Aquila audax fleayi

Wedge-tailed eagle

TASMANIAN THREATENED SPECIES LISTING STATEMENT

Photo: Bill Brown 2022

Scientific name:	***Aquila audax fleayi*** Condon & Amadon, 1954
Common name:	Tasmanian wedge-tailed eagle
Group:	Vertebrate animal, Class bird, Family Accipitridae
Status:	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999:* **Endangered**
	Tasmanian *Threatened Species Protection Act 1995*: **endangered**
	IUCN Red List: **Not listed**
Distribution:	Biogeographic origin: **Endemic to Tasmania**
	Tasmanian NRM Regions: **North, South, Cradle Coast**

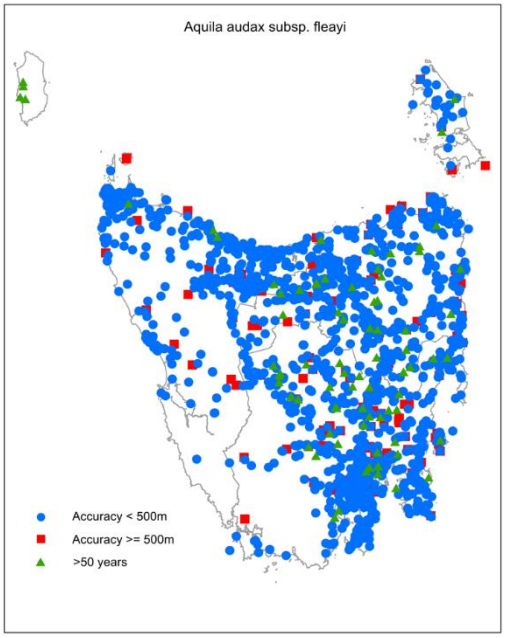

Figure 1. The distribution of *Aquila audax fleayi* sightings, showing NRM regions (from Natural Values Atlas as at 21 June 2022)

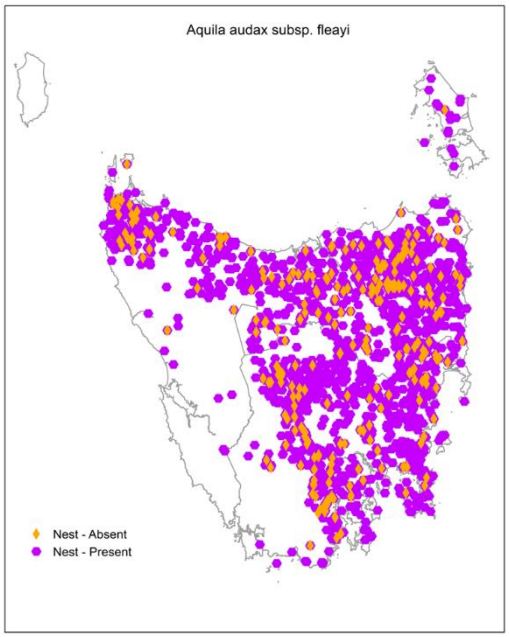

Figure 2. The distribution of *Aquila audax fleayi* nest records, showing NRM regions (from Natural Values Atlas as at 21 June 2022)

Tasmania

SUMMARY: The Tasmanian wedge-tailed eagle (TWTE) *Aquila audax fleayi* is an endemic subspecies of the wedge-tailed eagle, found across most of Tasmania. The TWTE is Australia's largest bird of prey with its distinctive wedge-shaped tail, brown-black plumage and soaring flight. The TWTE hunts and scavenges on animals including reptiles, birds, and mammals across a wide range of habitats, from the coast to highland areas. Mature individuals and breeding pairs will defend large territories, nesting in patches of intact forest with sheltered aspects, requiring large, established trees (typically of the genus *Eucalyptus*) in which to construct their substantial nests. The total adult population has been estimated at less than 1,500 birds. The principal threats to this species include loss of nesting habitat, breeding/nest disturbance, collisions (with power lines and wind turbines, and on occasion vehicles and aircraft), electrocution, poisoning and persecution. Ongoing management of the TWTE is aimed at ensuring a sustainable population through effective protection and threat mitigation actions.

