

Kea

(*Nestor notabilis*)

Husbandry Manual

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Department of Conservation
Te Papa Atawhai



Department of Conservation
Te Papa Atawhai

NOTICE OF APPROVAL

The Kea (*Nestor notabilis*) Husbandry Manual is a statement of standards of care for kea held in captivity. It reflects the collective experience of many individuals and organisations that have held kea in captivity nationally and internationally, and seeks to document current best practice in husbandry of captive kea. It also reflects the collective knowledge of researchers and field workers working directly with kea *in-situ* and, as such, aims to increase the standard of care the species receives in captivity.

The manual establishes clear minimum standards for some aspects of kea husbandry.

These minimum standards have not been established with the purpose of eliminating all variations on how holders keep and care for kea (and/or present them for display). Rather, the standards are there to reassure all those with an interest in kea, including the captive management community, the Department of Conservation, the Kea Conservation Trust, iwi groups, and the public of New Zealand, that the fundamental requirements of kea husbandry are being met by all holders.

This manual has been produced by the Kea Conservation Trust with support from the Zoo and Aquarium Association of New Zealand.

The draft manual has been reviewed by captive holders. In terms of the Department of Conservation's Captive Management SOP it is approved for implementation by the Department of Conservation.

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August 2010

This husbandry manual sets new standards and expectations for the captive husbandry of kea in New Zealand. The minimum standards throughout this document are designed to provide the minimum welfare guidelines for captive kea. It is hoped that all kea holders will strive for the best practice standards outlined here and even better, exceed them.

This husbandry manual has been the subject of extensive consultation with captive holders, experienced vet's, the Captive Management Coordinator (CMC) and industry participants. This husbandry manual is considered best practise by the KCT and ZAA and in line with the WAZACS. It has been submitted to the Department of Conservation for formal approval in terms of the Department of Conservation Captive Management Standard Operating Procedure.

This document is dedicated to Ariki, Hopara and Sweetie (Nauhea) and for all other kea in captive facilities throughout New Zealand; here's to a brighter future for you all!

"the critical role of zoos and aquariums within conservation is more important than ever. Zoos and aquariums are in a unique position: that of providing conservation in a genuinely integrated way. For the young people of the world's cities, zoos and aquariums are often the first contact with nature and so you are the incubator of the conservationists of tomorrow."
 Achim Steiner - Director General, IUCN (WAZACS, 2005)



Ariki during a training session, spreading his wings during a health check.
 Photo credit: T Orr-Walker 2003

Cover Photo:

Alyssa Salton and Silver during a relaxed training session in Orana Parks walk through Kea enclosure. Photo credit: Orana Wildlife Park

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1.0 PREFACE

The production of this husbandry manual has been supported by the Kea Conservation Trust (KCT), Zoo and Aquarium Association (ZAA) and Department of Conservation (DOC). Changes to this document require appropriate consultation with all stakeholders including the author, KCT, ZAA and DOC.

This document is to be considered a living document and updated as required. It will be formally reviewed in 2012 and at five yearly intervals thereafter.

2.0 INTRODUCTION

This husbandry manual has been prepared for all holders of captive Kea, *Nestor notabilis*. It reflects the collective experience of many individuals and organisations that have held kea in captivity nationally and internationally, and seeks to document current best practice in husbandry of captive kea. It also reflects the collective knowledge of researchers and field workers working directly with kea *in-situ* and as such aims to increase the standard of care the species receives in captivity.

This manual also establishes clear minimum standards for some aspects of kea husbandry. These minimum standards have not been established with the purpose of eliminating all variation on how holders keep and care for kea (and/or present them for display). Rather, they are there to reassure all those with an interest in kea, including the captive management community, the Department of Conservation, Kea Conservation Trust, iwi groups, and the public of New Zealand, that the fundamental requirements of kea husbandry are being met by all holders. It is envisaged that fulfilment of minimum standards will be a staged process with all stakeholders working practically and in collaboration to ensure the best outcome for captive kea in New Zealand.

Optimal standards are also provided for relevant sections and are in addition to the minimum standards.

Consistent terminology is used throughout the document. Recommendations or guidelines are worded using 'may', 'can', 'should try to' etc, whereas requirements or minimum standards use 'must'. A six monthly internal audit document can be found in Appendix 1. This aims to provide holders with a means of assessing minimum standards in regards their own kea. It also provides holders with a tool to help them focus on where they need to improve to come up to standard. This document will be used with other resources by DOC to assess permit approval.

It is not the intention of this manual to reproduce material which has been published elsewhere. As such this manual should not be considered in isolation, but as part of a series of resources that lay out why and how we care for kea in captivity. All resources may be found on the Kea Conservation Trusts website

(www.keaconservation.co.nz). Resources available to download or access include papers and manuals on kea behaviour and enrichment and captive and wild research as well as a comprehensive bibliography on the species or related issues and links to other organisations involved in kea specific work. These links at the time of publication are as follows:

- <http://www.avianbibliography.org/kea.htm>
- <http://bsweb.unl.edu/avcog/research/keapubs.htm>
- <http://www.keaconservation.co.nz>

People with an interest in the husbandry of kea, especially those that care for kea on a daily basis, are encouraged to contact the Captive Management staff (see section 2.3) with suggestions and comments.

2.1 Taxonomy

Class: Aves

Order: Psittaciformes

Family: Nestoridae

Species: *Nestor notabilis*

2.2 Conservation Status

Kea are presently classified as 'naturally uncommon' (Townsend *et al.*, 2008) and as Vulnerable in the IUCN Red List (Birdlife International 2008).

2.2.1 Population Estimates

The current population status of Kea in the wild is poorly known. The lack of accurate population data is due to the difficulties in surveying and monitoring kea. The low density, marked seasonal and life stage variation and extremely rugged habitat of this species present a number of challenges to obtaining an accurate total population count (Elliot & Kemp, 2004).

The most recent estimate of overall population size gives numbers of between 1000-5000 individuals remaining (Anderson, 1986).

Results of research into the effects of hunting and predation on kea by Elliot and Kemp (2004) suggest a marked increase in the risk of extinction over 100 years from 0.8% in the 1850's versus 32% in 2004 and a lack of confidence in population stability.

2.3 Captive Management Coordinator and Contacts

DOC Lead Technical Support Officer (TSO) for kea

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2.4 Captive Population

As of March 2010 the known New Zealand captive kea population numbered 86 birds (58.5 males, 27.5 females) held by 19 public facilities (14 of which are ZAA members) and 12 private holders. Age of captive population is shown in Fig 1 and founder representation in the current ZAA membership population is shown in Fig 2 (Behrens, 2010).

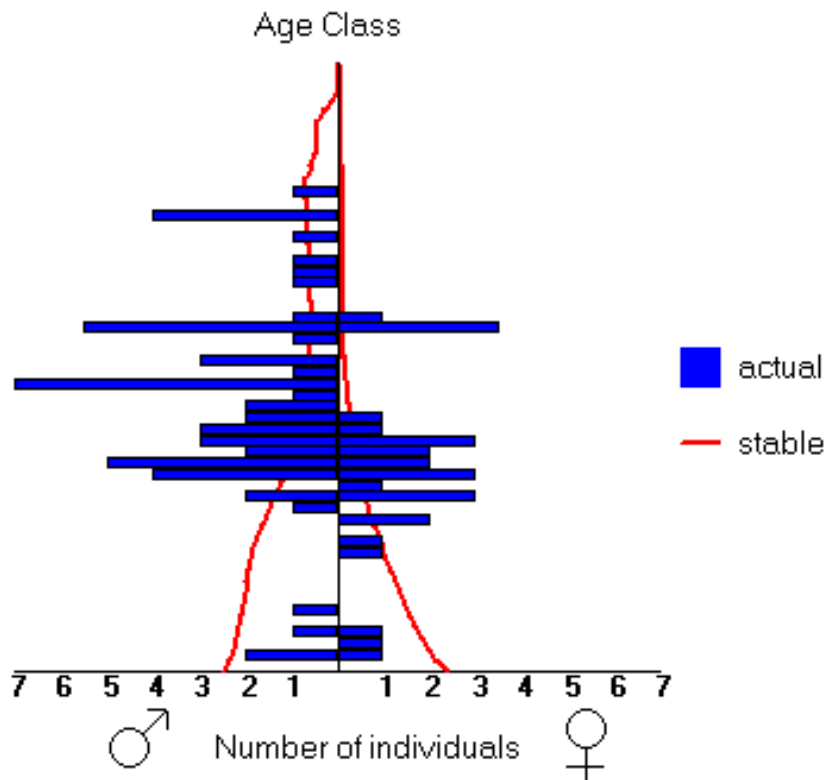


Figure 1: Age Pyramid for total living captive population

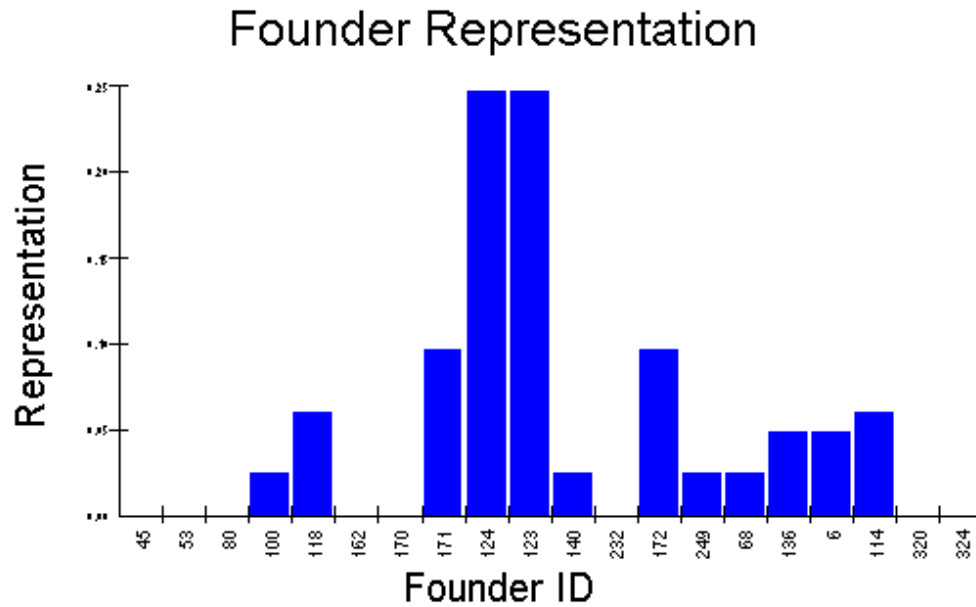


Fig 2: ZAA member organisation founders. #45; 53; 80; 162; 170; 232; 320 and 324 are still living although they are not genetically represented in the current captive population. It is thought founders #123 and #124 escaped. #6; 68; 78; 114; 136; 140 and 172 are dead. Of the 12 living founders, 11 are male (seven with no genetic representation in the population) and one is female (also without genetic representation).

3.0 NATURAL HISTORY

3.1 Introduction

Kea (*Nestor notabilis*), are a psittacine species endemic to New Zealand's South Island alpine areas. They are the world's only alpine parrot and as such are unique. Kea, along with the kaka (*Nestor meridionalis*) and kākāpō (*Strigops habroptilus*), are thought to together form the sole members of a distinct parrot family, Nestoridae, within the avian order Psittaciformes (parrots and cockatoos). It seems likely that the Nestoridae lineage diverged from that of other parrots some 80 million years ago, perhaps as a result of geographical isolation associated with the separation of 'Zealandia' (the precursor to New Zealand) from Gondwanaland (Christidis & Boles, 2008).

Kea have been subject to an extended and unusual period of persecution in New Zealand which has resulted in a major decline in numbers and an uncertain present day status. Kea gained full protection under the Wildlife Act (1953) in 1986. Prior to this they were hunted in a government bounty system up until 1971, which resulted in an estimated 150,000 killed.

They are considered by scientists nationally and internationally, to be one of the most intelligent bird species. They are also considered the 'Clown of the Mountains' by our overseas tourists and do much to bring life and colour to the Southern Alps. They are of both national and local significance to the peoples of New Zealand and are considered to be "*the guardians of the mountains*" by the Waitaha Maori (Temple, 1996).

Maori gave the species their common name, kea, describing the sound of their call. Kea were considered guardians of the mountains for the Waitaha Maori during their search for Pounamu (greenstone) (Temple, 1996). The kea's species name, *Nestor* is from Greek mythology. Nestor was said to be a wise old counsellor to the Greeks at Troy. *Notabilis* (Latin), means, 'that worthy of note'.

3.2 Biodata

Adult weights and measurements vary significantly between individuals particularly in beak length. However males are generally larger and heavier than females (Fijn, 2003). A combination of weight, skull and beak measurements can be used to identify probability of gender in kea as follows:

Gender	*Weight range	Body length	Beak length	Skull length
Males	850 -1000g (average 930g)	46cm	>45mm	>65mm
Females	750-950g (average 840g)	46cm	<45mm	<65mm

Table 1: Average adult kea weights and measurements (Elliott & Kemp, 1999; Kemp pers. comm. 2009)

** Westland lowland kea weights are significantly less (e.g. males average 850g) (Barrett, pers comm., 2010)*

3.3 Distribution, habitat and home range

Kea are now restricted to the South Island of New Zealand. They inhabit lowland areas of podocarp forest on the West Coast of the South Island, through to alpine beech forests, alpine meadows and mountain scree slopes along the length of the Southern Alps. A separate population inhabits the Kaikoura Mountains on the East coast of the South Island. It is not known if this is a genetically distinct population isolated from the rest of the South Island population. Genetic testing of this population is currently being undertaken by researchers at Otago University (Robertson, pers. comm., 2009).

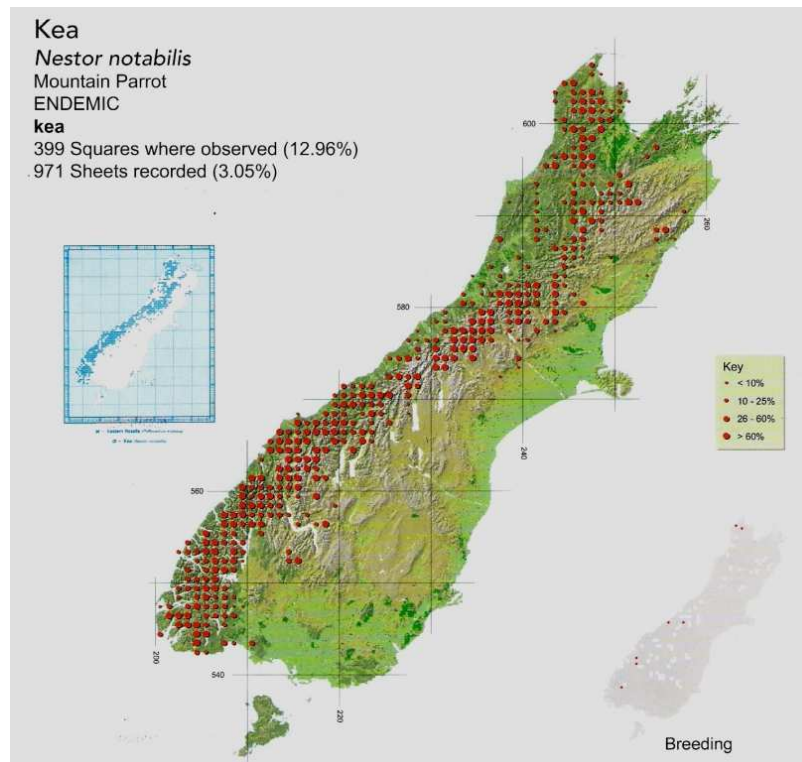


Fig 3. Present distribution of kea in the South Island of New Zealand (Robertson et al, 2007)

A significant decline in kea distribution from the 1980's has been identified in the North West part of the South Island (Robertson *et al.*, 2007).

Territories are extensive and can cover up to 4kms² (Jackson, 1969; Elliott & Kemp, 1999). Breeding pairs may have one or more nest cavities positioned on a spur and their territory will extend from the forest floor up to the alpine area above tree line (Kemp pers. comm., 2009). There has never been evidence of more than one breeding pair occupying a spur (*ibid*).

3.4 Habits, movements and social structure

Although kea are considered to be diurnal they are generally more active early morning and late afternoon/evening.

