ driving forces within the system supporting OWE population

- Rat control efforts on IAA and at EF
- Birds will repeat clutch if first eggs removed/predated
- Exotic plants provide habitat for nesting (e.g. at Combo)
- Supplementary feeding at IAA and EF
- Continued restoration of IAA providing diverse invert community and nectar
- The species is flexible- able to survive in range of habitats- native and exotic
- Exotic nectar-producing plants becoming more common
- Multiple organisations now working on the species- EF and MWF
- Improved understanding of breeding biology and hand-rearing techniques
- Exotic insects as food source
- More restored endemic forest than before for food and nesting

Negative/restraining forces within the system threatening the OWE population

- Rats predating on eggs and nestlings/ fledglings.
- Reduction in forest cover
- Monkeys predating all life stages
- Limited territories reducing options for recruitment of new breeding pairs
- Isolated populations in small pockets making vulnerable to loss of that subpopulation
- Predation on eggs by introduced birds
- Ageing population (knock-on effect on inbreeding)
- Gene flow between sub populations becoming harder- potential inbreeding impacts
- Competition for food from introduced birds
- Limited pool of eggs to harvest from for management
- Invasive plants reducing habitat quality
- Predation of eggs by native birds (e.g. bulbul)
- Resource availability to implement conservation interventions
- Asian crows disturbing nesting birds and eating eggs and chicks
- Endemic nectar-producing plants becoming rarer
- Relationships between organisations limits cooperation/ joint work
- Competition for food from native birds
- IAA reaching carrying capacity limiting further growth
- Climate change shifting rain patterns reducing food- knock on effect on breeding
- Political will and support for the work
- Lack of understanding of what "good habitat" looks like- delays our ability to prep for it
- Spraying from agriculture reducing invert food availability
- Lack of public appreciation for the species makes it difficult to gain public support for actions
- Noise pollution (e.g. around tea plantations) disturbing birds



Threat type	Ranked score
<b>Climate Change</b>	<b>7.2</b>
Climate change shifting rain patterns reducing food- knock on effect on breeding	7.2
<b>Habitat - Destruction and fragmentation</b>	<b>16.3</b>
Isolated populations in small pockets making vulnerable to loss of that subpopulation	15.8
Limited territories reducing options for recruitment of new breeding pairs	16.0
Reduction in forest cover	17.0
<b>Habitat - Quality</b>	<b>10.2</b>
Endemic nectar-producing plants becoming rarer	7.4
Invasive plants reducing habitat quality	13.0
<b>Institutional challenges</b>	<b>6.9</b>
Lack of understanding of what 'good habitat' looks like- delays ability to prep for it	4.4
Political will and support for the work	6.6
Relationships between organisations limits cooperation/ joint work	7.4
Resource availability to implement conservation interventions	9.2
<b>Intrinsic threats</b>	<b>12.6</b>
Ageing population (knock-on effect on inbreeding)	15.2
Gene flow between sub popns becoming harder- potential inbreeding impacts	14.2
IAA reaching carrying capacity limiting further growth	7.2
Limited pool of eggs to harvest from for management	13.8
<b>Invasive species (predation/competition)</b>	<b>15.04</b>
Asian crows disturbing nesting birds and eating eggs and chicks	9.0
Competition for food from introduced birds	13.8
Monkeys predated all life stages	17.0
Predation on eggs by introduced birds	15.2
Rats predated on eggs and nestlings/ fledglings.	20.2
<b>Native species (predation/competition)</b>	<b>8.4</b>
Competition for food from native birds	7.2
Predation of eggs by native birds (e.g. bulbul)	9.6
<b>Pollution</b>	<b>3.3</b>
Noise pollution (e.g. around tea plantations) disturbing birds	2.6
Spraying from agriculture reducing invert food availability	4.0
<b>Public support</b>	<b>3.2</b>
Lack of public appreciation for the species makes it difficult to gain public support for actions	3.2