IDENTIFICATION AND ECOLOGY

The Tasmanian wedge-tailed eagle *Aquila audax fleayi* (TWTE) is a subspecies endemic to Tasmania. The population is thought to have been isolated since the flooding of the Bass Strait ~13,000 years ago. However, contrary genetic data exists to suggest that the subspecies may have diverged more recently, having established itself on Tasmania some 200 to 1,000 years ago (Burridge *et al.* 2013).

Like most raptors, female TWTE are larger than the male. Typically, total body length ranges from 100–110 cm, the wingspan ranges from 1.9–2.3 m, and body mass from 3.0–5.5 kg. The species has long, deeply emarginated wings, strong legs and large talons. The legs are feathered to the feet, typical of the genus *Aquila*. Adult birds are mostly a dark, blackish brown, with lighter bases to the underside of primary feathers. Immature TWTEs are lighter brown, with a blonde nape.

TWTEs occupy a broad ecological niche from top predator to scavenger (Marchant and Higgins 1993, Olsen 2005, Debus 2017), and hunt over a wide range of habitats in Tasmania. A variety of prey are consumed, including reptiles, birds and mammals. Most prey items weigh less than 1kg, although larger prey can be taken at times (Gaffney and Mooney 1992). TWTEs can carry prey up to half their body mass during flight, with larger prey typically being dismembered prior to take-off (Fleay-Thompson 2002). Carrion, particularly roadkill pademelon, wallaby, wombat and possum provide an important scavenged resource, but also create a vehicle collision risk.

The lifespan of a TWTE is thought to be up to approximately 25 years in the wild, with an age of first breeding at around five years (Bell and Mooney 1998). The IUCN lists a generation length of 18 years for the wedge-tailed eagle species. TWTEs are territorial breeders, and are considered monogamous, forming pairs for life. However, if one bird of a pair dies, the surviving bird will find a new mate, dependent on availability (Mooney and Holdsworth 1991). Each territory contains multiple nests and perch sites, although only one nest within a territory is active in any one year (Mooney and Holdsworth 1991).

As a top-order predator, the TWTE requires relatively large territories to ensure sufficient resources to successfully breed (Bell and Mooney 1998). Nest survey data analysed by Bell and Mooney (1998) indicated that TWTE occurred at higher densities in productive habitat areas (a mosaic of dry forest and open modified habitats), with densities of one breeding pair per 20–30 km². Densities in more forested areas such as the west and southwest of Tasmania can be as low as one breeding pair per 1,200 km² (Bell and Mooney 1998).

The breeding season spans the period July through January (inclusive), but territorial advertising and courtship can commence as early as June, and nestlings may still be present as late as March (FPA 2022). The season includes four distinct stages; (1) courtship and nest-lining, (2)

egg laying and incubation, (3) hatching and nestling, and (4) chick fledging and dependence. There is also a period of approximately four months to two years (and occasionally much longer) after fledging, during which the young birds remain in their parents' territory (Pay 2019).

The female typically lays one or two eggs in a season (Bell and Mooney 1998). Tasmania's TWTEs are notoriously shy nesters (Gaffney and Mooney 1992)—a breeding pair disturbed from a nest will remain in sight of the nest, but are easily kept away with prolonged disturbance, potentially increasing the risk of death to the egg/s or chick/s from exposure, starvation or predation.

Little detail has been published on survivorship of different age classes of TWTE and more research and longitudinal monitoring is required. Such information is crucial for the development of population viability analyses and population projections for the sub-species.

TWTE nests are substantial structures, measuring 1–3 metres across and 0.5–2 metres deep, made up of varying sized branches and sticks. TWTEs tend to establish their nests on a robust fork, close to the trunk, of large intact trees (FPA 2023). The nests typically occur low within the canopy on the lee (sheltered) or downhill side of a site protecting it from prevailing winds (Mooney and Holdsworth 1991). It was previously thought that TWTEs preferred to locate and construct their nests in patches of old-growth forest or forests with old-growth elements greater than 10 hectares (Mooney and Holdsworth 1991). However, nests are increasingly being identified in more fragmented and modified landscapes (NVA 2022). Further research is needed to understand whether nesting habitat preference is changing, and if this is in response to declining availability of preferred primary nesting habitat and/or human activities.