They are a highly gregarious species which in the wild, form large flocks with non-linear hierarchies. Once adults reach breeding age they tend to leave the main flock and pair up for breeding (Jackson, 1963; Jackson, 1960). Studies by Clarke (1970), of kea population, movements and foods in Nelson Lakes National Park, showed very definite changes in group composition and location related to different times of the year. During August - September it was observed that kea formed flocks of 6 -8 birds which dispersed in October – December into smaller groups of 2 – 3. In January and February large flocks of up to 13 individuals again formed.

Studies by Jackson (1960) in Arthur's Pass also observed large groups of around 20 first year birds during the summer period. These large flocks were then seen to disperse into groups of 2 -6 in autumn. Movement of all groups was seasonally and food related with those birds that moved to higher altitudes (1,219m – 2,133m) in the warmer months observed foraging for food and retreating back to the shelter of beech forests (up to 1219m) during autumn and winter.

3.5 Feeding behaviour

Kea are opportunistic omnivores and consume a wide variety of foods in the wild. Behavioural, faecal and gut studies have shown that kea eat over 200+ different varieties of natural foods including a wide range of animal and vegetable matter. Foods include grasshoppers, beetles (adults and larvae), ant larvae, weta and cicada nymphs, other invertebrates and the roots, bulbs, leaves, flowers, shoots, seeds, nectar and fruit of over 200 native plant species (Brejaart, 1988; Clarke, 1970).

Kea have also been recorded eating other bird and mammal species including: Huttons Shearwater (chicks and eggs), racing pigeon, sheep meat and bone marrow, stoat and possum carcasses (Brejaart, 1988).



*Kea eating snowberries
Andrew Walmslev*

They have also been known to consume fat from the carcasses of hunted introduced mammal species such as Tahr, deer and Chamois (Maloney, pers. comm.), and on occasion are also known to attack the fatty area around the kidneys of live sheep left high in the alpine areas (i.e. above 600m) during winter when resources are low (NHNZ, 2006).

Kea are one of the few species which have managed to take advantage of humans moving in to their habitat. They use their beak, cognitive abilities and tenacity to access resources and investigate any potential uses of new objects. Rubbish dumps/bins, seasonal deer culls, farms and ski fields continue to provide useful sources of food (and toxins in some cases) for kea in times of hardship.

Historical burn-off of high country forests by farmers, and continued legal annual burn-off of these areas between June and October (ECAN, 2005) have significantly decreased the availability of natural food sources throughout the natural range of kea. How this impacts the survival of the species is unknown. However, research into the major cause of death in kea has historically been attributed to lack of food resources (Jackson, 1969).

3.6 Reproduction

Pairs are generally considered monogamous, although there have been accounts of males pairing with more than one female (Jackson, 1963). Kea reach sexual maturity around 3-4 yrs of age. Mating behaviour begins in midwinter around June. Egg laying begins in July and peaks in October, but can extend right through into January (Jackson, 1962; Jackson, 1960).

Up to six eggs may be laid but the typical clutch size is 2–3 in the wild. The eggs are incubated for approx 28 days by the female. The male feeds the female at the nest entrance who in turn will regurgitate food to the chicks inside the nest. In the latter stages of rearing, the male will also directly provision the chicks until after fledging. This is a resource intensive period for the male who must not only provide for his own maintenance in often harsh conditions, but also his mate and offspring. Chicks spend up to 12 weeks or more in the nest (Pullar, 1996). Kea chicks have a long juvenile period and as such are dependant on their parents for the first 4-5 months of their lives. The majority of kea chicks fledge from December – end of January (Kemp, 1999).

Because of the long period associated with rearing chicks (approximately four months from start of incubation to chicks fledging) it is uncommon for kea to rear more than one brood in a season. However, if the eggs fail to hatch or are damaged, or if the chicks die or are removed, pairs will generally re-nest almost immediately. This has been observed in both the wild and captive situations (Pullar, 1996; Barrett, pers. comm. DoC, 2009).

Lifestage	Timeframes	Time of Year
Egg to hatching	28 days (23-26 days Woolcock, 2000)	July - October
Fledgling	13 weeks	December - February
Parental care period	Minimum 19 - 26 weeks invested in chick rearing (2-6 weeks of this after fledging)	June - March

Table 2: Life stages and time frames (adapted from Fijn, 2003)

3.7 Protected species' role in ecosystem

Kea, as a significant berry and seed eating species in alpine areas, are considered to be important in the dispersal of the seeds of native alpine plants (Brejaart, 1988; Clarke 1970). Kea habitat covers an extensive area (4ha²) with a large proportion of this regenerating native bush from high country areas previously cleared for farming. Dispersal of native plant species in these areas is important to help combat invasion of pest plant species.

Although not considered carrion feeders, kea are opportunistic and have been observed feeding off the carcasses of rabbits, possums and deer which have been killed on the roads, through pest poisoning programmes and/or hunting (Walmsley, pers. comm., 2009; Maloney, pers. comm., 2009; Kemp & van Klink, 2009). Kea may have played a role in cleaning up carcasses prior to human arrival.

3.8 Threats in the wild

The main threats to kea are intentional and unintentional human induced deaths, predation by introduced species and reduced availability of natural foods (Elliott & Kemp, in press; Kemp & van Klink, 2009; Grant, 1993; and Temple, 1996). Ongoing research continues to highlight the often widespread incidence of these pressures.

3.8.1 Human Induced threats

Intentional

Kea underwent extensive historical persecution in a government bounty which reduced the population by an estimated 150,000 individuals (Temple, 1978; Temple 1996) from 1860 – 1971. Kea gained partial protection in 1970 and full protection in 1986 under the Wildlife Act (1952). Persecution of kea still occurs throughout the species' range. Intentional poisoning and/or shooting of kea continues to be reported in the media (NZ Herald, 2008; McDonnell, 2009) although prosecutions are rare. Smuggling of kea for the international black market has also been documented in the past and as with other unique New Zealand species, remains a concern (Diamond & Bond, 1999).



Kea were persecuted for their attacks on sheep in high country areas. Unknown artist 1882. Photo credit: Alexander Turnbull library

Unintentional

Human made toxins identified as having potentially widespread and extensive impacts on kea include lead (McLelland, 2009) and 1080 (Kemp & van Klink, 2009). Both toxins have been used throughout kea habitat over an extended period of time and are now known to directly impact the health and survival of kea populations throughout the species' range. Lead, predominantly in the form of lead flashing and nail heads, has been used extensively throughout the landscape since the late 1800's – 1990's and still exists in substantial quantities in old mining areas, public and private high country dwellings inclusive of ski fields, tramping huts and sheep stations. 1080 has also been used widely by DoC and the Animal Health Board (AHB) throughout New Zealand since the 1950's for control of introduced pest species and in particular brushtail possums as they are a vector for bovine TB. Research is currently being conducted by the KCT and DOC into preventing 1080 poisoning with initial positive results and subsequent changes in 1080 drop protocols. Investigations into the extent of lead throughout Conservation estate is currently being undertaken by the NZ Royal Society (supervised by Unitec, NZ).

Other human induced causes of death include vehicle incidents, accidental capture in possum traps and ingestion of other pest control poisons, and ingestion of human foods toxic to kea (e.g. chocolate).

3.8.2 Predation

Predation by introduced predators such as rats, stoats and possums, has historically been considered a lesser issue to kea than many other New Zealand endemics (Elliott and Kemp, 2004). Kea ground nest and are therefore potentially as vulnerable to predation as their close relative the kaka, although nesting success has previously been found to significantly increase above 600mtrs (Elliott and Kemp, 1999). However, with evidence of predators moving higher into alpine areas, possibly due to changing climatic conditions, this threat may be increasing. Possum remains and fresh scat have being found in or around kea nest sites over 1000m (KCT, unpublished report 2009). Possums may not only directly predate on nesting kea and/or their chicks, they may also compete for available nest sites and natural food sources.

4.0 CAPTIVE HUSBANDRY

Kea are an easy species to hold badly and a difficult species to hold well.

In the poorest of captive environments they will survive. However, they will not only be an unexciting exhibit for the public, but be a poor advertisement for the facility holding them. Yet in stimulating and welfare driven facilities, they make an engaging and popular exhibit that enthralls the public. Kea thrive on new experiences; they have evolved to investigate new objects in new situations and as a result are insatiably curious; a characteristic familiar to visitors to our South Island alpine huts. Kea are one of our most robust avian species, reacting more positively to stimulus than to inaction in their environment. Provision of a stimulating, complex environment should therefore be considered a basic husbandry requirement for this species.

Primary reasons for holding kea in captivity are advocacy, education and research to support conservation of the species in the wild. Recommendations for management of *Nestor* captive populations by the Conservation Breeding Specialist Group (CBSG) state a strong research priority for this species to enhance *in-situ* knowledge. This includes studying and analysis of reproductive behaviours and population dynamics and developing techniques for husbandry that may be used for enhancing wild populations or help with possible re-introduction and supplementation (Grant *et al.*, 1993).

Captive facilities also play an important role in conservation through advocacy. However, the way in which animals are displayed is crucial to the perception of the public and their take home message;

“In the very best zoos, wild animals can be seen as ambassadors for the survival of their species in the wild. In the worst zoos, they generate nothing but negative reactions”.

– Hancock (2001)

Advocacy involves taking the conservation message outside captivity to *in-situ* initiatives in order to increase public understanding and buy-in of conservation efforts. This is achieved through clearly displayed links to *in-situ* organisations/initiatives at the enclosure (for a list of links, please refer to Appendix 2).

Captive holders must be aware that the public today are more cognisant of welfare standards and what constitutes natural behaviour in species. Animal welfare standards are increasingly under scrutiny, and captive holders are now obligated to provide for both the physical and behavioural necessities of species under the Animal Welfare Act, 1999 and as encouraged by the WZACS (WAZA, 2005). It should be seen of particular importance that facilities run by local and central government lead the way in ensuring standards for kea are of a consistently high standard.

This manual sets new standards and expectations for the husbandry of kea in New Zealand. The minimum standards in this section are designed to provide the

minimum welfare guidelines for captive kea. An audit document is also included to aid facilities in assessment of their own minimum standards (Appendix 1).

It is hoped that all kea holders will strive for the best practice standards outlined here and even better, exceed them.

4.1 Housing/Environment Standards

4.1.1 Introduction

Enclosure complexity and design is crucial for maintenance of an animal's physical and psychological wellbeing. Successful management of wild animals in captivity can be difficult, requiring housing of animals in a way that fulfils both their physical and psychological requirements (Croke, 1997; Young, 2003).

From a physical point of view, if an enclosure does not enable a species to perform its basic form of locomotion, then it is viewed as deficient in design (Young, 2003). Inability of animals to perform basic locomotor behaviours (in this instance flight) may result in atrophy of associated muscle groups as well as manifestation of inappropriately directed behaviours – namely stereotypies. This is documented in Kiepers (1969) where stereotypic route pacing in wild birds was extinguished when birds were introduced to larger aviaries which allowed appropriate levels of flight. However, larger enclosures on their own are not necessarily better, as space within that area may not be physically or psychologically useable by the species concerned. Enclosure design should therefore be species specific and take into account variation in topography, substrate types (as defined by Eisenberg, 1981 as cited in Young, 2003, p 122) and include a range of useable space and levels.

Kea are considered a highly intelligent and complex social species with many of the attributes that support a high level of cognition (Gadjon, 2005). They are opportunistic feeders with an almost complete lack of neophobia (fear of new things), and as such fit into Kreger and Mench's respective models of a high priority species requiring high levels of novelty and variability in their captive environment (Mench *et al.*, 1998). Additionally, kea in the wild cover an extensive range and variety of ecotones (Diamond & Bond, 1999).

The behavioural repertoire of captive kea in New Zealand facilities has been observed to be significantly effected by provision and complexity of enrichment and enclosure complexity (Orr-Walker, 2005). High enclosure standards are considered a basic requirement for this species.

4.1.2 Enclosure Types

There are three main types of enclosure presently housing kea in New Zealand; public walkthrough enclosures, limited access enclosures and traditional aviaries. Each has its place in housing kea and can provide vastly different experiences for kea and public alike.

Walkthrough enclosures are excellent for immersion and provide positive and exciting experiences for the public. Assuming that there are ample off display areas that are inaccessible to the public, and enclosures are of a size to accommodate public presence, they are also extremely effective for ongoing kea enrichment.



*Spot the kea! Walkthrough enclosure – Staglands
Orr-Walker 2005*

If the design of walkthrough enclosure is carefully thought out, all life and reproductive stages can be housed successfully and safely. Additionally due to the larger size typical of these enclosures, a greater number of birds can be housed together, providing for an increased potential for complex social interactions.

Pros:

- Excellent advocacy and public interactive immersion experiences
- Excellent enrichment opportunities for kea
- Excellent social opportunities for kea
- Excellent advertisement for the facility
- Benefits for training and conditioning to be included in encounter

Cons:

- Costly
- Public access may need to be monitored throughout the day to ensure public are not feeding birds, offering dangerous items or entering kea only areas
- Care must be taken to meet individual kea requirements; some birds may not be suitable in public access enclosures
- Potential issues relating to territorial behaviour. This would need to be assessed on an individual basis
- Potential transfer/introduction of disease

Limited access enclosures are useful for holding of kea where birds are less able to cope with direct human presence in their enclosure. This may be particularly true of older wild sourced birds, or non breeding pair-bonds.

Limited access enclosures allow for unobstructed views of the enclosure while containing public access to one area of the enclosure by use of a solid barrier system. Birds get the benefit of the extra space the public viewing offers when the public are absent (particularly at night when kea are active).

Pros:

- Allows public easy viewing with no mesh between public and birds
- Cost effective method of public immersion
- Provides increased space for the kea
- Safe for birds which may be less tolerant of public presence
- Easy to construct on existing enclosures with minimal disturbance to birds
- Allows for great encounters with the public (e.g. An alternative to free flight)



Kea enclosure with limited public access at Paradise Valley Springs, Paradise Valley, 2009

Cons:

- Public access may need to be monitored as with walk through enclosures (i.e. maximum numbers in larger holdings)
- Potential issues relating to territorial behaviour. This would need to be assessed on an individual basis
- Potential transfer/introduction of disease

Traditional aviaries are those which do not allow any human access into enclosures. They are appropriate for valuable breeding pairs which will have little desire for interaction with the public and may also be territorial during the reproductive season.

Traditional aviaries do not generally enable an interactive exhibit for the public unless kea are provided with good enrichment opportunities. Excellent signage and/or interactive interpretation will increase visitor interest in these cases (i.e. encouraging observation and describing what they are seeing in the enclosure and why).

Pros:

- Assuming best practice standards are followed, these aviary types are good for housing valuable breeding pairs

Cons:

- Difficult to provide an interactive experience for the public

- Advocacy potential substantially lowered
- Enrichment potential for birds substantially lowered

Enclosure design: Housing environment is extremely important for advocacy purposes – a poor enclosure can send the wrong message to the public and reflect badly on the facility. Enclosure design should seek to increase expression of natural behaviours in the kea of a normal duration (i.e. which decrease the incidence of stereotypic behaviours) and send a clear conservation message to the public providing a meaningful link for the public to species issues in the wild.

Signage: This may be static (fixed printed signs and images), interactive (quizzes, tactile, technological, encounters) and/or passively active (e.g. video footage). Information may include:

- Taxonomy
- Bio-data
- Natural habitat and range
- Population numbers
- Why are kea held in captivity?
- What are the issues in the wild?
- What can the public do to help the species?
- Links to outside organisations for more information (KCT, DOC)*

*(*For a list of Links please refer to Appendix 2).*

Signage type:

- Static: Traditional signage should be colourful, bold and to the point getting across key messages with minimal text. Use of powerful images should be used to lend weight to the text which should include questions to stimulate enquiry.
- Interactive: Signage which involves some physical interaction with the public is more likely to be read and information retained (Crawford, 2007). Examples may include quiz panels, tactile (kinaesthetic) displays (models of kea beaks etc), interactive touch panel video technology and/or cameras to view live animal footage
- Passively active: Displays which are constantly changing rely on installation of comparatively expensive equipment, however once in place this type of display can be updated indefinitely. A video display with voice over can showcase natural kea behaviours and send key messages relating to issues in the wild thus providing a visually powerful conservation message

4.1.3 Size

Stating minimum enclosure sizes for captive kea is problematic. In the wild kea are strong flyers covering great distances both horizontally and vertically (altitudinal) in any one day. Satellite tracking of juveniles and observations of adult kea at Nelson Lakes (unpub. KCT, 2009) has shown birds to fly several kilometres in a matter of minutes and over 40kms in normal dispersal behaviour

over a 2 month period. Kea territorial range for a breeding pair in the wild is estimated at 4km² (Bond & Diamond, 1992).

