SOP

Aerial 1080 in kea habitat Code of Practice

About this document

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Department of Conservation
Te Papa Atawhai

Policy
Standard Operating Procedure
Guideline

New Zealand Government

Contents

1. Background

1.1 Purpose and scope

The kea (*Nestor notabilis*) is a nationally endangered species that requires protection from introduced pests for persistence and maintenance of its range. However, kea can also be vulnerable to pest management tools, including aerially applied 1080 baits. **This Code of Practice is designed to make the best use of aerially applied 1080 for pest management whilst minimising negative impacts on kea populations long term.**

The target audiences for this Code of Practice are Department of Conservation (DOC) staff and other agencies managing aerial 1080 operations in kea habitat on public conservation land (Fig. 1). This includes the following roles as prescribed in the DOC Operational planning for animal pest operations SOP (docdm-1488532) and the Processing applications for vertebrate pesticides and trapping SOP (docdm-1490584):

- Operational planner
- Peer reviewer
- Assessor
- Operations Managers or Directors accountable for DOC permission.

For more information on these roles see Key roles in animal pest planning (docdm-1562274).

While the standards included in this Code of Practice are compulsory only on land managed by DOC, they should be regarded as important guidelines for any agency planning aerial 1080 operations in kea habitat in other areas.

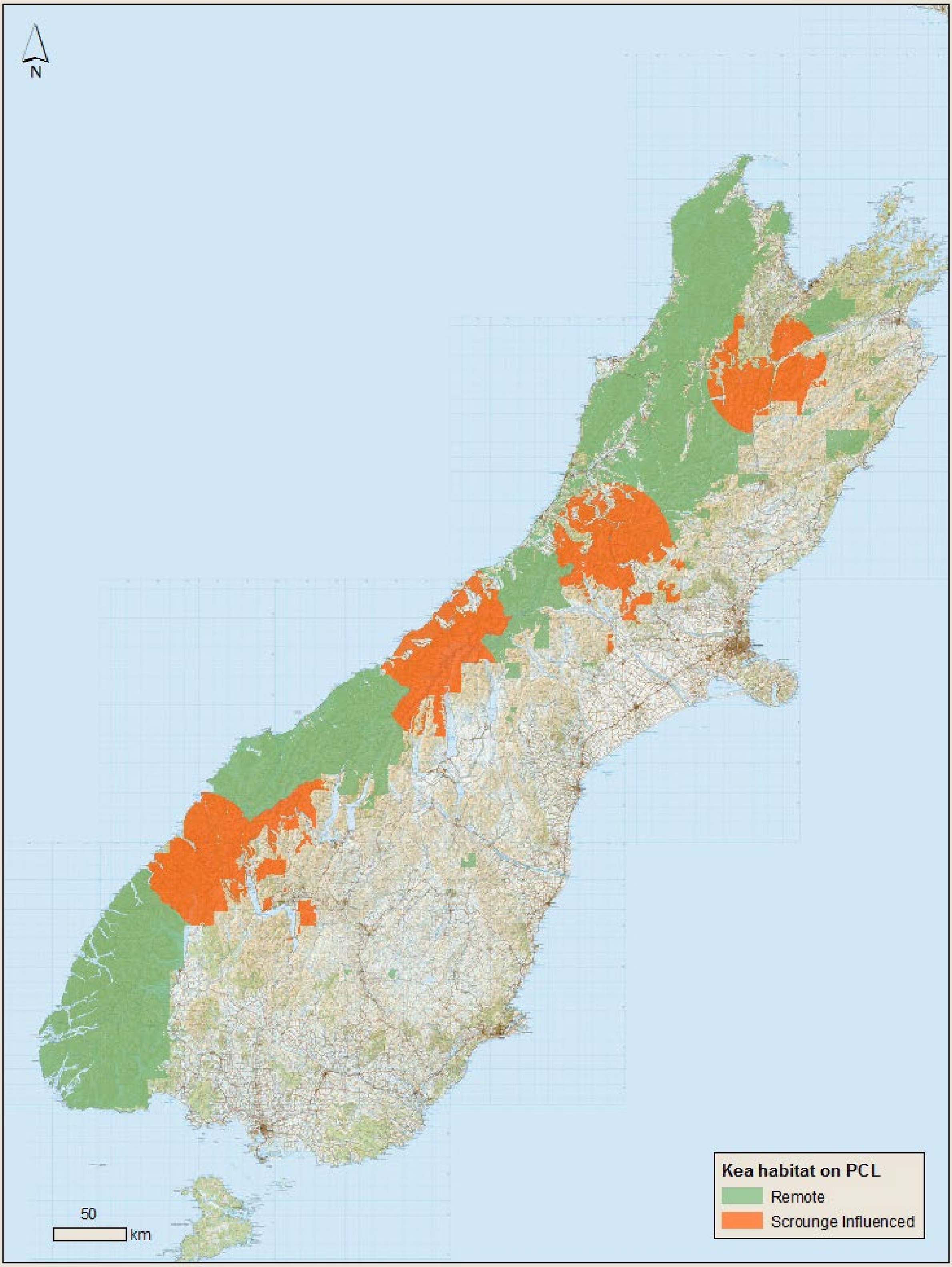
All applications for DOC permission to aerially apply 1080 in kea habitat must include an Assessment of Environmental Effects (AEE). This Code of Practice should be read by all applicants to inform their assessment and management of risk.

This Code of Practice includes two main sections:

- **Section 2:** Summary of research relevant to the risks and benefits of aerial 1080 in relation to kea conservation.

- **Section 3:** Compulsory performance standards applicable to all DOC permissions to apply aerial and handlaid 1080 in kea habitat on land managed by DOC.

Any queries specifically regarding this Code of Practice can be directed to the document coordinator.



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DOC, Geospatial Services

Kea habitat on Public Conservation land

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Figure 1: Areas of kea habitat on public conservation land. Information sources for the map include Robertson et al. (2007), the DOC kea database, DOC Bioweb, the DOC Tier 1 monitoring programme, and the Kea Conservation Trust database (keadatabase.nz/sightings).

'Scrounge influenced' habitat is kea habitat that falls within 40km of known recent or current 'scrounge sites'. 'Remote' habitat is any kea habitat further than 40km from such sites, or separated from them by significant geographical barriers.