Confusing species: Juvenile and immature white-bellied sea-eagles *Haliaeetus leucogaster* (WBSE) are strongly mottled-brown in colour and can be confused with TWTE. However, immature WBSEs display greater variation in colour, have a shorter pale tail, a pale half-moon at the base of their flight feathers and unfeathered, and heavily scaled lower legs.

Nests of TWTEs and WBSEs can be hard to distinguish, as their breeding ranges do overlap in Tasmania, and nest usurping or rival nest occupation has been observed (Mooney and Holdsworth 1991). This means a nest built by a WBSE might be used in some years by a TWTE and vice versa.

POPULATION PARAMETERS

The number of adult eagles in Tasmania has previously been estimated to range between 1,000 and 1,524 individuals, within 426 to 457 territories (Mooney 2005; Threatened Species Section 2006). However, ongoing work is required to improve the accuracy and robustness of this population index. Current methods rely on the extrapolation of nesting densities within different habitat types (as a proxy for productivity) to provide estimates of population size and trajectory. Additional work is also required to systematically identify habitats used by eagles and to quantify nest density. More recently, nest survey effort has tended to focus on 'potential' nesting habitat areas that are subject to immediate pressures such as imminent development or forestry activities. Pay (2019) has undertaken complementary 3-dimensional GPS tracking studies that will be used to inform future habitat use models.

Population trend estimates: Scientifically rigorous and robust baseline data is lacking, making it difficult to determine population trends and inform future management and monitoring programs. The various population monitoring approaches trialled in the past suffered from inconsistent repeatability, limited data within and across years, and limited survey coverage, and the data were not sufficiently robust to publish. A focus on quantifying the species' vital rates across habitat types (breeding productivity and age-structured survival) would greatly enhance population models.

Population Viability Analyses (PVA): A Population Viability Analyses (PVA) undertaken by Bekessy *et al.* (2009) predicted a population decline for the TWTE over the next 160 years, if rates of mortality and disturbance to breeding eagles continued at the levels modelled. However, this PVA only applied to the north-east of the state (~17% of the state), and much of the life history data used to parameterise the model were based on metrics borrowed from other *A. audax* populations elsewhere, and other *Aquila* species.

Future focus: The incorporation of contemporary life history data and habitat modelling parameters specific to the TWTE would significantly improve the rigor of quantitative predictions of state-wide population trends. A stratified state-wide PVA would prove valuable in evaluating the magnitude of different threats and inform management decisions, including the prioritisation of recovery actions and the allocation of resources. It will take some time before this data is available to enable suitably accurate predictions.

Survey techniques: A range of survey techniques are used to capture information about the TWTE, dependent on the aspect of the bird's ecology being examined, including:

- standardized point and transect counts,
- nest surveys, and
- nest productivity assessments.

The TWTE is active all year-round and can be readily detected and observed flying and soaring high in the sky or perched strategically in a tree (or atop a power pole) on the lookout for prey. Standardised observational counts are the main technique used to record field sightings. Sighting survey designs include standardised observational point counts and more structured monitoring designed transect counts. Observational point counts are considered a highly suitable, relatively low-cost citizen science monitoring method (Hawkins *et al.* 2020).

Searching for new eagle nests is generally undertaken by ground survey or by aerial searches and occurs strictly outside the breeding season from early- to mid- February dependent to the end of June (FPA 2023). Several predictive spatial habitat and nest models have been developed to support the identification of suitable potential habitat to target for nest searches.

Surveying known nests to assess nest condition and breeding activity, provides important information on the past and potential future use of nests and on population abundance. Nest productivity checks are only undertaken by highly experienced specialists. The Forest Practices Authority (FPA) undertakes aerial inspections of a subset of active nests to evaluate chick mortality and fledging survival rates.

Ground and aerial surveys for new nests should only be conducted by appropriately skilled practitioners and undertaken outside the eagle breeding season. It is recommended that specialists proposing to undertake ground-based surveys complete the Forest Practices Authority (FPA) eagle training course to ensure industry best practice survey techniques are adopted and implemented. The use of UAVs to assess nest condition should only occur between April and June and with strict adherence to the Guidelines developed by Sustainable Timber Tasmania, FPA and the Department of Natural Resources and Environment Tasmania (NRE Tas).