For a highly intelligent, social and mobile parrot species living in a complex alpine environment, flight, social interactions and exploration are fundamental behaviours for kea. Unfortunately captive environments for birds often allow only limited expression of these behaviours (Engebretson, 2006), denial of which can result in physical (Graham 1998) and behavioural abnormalities (van Hoek & ten Cate 1998; Garner *et al.*, 2003b; Meehan *et al.*, 2003a, 2004; Meehan *et al.*, 2003b cited in Engebretson, 2006).

A measure of adequate housing for kea is difficult to define as a smaller but more complex enclosure may be preferable to a large empty one. ***It is a combination of enclosure size, complexity and enrichment that helps prevent stereotypies and encourages the expression of natural behaviours in kea.*** All holders must provide sufficient space and enrichment so that birds do not develop overt stereotypic behaviours.

Research on the development of locomotor stereotypies (route tracing) in parrots has been identified as related to lack of space and physical complexity while development of oral stereotypies (i.e. feather plucking) to lack of opportunity to perform foraging behaviour. Both stereotypy types are seen to be related to lack of social interaction (Sargent & Keiper 1967; Keiper 1969; Meehan *et al.*, 2003a, 2004; Meehan *et al.*, 2003b cited in Engebretson, 2006). Changes in the captive environment including enclosure size, enrichment, and socialisation have been shown to improve the welfare of captive parrots (Engebretson, 2006).

The high level of stereotypies observed in the New Zealand captive population (Orr-Walker, 2005), which include both oral and locomotor stereotypies, would suggest that the present captive environment does not provide adequately for the welfare of kea particularly in the areas of space, complexity, social structure and opportunity to perform foraging behaviours. Although the majority of facilities involved in this study have exceeded pas minimum standards, the results of this research may indicate that these still fall short for this species.

An increase in enrichment, and number of feeds per day, were seen to significantly decrease the amount of stereotypic behaviours observed. The role of enclosure size and social structure was less clear although as larger enclosures tended to correspond with enclosure complexity, size may be an important factor in reducing stereotypies by providing more areas for exploration, space between animals and more opportunity with larger group size for socialisation.

As such, until further research can be conducted to ascertain minimum acceptable enclosure size for kea, it should be presumed that the average enclosure size (which provides an area of <80³m/bird) is inadequate (ie does not provide the space and/or the ability to provide the complexity the kea require). Kea enclosures should therefore have the following minimum area:

- 2 kea - 180m³ (e.g. 10x6x3m)
- 3 kea - 312m³ (e.g. 13x8x3m)
- 4 kea - 528m³ (e.g. 16mx11mx3m)
- 5 kea - 798m³ (e.g. 19mx14mx3m).
- 6 kea - 1122m³ (e.g. 22mx17mx3m)*

(Each additional kea = 3m³)

It is important to remember that more birds in an enclosure are likely to increase conflict issues, particularly in the case of pairings. As such simply increasing by a further 90m³/bird may not be adequate in some instances. Groupings of 6+ kea must be closely monitored to ensure that subordinate birds do not become aggressed by dominant birds or breeding pairs. Although kea can form large flocks in the wild, these tend to be fluid groupings of juveniles and sub adult birds moving over an extensive area prior to pairs forming and establishing breeding territories (Clarke, 1970).

Height of the enclosure must be a minimum of 3 metres. All other proportions are up to the holder assuming that the minimum area is surpassed.

The dimensions above are to be reviewed and may also be determined by group makeup (i.e. a breeding pair may be intolerant of other females in their environment whereas flocking juveniles/sub-adults may be more comfortable in larger groups).

If birds are to be kept in below minimum housing areas for longer than 6 months, an exemption will need to be applied for (to be reviewed 6 monthly thereafter)

Exceptions to housing standards:

Kea less than three months old or undergoing medical treatment or quarantine can be held in any enclosure suitable for housing an individual of that life stage and/or medical condition temporarily (e.g. brooders, small enclosures, if required to limit movement of injured birds).

Although kea should never be housed singly long-term, birds which have not been properly socialised (i.e. are hand reared and are unable to be integrated with other kea) may require a separate enclosure. This must have a minimum volume of 108m³ (6x6x3m). The number of birds unable to be integrated will decrease over time as current practice ensures birds are appropriately socialised.

4.1.4 Materials for housing

(For a list of housing materials and sources, refer to Appendix 3).

All materials used in the construction of kea enclosures (both public display and holding facilities) should be durable, non-toxic and of a strength that can withstand manipulation by kea beaks.

- Mesh – mesh size should ideally exclude entrance of pest species into the enclosure (e.g. mice, rats and sparrows). Care must be taken with galvanized welded mesh that poisoning does not occur through ingesting of coating (this should not occur in a well equipped and enriched enclosure). Mesh should extend into the ground (or conversely foundations should extend above ground level) to ensure that kea do not dig out under enclosure perimeter. Breach of containment through digging by kea has been observed.

Mesh must be of a strength which ensures no other animal species (e.g. dogs) can access the enclosure and that unauthorized access by humans is discouraged.

Control of pest species such as rodents and sparrows may be effectively controlled with the addition of weka into the enclosure. However this requires careful monitoring and a large area with appropriate refuges for both species.

- Frame – enclosure framing should be of a material that is not prone to decay over time. Care must also be taken that frame materials are not toxic. No lead based paints should be used at anytime. Tanalised timber may be used but care should be taken that there are no available perching areas which allow direct access to framing as birds may gnaw and ingest timber. Galvanised metal framing should be painted where possible or be inaccessible to birds. The kea's beak is designed more for digging and probing than gnawing and they are generally less likely to gnaw on hard materials if other furniture is made available.
- Footings – perimeter footings must extend well below ground level, preferably to 600mm (Pullar, 1996). Alternatively, a 600mm skirt (10mm square galvanised mesh) may be folded out from the base of the enclosure and buried approximately 50mm below ground. This skirt must run the entire enclosure perimeter. Toxic plants should be kept well clear of the enclosure perimeter fencing.
- Entrance/exit doors – a double gating system where outside door must be shut before accessing the enclosure should be installed. This is essential in a public accessed enclosure. All doors must be lockable.
- Nest boxes – a nest box should be provided for all enclosures which house a female whether authorised to breed or not. Nest material should also be provided during the nesting season (June – December) to all enclosures (inclusive of all male only groupings) to allow natural behaviours to be expressed. Any eggs produced by a non breeding female should be removed and replaced with dummy eggs. Nest box dimensions should ideally be 1m² with a tunnel 250mm diameter x 1m long extending from the front of the nest box (a round concrete drain is perfect for this purpose). Nest material may include tussock, hay/straw, rotten logs (kea will strip off wood and bark), sphagnum moss (available from garden centers) untreated wood wool etc. Material should be dry and free of dust, mould and foreign objects (watch for baling twine). ***It is particularly important that any hay/straw introduced should be checked for aspergillosis spores as this has been a cause of death in captive kea.*** Hay/straw must always be stored in a dry, well aired storage area to inhibit mould development.

4.1.5 Shelter/screening/barriers

Shelter and screening can be temporary or permanent depending on the reason for use (i.e. additional temporary screening may be required on introduction of new birds) and may be made from naturalistic or manmade materials. Rock walls

or overhangs, timber structures (e.g. tramper's huts or roofs), live vegetation or browse are examples of shelter/screening type. Public barriers in walkthrough or limited access enclosures should be obvious to visitors and of a design that discourages breaching.

- Undercover area – multiple undercover areas should be made available to kea to ensure that subordinate birds are excluded by more dominant individuals. If only one area is available, it should be of a size that is able to accommodate all birds easily and must have sight barriers and multiple access/exit points. Each bird should have a 1m² area which is undercover to access. Separate naturalistic shelter areas can be achieved by provision of rock ledges, large fallen logs etc.
- Visual barriers between birds – each bird should have access to at least two areas that allow visual separation from other kea. This can be in the form of vegetation, rocks or solid screens/walls.
- Visual barriers to public– vegetation, rocks and barriers should be used to ensure that the public are not allowed constant visual and/or physical access to all areas of the enclosure which may cause stress to the birds. This is particularly important in the case of public access enclosures.

4.1.6 Water

Kea in the wild have access to fast running alpine streams and high altitude tarns at all times. Bathing in these areas is a part of daily maintenance. Kea are also sensitive to heat (Freudenberger *et al.*, 2009) and need to be able to cool off in warmer temperatures.

Fresh water must be provided at all times in enclosures. If using containers, the main water container must be large and deep enough to allow birds to bathe (approx 1m² x 200 mm deep). A second water bowl should be located elsewhere in the enclosure to ensure a subordinate bird is not kept from drinking water at any time.

Ideally running water features and pools should be used in enclosures but care must be taken to ensure that birds can easily exit the pool should they fall in. Water presented in appropriate sized containers will likely be used for bathing. Positioning of the water source in relation to human proximity is therefore very important especially with respect to public access enclosures (ie water should be away from public access to ensure birds are not restricted in their use of water throughout the day).



*Kea bathing in enclosure stream.
Photo credit: User Avenue.*

Running water – a water feature (natural waterfall or flowing water through/spigot system) can be easily set up with a circulating pump system. Water and receptacle area in a closed system will need changing and cleaning on a regular basis (twice weekly) to prevent build up of pathogens and algae. Kea also have a tendency to dip their food into water during feeding so it is important to ensure that food remnants are removed on a daily basis.

4.1.7 Furnishings, vegetation and substrates

In the wild Kea spend a large proportion of their time foraging on the ground in alpine herb fields or on the beech forest floor. They dig up the roots of plants and search for invertebrate species. It is therefore very important to provide them with diverse vegetation, substrates and enclosure furniture (such as rotting logs) that can be manipulated by the birds on a daily basis.

Captive kea are predominantly held at low altitude across the length and breadth of New Zealand. These environmental conditions may not support the growth of vegetation native to their natural habitat. Local or introduced plant species will likely be more practical to grow. However care must be taken to ensure they are non toxic (refer to the list below).

All new leaf-litter and soil should be screened before being placed in the enclosure to ensure it is free from harmful material such as small metal or plastic objects, and/or herbicide/pesticide residue (Fraser, 2004).

Enclosures should also contain shrubs/trees. Vegetation may provide some food if appropriate species are planted. Plant cover will also generate leaf litter. In general, native plant species are considered appropriate, however if the safety of a plant species is not known then do not introduce into the enclosure until confirmed safe.

The following toxic plant species **must not be used in any enclosures** as they are either known or thought to be toxic (see Shaw & Billing 2006 cited in Fraser, 2004) This is not a complete list:

- Onion Weed – *Asphodelus fistulosus*
- Black Nightshade- *Solanum nigrum*
- Bittersweet Nightshade – *Solanum dulcamara* L
- Jerusalem Cherry – *Solanum pseudocapsicum*
- Karaka – *Corynocarpus laevigatus*

Examples of furnishings, substrates, and vegetation

- Ground vegetation: kea have been observed in captivity foraging on the young shoots of grass or picking up scattered food in carex grasses. A grass area to simulate an alpine herb field in the enclosure is considered ideal to encourage expression of normal foraging behaviours.
- Substrates: A variety of substrate types should be included in the enclosure to encourage foraging and digging activities. These should include, soil, leaf-litter, different sizes of stones/rocks, mulch bark and snow where possible. Different substrates can also be used to vary the topography in the enclosure and encourage natural behaviours such as

climbing on moving scree slopes etc. Research into kea nest site preference indicates mainly coarse and very coarse gravel is preferred followed by gravel, and sand. Areas with silt and clay as well as areas with boulders received very low probabilities of presence (Fredenberger *et al.*, 2009).

All introduced substrate should be checked for foreign objects, spores and be screened for seeds etc. Existing soil in enclosures should be turned over each year to ensure soil health and decrease anaerobic organisms.

- Trees and shrubs: Kea spend much of their time within alpine beech forests foraging for food. Enclosures should be able to support the growth of nontoxic native/exotic trees and shrubs which will provide shelter, shade, perching areas and encourage natural behaviours. Vegetation may need supplementing with browse to support investigative behaviour and decrease damage to live vegetation.
- Furniture: Semi permanent items such as large logs, tree trunks, ponga logs, live trees, and multiple perches will increase the enclosures useable area and encourage flight behaviour between areas.
- Human objects: Human objects can demonstrate a link for the public and if presented appropriately can provide opportunities to send useful advocacy messages to those intending to visit the South Island (e.g. don't feed the kea, ensure your equipment stowed in kea habitat). Objects may also provide a diversity of enrichment for the kea (e.g. swandri, camping/tramping gear, ski equipment, farm equipment, DoC/tramping huts) which can readily and frequently be changed. ***Care must be taken to ensure that introduced items are safe, non-toxic and do not have parts which can be ingested.***

4.1.8 Multi-species Exhibits

Kea in the wild interact with many introduced and endemic species, Native species include kaka, kakariki, bellbird, NZ robin, tomtit, blue duck and kiwi in the lowland and montane forest areas; falcon, takahe, kākāpo, rock wren and alpine reptile species in the higher alpine areas. This list is by no means exhaustive.

Introduced species which share kea habitat include large grazing mammals; sheep, thar, deer and wild pigs; and smaller animals; birds, mice, rats, rabbits, stoats and possums.

DOC Guidelines for holding protected wildlife for advocacy purposes (DOC, 2007), states that exotic and protected native species cannot be held together. It may be argued however that in the wild kea share their environment with many introduced species and important advocacy messages and enrichment opportunities may be gained by holding kea with exotic ungulates (other exotic animal groups such as birds, rodents and mustelids would not be appropriate, unacceptably increasing the risk of disease and stress for the kea). This would be particularly interesting in a walkthrough enclosure area assuming there was ample grazing area for any large herbivores and they were of a type that was of no threat to the public. Holding appropriate exotic and endemic species together

would also provide an opportunity to discuss high country farmers concerns of kea interaction with their stock and competition of grazing species for native plants on conservation land.

The majority of native species listed previously would not be recommended to hold with kea unless in a very large enclosure which allowed for adequate territory sizes. Kea can become very territorial so any species held with kea must be either non-threatening to the kea, occupy quite different niches and/or be equally as robust. Each species must be given the ability to safely utilize different portions of the enclosure through provision of species specific areas (nest boxes/cavities, perches, ecotones etc). There must also be provision of adequate space and visual barriers (vegetation, topography, rocks, enclosure furniture). It is important to ensure that no corners exist where an individual animal can become trapped.

Consideration of kea social structure is essential to ensure that another species are not stressed. Kea are particularly aggressive during the reproductive season and breeding pairs may not tolerate another species in their local environment. Seasonal rotation can mitigate this. Individual kea may also react quite differently to the presence of other species, therefore integration should be observed closely to ensure animals do not become stressed, injured or killed.

At present only one facility in New Zealand holds kea in a multi species exhibit with weka. At the time of writing an initial integration of kea with two male weka had resulted in a weka fatality whilst subsequent integration of a pair of weka with resulting chicks was observed to be highly successful with all weka chicks successfully raised and normal behaviours of both species observed. As such introduction of kea into multi species situations must only be undertaken with standardised monitoring protocol in place and in an enclosure of significant area.

Holding of kea in multi species exhibits will require further research to determine best practice and welfare standards for all species involved.

Native species to be considered

Weka (*Gallirallus australis*). Weka are a robust flightless species and have been successfully held with kea in New Zealand. Inclusion of this species in an enclosure has the added benefit of controlling pest species such as rats, mice and sparrows. Observations of the Otorohanga Kiwi House kea enclosure over a three week period showed a complete lack of pest presence (including faecal matter) and infrequent and non-injurious territorial displays by the kea to counter weka incursions into kea 'territory' (an undelimited area at the front of the enclosure designated by the kea). A lack of pest species was also noted throughout the year by staff (Fortis, pers. comm., 2009) Care must be taken however as fighting between kea and weka has occurred in other holdings.