The shapefile associated with this map determines where this Code of Practice applies, and where those performance standards that are only relevant to 'scrounge influenced' habitat apply. Boundaries between remote and scrounge influenced habitat will be regularly updated so please refer to the online version. The map and/or shapefiles are available:

Via DOCgis (https://intmap.doc.govt.nz/internalmaps/index.html?viewer=docgis#):
Open DOCgis

Select 'Other Tools' tab

Select 'Layer Catalog'

Select and expand 'Kea habitat', then OK

NATIS (for use by Geospatial Analysts only):
\\intsql4\NEGIS_Connections\NATIS1_os.sde\NATIS1.NATISADM.FAUNA_DOC_KeaHabitat

For external users, data can be accessed as a Geodatabase:

https://opendata.arcgis.com/api/v3/datasets/79ea1d1b63fa436ca8702b1d459b4e7f_0/downloads/data?format=fgdb&spatialRefId=2193

or as a Shapefile:

https://opendata.arcgis.com/api/v3/datasets/79ea1d1b63fa436ca8702b1d459b4e7f_0/downloads/data?format=shp&spatialRefId=2193

Note: The addition or removal of areas as kea habitat in general or as known 'scrounge influenced' habitat would require supporting evidence to be gathered and the Code of Practice coordinator to be contacted.

2. Summary of kea research

This section summarises research relevant to the risks and benefits of the application of aerial 1080 in relation to kea conservation. Additional monitoring results or different analysis methods could change our understanding of kea and predator dynamics. A thorough reading of this section will explain the reasoning behind the Performance Standards outlined in Section 3, but the key points can be summarised as follows:

- Kea nest most years but their nesting behaviour places them at high risk from mammalian predators, with the greatest pressure occurring after mast seeding events (Section 2.2).
- Uncontrolled stoat (*Mustela erminea*) irruptions are a significant cause of the ongoing decline of kea, due to the associated high rates of nest predation (Section 2.3).
- Carnivores such as stoats can be controlled over large areas with aerial 1080, via secondary poisoning. Carnivore kills are likely to be highest when a high proportion of rodents access bait and thereby become toxic. There is evidence that kea nesting success and survival are markedly higher at sites where aerial 1080 operations are timed to prevent stoat irruptions following a mast event compared to untreated sites (Section 2.4).
- Kea can be at risk of poisoning during aerial 1080 operations but this risk is unevenly distributed. Risk is strongly linked to two factors: proximity to locations where kea scrounge from artificial food sources, and previous exposure of kea at the site to 1080. There is a very low poisoning risk in areas that are remote from scrounging opportunities and where there has been previous use of aerial 1080, so in these circumstances we expect net benefit from aerial 1080 operations regardless of operational timing (Section 2.5)
- At those sites where kea are at a greater risk of poisoning operations that successfully prevent stoat irruptions following mast events are expected to have net benefits to kea. It remains unclear whether aerial 1080 operations during non-mast years bring sufficient benefit to offset the accidental poisoning of kea at these high-risk sites (Section 2.6).

2.1 Threat status of kea

Kea are classified as Nationally Endangered, due to recruitment failure caused by predation at the nest and pulses of increased predation of adults and juveniles during stoat irruptions and feral cat (*Felis catus*) incursions.

The kea is a large parrot that is endemic to the South Island of New Zealand (Higgins 1999; Robertson et al. 2007). It is currently classified as 'Nationally Endangered' under the New Zealand Threat Classification System (Robertson et al. 2017), the criteria for which are a population estimate of 1000–5000 and an ongoing or predicted decline of 50–70% in the total population over the next 10 years.

An estimated 150 000 kea were killed between around 1870 and 1970, during which time culling was encouraged by a government bounty (Temple 1996). Kea gained partial protection (except where causing injury or damage to property) by law in 1970 and full protection in 1986 (Miskelly 2014). In 1993, DOC published a management guide for the protection of kea which identified actions to conserve kea, particularly in areas where their activities were causing problems, such as high country runs, ski fields and alpine villages (Grant 1993). A wide range of human activities indirectly threaten kea survival in the wild, including lead poisoning, accidents with human objects, the removal of nuisance individuals and poorly deployed pest control. However, predation by introduced pests is driving the current high risk of extinction.

Kea are recognised as a taonga species, one of special cultural significance and importance to Ngāi Tahu, as acknowledged in the Ngāi Tahu Claims Settlement Act 1998. DOC and Te Rūnanga o Ngāi Tahu are committed to developing a recovery plan. Kea Conservation Trust, the Zoo and Aquarium Association and other organisations are also parties in this discussion.

2.2 Kea productivity

Kea can be very productive in the absence of predators, but their nests are vulnerable to predation.

Unlike other large New Zealand parrots, kea breeding happens in most years. Approximately half of the adult population attempt to breed in any given year and successful breeders fledge between one and four chicks each season (Elliot & Kemp 1999; Higgins 1999). Kea nest in rocky crevices, hollow logs and other natural cavities on the ground within forests (Jackson 1960, 1963; Elliott & Kemp 1999; Higgins 1999), except where no forest cover is available such as at Aoraki Mount Cook. Active kea nest sites are sparsely distributed within the landscape at a density of around one nest per four square kilometres (Jackson 1960; Bond & Diamond 1992; Elliott & Kemp 1999). Kea have a long nesting cycle, with egg laying beginning in August and chicks fledging in December. The combination of ground nesting and a long brooding period places the eggs and chicks at high risk when mammalian carnivores are abundant.

2.3 Predators of kea

Predation is particularly high in the year following a mast seeding event.

The ground-nesting habit and extended nesting cycle of the kea means that the eggs and chicks are vulnerable to predation by mammalian carnivores, particularly stoats.

By contrast the predation of adult kea by stoats is relatively rare due to this large bird (c. 800-1050 g) being at the upper limit of a stoat's prey-size spectrum. Adult kea are easy prey for feral cats, which is exacerbated by their ground-foraging habits, but encounters between these two species are relatively rare and limited to certain times and places. However, any predation on adults will have a high impact at the population level due to the kea's long life and low annual reproductive output.

Stoats affect kea populations across the species' range, particularly following mast seeding events. Mast seeding is defined as the 'strongly variable seed production by a geographically definable population of plants' (Kelly 2008) and significantly increases seed availability. In a mast year, particularly in forests dominated by beech (Family Nothofagaceae) or rimu (*Dacrydium cupressinum*), a large quantity of seed is produced in summer and autumn and rodents become plentiful by the following spring (see Fig. 2). Stoats only breed once per year, in spring, with female stoats giving birth to up to 13 kits generally in mid to late October in the South Island (King & Murphy 2005).

Annual recruitment of stoats is closely related to food availability. When little food is available this is controlled both by reabsorption of embryos and mortality of kits, but during mast years most will survive, leading to a large spike of recruitment into the population in mid to late summer when juveniles leave the nest. This surge in stoat numbers during the year following mast seeding is known as a stoat irruption and corresponds with a very high failure rate for kea nests. In a post-seedfall year without predator control, the survival of kea nests, juveniles and adults is low compared to non-irruption years (Kemp *et al* 2015a, b, 2018).

Other potential predators that have been detected visiting kea nests by cameras include possums (*Trichosurus vulpecula*), ship rats (*Rattus rattus*), house mice (*Mus musculus*) and weka (*Gallirallus australis*). However, these appear to be relatively unimportant compared with stoats and feral cats.