Nest activity assessments, either aerial or ground-based, for the purpose of determining whether a nest is active is considered a highly disturbing activity and should only be undertaken by appropriately qualified and experienced persons, in consultation with the regulators. Surveys are normally conducted between mid-October and the end of December and require a different approach and skill set to that of new nest searches. Ground based nest activity checks are discouraged, while aerial activity checks require highly technical skills to ensure minimal disturbance to breeding eagles. Aerial searches require highly specialised skills, search experience and planning beyond the FPA course and come with significant resource and operational challenges.

For further information on TWTE habitat and nest survey techniques please refer to the FPAs website to obtain the *Fauna Technical Note No.1: Eagle nest searching, activity and nest management guidelines*.

The University of Tasmania (UTAS) and the FPA are collaborating on several research

projects using GPS technology, under strictly regulated conditions, to track individuals and collect data about territorial (home range) extents and fledgling survival rates in different landscape contexts. This has generated important information about TWTE breeding, disturbance impacts, fledging behaviour, and their response to nearby anthropogenic activities (Pay 2021).

Publicly available information: NRE Tas has established and maintains a register and data layer of all recorded nest sites (the Tasmanian Raptor Nest Database). This information is available via the Natural Values Atlas (NVA). New nest and existing nest condition and activity assessment observations for TWTE should be reported to the Department to continue to build knowledge of TWTE ecology and habitat requirements.

Nesting habitat models have also been developed (e.g. Brown and Mooney 1997) and continual refinement occurs through NRE Tas (Bill Brown pers. comm. 2020). The FPA data is accessible as layers on LISTmap and the NVA. The FPA has developed a variety of eagle technical notes which can be accessed from the FPA's website.

Future focus: There is a need to coordinate and centralise data relevant to eagle conservation, making it accessible to stakeholders in real time, to inform effective conservation management of the species. Improved nest records and associated mapping processes will be critical in ongoing management of the species.

RESERVATION STATUS

As of June 2022, 332 (16%) TWTE nests were recorded on formal reserved land (National Park and Conservation Areas) and 980 (46%) nests were recorded in informal reserves including, Permanent Timber Production Zone Land and Future Potential Production Forest Land. A further 130 (6%) recorded nests are protected by conservation covenants on private land (NRE Tas 2022).

CONSERVATION STATUS

The TWTE is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Tasmanian *Threatened Species Protection Act 1995* (TSP Act). The TWTE was initially listed as vulnerable under the TSP Act but was elevated to endangered in 2001. The reasons for listing included an estimated low breeding population (~100 pairs), the threat of persecution, and a loss of old growth forest habitat and nest disturbance. The Australian wedge-tailed eagle was assessed for the IUCN Red List of Threatened Species in 2016 and listed as *Least Concern*. This assessment did not consider the Tasmania subspecies specifically as part of the assessment.

Please note that this assessment was conducted under the previous version of the *Guidelines for Listing under the Threatened Species Protection Act 1995*, which has since been superseded by a newer version endorsed by the Scientific Advisory Committee (Threatened Species) in March 2023.

KEY THREATENING PROCESSES AND MANAGEMENT CHALLENGES

One of the key challenges to the effective management of the TWTE is an absence of robust information on the species ecology and its past, present and future role in Tasmania's ecological systems. Such data would support the quantification of success of management actions, the detection of emerging threats, improve our understanding of responses to existing threats, and help inform prioritisation of recovery actions.

Multiple, interrelated key threats on TWTE populations have been postulated, including:

- habitat loss (vegetation clearance),
- breeding and nest disturbance,
- collision and electrocution,
- persecution and poisoning, and
- the direct, indirect and cumulative effects of climate change.

These threats present multifaceted and complex management challenges relating to:

- the derivation of population and trend estimates,
- habitat protection and threat mitigation,
- research, monitoring and reporting,
- strategic coordination and stakeholder partnerships, and
- community awareness and engagement.

A joint species' management plan was developed under Tasmanian and Commonwealth threatened species legislation in 2006, and is due to sunset under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* in April 2024. The Threatened Tasmanian Eagles Recovery Plan: 2006–2010 was formally reviewed in 2021 and a recommendation to update the plan was approved by the Tasmanian Minister. The Federal Minister will be invited to jointly make the plan.