Pukeko (*Porphyrio porphyrio melanotus*) Pukeko are a common native ground swamp dwelling species which may be used as an analogue species for the threatened Fiordland Takahe. Pukeko have a very strong beak and may be territorial so care should be taken when first introducing this species to ensure that no injuries result.

Duck species Kea inhabit areas where threatened Blue Duck (*Hymenolaimus malacorhynchos*) are present. Other more common less territorial native duck

species such as Scaup may potentially be integrated into a multi species exhibit. Scaup and Grey duck are presently held successfully in multispecies exhibits with pukeko and weka. Their different niches should ensure they have limited and non-territorial contact with kea. Water margin areas should be designed to be less accessible to the kea to ensure duck species are afforded safe areas to escape easily to water.

The success of a multispecies exhibit depends on the ability of each species to safely utilize separate portions of the enclosure through provision of species specific areas. There must be provision of adequate space and visual barriers. No corners or funnels should exist where an individual animal may become trapped. In the case of any large grazing species, it may be prudent to have night quarters separate from the kea to ensure that a sleeping animal does not get harassed when staff are not around.

Consideration of kea social structure must also be taken into account to ensure that any other species are not put under undue stress during the reproductive season. Pairs going into reproductive behaviour may not tolerate another species presence in their local environment so animals may need to be rotated seasonally in this case.

4.1.9 Enclosure Siting

The enclosure must be sited in such a way which provides for correct thermoregulation and humidity taking into account the following:

- **Sunlight:** The natural environment of kea is exposed to high levels of solar radiation. Research has identified that kea prefer areas of high solar radiation (approx MJ m⁻²day⁻¹) (Freudenberger *et al.*, 2009) although areas with very high solar radiation are preferred less than low solar radiation areas. Sunlight is very important for manufacture of vitamin D in all species (important for bone mineralization); a deficiency can result in bone softening diseases (Grant, 2005). Access to adequate sunlight (minimum 2-3 hours per day) within the captive environment is considered vital for maintenance of health in kea.
- **Shade:** The kea is a stocky bird which has evolved to survive in low temperatures. They are essentially an alpine forest dwelling species and may therefore be prone to heat stroke. Access to shaded areas throughout the day, particularly during the middle of the day when they generally rest, is necessary. Multiple shade areas ensure that subordinate birds are not displaced by dominant individuals. In public access areas, these should be away from direct human access points.
- **Airflow:** Adequate airflow is important to ensure an environment does not become persistently damp as this may encourage the development of pathogens.
- **Moisture:** Kea tolerate higher rather than lower precipitation rates (Freudenberger *et al.*, 2009) with known wild nest sites located in areas of higher humidity.

- **Ambient Air Temperature:** Kea live in alpine regions where temperatures can drop below -4°C in winter (Nelson Lakes, Freude nberger *et al.*, 2009). This may be the high end of the scale with kea habitats further south routinely exceeding this. They have evolved to tolerate cooler, wetter conditions. In warmer areas kea have been observed 'swimming' when a larger body of water is provided. This may be an important requirement for thermoregulation in more northern facilities.
- **Topography:** Kea live and nest on steep and often unstable mountain terrain. They spend much time walking on uneven ground foraging, digging and investigating. Enclosure design should therefore incorporate variations in topography. This can be achieved by the addition of rock walls, scree slopes and building up of soil mounds.

4.1.10 Enclosure Security

All reasonable steps must be taken to ensure that kea on public display are secure from theft, physical disturbance and injury. This is particularly important where kea are housed in public walk through or limited access enclosures. The following steps should be implemented to ensure security of kea areas:

- Materials must be of a strength to prevent unauthorised access to enclosures and prevent a containment breach by larger animal species such as dogs
- Appropriate locks and latches are to be used to ensure no unauthorised access
- No entry signs should be displayed in non-public access areas

Areas containing the kea enclosure should have an external perimeter fence which cannot be accessed by the public after hours when staff are offsite. This is also preferable for those facilities which do not fall under MaF regulations (i.e. that do not hold new organisms and are therefore not subject to the HSNO Act, 1996).

Minimum Standard 4.1 - Housing Environment Standards

(refer Internal Audit Document in Appendix 1).

All kea must be held on public display except in the following situations:

- During temporary holding while building a new display enclosure, for a maximum period of 1 year. During time off display living conditions must fulfill the minimum requirements of 4.1 and birds must be accessible within reason for research and advocacy purposes
- Undergoing veterinary treatment
- Undergoing quarantine
- If introductions are being made in 'neutral' territory
- In transit from one facility to another
- Involved in permitted research project (with relevant ethics approval)

- Proven to have breeding difficulties on display (*evidence required to be documented*)
- Held by private holders prior to 2009

Please contact the Captive Management Coordinator if birds are to be held off display for any other reasons. An exemption is required for longer periods.

4.1.2 Enclosure type

For those kea held in public access enclosures the following is required:

- Barriers (natural/manmade) to kea only areas and signs clearly stating no public access into these areas must be clearly visible within the enclosure
- A safe double gating system in place at the exit/entrance points
- Enclosure must be checked (walk through) a minimum of twice daily (on top of feeds) to ensure birds are safe and public are not feeding birds or straying from public pathways

4.1.3 Size

All kea must be held in facilities that provide an adequate mix of space, complexity and enrichment to prevent the development of stereotypies and to encourage natural behaviours. Locomotor stereotypies such as repetitive pacing in parrots (a common stereotypy observed in captive kea), have been identified as related to lack of space and physical complexity while development of oral stereotypies (i.e. feather plucking) to lack of opportunity to perform foraging behaviour. Both stereotypy types are seen to be related to lack of social interaction.

Enclosures should therefore have the following dimensions:

- 1 kea - 108m³ (e.g. 6Wx6Lx3m H) (*justification for holding a single bird must be documented and available*)
- 2 kea - 180m³ (e.g. 10x6x3m)
- 3 kea - 312m³ (e.g. 13x8x3m)
- 4 kea - 528m³ (e.g. 16mx11mx3m)
- 5 kea - 798m³ (e.g. 19mx14mx3m).
- 6 kea – 1122m³ (e.g. 22mx17mx3m)
- Each kea after this must be provided with an additional 3 cubic metres of space (*because of territorial behaviour, more kea will require more space*)

Enclosure height to be a minimum of 3 metres.

4.1.4 Materials for housing

All enclosure materials must provide for the requirements of full containment and be:

- Non-toxic/unavailable to be gnawed by birds
- Rust and rot resistant
- Of a strength to prevent a containment breach by predators and humans into the enclosure and by kea out of the enclosure.

4.1.5 Shelter/screening

The following natural or manmade shelter/screening must be provided:

- A minimum of 1 undercover shelter area per bird (ie fallen log/rock structure of a size to provide shelter for a single bird from rain, wind and sun)
- A minimum of 2 visual barriers between each pair of birds per enclosure (ie trees, rock wall, screens)
- A minimum of 2 visual barriers per enclosure for each pair of birds from direct human eye contact (as above)

4.1.6 Water

Fresh water must be provided at all times in a way which enables all birds to access freely as follows:

- A main water source of minimum dimensions 1m² x 200 mm deep (to allow bathing behaviours)
- In the event of only one confined water source being accessible to multiple birds, an additional water bowl must be provided at all times at another location in the enclosure to ensure subordinate birds have access to water at all times (a stream system which provides water across an extended area is adequate on its own).

4.1.7 Furnishings, vegetation and substrates

A minimum of 3 different types of each of the following must be included in the enclosure:

- Movable substrates (one of which is soil to encourage digging)
- Ground vegetation (one of which is grass/ground covers to encourage foraging)
- Trees/shrubs (to encourage foraging, provide perches and or visual barriers)
- Furniture (one of which is rotten logs to encourage foraging) in addition to basic enclosure furniture (nest cavity/box, perches, water source etc)

4.1.9 Enclosure siting

The enclosure must be sited in a way which provides for correct thermoregulation and humidity taking into account:

- Sunlight: access to full sunlight for a minimum of 2 hours of each day
- Shade: must be accessible in multiple outdoor locations at all times to allow birds to cool down
- Airflow: throughout external enclosure areas only
- Moisture: to be at a level which does not encourage the build up of pathogens, fungus and slime but enough to ensure the environment is not arid
- Ambient Air Temperature: to be naturally variable throughout the enclosure with adequate cool areas available throughout the day
- Topography: a variety of gradients must be provided to ensure 3-dimensionality and encourage exercise. Where there are no naturally occurring variations in topography, built areas must be provided

4.1.10 Enclosure security

- Correct materials of a strength and quality that ensure containment is not breached
- Locks and latches to be attached to all doors accessing the enclosure
- No public access areas clearly visible

- Public standoff barriers to boundary fence are in place to ensure enclosure fence integrity
- Presence of an external perimeter boundary fence (for facilities subject to MAF containment requirements)

4.1.11 Advocacy and Links

Enclosure design: Enclosure must be of a standard which encourages natural kea behaviours of a normal duration (i.e. which decrease the incidence of stereotypic behaviours) and which sends a clear conservation message to the public.

Signage: At least one form of signage must be clearly visible at the enclosure with appropriate conservation messages and links displayed.

Best Practice 4.1 - Housing Environment Standards

4.1.3 Size

Dimensions of enclosures should exceed the minimum standards to allow a full range of natural locomotor activities such as full flight and foraging to take place and to allow larger social groupings. In particular enclosure height should be exceeded as kea utilise their natural environment vertically as well as horizontally.

4.1.6 Water

Water source should be running and of a size which replicates a natural montane stream/tarn.

4.1.7 Furnishings and vegetation

The amount and variability of furnishings and vegetation in the enclosure should be increased as much as possible to allow expression of all natural behaviours (from ground level through to high canopy).

4.1.8 Sharing of enclosures with other species

In a larger enclosure area, kea should be housed with a variety of other species (native and/or exotics where appropriate), to encourage normal interactive behaviours.

4.1.9 Enclosure siting

Enclosure should not only be sited to take into account thermoregulation requirements but also be positioned where possible to take into account height to maximise the birds' outlook. Enclosure should be sited in an area to maximise natural environmental (sun, shade, wind, temperature gradients) and landscape factors (topography, vegetation, water sources). If these are not available, design of an enclosure which takes the keas natural environmental conditions into account to maximise expression of normal behaviours should be developed.

4.1.11 Advocacy and Links

Advocacy potential should be maximised through optimal enclosure design which encourages natural behaviours in kea and allows for a public immersion experience. Appropriate human related conservation messages should be portrayed through signage (with preference for interactive and passive active

displays) and encounters with links to outside organisations clearly seen on enclosure signage and facilities website/ literature.

4.2 Enrichment

4.2.1 Introduction

Stereotypes - repetitive behaviours which appear to have no obvious goal or function (Mason, 1990) have long been used as welfare indicators. As they are not seen in wild animal populations, their development has been linked to sub-optimal captive environments which discourage expression of natural species specific behaviours (ibid).



Snow! Photo credit: T.Orr-Walker 2003

One method of preventing and reversing stereotypes is with appropriate environmental modification (Meehan *et al.*, 2004). Five types of environmental enrichment have been identified and include social, occupational, physical, sensory and nutritional enrichment (Bloomsmith *et al.*, cited in Young, 2003). Nutritional enrichment is often introduced via different modes of delivery (which includes variation in frequency and presentation), and type (e.g. browse and treats) (Young, 2003), and is widely used in captive facilities to increase foraging and investigative behaviours. These behaviours have been shown to decrease stereotypic behaviours (Croke, 1997).

Research on kea behaviour in NZ facilities (Orr-Walker 2005) showed a high prevalence of stereotypes performed by captive kea (50% of individuals observed over 13 facilities).

All stereotypes involved some form of locomotor activity (flying, running, hopping or rocking from one leg to the other) and anecdotally were linked to pre-feed times. Carlstead (1998) maintains that the form in which stereotypes are expressed often indicates which wild behaviour is being frustrated. Therefore stereotypic locomotor activities may indicate a need to forage for food, search for mates or fly long distance - all high energy activities in the wild. Stereotypes that are linked to a



Feather plucking in kea may also indicate a lack of ability to perform foraging and social interactive behaviours. Photo credit: KCT 2009

food motivation may be observed to increase prior to feeding episodes (Carlstead, 1998). This has been observed in species which expend much time and/or energy in procurement of their food source and may be reduced by varying temporal feeding patterns and providing in a form which more closely replicates the natural situation (*ibid*). This was found to be evident in New Zealand captive kea as provision of additional feeds during the day (as a form of nutritional enrichment) in 3 of the 13 facilities observed, significantly increased foraging, investigative and manipulative behaviours across all groups and decreased body maintenance behaviours such as self-preening. Therefore it can be surmised that complex, daily enrichment was found to increase species typical behaviour patterns and decrease abnormal behaviours particularly in captive bred birds. This highlights the benefits and rationale for increasing enrichment frequency and variability in the captive environment for high priority species (Mench, 1998; Kreger *et al.*, 1998) and shows as a management tool, enrichment can be useful for this species (Orr-Walker, 2005).

Kea are considered to be highly intelligent (Gadjon, 2005) and have developed to survive in a complex environment. They fall into the category of a high priority species as described by Kreger *et al.*, (1998) and are considered to require high levels of complexity and novelty in their environments to prevent stereotypies. Any enrichment programmes must be highly variable, evolving and adaptable and encompass the keas physiological, psychological and social requirements. Where possible, routines should be flexible to ensure the reduction of any anticipatory behaviour.

As any degree of stereotypic performance has been linked with a deficit in the captive environment (Mason, 1991), it may be concluded that there are potential welfare issues in holding kea in captivity that require careful management.

4.2.2 Behavioural needs

Wild kea spend over half of their day inactive (over 54%) with the remainder spread fairly evenly between foraging, locomotor and body maintenance activities (Brejaart, 1988; 1994). Stereotypic behaviour has not been recorded in the wild.

Although no comprehensive daily activity budget studies of kea in captivity have been undertaken, initial behavioural studies do suggest a higher proportion of motor activities expressed (Orr-Walker, 2005). It must be remembered however that wild activities such as flying between ridges and digging up the roots of plants in a cold environment are likely to be much more resource expensive than in captivity. Holders should therefore seek to increase the energy expenditure of their kea over the course of the day by encouraging natural foraging activities and flight opportunities. This can be achieved with additional perches, increased flight area and by giving birds reasons to fly between areas such as enrichment and/or food placement.

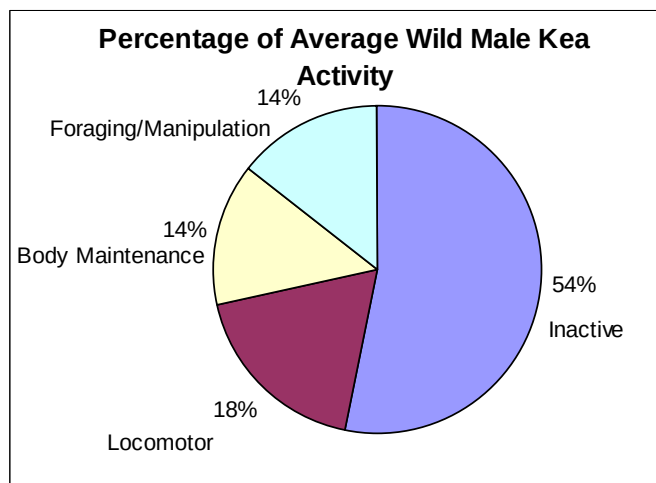


Fig 4. Although wild kea spend over half their day inactive, activity expenditure is high at all other times involving resource expensive activities such as foraging, exploration and flying.

Kea behavioural needs in captivity may more closely be satisfied through the provision of:

- Complex enclosures (inclusive of walkthroughs)
- Larger flight areas with multiple perches to encourage flight between areas
- Complex enclosure furniture which encourages manipulation
- Variable diet and multiple feeds throughout the day
- Frequent introduction of new furniture and substrates
- Appropriate and complex social interactions (inclusive of multispecies exhibits)
- Positive keeper interactions – training/conditioning
- Daily (unpredictable) enrichment

4.2.3 Enrichment programme

Enrichment may include either naturalistic or man made objects. The message which an individual facility wishes to convey to the public will dictate which design

is preferred - both are considered highly effective to decrease abnormal behaviours and increase natural behaviours assuming they are used inventively. Behavioural enrichment should be rotated on an ad lib, non-cyclic system and provided on a daily basis. Setting up a rigid timetable for a highly intelligent species is counter intuitive to the concept of enrichment – enrichment must be unpredictable to be enriching.