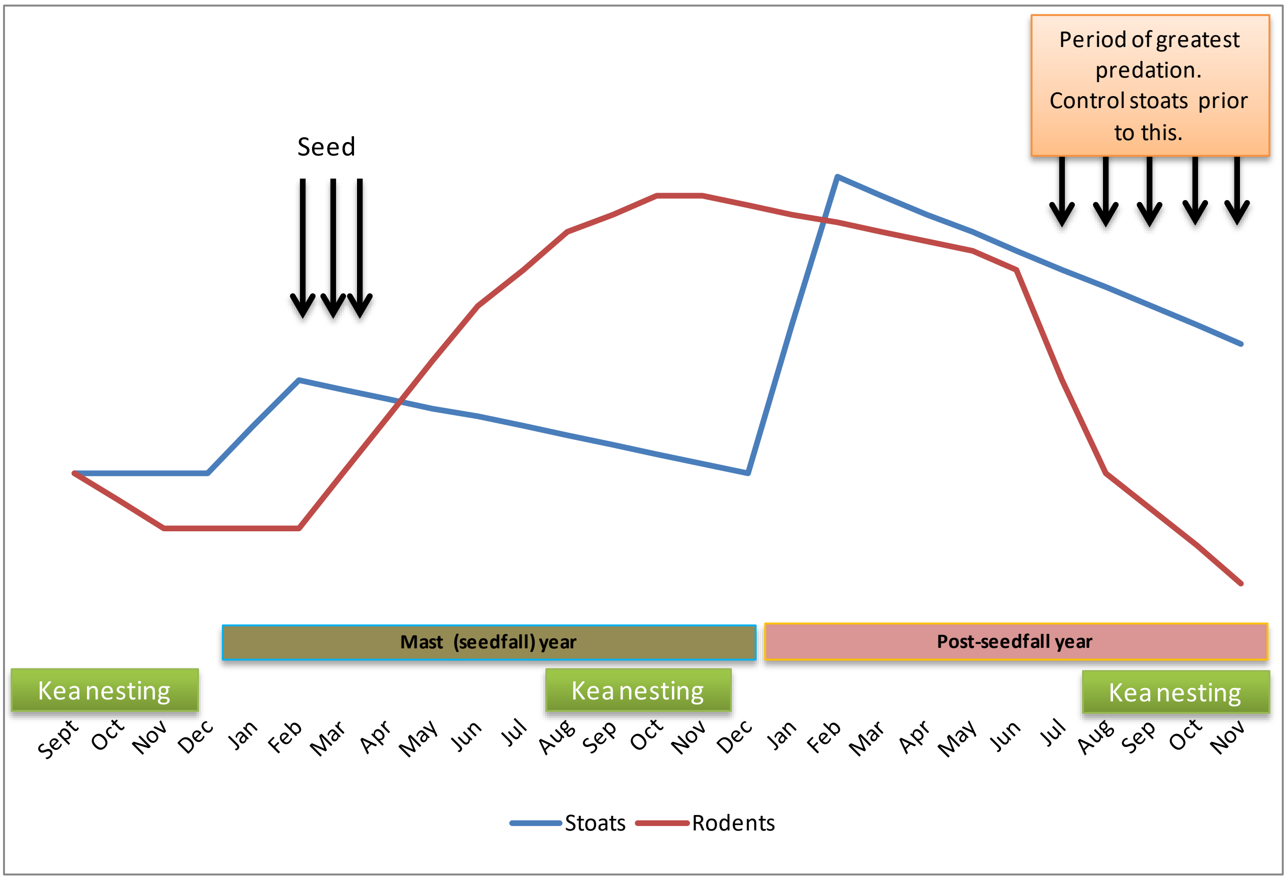

Figure 2: Illustration of how rodent and stoat tracking indices fluctuate during a beech or rimu mast (seedfall) year and in the post-seedfall year.

2.4 Benefits to kea from predator control via aerial 1080

By-kill of stoats from aerial 1080 operations targeting rodents and possums during mast years is the best tool that is currently available to protect kea from stoat irruptions.

The nesting behaviour of kea combined with the biology of stoats means that predator control needs to take place on a landscape scale for effective protection. Kea breeding pairs and nests occur at a low density so broad scale control is needed to cover even a small number of nests (Jackson 1960; Bond & Diamond 1992; Elliott & Kemp 1999). Stoats have a large home range and dispersing young are capable of travelling over long distances (Murphy & Dowding 1994; King & Murphy 2005), meaning that small scale control measures are quickly undone through immigration unless continuously applied. An extensive area (e.g. 30 000 ha, Kemp et al. 2018) must be controlled for stoat suppression to last for a meaningful duration. Control methods must target both female and male stoats to be effective, taking into account that home ranges are smaller for females, and for both sexes when food is abundant (King & Murphy 2005).

Aerial 1080 is the main method used for rat and possum control over large remote areas and can be effective for reducing stoat numbers through secondary poisoning (Brown et al. 2015). The first record of a reduction in a stoat population following the application of aerial 1080 was made by Murphy et al.(1999) at Pureora Forest, who observed prey remains in 12 of 13 radio-tracked stoat corpses after the operation including rat remains in eight corpses and possum remains in a single corpse.

Both rats and mice have been known to be effective vectors of poison to stoats in aerial 1080 cereal operations. This has been accepted for rats for some time, based on consistent rat kills at pre-fed aerial 1080 cereal operations (Fairweather & Broome, 2018) and their common occurrence in the stoat diet (King & Murphy 2005). In the Tongariro Forest (podocarp/broadleaf forest), where rats are abundant (> 60% tracking rates prior to aerial 1080 operations), stoat tracking rates have been reduced to 0% after 1080 operations (Guillotel et al. 2014).

Mouse kills at pre-fed aerial 1080 cereal operations have been more variable than rat kills (Kemp 2015; Fairweather & Broome, 2018). Kemp (2015) compared rat and mouse monitoring results at 22 aerial 1080 operations in mid to late 2014 with the stoat tracking in summer 2015 at treated and untreated sites. Strong stoat reductions were observed where either rats or mice were moderately abundant before the operation and very low afterward. Stoat tracking levels remained high when the operation failed to reduce rats and mice to low levels, leaving healthy rodents in the system (Kemp 2015).

Kea productivity is very low during uncontrolled stoat irruptions. Monitoring of kea productivity and survival following mast seeding events at treatment and non-treatment areas in lowland rimu forest in Westland (Kemp et al. 2018, see Fig. 3) and at several beech forest sites in Kahurangi, Nelson Lakes, and Arthurs Pass National Parks (Kemp et al. 2015a) showed that, nest survival was very poor (< 10%) in the post-seedfall year in the absence of predator control, but high (>70%) when predators were controlled to low levels over a large scale by applying aerial 1080 during the mast year. Thus without the use of aerial 1080, the increase in stoats in the post-seedfall year can strongly reduce kea survival and recruitment.