HABITAT LOSS

Clearing of nesting (and potential nesting) habitat resulting from changed land use such as agriculture, public and private development activities, forest harvesting (of potential nesting habitat), and illegal logging are considered key threats to TWTE conservation. This can lead to a reduction in available nest sites. Conversely, the creation of mosaic habitat may augment the available prey base, leading to increased adult fitness and improved breeding success. A paucity of autecological data, the lack of long-term landscape-scale management strategies, and supportive legislative protection is contributing to this overall threat.

The *Forest Practices Act 1985* (and associated Forest Practices Code), has incorporated provisions for eagle nest protection, including the capacity to informally reserve areas containing identified TWTE nests (≥10 ha). Standard forest management practices also prescribe a 500 m (or 1 km line of sight) management zone around known nests, with the goal of limiting disturbance to adult birds and nestlings during the breeding season. However, the level of legislative protection afforded to TWTE nests within planning schemes across local government agencies is inconsistent and not supported by similar robust decision support tools. An integrated approach across commonwealth, state and local government legislative and regulatory frameworks could support improved conservation outcomes for threatened species (including TWTEs) and their habitat, and improve the ability to assess, evaluate and address cumulative impacts across different scales.

Offsets are another planning mechanism used to account for impacts on threatened raptors. Until recently, offsets aimed at eagle conservation were primarily in the form of protecting nests on private land through the establishment of perpetual conservation covenants. More recently, formal financial contribution offsets have been required by commonwealth and state regulators as a mitigation measure for wind farm developments in Tasmania in situations where impacts are unavoidable and predicted to result in net loss of habitat. These financial contributions have focused on supporting strategic priority research and conservation activities administered via NRM bodies through a dedicated offset fund.

BREEDING AND NEST DISTURBANCE

Disturbance of breeding TWTEs is considered a significant and ongoing threat. Long-lived species with low annual breeding output, such as the TWTE, rely on low adult mortality rates to maintain populations (Newton 1979). Disturbance can be triggered by either visual or aural cues, including activities as innocuous as people bushwalking, photography enthusiasts, or mountain biking in the vicinity of a nest. Other activities such motor biking, firewood cutting, helicopter flights, forest harvesting, and development operational undertakings have been found to lead to far more serious disturbance impacts (Mooney & Holdsworth 1991). Inappropriate inspection or monitoring activities of nest trees (using either aerial or ground-based methods) can also initiate nest

abandonment and reduced breeding success. While individual TWTE responses vary, research has shown that disturbance occurring even many hundreds of meters away can cause some breeding birds to temporarily abandon eggs or chicks, leaving them at risk to exposure, starvation or predation, or even desert the nest site for years (Mooney & Holdsworth 1991).

Unmanned aerial vehicles (UAVs or drones) are a relatively new technology widely used recreationally and increasingly used for scientific research and monitoring purposes. However, the use of drones near eagle nests during the breeding season poses a significant risk to breeding disturbance and nest abandonment. There is also a risk that a TWTE may perceive the drone as another bird or threat and attack the drone potentially injuring the bird.

The FPA have developed fauna survey guidelines including raptor nest survey techniques *Fauna Technical Note No.1: Eagle nest searching, activity and nest management guidelines* to address and mitigate breeding and nest disturbance impacts. The FPA also provides industry training courses specific to TWTE and WBSE surveying techniques and protocols.

Sustainable Timber Tasmania, FPA and NRE Tas have collaboratively developed guidelines for the appropriate use and operation of UAVs around TWTE nest locations.

Enthusiast birdwatchers and photographers may also pose a potential disturbance risk to nesting TWTE and WBSE. To address this gap, NRM South have developed *Ethical Nature Photography in Tasmania Guidelines* to address some of the potential risk behaviours.

Future focus: Develop contemporary species management plans incorporating comprehensive survey, data collection and management protocols, and tailored management advice and mitigation guidelines. There is an emerging need to review and amend existing drone operational guidelines in Tasmania that has specific regard for TWTE and other raptors. Regulation guidelines, operating procedures and Fly Neighbourly Advice for the use of aircraft and drones in the vicinity of TWTE nests also need to be reviewed and standardised in collaboration with those agencies responsible for such activities.