A list of enrichment types and items should be made available to keepers for reference. A combination of two or three items should be picked out at random from each type on a daily basis so that birds do not end up with predictable regimes. If there is repetition of one or two enrichment items on subsequent days that is part of the unpredictability.

Enrichment is only limited by your imagination – get everyone to suggest ideas; the more people involved in this the better. All enrichment ideas and items must first be checked prior to introduction to ensure that no components are toxic or could be broken off and ingested. This is extremely important in the case of juveniles who are prone to ingesting novel objects in the wild (e.g. rubber, toxins) with often fatal results (Grant, 1993). It is also important to closely monitor animals' access to enrichment during or after a period of illness to ensure they do not develop unusual behaviours and ingest an object previously considered safe.

The following is a basic enrichment list incorporating different types of enrichment (please note that social enrichment in the activities section only relates to cooperative enrichment and not changing of social groupings).

Nutritional:

- Different browse/food types; native browse species, nectar (jam/honey water mix), grass, vegetables/fruit/ ice blocks. These should be presented in multiple and unusual ways e.g. hole in a pumpkin or coconut stuffed with nuts, grass etc or in a different form than usual. Liquids may be frozen or warm for example, or constituents not mixed (e.g. blob of honey in bowl of water).
- For additional ideas on food presentation as enrichment see Auckland Zoo's Kea Enrichment Manual (Freeman *et al.*, 2003).

Physical/ Sensory:

- **Smell** herbs/spices, keeper's t-shirts, bedding from other species enclosures (non avian to minimise cross infection), perfume. Kea appear to be very responsive to smell
- **Taste** herbs/spices, honey, jam smeared on branches, drop of essence in water (rose, vanilla, honey, lemon etc)
- **Visual** mirrors, cut out objects (e.g. kea model, hawk, cat), lights (bomb proof torch), different coloured objects



*Kea in pile of clean, dry straw –
Otorohanga
Kiwi House (KCT, 2009)*

- **Tactile** big clump of straw, smooth surfaces (metal plate), thick rubber mat or ball (watch they don't ingest it), non toxic coloured wax (not white) or clay they can manipulate etc
- **Auditory** other kea calls, music, etc

Occupational:

- Puzzles to manipulate (requires use of cognitive abilities)
- Large hessian sack or large paper rubbish bag filled with other enrichment items (birds can make holes in sacks and pull items through – large enough for several birds to have a go at once)

Social:

Those items which require cooperation or interaction from other kea or keepers:

- Puzzles requiring cooperation
- Kea are motivated to watch keepers pulling items apart or burying them
- Training sessions would also fit into this – must be fun and positive



*Kea checking out a puzzle.
Photo credit: Rachel Johnston*

Be inventive and have fun! Anything that could be broken of and ingested will need to be monitored carefully, particularly where there are juveniles present. However kea are unlikely to swallow most items unless they think they are food. Watch for white objects which may illicit a fat response – anything that is white and able to be manipulated may be considered high energy food (fat) and ingested. This has been noted by hunters who have observed kea eating white candle wax instead of fat at the site of a deer carcass (Moloney, pers. comm., 2009).

4.2.4 Additional Links

For additional enrichment ideas refer Auckland Zoo's Kea Enrichment manual (may be downloaded from www.keaconservation.co.nz).

Enrichment ideas and information can also be found at the following websites:

- The Shape of Enrichment – www.enrichment.org
- Enrichment Online (Fort Worth Zoo) – www.enrichmentonline.org
- Animal Enrichment – www.animalenrichment.org

Minimum Standard 4.2 - Enrichment

(refer Internal Audit Document in Appendix 1).

4.2.2 Behavioural needs

These must be met through provision of a complex enclosure which stimulates both physical and mental activity. This is particularly important for high maintenance birds, such as those exhibiting high levels of stereotypic behaviour

or those which are human orientated. These birds must be housed in an enclosure of maximum complexity.

Minimum requirements depend on the size, complexity and social interaction available to the birds. However all enclosures should be designed to stimulate interest and encourage activity. This should include:

- Large flight area: a minimum of $1/3^{\text{rd}}$ of the enclosure area with perches placed so as to encourage flight between areas

For an enclosure of 180m³ the following must be made available (larger enclosures require a proportional increase in these requirements) to ensure complexity and encourage increased physical and mental activity:

- A variety of perches of varying composition, levels, angles and stability between flight areas
- A variety of large complex enclosure furniture pieces (rotting log/s, stream, trampers hut, ponga logs, climbing apparatus, rock wall/pile) which encourage manipulation
- A minimum of 2 new browse or small furniture items introduced into the enclosure per week (substrate, logs, straw (remove if wet), human objects etc)
- Positive keeper interactions – training/conditioning a minimum of twice weekly
- A minimum of two feeds per day (in addition to browse presentation) presented in different ways (e.g. scatter feed spread out in enclosure trays, furniture holes) to encourage foraging over an extended period of time

4.2.3 Enrichment Programme

Daily (unpredictable) enrichment is to be administered on a rotational adlib basis as follows:

- A minimum of 1 item from 3 different types of enrichment must be supplied per day (nutritional, occupational, physical/sensory or nutritional, social and occupational etc) on a rotational, unpredictable basis.

** For additional enrichment ideas use the links specified in 4.2.4 and refer to Appendix 4.*

Best Practice 4.2 - Behavioural Enrichment

4.2.2 Behavioural needs

A highly variable environment that allows expression of all natural behaviours should be maintained with addition of new items on a daily basis.

4.2.3 Enrichment Programme

Any programme should take into account the high activity times of kea (morning and evening) and as such provide kea with stimulation after hours (introduction of additional enrichment items and browse last thing before leaving).

4.3 Training and conditioning

4.3.1 Introduction

Training is used in captive facilities to aid in the husbandry, health, advocacy and enrichment of a diverse range of species. However training of birds has, until recently, generally only been used for free flight shows and public entertainment.

Difficulty managing larger more dangerous species such as big cats or primates has led to development of training regimes to reduce incidence of injury to keepers. Birds are not routinely trained for basic husbandry practices (worming, health checks, crating etc) as it is considered less resource intensive to catch birds up on an annual basis. However with minimal input, training for basic husbandry procedures can significantly reduce stress and increase positive interactions for the public, keeper and kea.

Public encounters and keeper talks are an extremely powerful tool providing a direct link to the birds via the keeper. By providing a personal interaction which illustrates a relationship between humans and kea, the public are more likely to be able to identify with and as a result care for the species in the wild; Live interpretation is generally considered to be the most effective method of getting across conservation messages (WAZA, 2005).

4.3.2 Relevance

It is important that training and conditioning is relevant to the husbandry of the species and has direct welfare benefits to the individual birds. As such training should include basic management techniques inclusive of stationing, body presentation, weighing and crating. These behaviours will ensure less stress when moving birds or performing basic health checks. Additional behaviours sought by trainers should be relevant to captive management, aid in behavioural research and/or should aim to send important advocacy messages to the public. Expression of behaviours which are not natural for the bird or for the express purpose of public entertainment should not be undertaken.

4.3.3 Methods

Only positive reinforcement methods during training should be used. Food deprivation techniques are not appropriate for this species and are considered unethical. Bridging techniques to reinforce desired behaviours should be used – a whistle, voice command or clicker can be used for this purpose depending on trainer



Orana Wildlife Park - relaxed training session enjoyable for both trainer and kea.

preference. Training techniques and advice may be found in “Don’t Shoot the Dog”, Pryor, 2002.

All social groups (except breeding pairs during reproductive season) should have a minimum of twice weekly husbandry routines (5-10mins per bird per session). Routines must cover basic husbandry and health requirements (weighing, crate training, checking body etc). Additional training to capture desired behaviours for advocacy (encounters) may also be developed if birds are receptive to training regime.

4.3.4 Trainers

At least 2 people should be trained up in all aspects of husbandry and training /conditioning to ensure that if one person is on leave a secondary trainer can take over. Multiple trainers also add to the enrichment value of the training as there will be natural variation in training technique between trainers.

All training events and regimes (aims and outcomes) must be recorded in daily diaries.

Minimum Standard 4.3 - Training and Conditioning

(refer Internal Audit Document in Appendix 1).

4.3.2 Methods

- Only positive reward methods must be used. No food deprivation techniques may be used to train or condition birds.
- Training/conditioning to be conducted twice weekly for 5-10 mins per bird/or 30 mins for a larger group (whichever is less). The goal being to illicit the following behaviours that enable health checks and husbandry procedures:
 - Targeting and stationing: basic training to allow for development of other behaviours (refer below) and for ensuring stress free interactions (particularly when there are dominant/subordinate interactions between birds)
 - Weighing: for the purpose of attaining regular weights of birds
 - Crate training: to allow for stress free movement of birds from one enclosure to another
 - Body presentation (spreading wings, allowing touch on keel and feet) for parasite and basic health checks

Training must be at a level and speed which is comfortable to the individual bird/s (some birds may remain uncomfortable in close proximity to staff and only accept targeting/stationing while others require increasing stimulus).

4.3.3 Relevance

- Training must include the following basic management techniques; stationing, body presentation, weighing and crating.
- All other behaviours sought are relevant to captive management, aid in behavioural research and/or send important advocacy messages to the public.

- Training can also be used as an enrichment tool to increase complexity.

4.3.4 Staff

- A minimum of two committed persons who are confident and competent in basic kea training methods
- Staff must detail each training session's objectives and results in a daily diary (e.g. *Crate training – Pluto stepping into crate with more confidence today. Will look to extend time he spends in the crate over the next week*).

NB. Those birds involved in breeding behaviour may not respond to training between the months of June - January however training must resume once reproductive activity has finished or if a bird within the pair is expressing stereotypic behaviours

Best Practice 4.3 – Training and Conditioning

4.3.2 Methods

As above with training regime extended to a daily training and inclusive of behaviours for advocacy and education of the public (utilising birds that show interest in “throwing “behaviours).

4.3.3 Staff

Kea respond well to change and novel items and as such should be provided with some level of exploratory value in their training through introduction of new personnel and training objectives introduced by staff. This should be aimed at increasing stimulation rather than measurable outcomes (i.e. this may be linked to some cognitive research work).

4.4 Social Structure

4.4.1 Introduction

Social enrichment of species is considered to be crucial for maintenance of normal species specific behaviours (Kreger *et al.*, 1998). It is generally acknowledged that group housing of any social species is necessary for psychological health of individuals and as a form of enrichment is one of the most complex and effective, assuming group structures are appropriate (Young, 2003). Inappropriate group makeup and size can negatively impact on reproductive success of some species. However research has concluded that the benefits of social enrichment far outweighed the benefits of any other forms of enrichment, hence its importance in captive management (Schapiro *et al.*, 1996).

Kea as a social species must be held with other con-specifics (Pullar, 1996). They are a highly mobile species, forming and dissolving flock groupings depending on age of individuals and season (Jackson, 1960; Clarke, 1970). Although changing social groupings seasonally is not logistically possible or necessarily in the best interests of the birds in captivity, holding of kea in age and reproductive

appropriate groups is important to ensure optimal psychological and physiological wellbeing.

4.4.2 Life stages and gender requirements

Females: There is some indication that holding single sex female groups is stressful with high stereotypies and aggressive behaviours observed in research to date (unpubl, Orr-Walker, 2005). It is therefore preferable that females be grouped with males in multi sex enclosures. If females pair bond with males, they should be allowed to go through reproductive process, inclusive of nest building and laying of eggs. Those pairs not recommended to breed must have their eggs replaced with dummy eggs to ensure that the female does not continue to lay eggs (which may cause health problems). If female only groups are held, and until additional research is carried out to ensure that welfare is not compromised, females will require standardised monitoring to be undertaken in facilities with appropriate expertise, due to a potential increased risk of stress and aggression.

- Males held in single sex groups have been observed to pair and to demonstrate mating and regurgitative behaviours during breeding season.
- Juveniles should be held together to allow appropriate flocking behaviour for first 3-4 years. After this time they should be placed in either bachelor or mixed adult groups or pairs for future breeding.
- Present adult pairs should be allowed to remain in existing pair-bond where possible. Kea mate for life and it may be unnecessarily stressful for females in particular to be removed from the pair-bond. Parrots are also notorious for being picky with mates and may not bond with a new mate (even if genetically a perfect match).



Wild juvenile kea playing
Photo: Andrew Walmsley

4.4.3 Development of new social groupings

When establishing new social groupings or introducing new birds into an existing group, care must be taken to ensure that aggressive interactions are minimised.

There have been cases when new kea introduced into an existing social unit have been badly injured or killed. The introduction process must be carried out by staff with a sound knowledge of kea behaviour and over a period of time.

All new kea must be quarantined to minimise possible disease transfer. Stress during transport can depress an animal's immune system thereby increasing its susceptibility to any baseline conditions in local birds. Stress can also result in expression of an underlying disease lying dormant in a previously healthy individual.

Integration should be carried out as follows:

- Introductions should be made early on in the day to ensure behavioural observations can be carried out

Release area must:

- be of a size which allows birds space to get away from each other
- have appropriate sight barriers in place to ensure birds can move out of eyesight
- have multiple food and water receptacles to ensure all birds are not restricted from basic nutrition
- have access to multiple shelter areas to ensure basic shelter requirements are met
- be enriched to ensure environmental distraction

Integration duration is dependent on individual birds so it is important to be flexible with procedure. If overt aggression is evident, birds should be separated when not under observation (e.g. overnight). Newly introduced birds must be monitored at all times utilising standardized protocol to ensure unwanted behaviours do not develop.

Minimum Standard 4.4 – Social Structure

(refer Internal Audit Document in Appendix 1).

Kea should not be held singly unless the following applies:

- Where birds have been held singly for the entirety of their lives and are proven to be unable to be integrated with other kea (evidence required)
- Undergoing medical treatment
- Undergoing quarantine

4.4.2 Life stages and gender requirements

- Adult females: are housed in mixed sex exhibits with equal male/female ratio or more males than females represented where possible. If females are held in single sex groups, and until such time that evidence shows welfare is not compromised, birds should be placed by the authority of the species coordinator, in facilities with appropriate expertise and standardised monitoring in place to ensure undesirable levels of aggression and/or stereotypies do not occur. Records to this effect must be documented.

- Adult males: may be held in single sex groups
- Juveniles: must be housed together where possible in mixed sex flocking situation until sexual maturity at 3-4 years. Juveniles may also be housed with other adults
- Current non-reproductive pairs: Unless a particular bird is required for important pairing at another facility, current pairs engaged in normal pair behaviours should not be separated

4.4.3 Development of new social groupings

- Integration of new birds must be undertaken in appropriate facilities by experienced personnel
- Birds must be monitored during this period utilising standardised protocol by competent personnel
- Daily records of integration process must be maintained

Best Practice 4.4 – Social Structure

4.4.2 Life stages and gender requirements

All life stages and gender requirements should be fully met with natural social groupings maintained at all times. Juvenile flocking should be undertaken for 3-4 years and pairings (non-breeding and breeding) developed after this period. Non breeding pairs should be maintained as single pairs or housed in groups with appropriate contraceptive methods in place to ensure no unwanted breeding occurs. Important breeding birds may be held as pairs only but should be held within audible and/or visual distance of other kea.

4.5 Health Care Standards

Build up of gross matter in a closed environment can encourage the development of harmful pathogens. Daily maintenance to ensure a clean, pathogen free environment is important to for optimum health of any captive animal. However in the case of kea, a clean enclosure should not be confused with a tidy enclosure. Tidy enclosures may equate to an unstimulating environment which may ensure physical health but not mental health. A complex “untidy” enclosure must however still maintain acceptable physical health standards.

4.5.1 Environmental hygiene and cleaning (adapted from Fraser, 2004)

Avoid build-up of food debris in enclosures by removing all food scraps around feeding sites daily.

Nest boxes must be cleaned as required (i.e. if faecal material has accumulated within the box) and should be moved periodically to prevent a large build up or concentration of faecal material in one area. Nest boxes should be cleaned at the end of the breeding season, disinfected by washing with Trigene or similar disinfectant, and rinsed thoroughly in readiness for the following year. Boxes washed with Virkon or Trigene must be completely dried, then allowed to stand for at least 24 hours before being placed back with birds due to the respiratory

irritation associated with these disinfectants. Boxes in which kea are nesting should not be moved or disinfected during the breeding season.