In some forest types within the range of kea, moderately high rodent numbers are present at all or nearly all times, independent of mast events. Small seasonal stoat population increases may occur every year at these sites. However, the presence of rodents also means that effective stoat control through the use of aerial 1080 may be achievable at most times.

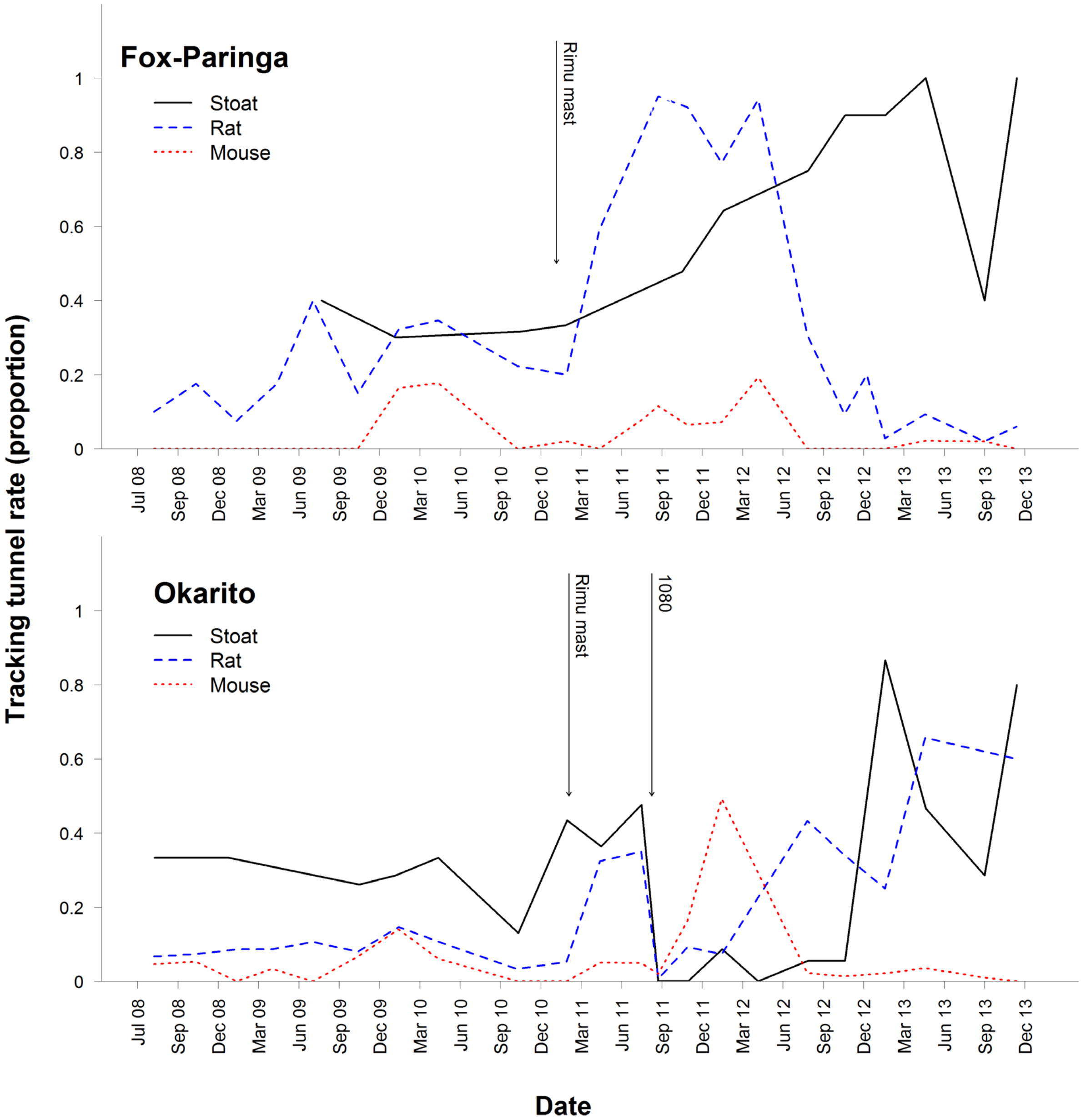

Figure 3: Relative abundances of stoats, rats and mice during a rimu mast year (2011), in the post-seedfall year (2012), and in the following year (2013) where aerial 1080 was applied following mast seeding (Ōkārito) and at a non-treatment site (Fox-Paringa). (From Kemp et al., 2018)

2.5 Non-target risk to kea from aerial 1080 cereal operations

There is some risk to kea from eating 1080 baits but observed mortality rates have been highly variable between operations.

Kea survivorship was monitored through 19 aerial 1080 operations between 2008 and 2016 (Kemp *et al.* 2019; see Table 1). 24 deaths were recorded from a total sample of 222 birds, however within each operation sample size varied greatly as did the proportion of recorded deaths. In 13 of these operations, all monitored birds (n=106) survived. These monitoring data were used to assess how the following variables affected kea survival during aerial 1080 operations: proximity to sites where kea scrounge human food, history of previous aerial 1080 operations at the location, bait size, and kea age/sex class. The most significant predictors of kea survivorship were proximity to scrounge sites and prior 1080 history, with risk to the birds increasing within 20 km of known scrounge sites and during first-time operations at a site. It should be noted that there was an absence of data from operations between 20 and 40 km from identified scrounge sites in this study so for the purposes of this Code of Practice, 40 km is treated as the watershed between 'scrounge-influenced' and 'remote' kea habitat.

At scrounge sites young kea are constantly exposed to rewarding novel foods. The repeated rewarding of bold behaviour is thought to suppress innate cautious behaviours (Kemp *et al.* 2019) resulting in an increased likelihood that a bird will sample new food types including bait. It is possible that this foraging behaviour develops only where juveniles have access to a wide range of food sources (c.f. the 'Neophobia Threshold Hypothesis' in Greenberg 2003) but is maintained throughout the birds' lives, meaning that the influence of any given scrounge site can remain in the population for some time after the source has been removed.

In locations that are remote (i.e. >40 km) from the identified scrounging sites the expected risk to kea is lower but is dependent on the history of previous aerial 1080 use. Kea may be more likely to sample bait when 1080 is being used for the first time, compared with when they have had previous exposure. This effect would be expected to weaken with increased time since the last 1080 operation, but it is currently unclear how quickly this desensitisation occurs. For the purposes of this Code of Practice we regard any site where 1080 has not been used in the previous five years to be the same as a site being subjected to a first-time operation. The elevated risk to kea is managed in the same way as in all operations in 'scrounge influenced' habitat (see Section 2.6).