Appendix C: Action tables

Goal 1: Significantly reduce predation and competition of all life-stages of OWE to increase recruitment and survival	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Continue capture of monkeys at BF, EF, BO, VDL at current levels	Check and bait traps at VDL and EFR	Predator control report	NZ	EFR and VDL team	Ongoing	NA
	Develop optimised Good Nature trapping strategy based on research/ trials at EF and BF	Continue trial of new baits and traps to find optimum control strategy	Paper or report on bait and trap testing	NZ	EFR team	Ongoing	NA
	Develop optimised Good Nature trapping strategy based on research/ trials at EF and BF	Research new traps and trial them	Predator control report	NZ	EFR team	Ongoing	NA
	Maintain NPCS crow campaign focused on OWE priority sites	Regularly share observations of Crows on IAA	Correspondence with NPCS	SH	NPCS	Send monthly updates of Crow observations to NPCS.	Observations are accurately recorded and transmitted to NPCS. (Mitigate with monthly correspondence)
	Develop optimised Good Nature trapping strategy based on research/ trials at EF and BF	Continue to experiment with GoodNature traps in BF mainland island. Reduce number of gas canister checks from biweekly to monthly - see impact on rat index.	BF Mainland Island report	SH	MWF Team	February 2024 (repeated annually each breeding season)	Trained staff operate the mainland island through the experiment period.
	Develop optimised Good Nature trapping strategy based on research/ trials at EF and BF	NPCS establishing grid at Combo		VT, NPCS			
	Maintain NPCS crow campaign focused on OWE priority sites	NPCS to maintain annual crow control		VT, NPCS			
	Maintain NPCS crow campaign focused on OWE priority sites	Provide advice/recommendations to NPCS to achieve significant reduction of crow population achieved through poisoning/shooting/trapping throughout the year (not just occasionally)		VT, NPCS			
	Maintain NPCS crow campaign focused on OWE priority sites	Removal (shooting) of last few when down to small numbers		VT, NPCS			
Maintain NPCS crow campaign focused on OWE priority sites	Continue discussions to bring external consultant in to remove final crows following proposed actions submitted to gov't		VT	NPCS, Pete Haverson, Mauritius Police, PM's office			
Continue capture of monkeys at BF, EF, BO, VDL at current levels	Notify NPCS of monkey observations in BRGNP	Informal/f2f updates	SH		Ongoing		



Goal 2: Establish a system for screening and response to disease in order to minimise impacts on OWE recovery	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Improve testing of animal imports to include more ecologically-relevant diseases	Update list of diseases of potential threat to OWE, with advice from Shiva	List of updated diseases to screen for developed	VT	Govt Vets, IZVG, Shiva	Dec-23	Time being sufficient for task.
	Vet services and IZVG to receive duplicate samples for OWE	Collect duplicate samples, one screened in Mauritius, and second screened in UK.	Results of tests obtained	VT	Govt Vets, IZVG	Sept-24	Permissions / permits obtained.

Goal 3: Understand the genetics, demographics, health and distribution and movements of the OWE population (island-wide) to be better able to make evidence-based management decisions	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Undertake targeted demographic study of Combo and the tea fields and determine if/ over what timeframes it should be replicated	Monitor the tea field pairs (survival and breeding) during the breeding seasons	Monthly and annual reports	CF	EFR Team	End of march each hand-rearing season	Will only happen for the hand-rearing
	Undertake targeted demographic study of Combo and the tea fields and determine if/ over what timeframes it should be replicated	Identify and monitor all suspected OWE territories in the Combo forest - determine presence / absence of OWE. (Except the tea field pairs monitored by EFR)	MWF monthly reports	SH	MWF	February 2024 (repeated annually each breeding season)	That appointed staff members will be able to effectively survey the area. Shared space is updated and used regularly
	Undertake targeted demographic study of Combo and the tea fields and determine if/ over what timeframes it should be replicated	Capture with mist net and ring at least one OWE in each suspected territory in Combo forest and tea fields.	MWF monthly reports	SH	MWF	February 2024 (repeated annually each breeding season)	That there will be sufficient time in the work schedule to achieve good levels of mist netting, within multiple territories.
	Establish and implement system for genetic and health screening for OWE beginning with existing managed sites.	Continue observations of physical condition for all sightings of OWE on IAA and in Combo	MWF monthly reports	SH	MWF		That clinical signs will be visible for problematic diseases that could occur, and that these will be observed and accurately recorded by the field team.
	Undertake targeted demographic study of Combo and the tea fields and determine if/ over what timeframes it should be replicated	Create shared space listing known territories and survey effort/results of both MWF and ERF across Combo and EFR	Shared document produced	SH	EFR Team, NPCS	February 2024	Document is produced an all parties contribute to the document
	Establish and implement system for genetic and health screening for OWE beginning with existing managed sites.	Blood sample collected from any bird caught during mistnetting and ringing for future genetic analysis	MWF monthly reports	SH	MWF	Ongoing	
	Establish and implement system for genetic and health screening for OWE beginning with existing managed sites.	Understand historical loss of diversity from Combo birds vs historical samples		SH	Ben Warren, NPCS	Ongoing	Communication with Ben and results of lab work
	Establish and implement system for genetic and health screening for OWE beginning with existing managed sites.	Start discussion to establish research question/proposal to investigate diversity on IAA vs mainland	Initial meeting notes	SH	Cock van Osterhout	Ongoing	



Goal 4: Ensure the OWE population on IAA is genetically healthy to secure its long-term viability	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	If early indicators of the genetic study suggest a need for further introduction of GD, a decision will be made and implemented to incorporate the new GD into the population.	Provision of hand-reared birds from Mainland to increase GD at IAA	Monthly and annual report	NZ	EFR Team	January 2024	Result of genetic study
	Determine likelihood of achieving carrying capacity on IAA in order to inform the extent of harvesting, management etc. that might be required and to predict future trajectories.	Analyse demographic characteristics of OWE population on IAA	MWF OWE Annual report	SH	Theresa Robinson, MWF	Oct-23	There is sufficient time available to analyse this information.
	Develop population model to determine offtake possible to avoid negatively impacting the population on IAA.	Determine demographic variables for IAA OWE population - and model harvesting implications using Vortex	MWF OWE Annual report	SH	Theresa Robinson, MWF	Oct-23	There is sufficient data available to accurately forecast the impacts of harvesting.
	If early indicators of the genetic study suggest a need for further introduction of GD, a decision will be made and implemented to incorporate the new GD into the population.	Collect blood and other samples from birds on IAA and BRGNP, assess genetic diversity and differences between these populations	Published Research	SH	C. van Oosterhout, MWF	Dec-24	There is sufficient samples and data available to conduct the study and researcher and funding available.
	If early indicators of the genetic study suggest a need for further introduction of GD, a decision will be made and implemented to incorporate the new GD into the population.	Start discussion to establish research question/proposal to investigate diversity on IAA vs mainland (see also Goal 3)	Initial meeting notes	SH	Cock van Oosterhout	Ongoing	