As far as possible, ensure that no foreign material (e.g. tacks, screws, tape, nails, hairclips or jewellery) is introduced into kea enclosures as kea may inadvertently ingest such material. Be especially vigilant after extensive enclosure renovations or construction of new enclosures. A metal detector should be used following any construction work in or significant renovation of an enclosure.

Feed dishes, behavioural enrichment containers and hoppers must be cleaned daily in hot water and detergent. They should also be rinsed thoroughly with water before drying to remove detergents.

Food preparation surfaces and areas must be kept clean at all times and should be constructed of impermeable material such as stainless steel or formica.

4.5.2 Health problems

Kea are not known to have any disease or health problems that are specific to the species (other than a wild flea) however they are susceptible to common parrot diseases and health problems. Records of ill birds must be reported to DoC's Wildlife Database at <http://www.doc.govt.nz/wildlifehealth>

Health problems or diseases which have been known to affect kea or are significant parrot diseases which require monitoring include:

- Psittacine Beak and Feather Disease (PBFD)
- Aspergillosis
- Avian Malaria
- Ingestion of foreign bodies

Psittacine Beak and Feather Disease (PBFD) (Also known as Psittacine circovirus PCV)- (Information from Avian Biotech)

Beak and Feather is a serious disease which causes high juvenile mortality and chronic lowered suppression in parrots and has been found in wild populations of parrots in New Zealand (DoC, 2004). Although this disease has not yet been identified in kea, there is no reason to suppose that kea cannot contract this disease (Potter, pers. comm.) The virus is extremely infectious and as well as affecting the beak and feathers of infected birds, can also affect the liver, brain, and immune system causing diminished resistance to infections. Consequently premature death usually occurs from these secondary bacterial, fungal, parasitic, or viral infections.



A wild salmon crested cockatoo with PBFD. Photo credit: Burdr.com

Signs and Symptoms

Symptoms include irreversible loss of feathers, shedding of developing feathers, development of abnormal feathers, new pinched feathers, and loss of powder

down. Other possible symptoms include overgrown or abnormal beak, symmetrical lesions on the beak and occasionally nails.

Immunosuppression, rapid weight loss, and depression are also possible in later stages of the disease.

Secondary viral, fungal, bacterial or parasitic infections often occur as a result of diminished immunity.

NB cases of PBFD have been found in Antipodes Island Parakeets where no common physical symptoms have been observed (i.e. beak or feather issues).

Transmission

Transmission of the virus between birds is primarily through direct contact, inhalation or ingestion of aerosols, crop-feeding, infected fecal material and feather dust. Most chicks are infected in the nest from a carrier parent. The virus can also be transmitted via contaminated surfaces such as bird carriers, feeding formula, utensils, food dishes, clothing, and nesting materials. The viral particles can remain viable in the environment for months.

Lovebirds and budgies are common carriers of the virus. Kea should be tested prior to transfer if held in facilities that also house these species,

Prevention and Treatment

There is no known treatment for this disease so prevention is the key to stop spread between birds. Strict quarantine should be practiced if beak and feather is suspected and testing of all parrot species in the facility should be conducted to rule out latent infection in individuals.

Testing

If an outbreak of Beak and Feather is suspected, it should be confirmed by PCR testing from a blood sample together with one or two feathers (especially abnormal or suspicious-looking feathers). Strict quarantine should be practiced and the bird should be re-tested after 4-6 weeks. If the bird tests negative the second time, a third test after 4-6 weeks is recommended.

In the event of a dead bird, post-mortem samples should be tested inclusive of liver, spleen, kidney, feathers and swabs (as above).

As with any incidence of illness in a sick native species, DoC must be informed <http://www.doc.govt.nz/wildlifehealth>

Aspergillosis (Information from Avian Biotech)

Aspergillus species of fungus are common in the environment and in most cases do not cause ill health. However fungal spores of some species produce endotoxins which can cause fatal aspergillosis in immunosuppressed individuals. Very high numbers of spores may overwhelm a bird's immune system. This opportunistic pathogen is common among domesticated and cage birds and has been known to affect kea.

Signs and Symptoms

Symptoms range from respiratory distress, gasping, accelerated breathing, voice changes, abnormal droppings, emaciation, regurgitation, poor appetite, diarrhoea, anorexia, gout, increased thirst, nasal discharge, conjunctivitis, dyspnoea, neuromuscular disease, and somnolence, lesions (yellow or gray nodules and/or plaques in the lungs, air sacs, or trachea; less often in the peritoneal cavity, liver or other sites).

Infected eggs may develop a slightly greenish tint when candled. Well developed lesions may appear on infected embryos after they hatch.

Transmission

Spores can may be inhaled from contaminated feed, fecal material, and soil and develop in the respiratory system, lungs, eyes, and ears. Young and old birds, birds on antibiotics, and those birds whose immune systems are suppressed by surgery, reproduction, environmental changes, capture, shipping, or age are frequently infected.

Aspergillus can also infect the developing embryo by penetrating the egg while the embryo is developing.

Prevention and Treatment

Use of damp and contaminated hay, straw, leaf litter or similar material inside bird enclosures must be avoided to reduce the number of spores in the environment. All such material must stored in dry area. If a bird is suspected of having aspergillosis, aggressive veterinary treatment should begin immediately. Long courses of antifungal treatment such as Amphotericin, & Itraconazole may be given as well as immunostimulants. Surgery may be required with certain localised aspergillomas.

Prevention is through minimisation of stress and overcrowding and provision of adequate ventilation and uncontaminated nesting materials. Feed should be stored in a dry environment to prevent fungal growth. Enclosure placement and design are also important in preventing this disease. See 4.1 Housing/Environment Standards.

Testing

Tentative diagnosis can be made with clinical signs, blood tests (showing a very high white cell count), x-rays and is sometimes confirmed by culture. Unfortunately this disease is most often confirmed after death.

Avian Malaria

In 1996 Avian malaria was first confirmed as causing a severe disease outbreak in New Zealand dotterel chicks (*Charadrius obscurus*) in two captive rearing institutions in the North Island (Auckland Zoological Park and Otorohanga Kiwi House), leading to the death of 10 out of 16 birds – a significant loss for this endangered species (Jacob-Hoff *et al.*, unpublished data.) Another captive outbreak occurred in 2003-2005 in mohua at Orana Wildlife Park after they were translocated from the wild.

This is a potentially serious disease which has caused widespread extinction on the Hawaiian Islands due to the naivety of the wild bird population to this disease

and corresponding lack of natural resistance (Derraik *et al.*, 2008). The actual symptoms depend very much on the species, as many species carry the parasite but remain clinically unaffected. It is not known whether kea are susceptible to this disease.

Signs and symptoms

Weakness, lethargy, anaemia and death if severely affected.

Transmission

Spread by biting insects such as mosquitoes.

Prevention and Treatment

Mosquito control is the best way to prevent spread of the parasite. Seek veterinary advice for possible treatments if the clinical signs of this disease are seen.

Testing

Can sometimes be confirmed by the presence of the parasite in blood smears.

Ingestion of Foreign Bodies

Ingestion of foreign bodies may also pose a significant risk for captive kea, particularly in the case of young or sick birds. Care must be taken when objects are placed in the kea's enclosure and daily monitoring must be undertaken to ensure no changes in behaviour or physical status occur. Signs of damage to plastic/hard rubber objects must be recorded and removal considered if it is suspected material has been ingested.

Changes in behaviour have been recorded in kea when ill, with death resulting from ingestion of objects normally considered safe. Early identification of behavioural changes through daily monitoring may help prevent serious effects.

Parasites (external and internal)

External and internal parasites can impact on general health over time by placing pressure on the bird's immune system. External parasites may be identified visually either through presence of the parasite itself (this may be achieved through conditioning/training routines) or through visible damage caused to feathers through excessive preening or poor skin/feather health.

Identifying the presence of internal parasites is more difficult and routine testing of faecal samples is required as part of normal husbandry practices.

Internal parasites

Faecal screening should be carried out in spring, summer and autumn. As the parasite is dormant in winter testing may not pick up presence of worms during this period. Birds should be treated when parasites are present as testing on birds shows presence/absence only.

External parasites

Presence of external parasites (mites, lice) can be established during routine training sessions.

Prevention and Treatment

Daily cleaning of the bird's environment to remove faecal matter, particularly from feeding utensils and areas, will help prevent build up of parasites. Internal parasites are usually treated with ivermectin or fenbendazole (panacur) and external parasites with Frontline. Veterinary advice must be sought regarding dose rates as these will differ depending on the parasite.

4.5.3 Preventative measures

Sensible aviary design, hygienic management, a balanced diet, and preventative health care (e.g. daily monitoring and faecal screening) should reduce disease risks to a minimum.

Monitoring (inclusive of distance examinations) must be conducted on a daily basis as part of daily husbandry practices. Any behavioural or physical changes must be recorded in a daily diary as these may indicate a chronic or acute condition. Changes in the following should be noted:

- Food consumption
- Interaction with con-specifics
- Weight
- Behaviours
- General demeanor
- Movement

Weights from kea should be recorded at least once per month; this can be achieved through instigation of a basic conditioning/training programme. Weight ranges for males and females (fledglings through to adults) are as follows:

Gender	Weight
Male	850 -1000g
Female	750-950g

Table 3. *Chick weights can be viewed in section 4.7.3.

Faecal samples

It is recommended that faecal samples be taken once in spring, summer and autumn for internal parasite examination at a laboratory.

Enclosure checks

Enclosure checks must be made on a daily basis as part of the normal husbandry routine to check that the environment has not been compromised in anyway. Daily inspections should check perimeter integrity, presence of any introduced foreign objects, evidence of pest species invasion (toxic plants, animals) etc.

Staff

All staff must be aware of procedure in the event of a sick kea. This must include knowledge of veterinary contact details, isolation/quarantine protocols, information records and additional contact requirements. Note: in the event of illness the DoC Wildlife Database must be contacted.

Any staff in contact with other parrots (wild or pets at home) must follow proper hygiene protocol to prevent cross contamination:

- Disinfect all clothes/field gear/equipment using Trigene disinfectant.
- Trigene can be added to a normal warm or cold wash in the washing machine (instead of laundry detergent) at 50mL per 4.5kg load.
- Boots must be cleaned of gross dirt or debris and then soaked in 1:20 dilution for 10 minutes and then rinsed thoroughly (McInnes, pers. comm. 2009).
- Alternatively, clothing and footwear used at work must remain separate from that worn while with wild or pet parrots

4.5.4 Treatments and Veterinary Procedures

All birds must have access to veterinary treatment. Contact name and details must be easily accessible to staff in the event of an emergency.

Useful reference material can be found in **Clinical Avian Medicine** by **Harrison and Lightfoot** (2006).

4.5.5 Dead specimens

It is a Department of Conservation requirement (Wildlife Health Standard Operating Procedure) that all dead native wildlife undergo necropsy (post-mortem (PM) examination) to attempt to determine the cause of death and to provide information that might contribute to our understanding of the species.

Any dead kea must be submitted to a veterinarian for necropsy. The procedure for preservation is as follows (from Fraser, 2004):

1. **Do not freeze the carcass.** Wet the carcass thoroughly with clean water to reduce the temperature of the carcass quickly, and refrigerate it as soon as possible. Do not put it in the freezer as this will damage tissues and make a full investigation more difficult. Only freeze the carcass if it is unable to be delivered within 36 hours of discovery.

2. Complete a Huia Database Wildlife Submission Form. This can be downloaded from http://wildlife.massey.ac.nz/diagserv/diagserv_diagnosticspecs.asp or copied from Appendix 5. The purpose of the form is to identify the specimen, list any background information that may help identify the cause of death (including behavioural factors), state any special information the submitter is seeking about the sample, aside from cause of death, and to record if there are any special instructions regarding the disposal of the carcass following necropsy (e.g. returned to submitter, given to iwi, offered as teaching resource).

3. Place the labelled (tag around leg) carcass in multiple puncture and tear resistant plastic bags or a plastic container with a secure and tight-fitting lid. Put a paper towel or other absorbent material in the bag or container to absorb any fluid that may seep out. Put the bag/container in a robust container (either a small polystyrene chilli bin, or a strong cardboard box) together with a non-leak freezer pack (or frozen, half-filled, soft drink bottle) and packaging (e.g. screwed-up paper, bubble-wrap) to ensure the contents do not move around in transit. Label the package **urgent, perishable** and/or **keep cool, do not freeze** and courier to:

Attention: Maurice Alley/Brett Gartrell/Kerri Morgan
Room 8.28, Vet Tower, Massey University, Palmerston North.

A copy of the necropsy report must be sent to the Captive Management Coordinator and DOC.

4.5.6 Quarantine procedures (Refer appendix 5 for Quarantine Procedures) (adapted from Fraser, 2004)

Pre- or post-transfer quarantine is undertaken to minimise the risk of transferring diseases between institutions or between an institution and the wild. Advice should be sought from the DOC veterinarian (kmcinnes@doc.govt.nz) on the tests recommended for each transfer.

A full quarantine period often needs to be undertaken by either the receiving OR the sending institution, not both. The two institutions involved in the transfer should discuss quarantine options and decide which facility will undertake to hold the birds in quarantine. Commonly it is the sending institution that will do the quarantine, but this can be reversed if the parties involved agree to it.

Results from laboratory analyses for internal parasites should be available from the laboratory providing the analysis 24 hours after they received the sample. Enteric screen results (Salmonella, Yersinia, Campylobacter) are normally available after 48 hours, but further time is often needed to identify specific strains. If the receiving institution is doing the quarantine the sending institution must still ensure that the bird is fit for travel by getting an experienced veterinarian to examine the bird prior to transfer.

A complete copy of a bird's individual records must be sent by the holding institution to the receiving institution - including any records from pre-transfer quarantine and vet checks. An information sheet with a summary of the individual's specimen record should accompany the bird being transferred. Facilities using ARKS software can use a modified specimen report while institutions not using ARKS software should use a report such as the one shown in Appendix 5. In addition, a current diet sheet and a list of observed personal behavioural traits can be included with the animals' information to help ensure ease of transition to a new facility.

4.5.7 Handling/physical restraint

No one should handle kea without first having been trained and supervised by someone experienced with handling the species. Although kea are a robust species which do not stress easily, physical restraint of any bird species should be done with care. Avian bones are less dense than mammalian species and are easier to damage as a result.

There are three main capture techniques. It is important that proper technique be learned from an experienced handler. DOC and staff of Zoos/Birdparks are a good resource for learning how to properly work with kea. Contact the species coordinator for further information.

Handlers' hands must be clean and dry so as not to damage feathers. Correct handling protocol must be followed at all times to ensure that both the kea and handler do not sustain any injuries. Kea are a strong bird with a particularly strong beak which can cause serious injury.

Kea should be held with one hand controlling the head and the other the legs. One finger should be positioned under the jaw and the other on the crest of the head. Care must be taken not to obstruct the airway at anytime. Legs should be held together in the other hand with a finger in between the legs to allow for easy banding (refer photo of restraining method).



*Correct restraint technique.
Photo: Brent Barrett, 2010.*

An alternative common restraint method is the parrot hold where the hand restraining the head uses two fingers to hold on both sides of mandible (fingers do not cover the crop). Leg hold with the other hand is the same.

4.5.8 Transport Requirements (Adapted from Fraser, 2004)

Over short distances (i.e. from one enclosure to another within a single institution) kea can be transferred in a solid carry cage (available from any vet practice) which the kea cannot stick its bill through. Cage must have the following;

- Non-slip floor surface (newspaper/toweling/mat of a type not able to be ingested)
- Ventilation
- Water supply with refilling capabilities on the outside of cage or a suitable moist food such as apple or melon.

For air transport, containers must comply with the principles specified for the relevant International Air Transport Association (IATA) container requirement (Container Requirement 21, IATA 2008).

A DOC transfer permit (Authority to Transfer Protected Wildlife) must be obtained from the local conservancy office prior to transferring a bird between captive facilities. A copy of the permit should accompany the bird in transit.

Transport boxes should be wiped down with disinfectant (e.g. Trigene or Virkon S) after use.