In locations that are remote from scrounge sites where there has been recent use of 1080 (i.e. within five years), the expected risk to kea is sufficiently low that it will be outweighed by the benefits from an operation, even where these are minimal.

Operation	Number of birds tracked	Deaths recorded	Years since previous 1080	Proximity to scrounge sites
Arawhata 2008	10	0	4	Remote
Fox-Franz Josef 2008	17	7	N/A	Scrounge Influenced
Mt Arthur 2009	13	0	N/A	Remote
Hawdon 2009	10	0	3	Scrounge Influenced
Ōkārito 2011	37	8	13	Scrounge Influenced
Wangapeka 2011	13	0	5	Remote
Abbey Rocks 2011	8	0	2	Remote
Copland 2012	2	0	6	Scrounge Influenced
Hawdon 2012	6	0	3	Scrounge Influenced
Ōtira 2013	34	5	8	Scrounge Influenced
Abbey Rocks 2014	21	1	3	Remote
Hawdon Andrews 2014	4	0	3	Scrounge Influenced
Mt Arthur 2014	7	0	5	Remote
Anatoki 2014	2	0	5	Remote
Wangapeka 2014	8	0	3	Remote
Ōpārara 2014	5	2	N/A	Remote
Rotoiti 2014	2	1	N/A	Scrounge Influenced
Ōpārara 2016	5	0	2	Remote
Wangapeka 2016	18	0	2	Remote
TOTAL	222	24		

Table 1: Sample sizes and outcomes for kea monitored via radio telemetry before and after aerial 1080 cereal operations (adapted from Kemp et al. 2019). 'Number of birds tracked' refers to the number of radio-tagged kea confirmed in the treatment area at the time when 1080 was applied. Deaths were recorded by regular telemetry surveys after the aerial 1080 operation and through searches for any transmitting mortality signals. 'Years since previous 1080' indicates the number of years since aerial 1080 was last used in the operational area, with N/A indicating the first use of aerial 1080 at that site. 'Proximity to scrounge sites' indicates whether the site was more than 40km from ('Remote'), or within 20km of ('Scrounge influenced'), the nearest known location of scrounging kea. Note that kea survivorship data from two 2019 operations in the Perth/Whataroa catchments have not been included, as these operations used non-standard baits and sowing rates.

The evidence suggests that kea are poisoned directly by eating 1080 cereal baits and not by scavenging the carcasses of poisoned animals. Of the 24 monitored kea that died during 1080 operations, 13 died the day after 1080 baits were sown and a further seven had died by the fifth day after sowing. All 17 of the poisoned kea that were autopsied had bright green contents in the digestive system, indicating that green-dyed 1080 cereal bait had been consumed (Kemp et al. 2019).

2.6 Optimising the benefit of 1080 from operations to kea

When aerial 1080 operations are timed to coincide with a mast or post-seedfall year, they are highly likely to prevent the high rates of stoat predation on nests that would otherwise occur. At other times, it is less certain whether the level of stoat by-kill will be sufficient to offset potential kea losses at high risk sites.

Operational timing and scale are critical to preventing the predation of kea and the destruction of their nests by stoats to a degree that compensates for any potential loss of kea through poisoning. Since mast events drive rapid increases in stoat populations, nest predation rates are highest at these times in the absence of predator control (see Section 2.3) and lower between stoat irruptions. Consequently, kea populations will benefit most when aerial 1080 operations cover sufficient areas and are timed correctly to prevent stoat irruptions (see Section 2.4).

At locations where rodent numbers remain moderately high independent of mast cycles, aerial 1080 operations at most times would be expected to control stoats and benefit kea.

Although there is some risk to kea from eating 1080 baits, observed mortality rates have been highly variable. The risk appears to be diminished beyond 40 km from sites where kea are known to scrounge from artificial food sources, and at sites where aerial 1080 has been used previously (see Section 2.5). Table 2 shows the interaction between the benefit according to operational timing and the risk according to the location or previous 1080 history, and whether this is likely to result in an overall benefit to kea.

At low-risk sites, even a minimal benefit to kea will outweigh any losses through poisoning. While it is optimal to time 1080 operations to prevent stoat irruptions, operations at other times are also acceptable if performance standards regarding bait type and sowing rate are followed.

Within 'scrounge influenced' habitat or in areas where there has been no aerial 1080 application in recent years, some kea deaths are expected to result from aerial 1080 operations. However, when these operations successfully prevent stoat irruptions, this is likely to be outweighed by population level benefits. In most forested kea habitat, stoat irruptions and the ability to control them through use of 1080 are closely linked to mast seeding events, so different performance standards are applied to aerial 1080 cereal operations depending on the timing of toxic bait application (see Section 3.1). The timing set out in Performance Standard 4 is optimal for preventing or controlling a stoat irruption. Performance Standard 5 applies to bait application early in a mast year, when a stoat irruption can be prevented if rodents are widespread and subsequently reduced by aerial 1080. Performance Standard 6 applies between mast events, when there is no certainty that the elevated risk to kea will be compensated by protection from nest predation. Operations should only be carried out if it can be demonstrated that the local conditions and operational design will provide net benefit to kea (e.g. if rodent populations remain high enough at other times to be a reliable vector of 1080 to stoats, or stoats will be controlled over a large area by other means such as trapping), or if the proposed timing is critical for other higher priority outcomes.

	Mast event (high benefi to kea)	Pre mast (conditiona benefit to kea)	Non mast (low benefit to kea)
<40km from scrounge sites OR no recent exposure to 1080 (increased risk to kea	Net benefit to kea expected (Performance Standards 1-4 apply)	Net benefit to kea if sufficient rodent populations to provide secondary poisoning pathway to stoats, otherwise net loss possible (Performance Standards 1-3 & 5 apply)	Net loss to kea possible (Performance Standards 1-3 & 6 apply)
>40km from scrounge sites or previous recent 1080 us (low risk to kea)	Net benefit to kea expected (Performance Standards 1-3 apply)	Net benefit to kea expected if sufficient rodent populations to provide secondary poisoning pathway to stoats, otherwise neutral (Performance Standards 1-3 apply)	Neutral to net benefit to kea (Performance Standards 1-3 apply)

Table 2: Likelihood of a single aerial 1080 operation delivering a benefit to kea, where rodent and stoat abundances are linked to mast seeding events, as predicted by the operational timing (kea will benefit from operations that prevent post-mast stoat irruptions) and proximity to scrounge sites (kea are at increased risk from poisoning where their behaviour is influenced by scrounging and/or there has been no recent exposure to 1080 use). Regardless of the scenario, the long-term benefits to kea will be further enhanced when an operation is conducted as part of a wider predator management programme.

2.7 Methods to prevent kea from eating 1080 cereal baits

Repellents are not yet available for operational use but there are actions that can be taken to reduce bait take by kea, in aerial 1080 operations and to manage other human interactions with kea.