Goal 5: Establish a viable population of OWE at Ebony Forest to capture existing genetic material	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Propose which eggs/chicks harvested from IAA	Report shared	SH	EFR team, NPCS	Dec-23	There are sufficient breeding attempts on IAA to allow for the harvest of eggs / chicks.
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Monitor nesting pairs at Tea Fields to identify where/when to harvest	Report shared	CF	EFR team	Apr-24	There are sufficient nests, eggs or chicks. Staff can access nests for harvesting safely.
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Harvest wild eggs/chicks from IAA for hand-rearing	Report shared	NZ, SH	EFR team, MWF team, NPCS	Dec-23	Permission secured from NPCS. Harvesting not detrimental to population.
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Harvest wild eggs from Tea Fields (and elsewhere to optimise genetic diversity captured from mainland, eg VdC, BO) for hand-rearing	Report shared	CF	EFR team	Mar-24	Permission secured from NPCS
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Hand-rear harvested eggs/chicks at GDEWS	Report shared	EDS	EFR Team	Mar-24	Permission secured from NPCS
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Release 15 hand-reared birds at EFR	Report shared	NZ	EFR Team	Apr-24	Permission secured from NPCS
	Annually release a minimum of c15 birds to the point of a minimum of 30 individuals survived and breeding	Monitor released birds at EFR	Report shared	CF	EFR Team	Ongoing	NA



Goal 6: Mitigate threats to improve the security of existing naturally occurring fragmented 'sub-populations' of OWE	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Determine simple, effective actions to mitigate threats to these significant populations	Continue planting/propagation of nectar providing plants for OWEs at EFR/ML/VdL	Annual report	AS	EFR Team	Ongoing	NA
	Determine simple, effective actions to mitigate threats to these significant populations (e.g., landowner engagement, closing paths, promoting planting of nectar-provisioning plants by landscapers etc.)	Continue planting/propagation of nectar providing plants for OWEs at IAA		VT	MWF		
	Determine simple, effective actions to mitigate threats to these significant populations (e.g., landowner engagement, closing paths, promoting planting of nectar-provisioning plants by landscapers etc.)	Engage landowners on good nature positive land management, saving biodiversity		VT	MWF		

Goal 7: Initiate re-establishment/ re-enforcement of a new subpopulation within appropriate OWE habitat to improve viability of global population and move towards downlisting.	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Post-OWE survey an evaluation of site selection completed to identify how best to promote population growth	Help to define evaluation criteria of site selection	Shared report about site selection	NZ	EFR Team and MWF team	Mar-24	NA
	Begin work to establish population in prioritised area	Mainland island in Brise Fer	Mainland Island report	SH	MWF	February 2024 (performance of BF Mainland Island reviewed annually)	That the mainland island remains effective at maintaining low rat abundance.
	Post-OWE survey an evaluation of site selection completed to identify how best to promote population growth	Territory mapping and searching in tea fields to contribute to data collection for Island-wide survey (2024-25)	Report	CF	EFR team	Mar-24	
	Post-OWE survey an evaluation of site selection completed to identify how best to promote population growth	Acoustic survey trials with a view to apply in island-wide survey		SH	MWF, Curtin University		
	Post-OWE survey an evaluation of site selection completed to identify how best to promote population growth	Territory mapping and searching in Combo forest to contribute to data collection for Island-wide survey (2024-25)		SH	MWF team		

Goal 8: Reduce invasive plants and increase endemic/native in order to improve food sources, territories and habitats for OWE.	Strategy	Action	How we will know it has been completed?	Lead	Collaborators	Completion date	Dependencies?
	Ongoing habitat restoration as part of wider organisational objectives for NPCS and EB	Continue habitat/forest restoration at EFR, VDL and Montagne Longue	Annual report	NZ	EFR, VDL and ML teams	ongoing	NA
	Develop weeding and planting strategy to minimise negative short-term impacts on OWE	Promote weeding and planting strategy to benefit OWE for Combo	Document produced	VT	NPCS	Jan-24	
	Assess additional OWE areas for habitat improvement considering options to achieve multi-species gains	Sites assessment	Ranked site list produced	VT		Jun-24	Staff have time to conduct this task
	Develop weeding and planting strategy to minimise negative short-term impacts on OWE	Continue weeding and planting on IAA		VT	MWF		