4.5.9 Transfer and quarantine

(Adapted from Fraser, 2004)

All Kea being sent to or received from another captive facility, or from the wild, must, as a minimum, undergo the following quarantine procedure either immediately before or after the transfer:

- a) Birds should be isolated in quarantine for a minimum of 14 days after arrival or before being transferred (depending on whether the quarantine is being undertaken by the sending or the receiving institution). If birds that have been/are about to be transferred are held in an enclosure with other birds then ALL birds in the enclosure must undergo the quarantine, including all medical checks and faecal and blood sampling and analysis.
- b) Enclosures containing birds undergoing post-transfer quarantine must be serviced **after** other enclosures containing kea and or related species. Enclosures containing birds undergoing pre-transfer quarantine must be serviced **before** other enclosures containing kea etc.
- c) The bird(s) must undergo a thorough physical examination by a vet at the start and end of the quarantine period.
- d) The birds must be weighed at the start and end of the quarantine period (and the weights recorded).
- e) A faecal sample from each bird undergoing quarantine (or a pooled sample for birds sharing an enclosure) must be collected and analysed by a veterinarian or suitably trained laboratory technician for eggs of endoparasites (*Ascarid*, *Heterakis*, *Capillaria*, *Strongylate* and *Coccidia*) at the start **and again** on day seven-nine of the quarantine period (to allow for analysis to be completed before the quarantine period ends). A faecal sample or cloacal swab should also be collected for Enteric screen.
- f) A blood sample must be collected from each bird in quarantine at the start of the quarantine period to check for haemoparasites and to check that blood cells and chemistry is within the normal range for kea if known.
- g) Except where birds have been transferred to undergo medical treatment, only birds that have undertaken the quarantine procedure outlined here, and have been found to be healthy, should be released into the general kea population at your facility. If medical checks or samples reveal health problems these should be resolved or adequately controlled before the birds are released from quarantine.
- h) A complete copy of the bird's individual record must be sent by the sending institution to the receiving institution.
- i) All kea being transferred must undergo a thorough physical examination by a veterinarian prior to transfer (regardless of whether the quarantine is being conducted by the sending or receiving institution).

Minimum Standard 4.5 – Health Care Standards

(refer Internal Audit Document in Appendix 1).

4.5.1 Environmental hygiene and cleaning must include the following:

- Daily cleaning of food and water bowls
- Daily removal of gross matter in enclosures
- Cleaning of water sources as appropriate

4.5.2 Health problems

The following diseases/health problems are a potential threat to parrots and as such the signs and symptoms of each must be known by staff:

- Beak and feather (PBFD)
- Toxic response
- Respiratory infection

Any instances of ill health must be reported to DOC's Wildlife Database at <http://www.doc.govt.nz/wildlifehealth>

4.5.3 Preventative procedures

Monitoring must be conducted as follows:

- Observations: Daily distance observations (recorded in daily diary) recording changes in behaviour
- Weights: Weights attained through training programme to be recorded on a weekly basis
- Daily enclosure and perimeter checks for foreign materials, introduction of pest species and toxic plants or enclosure breach
- Worming: faeces should be collected for parasite screens 3 times per year. Animals should only be treated for internal parasites on veterinary advice after analysis.

All staff must be aware of the following:

- What constitutes behaviour indicative of ill health in kea
- The procedures to follow in the event of a sick kea
- Any staff that come into contact with wild parrots must follow proper hygiene protocol to prevent cross contamination
- Any staff that come in contact with pet parrots at home must follow proper hygiene protocol as above

4.5.4 Treatments and Veterinary Procedures

- All birds to have access to vet (contact name and details to be sighted).

4.5.5 Dead specimens

- Dead specimens are to be sent to Massey University for full post mortem.
- PM report must be sent to species coordinator and DOC
- Full reporting system to include cause of death and physical, environmental and behavioural factors leading up to death

4.5.6 Quarantine procedures

- Quarantine must be carried out by either the receiving or sending facility (to be determined between the parties) to minimise the risk of transferring diseases between institutions or between an institution and the wild (refer Appendix 6 for example of quarantine protocol)
- A complete copy of a bird's individual records (including summary of specimen records and current diet) must be sent by the holding institution to the receiving institution at time of transfer.

4.5.7 Handling/physical restraint

- Handling and restraint should be conducted by trained personnel or under supervision of trained personnel as per documented handling protocol.
- Restraint of birds must be for husbandry and/or research purposes
- Records must be maintained stating reasons for restraint, outcomes and techniques used

4.5.8 Transport Requirements

Appropriate transport containers available: Over short distances kea can be transferred in a solid carry cage with the following:

- Non-slip floor surface (newspaper/toweling/mat of a type not able to be ingested)
- Ventilation which does not allow the keas beak access outside the cage
- Water supply with refilling capabilities on the outside of cage or suitable moist food available.

Compliance with IATA container requirements where relevant: Air transport containers must comply with the principles specified for the relevant International Air Transport Association (IATA) container requirement (Container Requirement 21, IATA 2008).

DOC transfer permit - A DOC transfer permit (Authority to Transfer Protected Wildlife) must be obtained from the local conservancy office prior to transferring a bird between captive facilities. A copy of the permit obtained by the receiver from the senders conservancy, should accompany the bird in transit.

Appropriate hygiene protocol during transfer - All transport boxes should be wiped down with disinfectant (e.g. Trigene) after use.

Best Practice 4.5 – Health care Standards

4.5.1 Environmental hygiene and cleaning

In larger environments, the issues of hygiene and cleaning should be kept to a minimum. Kea enclosures should not be unnaturally tidy as this will limit complexity for the birds.

Detailed records should be kept regarding changes in behaviour (physical and mental).

4.6 Feeding Standards

4.6.1 Introduction

Kea are opportunistic omnivores. In the wild kea are known to forage on almost 200 different food items from over 100 species of plant and a variety of animal food sources including insects and their larvae (Clarke, 1970; Brejaart, 1988), animal carcasses (Brejaart, 1988; Maloney pers. comm.), and live animals. Live

animals include both native and introduced species, the chicks (Huttons shearwater) and eggs (shear water, Tokoeka brown kiwi and whio (McMurtrie *et al.*, 2004, cited in Reid, 2008) of other native bird species and introduced mammals such as mice (Beggs and Mankelow 2002, cited in Reid, 2008), and sheep (Brejaart 1988; NHNZ, 2003). Kea also scavenge carcasses as well as human rubbish and food around areas of human habitation and tourist locations throughout the South Island (Diamond & Bond 1999).



*Kea at Arthur's Pass eating rabbit.
Photo credit: Andrew Walmsley*

Because of the diversity of plant material consumed, kea are considered to be important dispersers of the seeds of native alpine plant species (Clarke, 1970). Prior to human habitation, evidence of damage to moa pelvic bones indicate that kea utilised Moa as a food source in much the same way as some kea target sheep today. They may also have scavenged moa carcasses after Haast Eagle kills (Holdaway & Worthy, 1997).

4.6.2 Toxic Foods

Many foods that we would consume are toxic to other species and parrots are no exception. The following foods are toxic to parrots and must not be fed to kea: This is not a complete list:

- Avocado
- Chocolate
- Onions
- Mushrooms
- Caffeine
- Dried Beans
- Rhubarb leaves
- Cabbage, broccoli and other members of the brassica family

Toxic browse items include but are not limited to:

- Onion Weed – *Asphodelus fistulosus*
- Black Nightshade- *Solanum nigrum*
- Bittersweet Nightshade – *Solanum dulcamara* L
- Jerusalem Cherry – *Solanum pseudocapsicum*
- Karaka – *Corynocarpus laevigatus*

- Other *Solanum* species including potato
- Tutu (*Cariaria* Spp.)
- Yew (*Taxus baccata*)
- Hemlock (*Conium maculatum*)

4.6.3 Diets and supplements

Kea as opportunist omnivores may be offered a variety of plant and animal products such as they would have access to in the wild. The more varied the diet and presentation then the more likely that birds will be able to fulfill their daily nutritional requirements and natural behaviours. A varied diet will also ensure that kea remain healthy, do not become obese and are mentally stimulated.

A mixture of browse species and choice of all food groups will provide for daily requirements.

Food Types and amounts:

For an example of a daily feeding regime and presentation, refer to Appendix 6.

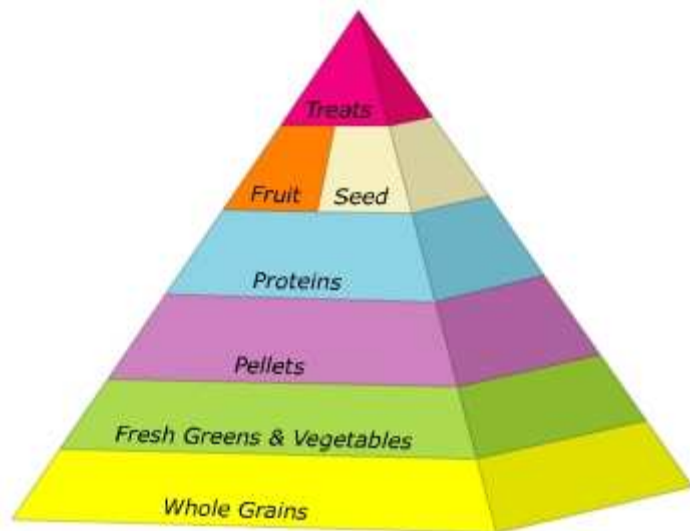
Foods must be of a type and diversity that increase daily motor activity and opportunity for display of natural behaviours (foraging, digging etc).

Enclosure vegetation may also be seen as a food resource for kea and so may need replacing over the course of a year. Digging up of grasses and perennials to access the roots or grubs in the soil is normal foraging behaviour for kea and provision of grass in the enclosure will provide additional interest and activity for the birds. Small shrubs and large trees may also be utilised as food sources. The introduction of browse species on a daily basis can reduce the amount of damage to planted trees.

Browse species of particular interest to kea include cabbage tree (*Cordyline australis*), coprosma species, puha (*Sonchus oleraceus*), and willow.

Note: A list of browse species will be built on by holders over the next few years which may be accessed as part of the appendices.

Amounts per bird: This will depend on size and presentation of food. However care must be taken to ensure that all food groups are given in appropriate proportions (i.e. foods at the bottom of the food pyramid should comprise the majority of feed and foods closer to the top in decreasing quantities).



Parrot food pyramid from avianenrichment.com

Routine weighing of birds will ensure that weights are maintained within acceptable ranges for sex and age group (refer to 5.3.1 for weight ranges). Quick and easy weighing can be achieved during weekly training sessions.

Proteins: Kea may be given whole uncooked beef or horse bones (preferably with the marrow inside the bones) to feed on. This will provide interest, ensure beak health as well as provide the opportunity to fulfill natural behaviours.

Treats: May be used predominantly during training periods and should be given in small amounts only (e.g. cheese, cashew nuts).



Presenting normal foods in unusual ways provides interest

Photo credit: Friedman et al, 2003.

Supplements:

Additional supplementation may be required for birds leading up to and during the breeding season, and for those birds that are immune compromised or need dietary supplements for health reasons.

4.6.4 Presentation of food

The daily allowance of food must be divided into multiple feeds over the course of the day, between multiple feeding sites. This will encourage birds to forage throughout their entire enclosure, thereby helping them maintain a higher level of fitness and mental wellbeing.

Splitting up the food and feeding areas will also ensure subordinate birds are not restricted in their feeding (a dominant bird cannot monopolise a single feeding tray or hopper). It is recommended that there is at least one feeding site per bird and that visual barriers are available between feed sights.

Food (ideally in the form of enrichment and browse), must be provided last thing in the afternoon to ensure that kea have interest in their environment during the highest activity times -- dusk and dawn.

For ideas on different food presentation methods, refer to Auckland Zoo's Kea Enrichment manual (Friedman, Jenkinson & Whybrow, 2003) which can be downloaded from www.keaconservation.co.nz



Kea feeding out of hanging cage, KCT 2009

4.6.5 Seasonal/breeding changes in feeding requirements

It is recommended that during the peak breeding season (June - November) the frequency and amount of food (and particularly food high in calcium) offered to breeding pairs is increased.

Food consumption by the female is likely to decline significantly during the week preceding egg laying, with a sudden resurgence of appetite observed once the female has laid an egg (Pullar, 1996).

4.6.6 Food Hygiene

Care must be taken particularly in warmer climates that food does not spoil. All fresh food (greens, fruit, and protein products) must be refrigerated prior to use (4°C). All grains and cereals must be stored in dry conditions in separate storage bins which do not allow the introduction of pest species or build up of pathogens or fungus.

All food preparation areas must be maintained to high levels of hygiene (refer section 4.5.1) with utensils cleaned and stored appropriately.

Minimum Standard 4.6 – Feeding Standards

(refer Internal Audit Document in Appendix 1).

4.6.2 Toxic foods

Novel foods must be checked to ensure they are not toxic to kea. Foods that must not be fed to kea include*:

- Avocado
- Chocolate
- Onions
- Mushrooms
- Caffeine
- Dried Beans
- Rhubarb leaves
- Brassica's

**This is not a complete list*

All browse material must be checked to ensure no toxic plant species are present. Toxic plant species which must not be fed to kea include*:

- Onion Weed – *Asphodelus fistulosus*
- Black Nightshade- *Solanum nigrum*
- Bittersweet Nightshade – *Solanum dulcamara L*
- Jerusalem Cherry – *Solanum pseudocapsicum*
- Karaka – *Corynocarpus laevigatus*
- Other Solanum species including potato

4.6.3 Diets and supplements

Quantity and types of food should be of an amount to allow for a complete and balanced diet and must include the following on a daily basis:

- Enough food that a small amount is left over after feeding. This will vary seasonally and individually and should be monitored and adjusted accordingly.
- The following food groups should be represented daily in decreasing amounts: cereals and whole grains, fresh greens and vegetables, proteins (meat/bone), fresh fruits and seeds, treats (diary products). High energy foods such as nuts and cheese may also be used in limited quantities for training.
- Browse items

Routine weighing is to be undertaken as part of weekly training sessions and individual bird weights recorded to monitor food intake.

4.6.4 Presentation of food

- Food must be presented at least twice daily (in addition to browse) in two different forms to encourage active foraging throughout the enclosure (for examples of food presentation refer to Friedman *et al.*, 2003).
- Food in the form of enrichment items and/or browse must be provided at the end of each day to illicit foraging at high activity times (dusk and dawn)

4.6.5 Seasonal/breeding changes in feeding requirements

- Additional nutrients must be provided for breeding pairs particularly during egg production and chick rearing
- Non breeding females must be provisioned with additional calcium supplements prior to and during egg laying

4.6.6 Food hygiene

- All foods must be stored appropriately to ensure they remain fresh and free of pests
- All food preparation areas must be kept clean and hygienic

Best Practice 4.6 – Feeding Standards

Diets and presentation of foods should be as varied as possible. Food types should mimic as best as possible a natural diet and be provided more than twice daily with at least one feed and browse provided late in the day to provide the kea with resources and foraging opportunities at their highest activity time each evening.

4.7 Reproduction

Conservation organisations around the world recognise a need to hold a pool of viable individuals of a threatened species to ensure the survival of that species should a catastrophe occur in the wild.

New Zealand, with its many at risk endemics and high number of introduced pest species has seen a high rate of extinctions (including species which are

functionally extinct in the wild) over the past 100 years. Species can go from being considered safe, to being on the brink of extinction very rapidly. One notable NZ example is the Black Robin (DoC, 2001). The tipping point is often not known until that point arrives at which time it is often too late.

A marked increase in the risk of extinction over 100 years from 0.8% in the 1850's, to 32% in 2004, and a lack of confidence in population stability has been put forward by Elliot & Kemp (2004). Ensuring that the existing captive population is physically and behaviourally viable is considered sensible future-proofing in the event of a stochastic event negatively impacting the wild population.

At present holders are only allowed to breed their kea if specifically authorised by Department of Conservation following the recommendation of the species' captive management coordinator (Pullar, 1996). Additionally there is no 'breed to release programme' for kea at present (unlike other native species including the closely related kaka) although this may occur in the future.

The selection of breeding birds and numbers of offspring hatched to each must be carefully managed to ensure maximum genetic diversity is retained and that the numbers of captive birds are carefully managed.

All kea holders will be notified of breeding recommendations (if any) by April each year. This will allow holders to make comments and prepare their facilities prior to the breeding season (June onwards).