In 2010 DOC introduced a mandatory baiting protocol for kea habitat on public conservation land. This restricted the bait type to the RS5 cereal formulation with cinnamon lure. The RS5 cereal formulation was selected because it was found to be less palatable to captive kea than the Wanganui #7 formulation in two independent aviary trials (Luey 2009; Blyth 2011). The RS5 formulation in these trials is consistent with available ProNature Dry Forest and Pestex 1.5g/kg 1080 baits. Cinnamon lure is commonly used in both prefeed (typically 0.15% wt/wt) and toxic baits (typically 0.30% wt/wt), primarily to mask the odour and taste of 1080 to possums (Morgan 1990) but also for its possible lack of attractiveness to birds. All operations where kea survival has been monitored have used cinnamon lure. It is not known how other lures or additives such as deer repellent would affect bait attractiveness to kea or other non-target species.

The use of repellents to deter kea from eating toxic baits has been investigated. Aviary trials showed that the addition of d-pulegone and anthraquinone reduced the consumption of cereal baits by kea (Orr-Walker et al. 2012, Nichols & Bell 2019). However anthraquinone also acts as a deterrent to rats at the concentrations that have been tested to date (Cowan et al. 2015, Crowell et al. 2016b), and d-pulegone dissipates from baits (van Klink & Crowell 2015, Crowell et al. 2016a) so neither of these can be considered a practical tool for field use at present. Zero Invasive Predators Ltd has investigated whether supplying non-toxic baits containing a high concentration of anthraquinone adjacent to an operational area would give kea a negative association with eating bait without compromising the consumption of toxic bait by target species, a strategy that could work in some circumstances (P. Bell, ZIP Ltd, pers. comm.). While aviary trials demonstrated that kea that had eaten bait with anthraquinone ate much less, if any, similar looking bait (Nichols and Bell 2019), it is not yet clear if the proposed strategy was effective in reducing kea interaction with toxic bait in the field.

This Code of Practice also includes a **maximum** sowing rate for prefeed and toxic baits. However lower sowing rates should be used if these will achieve the operation targets. The sowing rate must meet two needs. To control target species enough bait must be provided for all rodents in the operational area to have access to it, otherwise there is the risk that kea (and other non-target species) will be exposed to toxic bait with no resulting benefit. Sowing rates must however be sufficiently low to reduce the likelihood that kea will encounter bait that has not been eaten or cached by rodents. The maximum sowing rates permitted in this Code of Practice allow for the control of target species even when rodent populations are at very high densities, without leaving large quantities of excess bait available for kea.

Kea are likely to be more at risk of sampling baits if they have a history of interacting with human objects and food. Taking steps to reduce kea interactions with human objects could reduce their future risk of poisoning, with the additional benefit of reducing exposure to other lethal hazards. The Kea Conservation Trust website (keaconservation.co.nz) provides information on methods to reduce conflict with kea, including the following suggestions of how the general public can discourage scrounging behaviour:

- Never feed kea.
- Put your gear away and clean up your rubbish.
- Close your doors.

Adopting these behaviours as standard at DOC facilities and in communities that live in kea habitat would be likely to eventually reduce the level of scrounging so could be the most effective long-term strategy for decreasing the risk to kea from 1080 operations. Improved management of buildings, structures and car parks should be established where possible, for example using best practice rubbish bins at car parks and minimising building debris at construction sites.

Wild kea also often have elevated lead levels, likely due to exposure to building materials and lead shot or bullets in scavenged carcasses (Reid et al. 2012). As well as this having direct negative health impacts on kea, these birds may also be more likely to sample bait due to suppressed neophobia (Kemp et al. 2019). Consequently, the removal of lead from kea habitat may also reduce the risk of poisoning from 1080 operations in the long term.

Until a consistent strategy has been put in place for managing kea scrounging behaviour new sites not identified in Kemp et al. (2019) may become established, increasing the area over which an elevated risk to kea will need to be considered when planning 1080 operations. If sites are identified where kea scrounging has or is likely to become established beyond the areas identified in Fig. 1, the Code of Practice co-ordinator must be informed. Such reports, along with other information sources such as the kea database (https://keadatabase.nz/) will be used to regularly update the boundaries between 'remote' and 'scrounge influenced' kea habitat, and to identify priority areas where there may be an opportunity to prevent a new scrounge site from becoming entrenched.

The primary means of managing the risk to kea from aerial 1080 operations is to ensure wherever possible that operations are timed in such a way as to maximise the benefits to kea, while also working to eliminate the scrounging behaviour that places these birds at risk.

3. Compulsory performance standards in kea habitat

This section states the compulsory performance standards that apply to the aerial and handlaid application of 1080 within kea habitat on land managed by DOC (see Fig. 1).

- Section 3.1 Compulsory Performance Standards for aerially applied 1.5 g/kg 1080 pellets (**pesticide uses #1 and #140** on the DOC Status List) and handlaid 1.5 g/kg 1080 pellets (**pesticide uses #2 and #141**).
- Section 3.2: Compulsory Performance Standards for aerially applied 0.08% 1080 Pellets or 0.08% 1080 Rodent Pellets (**pesticide uses #7 and #10**) and handlaid 0.08% 1080 pellets or 0.08% 1080 Rodent Pellets (**pesticide uses #8 and #11**).
- Section 3.3: Compulsory Performance Standards for aerially applied and handlaid 0.2% 1080 Pellets (targeting wallabies, **pesticide uses #22 and #21**) or 0.04% 1080 Pellets (targeting rabbits, **pesticide uses #14 and #13**) and aerially applied and handlaid 1080 carrot (**pesticide uses #25, 30 and 33, and #27, 31 and 34**).

3.1 1.5 g/kg 1080 pellets

3.1.1 Aerially applied

(Pesticide uses #1 and #140)

Table 3 lists the compulsory performance standards for the use of aerially applied 1.5 g/kg 1080 pellets in kea habitat. The performance standards that are applicable to an operation depend on the location and prior 1080 history of the site.

Performance Standards 1-3 apply when:

- operational area overlaps only with **'Remote' kea habitat** as illustrated in Fig. 1 AND **aerial 1080 HAS been applied within the previous 5 years**.

Performance Standards 1-3 AND one of Performance Standards 4, 5 or 6 (depending on the timing of bait application) apply when either:

- The operational area overlaps only with **'Remote' kea habitat** AND **aerial 1080 has NOT been applied within the previous 5 years**; OR:
- The operation includes **'Scrounge influenced' kea habitat** as shown in Fig. 1.

Figure 4 illustrates the time periods when Performance Standards 4 (blue), 5 (yellow) and 6 (purple) apply. A coordinated annual process provides a mast determination for forest and tussock sites in the following year by November, as outlined in Section 3.1.3. Where operations cannot comply with the performance standard that applies to its planned timing, an exemption can be requested following the process in Section 3.4.

