

Implementing climate change adaptation options for Little Penguins

Summary

The Penguin Parade in southern Victoria forms an important component of Victoria's tourism. It generates \$500 million per annum for the State and provides direct employment to around 200 staff. Climate variability and change are known to affect seabirds, both directly (e.g. through heat-related mortality) and indirectly (e.g. through the impact of climate on habitat and food productivity). There has been considerable research and on the ground action conducted into the impacts of climate on the iconic Little Penguins of Phillip Island (see Figure 1). This snapshot illustrates observed and anticipated impacts of climate on the penguins and adaptation options used to limit negative effects.

The Little Penguin, *Eudyptula minor*, is an iconic seabird with important economic value to Victoria. The Penguin Parade on Phillip Island forms an important component of Victoria's tourism generating \$500 million per annum for Victoria and providing direct employment to around 200 staff.

Seabirds are recognised as potential indicators of the health of marine environments. Climate variability and change have long been known to affect them with their responses varying by location and species. Long-term datasets are essential to understanding how species respond to changes in their environment and the datasets available for the Little Penguins on Phillip Island are unusual in their durations (for some parameters data are available since 1968). This allows for sophisticated insights into how this species is likely



Figure 1: Adaptation options, such as those discussed here, increase the likelihood of Little Penguin chicks surviving to independence. Source: © L.E. Chambers.

Keywords

Climate change, adaptation, penguins, Phillip Island, Victoria

to respond to climate change and enables managers to target adaptation options that are most likely to result in reduced observed or anticipated negative climate change effects.

The first step in the adaptive management plan implemented for the Little Penguins of Phillip Island was an assessment of the likely impacts of climate change and a subjective assessment of the relative impacts, shown in Table 1 (Dann and Chambers 2013; Fuentes et al. 2016).

Adaptation options were generated in response to each of the potential climate change impacts; a subset of these options is shown in Table 2. Additional strategies included increasing the species resilience to climate change, for example, by removing all anthropogenic causes of mortality on land unrelated to climate change.

An example of implemented action includes restricting public access to breeding colonies (see Figure 1). In addition, an entire town has been removed from the penguin breeding area, as well as vehicular traffic at night (see Figure 2). Foxes and roaming domestic dogs have also been removed.

Table 1: Assessment of potential impacts of climate change on the Little Penguin with a subjective assessment of the relative impact of these potential changes (based on Dann and Chambers 2013).

Anticipated climate change effect	Anticipated impacts	Relative impact
Warming air temperatures	Slight increase in adult mortality; uncertain effect on breeding success	Low (generally negative) Some impacts can be reduced through effective management
Sea-level rise	Insignificant loss of breeding habitat; access to colonies disrupted; potential loss of inshore marine productivity	Low (generally negative)
Reduced rainfall (and humidity)	Increased fire risk leading to adult mortality and habitat loss; reduction in stream flow affecting spawning and productivity of prey species	Low? (generally negative)
Increased ocean temperatures and ENSO	Earlier and more productive breeding seasons in short-term; greater survival of first year birds; possible increase in adult mortality	Moderate to high (generally positive)
Ocean acidification and reduced wind strength	Reduced winds likely to reduce fish recruitment and thus prey availability; increased ocean acidification may reduce prey availability	Low – moderate? (generally negative)
Increased ocean stratification	Reduced marine productivity; possible increase in penguin foraging efficiency	Moderate? (overall impact uncertain)



Figure 2: Colony access has been restricted to increase resilience to climate change. Source: © L.E. Chambers.



Figure 3: Night-time road closures are one adaptation option being implemented to protect Little Penguins. Source: © L.E. Chambers.

Many of the proposed actions listed in Table 2 have been implemented and the response of the penguins monitored. For example, to reduce fire risk, all powerlines within the breeding areas are now underground, fire-resistant local vegetation has been encouraged, and fire response planning and capacity has been improved (Fuentes et al. 2016). To reduce the impact of high air temperatures, vegetation density has been increased to provide shade (see Figure 4), and enhanced insulation has been developed for artificial nest-sites.

There is currently no strategy identified to address the impacts of climate change on the marine habitat.



Figure 4: Implemented adaptation options also include the use of vegetation to reduce the impact of high temperatures on nesting Little Penguins. Source: © L.E. Chambers.

Table 2: A subset of climate impacts and proposed adaptation options for the Little Penguin (based on Dann and Chambers 2013).

Climate Change Effect	Adaptation Options
Warming air temperatures	Reduce internal burrow temperatures by increasing appropriate vegetation cover in breeding habitat
	Optimal design of artificial burrows to improve microclimate
Reduced rainfall	Increase appropriate vegetation to reduce evaporation of soil moisture
	Reduced fire risk through: <ol style="list-style-type: none"> 1. Planting fire resistant local vegetation, particularly succulent species 2. Give high priority to quick fire response planning and training 3. Ensure all power supply is underground
	Develop improved understanding of relationship between stream flow and anchovy spawning and production
Sea-level rise	Experimental removal of marram grass to assess impact of storms on dune profile
	Encourage colonisation on eastern side of current breeding area in order to maintain high level visitor experience

References

Dann P., and L. Chambers, 2013: Ecological effects of climate change on little penguins *Eudyptula minor* and the potential economic impact on tourism. *Climate Research* **58**: 67-79.

Fuentes, M.M.P.B., and Coauthors, 2016: Adaptive management of marine mega-fauna in a changing climate. *Mitigation and Adaptation Strategies for Global Change* **21**:209-224.

Further reading

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