COLLISION AND ELECTROCUTION

Collision with artificial structures such as power lines, windfarm turbines, motor vehicles and aircraft are ongoing threats that causes injury and or death to TWTEs. The current and anticipated expansion of the wind farm industry in Tasmania, importantly, represents an increasing risk for TWTEs from turbine collision mortality. Powerline infrastructure continues to be a collision and electrocution risk for TWTEs. The expected large expansion of transmission infrastructure required to support additional wind farm power generation presents a further risk to the species. Some birds may collide with powerlines and proceed to fly off having sustained substantial injuries ultimately resulting in their death or become entangled in the powerlines resulting in instant death by electrocution. Birds can also be electrocuted from pole top perching where the poles have not been capped with the appropriate material preventing the system from earthing. Records collected over the last decade indicate that mid-span collisions lead to significantly more TWTE deaths than pole top electrocutions (TasNetworks 2021). Pole top electrocution risk can be eliminated from a particular part of the network by retro-fitting these 'problem poles' with upgraded materials that prevent the birds from electrocution. The effect of mortality due to collision and/or electrocution on TWTE population dynamics remains largely unknown.

Various threat mitigation actions have been investigated, trialled or implemented by the industry. TasNetworks have developed a Threatened Bird Strategy and annual mitigation works are undertaken, including the installation of flappers and safe perching platforms to prevent electrocution.

The wind farm industry has been trialling automated monitoring and turbine shutdown systems at some wind farms. This technology is

in its infancy and its success in reducing eagle mortality from turbine strike remains unclear. Further research is needed to ensure its effectiveness.

Future focus: A continuous program of monitoring and systematic surveys of the overhead powerline network and associated infrastructure is considered critical to capture the most comprehensive data associated with TWTE collision and electrocution records and inform adaptive mitigation management actions.

On-going research into wind turbine placement and collision avoidance designs and technologies is another key area for investigation and investment. Understanding why eagles collide with turbines even though evidence indicates they are aware of them is also considered an important area of TWTE research. Windfarm and turbine placement currently uses a 1 km buffer from recorded TWTE nests, a measure derived to avoid risk of disturbance to nesting birds from forestry activities, rather than for collisions by flying birds. These types of regulatory mitigation measures need to be reviewed and informed by further research and monitoring. Dedicated research (such as applied to *Aquila* species elsewhere e.g. Murgatroyd *et al.* 2016 and 2018) is needed to ensure the Tasmanian context for management and protection is considered.

PERSECUTION AND POISONING

Unintentional or secondary poisoning continues to be a threat to, and cause of death of, TWTEs (Pay 2019). Anticoagulant rodenticides (especially second generation) are widely used to poison rodents in domestic and commercial contexts. TWTEs may ingest anticoagulants via animals that have eaten the baits (secondary poisoning) or via animals that themselves have fed on poisoned rodents/rabbits (tertiary poisoning). Even if a non-fatal dose of poison is ingested, it may predispose an individual TWTE to accident and injuries, exacerbate existing injuries, or increase the risk of mortality. The same applies to lead poisoning from ingested shot or bullet fragments; the presence of elevated lead levels in nestlings is of particular concern (Pay 2019). Legal use of alpha-chlorolose to control forest ravens (*Corvus tasmanicus*) during lambing and other nuisance birds also poses a threat to eagles via secondary poisoning.

TWTE continue to be the target of persecution by shooting, leading to mortality of adult and immature birds. Documented cases in Tasmania have declined significantly since the 1980s, however it is not clear if this is because there is a decline in persecution or reduced rates of detection and reporting.

Landcare conducted a series of public presentations in 2021/22 on anti-coagulant rodenticides in Tasmania, summarising key information on their website. BirdLife Australia currently has a national program covering the same issues, brought to the fore by recent mouse plagues and consequent overuse of rodenticides.

Future focus: Data on the effect of poisoning and shooting on eagle population dynamics is not available, preventing the quantification of these risks. An awareness and education program led by the agricultural and horticultural industries and targeting consumers and users of rodenticides and delivered by NRM and Landcare groups to raise awareness and appropriate use of the pesticides in the context of raptor conservation is needed.