Compulsory Performance Standards for aerially applied 1.5 g/kg 1080 pellets **Performance Standards 1-3 apply in ALL kea habitat**	
1	**Bait type:** Only use ProNature Dry Forest (previously known as Orillion RS5) or Pestex prefeed and toxic baits, cinnamon lured to Current Agreed Best Practice. (No other concentrations of cinnamon, and no other lures and additives such as repellents comply with this performance standard).
2	**Prefeed applications and sowing rates:** Use a single application of prefeed bait at a maximum of 2 kg/ha for 6 g baits (or 4 kg/ha for 12 g baits, nominal sowing rates), unless the toxin application is delayed by six weeks or more following the initial pre-feed application, in which case a further application of pre-feed at the same sowing rate is allowed.
3	**Toxic sowing rates:** Use a maximum of 2 kg/ha of toxic bait for 6 g baits (or 4 kg/ha for 12 g baits, nominal sowing rates).
ONE of Performance Standards 4-6 will apply in kea habitat defined as 'Scrounge Influenced' (see Fig. 1); OR in 'Remote' kea habitat IF aerial 1080 has not been applied in the previous five years	
4	**Timing in mast and post-seedfall years (Fig. 4, blue):** When forest or tussock is in a mast (seedfall) year or in the post-seedfall year (as determined by DOC), toxic bait application can occur in the 14 month period between 1 July in the seedfall year and 31 August in the post-seedfall year.
5	**Timing early in a mast year (Fig. 4, yellow):** If toxic bait application is planned for between 1 May and 30 June in a mast (seedfall) year, pre-operational rodent monitoring must be carried out at least once between February and May inclusive. Toxic bait application may only occur prior to 1 July if rodent tracking (rats and/or mice) is detected on at least 50% of *tracking tunnel lines* in each of the important habitat strata within the operational area.
6	**Timing between masts (Fig. 4, purple):** Toxic bait application at any other time (i.e. prior to 1 May in the seedfall year or after 31 August in the post-seedfall year), is not compliant with this Code of Practice.

Table 3: List of compulsory performance standards that apply to aerially applied 1.5 g/kg 1080 pellets on land managed by DOC. An application can be made for exemption from one or more of these performance standards following the process outlined in Section 3.4

3.1.2 Handlaid

(Pesticide uses #2 and #141)

Where 1.5 g/kg 1080 pellets are handlaid in conjunction with aerial application, Performance Standards 1–3 (and Performance Standards 4-6 if in scrounge-influenced habitat or where 1080 has not been applied aerially or by handlaying in the previous five years) apply to the handlaid blocks.

Stand-alone handlaid operations are prohibited in scrounge-influenced habitat or where 1080 has not been applied aerially or by handlaying in the previous five years. In 'remote' kea habitat where 1080 has been used within the previous five years, Performance Standards 1-3 should be followed.

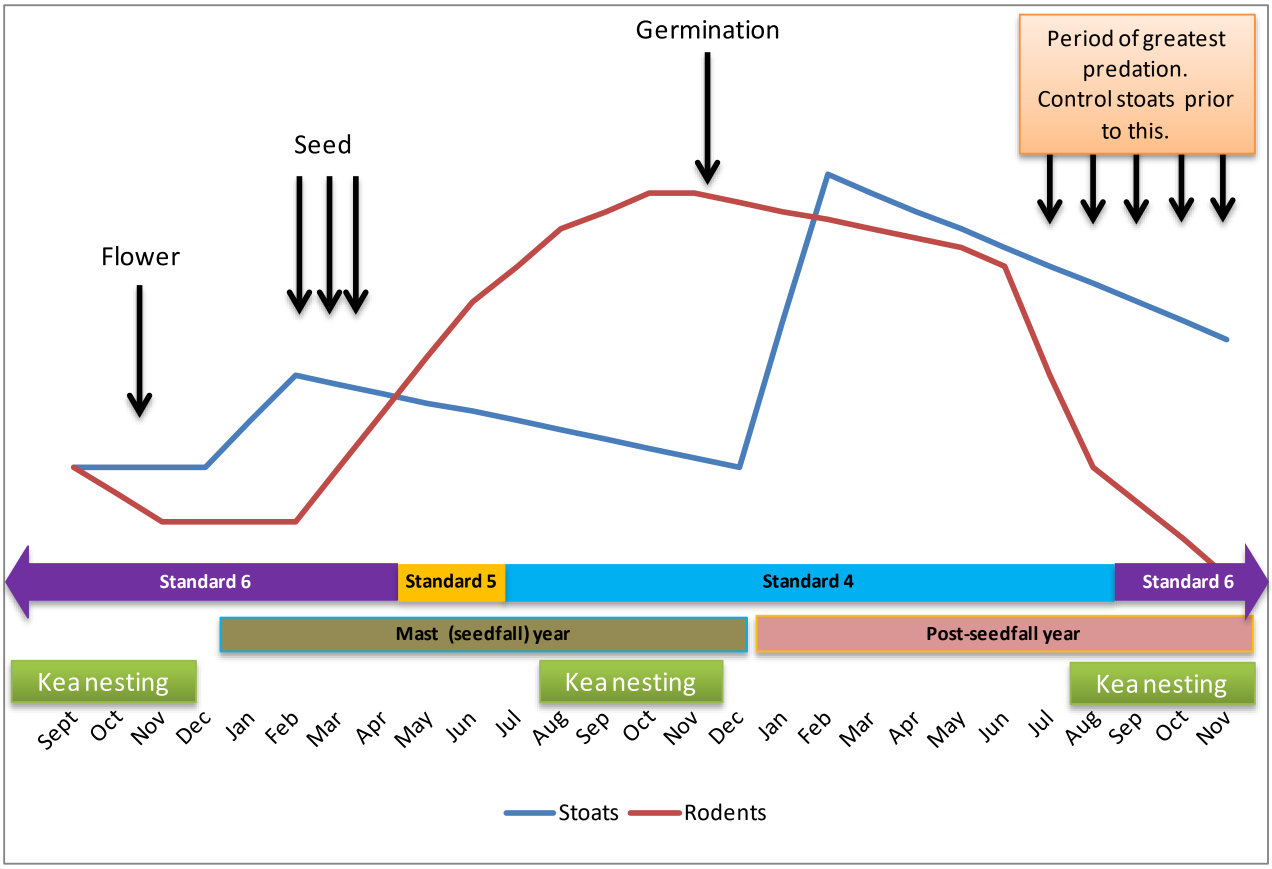

Figure 4: Illustration of the timing of Performance Standards 4, 5 and 6, alongside generalised rodent and stoat tracking indices during a beech or rimu mast (seedfall) year and in the post-seedfall year.

3.1.3 Process for determining whether a planned operation is in a mast or post-seedfall year

The applicability of compulsory Performance Standards 4, 5 or 6 (see Table 3) depends on whether forest within the operational area is considered by DOC to be in a mast (seedfall) or post-seedfall year. Mast forecasts for beech or rimu dominated forests are prepared by the DOC Threats Team, based on a combination of climate modelling (long term for beech) and seed/fruit sampling (short term for both forest types, also indicative over long term for rimu). Forecasts are held by DOC's Landscape Scale Predator Control planning team (within the National Operations Unit). Planners of operations led by external agencies, or within DOC but not aligned with the Landscape Scale Predator Control team, should contact the Code of Practice co-ordinator (ideally with shapefiles of the operational boundaries) who will advise on the likely mast status for that area.

Indicative forecasts based on data collected by April of the year prior to an operation identify those forests that are highly likely or unlikely to mast. For the remainder of forests where a mast event is considered possible or probable, follow-up monitoring (seed sampling) is carried out in February of the year of the operation to confirm the mast status.

For operations in 'scrounge-influenced' kea habitat when a mast event is not expected, managers must decide whether to apply for an exemption to Performance Standard 6 or to postpone the operation until either Performance Standard 4 or 5 is met.

Since the ecological drivers for rodent irruptions in tussock grassland and other non-forest systems are not yet well understood, the application for DOC permission for operations without significant forest habitat must be considered as requiring an exemption and follow the process outlined in Section 3.4.

3.2 0.08% 1080 Pellets or 0.08% 1080 Rodent Pellets

Compulsory restriction

3.2.1 Aerially applied

(Pesticide uses #7 and #10)

The aerial application of 0.08% 1080 Pellets and 0.08% 1080 Rodent Pellets is prohibited in kea habitat.

These products are only available in the Wanganui #7 cereal formulation. This formulation was preferred by captive kea over RS5 cereal pellets in two aviary trials (Luey 2009; Blyth 2011). Applications for DOC permission that do not comply with this compulsory restriction must follow the exemption process outlined in Section 3.4.

3.2.2 Handlaid

(Pesticide uses #8 and #11)

The handlaid application of 0.08% 1080 Pellets and 0.08% 1080 Rodent Pellets is prohibited in kea habitat, both in conjunction with aerial application or as a stand-alone operation.

3.3 0.2% 1080 Pellets, 0.04% 1080 Pellets, or 1080 carrot

Compulsory information need

3.3.1 Aerially applied

(Pesticide uses #22, #14, #25, #30, #33)

Any aerial application of 0.2% 1080 Pellets, 0.04% 1080 Pellets, or 1080 carrot must include the monitoring of kea survivorship (ideally using a minimum sample size of 10 individuals) through radio telemetry, following Kemp et al. (2015c, 2019) or van Klink & Crowell (2015). This requires specialist skills and should be carried out with support from the DOC Biodiversity Group.

Applications for DOC permission that do not comply with this compulsory information need must follow the exemption process outlined in Section 3.4.

No aerial 1080 operations using these cereal baits have been monitored for kea survival therefore the risk is unknown. The cereal baits used to target wallabies (0.2%) and rabbits (0.04%) are different from either the RS5 or Wanganui #7 cereal formulations and are not lured with cinnamon.

Two kea were monitored and survived in one aerial 0.08% 1080 carrot operation in 2007 (Kemp, unpublished data). This method is seldom used in kea habitat, but any future operations need to be monitored to help quantify the risk to kea. Carrot is eaten by captive kea and may be attractive to wild kea.

3.3.2 Handlaid

(Pesticide uses #21, #13, #27, #31, #34)

The compulsory information need identified above for aerial application also applies to handlaid operations of 0.2% 1080 Pellets, 0.04% 1080 Pellets, or 1080 carrot.

3.4 Exemption Process

Any planned operation that does not meet one or more of the relevant performance standards needs to be granted an exemption from that performance standard by the approving DOC manager.

Exemptions are assessed as part of the Processing Applications for Vertebrate Pesticides and Trapping SOP (docdm-1490584), following the process outlined below. The DOC assessment report must include advice from a Technical Advisor (Threats) regarding exemptions from any Performance Standard in this Code of Practice.

Applicants or assessors should contact the Code of Practice coordinator early in the planning process for advice on whether exemptions are required, additional information or actions required to support the exemption application, and alternative management strategies that would avoid the need for an exemption.

Exemptions from any performance standards should only be recommended if the timing of the operation is essential to achieve other required outcomes AND the prolonged control of stoats (more than two kea nesting periods) is likely due to the operation size and high rodent populations between mast events OR if any questions around kea management in circumstances that are not allowed for under the current Performance Standards will be addressed through monitoring during the operation. All outcomes should be reported so that they can be learned from.

Where an exemption from a performance standard is recommended, the reasoning behind the recommendation and supporting evidence should be clearly stated.

The exemption process includes four steps:

Step 1	**Preparing to apply for DOC permission** The applicant discusses their proposed application with the DOC assessor (person who will assess the application) before applying for DOC permission. The DOC assessor **must seek advice from a Technical Advisor (Threats) for exemptions from any performance standards in this Code of Practice.**
Step 2	**Applying for DOC permission** The applicant explains the reason why the performance standard should be waived in their application for DOC permission (docdm-95868) under 'Further information' in Section 5, including their assessment of the bullet points below.
Step 3	**Assessing the application for DOC permission** The assessor evaluates the request and makes a recommendation to the DOC manager in the application assessment report, including any specialist advice required to support the exemption. This might include: • Other priority outcomes that will be achieved if the operation goes ahead as planned • Evidence of sufficient consultation with local communities regarding outcomes for kea • Resilience of the local kea population (e.g. population size, survivorship through previous operations, presence of scrounging behaviour) • Likelihood of achieving stoat control over a large land area (i.e. are there sufficient rodents to provide a reliable secondary poisoning pathway?) • Other stoat control operations planned or in place across the operational area.
Step 4	**Decision on application for DOC permission** The DOC manager considers the recommendation and decides whether DOC permission will be granted. The DOC manager is accountable for the decision to exempt the operation from one or more compulsory performance standards.

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5. Document history

Date	Details	Document ID and version	Amended by
21/01/2020	Version 3 of COP approved on doc-5889535 copied to doc-2612859 to retain same number as previous version	Version 3	Nic Gorman
19/03/2021	DOCgis access to kea habitat map updated	Version 3.1	Nic Gorman
16/02/2024	Section 3.1.1 Performance Standard 1 updated to reflect Orillion brand changes, DOCCM links repaired.	Version 3.2	Nic Gorman

6. Documents replaced

This COP replaces the following document which has been revoked:

- Aerial 1080 in kea habitat Code of Practice V2.2. (doc-2612859 revision 23)