CUMULATIVE IMPACTS AND CLIMATE CHANGE

Cumulative effects on TWTEs (at territory, regional, or statewide scale) may be significant, but are currently not well understood, under-reported and not considered in development assessment processes. Other than industries that specifically monitor for direct impacts, such as forestry, TasNetworks and wind farms, there is no regular monitoring and only anecdotal reporting of eagle mortalities and injuries.

Regulation of disturbance through planning schemes does not include a mechanism to consider the impacts of changes to or intensification of use, subdivisions and future

development, which may result in significant and permanent disturbance.

Moreover, understanding the impacts of a changing climate will be critical in managing the TWTE into the future. Identified threats may include impacts on breeding season and breeding success, modification/loss of nesting habitat due to dieback and transitioning ecosystems, changes in wildfire frequency, and severe weather events (Pay *et al.* 2021a, Pay *et al.* 2021b, Mooney *et al.* 2021).

Wildfires and inappropriate fire regimes may also provide an ongoing threat to TWTE due to the potential for the loss and damage of nest trees, and to the surrounding vegetation. Planned burns during the species breeding season may also have an impact on breeding success if the appropriate avoidance and mitigation measures are not implemented.

While the effects of wildfire are difficult to manage, pre-burn planning and assessments for TWTE nest management are undertaken; however, greater consideration of nest proximity is required at the landscape scale and between seasons to reduce the threat of cumulative impacts on individual nests.

STRATEGIC COORDINATION, STAKEHOLDER PARTNERSHIP AND COMMUNITY ENGAGEMENT

NRE Tas coordinates the Threatened Tasmanian Eagles Conservation Management Reference Group (ECMRG) which includes membership from industry, NRM bodies, government and eagle experts to share information about conservation management challenges, issues and research and inform recovery planning.

Community education programs have proven critical in raising awareness about the conservation challenges associated with the TWTE. An annual 'Expedition Class' school education program, a range of community awareness and engagement events and other activities have been run since 2018 as part of promotion for the *Where? Where? Wedgie!* citizen science program, together with regular social media. The Nature Trackers citizen science program website brings together links on reporting, threat management and conservation science for the public.

The Raptor Refuge hotline was established for reporting injured or deceased raptors. Raptor rehabilitation continues to have high public and media profile.

Future focus: Provide information and support to relevant NRM committees, Landcare, local councils, government agencies, the local community and development proponents on the locality, significance and management of known nests and potential habitat. The NRE Tas Private Land Conservation Program extension and stewardship services provides covenant landowners with information and advice about how to best manage TWTEs.

A coordinated community education and engagement program on eagle conservation management is required, with a focus on methods to minimise disturbance around known nests, and other relevant aspects such as the threat from poisoning. Such a program could be extended to local councils, veterinarians, landholders and the broader community. Publicly available tools and data sets also need to be maintained (including the Tasmanian Raptor Nest database on the NVA, and information on the NRE Tas Threatened Species Link, NRE Tas website, FPA Technical Notes and website). Non-government bodies (e.g., BirdLife Tasmania, BirdLife Australia Raptor Group) should be better integrated into formal conservation efforts.

RESEARCH

Several TWTE research projects have been, or are in the process of being undertaken. These include a wide-ranging PhD investigating the conservation requirements of TWTE (Pay 2019) and subsequent studies building on this research, as well as an investigation into the effectiveness and social license of covenanting nests for conservation (Harris 2019). In 2020 TasNetworks commenced funding for a position at the Tasmanian Museum & Art

Gallery (TMAG) which is focused on investigating causes of death of TWTEs and other raptors by reviewing specimens lodged with TMAG (J. Clark, pers. comm). The TWTE Research Fund (managed by NRM South) is supporting several projects including a study using genetic techniques to estimate the size of the TWTE population and another investigating the spatial ecology and habitat use of the TWTE using high-frequency GPS telemetry in unmodified landscapes.

In recent years the Bookend Trust trialled the *Where? Where? Wedgie!* citizen science program to monitor all Tasmanian raptor populations, and a refined version of the method has been repeated annually since 2019. If these surveys continue over the required three generation lengths, this approach is expected to provide high quality information on population trends.

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Permit: A permit is required under the Tasmanian *Threatened Species Protection Act 1995* to "take" (which includes kill, injure, catch, damage, destroy and collect), keep, trade in or process any specimen of a listed species.