*Male feeding female early in the breeding season
Photo credit Alpinism and Ski Wanaka*

4.7.1 Introduction

Kea are a long-lived species which are generally considered to pair for life in the wild. Monitoring of kea in the Nelson Lakes has found that although this is true in many cases (with pairs showing fidelity to each other and a nest site over a 6 year period) (Kemp, pers. comm. 2009) there have been instances where pairs have exchanged partners (KCT, 2009) or opportunistic matings have occurred. It is quite common to see pairs with transitory males visiting, potentially to take opportunities to mate with the female while the male is foraging (Kemp, pers. comm. 2009). It has been suggested in previous literature that males will take on more than one female during a breeding season (Jackson, 1993), however considering the resource intensive nature of the males role during the harsh winter months, this seems a less successful strategy for both males and females. Males provision the females prior to her laying the eggs and then for the time she sits on the eggs and chicks (up to 3 months). This occurs during the freezing

winter months of June – December (Fijn, 2003). If a male dies during the period before fledging, the chicks invariably perish.

Wild kea generally nest in large underground chambers, often within beech forest. Nests have been found from sea level to 1600m and may be located under large rocks or fallen logs. They are usually situated close to a flight runway. Some nests found in the wild are large enough to allow a person to enter and turn around within the nest chamber area/s. The nest chamber/s is generally lined with shredded wood, moss, grasses and feathers.



*Wild kea chicks in a burrow filled with dry grasses.
(Photo: Tui de Roy, 2009)*

Progeny should be removed from the breeding aviary well before the next breeding season. Conflict and injuries are likely to occur when juveniles interfere with the nest site and attempt to interact with the breeding pair. The adult male can become particularly aggressive to his male progeny.



*Kea nest being checked by Josh Kemp (DoC)
2009*

Young birds can be transferred to a colony situation where they learn to socialise with a larger group of birds. Birds introduced into male-female groups will eventually select their own mates. However, natural pair selection is not always appropriate in a controlled breeding situation because the birds do not necessarily choose mates that will result in maximum retention of genetic diversity within the captive flock (Pullar, 1996)

There have been no accounts to date of injury caused by kea to humans entering the enclosure during breeding season even in the case of reproductively active birds housed in public walkthrough aviaries.

4.7.2 Forming new breeding pairs (adapted from Fraser, 2004)

When establishing a new pair, never introduce a new kea immediately into an existing enclosure. Kea can be very territorial, and will need time to get used to each other, otherwise aggression may occur which can result in death. Additionally all new kea must be quarantined to minimise possible disease transfer. Stress during transport can depress an animal's immune system thereby increasing its susceptibility to any baseline conditions in local birds. Stress can also result in expression of an underlying disease lying dormant in a previously healthy individual.

Pairing of birds at the beginning of the breeding season (June/July) may increase the likelihood of a positive outcome.

Pairing of birds should always be supervised by a person who is experienced in kea behaviour and particularly those who have experience of the normal behaviour of the birds involved. Introductions should follow the same general protocol as stated in section 4.4.3.

4.7.2 Nesting/breeding requirements

At the beginning of the breeding season nesting material should be made available to pairs within the enclosure whether they are recommended to breed or not. Nesting/breeding pairs may become territorial during this time so disturbance of the nest box should be kept to a minimum. If other kea are housed in an enclosure with paired birds, behaviours should be monitored to ensure that overt territorial aggression does not occur between birds.

In captivity, most pairs breed on the ground rather than using the traditional nest log or box. A semi-natural nest site can be constructed by placing a plywood box of approximately 1 metre square at ground level and then lining it with rocks inside and out. An access door should be included to allow for nest cleaning and observations. The birds can gain access to the nest area through a 200 mm diameter concrete pipe, or equivalent, of approximately 1.5 metres long (Pullar, 1996). Nesting materials which may be provided for kea should include tussock, hay/straw, logs (for shredding), wood chips (untreated), fern fronds and moss.

Although there is significant variation in successful nesting boxes, it is imperative that all natural nesting materials are dry, clean and free of mould spores (refer section 4.5.2 for information on aspergillosis).

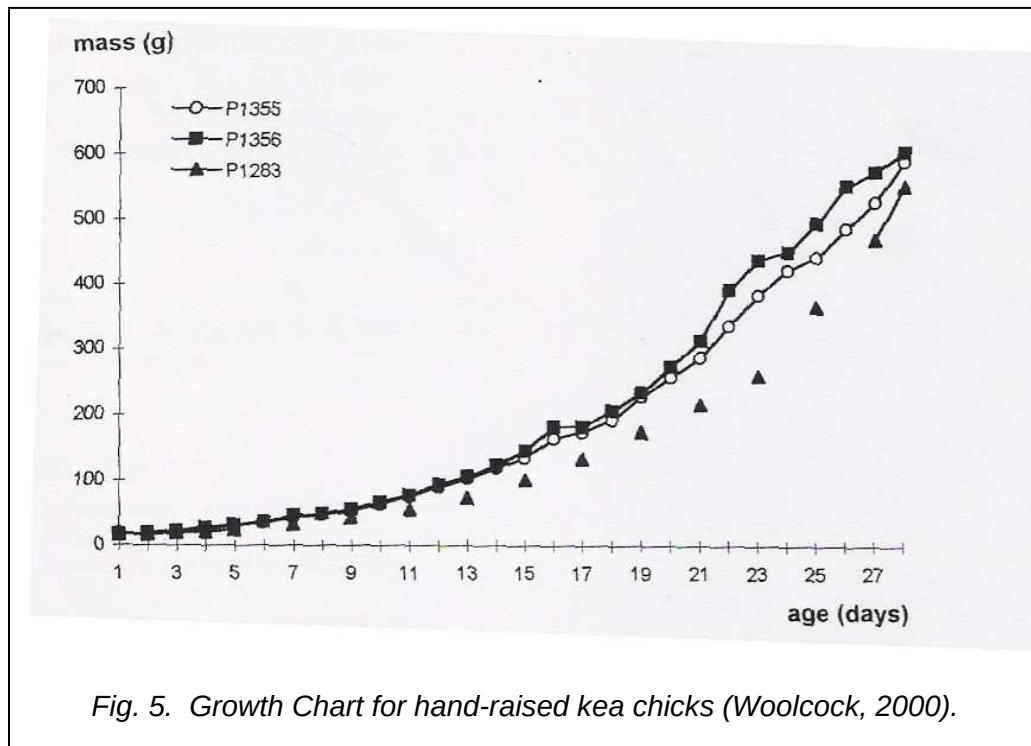
Food should be increased as appropriate during this period to ensure the female is not depleted of calcium etc (refer nutrition section). Egg/s should not be removed from non-breeding pairs without substituting with dummy egg/s.

Females will lay a number of eggs (up to 7) over a period of a week. Birds have been observed eating their own eggs in captivity (KCT, 2009). It is not known if this occurs in the wild although there is evidence that they do eat the eggshells (Barrett, 2008). If eggs continue to be eaten, fertile eggs may be removed and placed in an incubator, while dummy eggs are secreted into the nest instead. Once the female has completed laying eggs and is sitting then the fertile eggs may be returned to complete incubation.

Incubation takes approximately 3- 4 weeks (23-28 days) (Woolcock, 2000; Fijn, 2003) and during this time the female is provisioned by the male. Once the chicks have hatched out the male will continue to provision the female who will regurgitate the food to the chicks. The male will not directly feed the chicks until they venture outside the nest.

4.7.3 Requirements and development of young

Kea chicks are dependent on their parents for an extended period of time (two months from hatch to fledging and up to an additional 4 months thereafter). Kea chicks hatch after 23-28 days incubation (Woolcock, 2000; Fijn, 2003) at a mean mass of 18.0g (Woolcock, 2000) and thereafter develop rapidly (refer Fig 3)



Parent raised chicks tend to put on weight earlier but show a similar trend of weight gain (KCT, 2009).

Although no special foods are required for chicks directly, additional food should be made available to the parents to feed to the chicks. Once the young begin to leave the nest, they will investigate the food provided to the group as a whole.

4.7.4 Hand rearing Techniques

Although hand rearing of chicks is not presently practiced in New Zealand, it has been successfully carried out at facilities overseas. For details on hand raising techniques and diets refer to Appendix 7.

4.7.5 Methods of controlling breeding

If no chicks are required from kea already paired, any eggs laid should be replaced by artificial eggs and the real eggs removed from the nest. Unless

directed to do so by the Captive Management Coordinator, eggs should not be removed without an artificial egg replacing them as an empty nest will encourage the female to keep laying. Repeated egg laying may negatively impact on the health of the female by decreasing available calcium stores. If the female is still sitting on the artificial egg(s) after approximately 30 days the artificial egg(s) should be removed.

Bachelor groups of kea may also be used as a method of controlling breeding, however until further research is carried out, holding of multiple females together will require standardised monitoring to be undertaken, due to increased risk of stress and aggression.

The Captive Management Coordinator should be contacted to discuss how to dispose of kea eggs that are not earmarked for incubation as they may be required for research, advocacy or cultural purposes.

4.7.6 Breeding recommendations

Breeding may only be carried out by a facility once a breeding recommendation has been secured from the Captive Management Coordinator.

Preferential breeding rights will be given to those holders who:

- Show a commitment to holding kea in optimum conditions (enrichment, advocacy, health, enclosure design, training) AND,
- Hold or have the ability to hold founder and F1 individuals, particularly those which are unrepresented in the population.

Minimum Standard 4.7 – Reproduction

(refer Internal Audit Document in Appendix 1).

4.7.2 Maintaining or forming new breeding pairs

- Formation of new breeding pairs must be undertaken and monitored by competent, confident personnel following appropriate protocol
- Records of protocol, observations and outcomes must be maintained during the introduction process

4.7.3 Nesting/breeding requirements

- Each year all pairs (whether recommended to breed or not) must be provided with appropriate nesting areas and dry, clean nesting materials to allow expression of natural behaviours
- All pairs (whether recommended to breed or not) must be provided with additional nourishment to ensure health during the breeding period
- Recommended breeding pairs must be provided with a nest area which is undisturbed by the public (particularly important in public access enclosures) to ensure aggression and stress does not result.

4.7.4 Requirements of young

Kea chicks must be parent raised (unless otherwise approved by the Captive Management Coordinator)

4.7.5 Methods of controlling breeding

Reproduction must be controlled by one of the following methods (depending on social grouping):

- Removal of eggs from non breeding pairs and replacement with artificial eggs
- Maintenance of single sex groups (please note that holding of multiple females together will require standardised monitoring to be undertaken, due to increased risk of stress and aggression).

4.7.6 Facilities recommended to breed

Breeding must only be carried out by a facility who has obtained a breeding recommendation from the Captive Management Coordinator.

Preferential breeding opportunities will be given to those holders who:

- Show a commitment to holding their kea in optimum standards AND,
- Hold or have the ability to hold founder and F1 individuals, particularly those which are presently unrepresented in the captive population.

Best Practice Standard 4.7 – Reproduction

4.7.2 Maintaining or forming new breeding pairs

Behaviorally positive pairs should not be split to form new pairings unless necessary for the continued health of the captive population.

5.0 IDENTIFICATION

5.1 Introduction

Kea do not exhibit obvious sexual dimorphism although males are generally larger and heavier than females and have a longer upper mandible and skull. Variation between individuals is even more difficult to identify and external forms of visual identification are required to ensure correct identification of individuals in captivity.

5.2 Individual Identification

Reliable, safe and permanent individual identification of all kea involved in the captive management programme is essential for the maintenance of the programme. Individual identification is used to track parentage of new individuals and, to enable the identification of genetically appropriate pairings. It is also crucial for tracking information such as medical treatment and behavioural data on individual birds.

Metal leg bands with individual identification numbers must be placed on all captive kea as per DOC banding requirements (refer to DOC banding protocol). Metal bands are available from the DOC Banding Office (phone +64 4 4713294; email bandingoffice@doc.govt.nz).



*Banding a wild juvenile kea.
Photo credit: Florence Gaud (DOC)*

Common band sizes used for kea are LN bands (11mm internal diameter) or 27 series bands on larger birds (Kemp, pers. comm., 2008). To minimise the potential of leg problems, only one metal band should be used per leg.

Coloured bands (plastic or metal) may also be used to allow for easy visual distance identification. This will also decrease the need to catch up birds simply to identify individuals and will also minimise any error.

Trovan pit tags inserted under the skin are a non-visual method of identification which should be encouraged. These should only be used in addition to a visual identification method such as banding.

5.3 Sexing Methods

The two most common ways to sex kea are by morphological measurements and molecular techniques such as feather sexing. An additional method which should be used in conjunction with morphological sexing is behavioural sexing. As the sex of captive kea often determines where they are placed within the captive population, this information is required as soon as possible in a bird's life, preferably before birds are transferred for the first time.

Wild caught birds that are brought into captivity and are incorporated into the captive management programme (e.g. injured birds that cannot be released after treatment) must be sexed within 4 months using molecular techniques. Wild caught birds that have been injured and are being treated for release in captivity may be sexed by morphological and/or behavioural methods only and details recorded and sent to DoC.

Chicks that hatch in captivity as part of the management programme must be sexed by both morphological/behavioural and molecular techniques.

5.3.1 Morphological Sexing Method

Morphological sexing is possible on all age groups with bill and skull length in most cases determining the gender (Elliott & Kemp, 2004) in combination with weights. Sexing can usually be achieved from 9 weeks by the size and shape of the beak (the upper mandible of the male is 12-14% longer than the female; Juniper and Parr, 1998 referenced in Woolcock, 2000). However, sexing by this method alone has been known to result in errors. Confirmation is either by laparoscopy (although this is invasive) or more commonly DNA feather sexing.



*Measuring beak length
Jane Maxwell, 2009*

Gender	Weight	Length	Beak length	Skull length
Males	850 -1000g	46cm	>45mm	>65mm
Females	750-950g		<45mm	<65mm

Table 4. Morphological measurements used to sex kea

5.3.2 Behavioural Indicators for Sexing

Behavioural differences between males and females are most distinct during the breeding season. Care must be taken not to mistake male-male pairings for male-female ones. Normal pairing behaviours are very specific with no overlap of

female roles (i.e. females have not been seen to regurgitate to males in available literature, whereas known male-male pairings can show mutual regurgitation. The “female” of a male-male pairing generally shows no or minimal solicitation behaviour whereas females do). Both males and females may be active in nest building. A full proof confirmation of sex is presence of a female sitting on eggs. Although the absence of eggs does not necessary confirm that a female is not present, it should be viewed as suspect.

At other times of the year, and on the whole, adult females are less gregarious than males and may be more cryptic.

Observations over a relatively short period of time (several hours over a couple of days) may be carried out by volunteers/students and should provide a good indication of a bird's behaviour and interactions between other con-specifics.

5.3.3 DNA Feather Sexing

The sex of kea may also be identified through the presence or absence of female specific DNA isolated from tissue extracted from the base of a sample of feathers. The method of collection is as follows:

1. Pluck approximately six feathers from each bird (the chest is a good site from which to take the sample).
2. To avoid potential contamination of the samples, avoid touching the shaft of the feather where it attaches to the bird's body. Alternatively, gloves should be worn.
3. Place the feathers in a paper envelope.
4. Label the package with your name, institution name, date, and individual ID of the bird (band number or colour/transponder number).
5. Store at room temperature.
6. Send off the samples in an envelope with a covering letter or email to:

Private Bag Palmerston North
 Attn: Ian Anderson
 Equine Blood Type & Research Unit (EBTU)
 Drysdale Drive
 Massey
 Phone: 06 356-9099 ext 7261, 7204
 Email: I.L.Andersib@massey.ac.nz

Once the results are received, please inform the Captive Management Coordinator (see section 2.3) so that studbook information can be updated.

Minimum Standard 5 – Identification

(refer Internal Audit Document in Appendix 1).

- All kea held in captivity must be individually identified by a metal band as stated by DOC banding protocol within three months of hatch, or within three months of being transferred into captivity (for wild caught birds)
- Band numbers are to be sent to DOC banding office (bandingoffice@doc.govt.nz)

- All kea hatched in captivity must be sexed using molecular techniques (DNA feather sexing) within four months of hatching
 - All kea that are brought into the captive population from the wild, excluding birds held temporarily for medical treatment (i.e. held under an injured wildlife permit), must be sexed using molecular techniques (DNA feather sexing) within four months of their transfer into captivity
 - All other kea in captivity must be accurately sexed using morphological and behavioural methods
 - ID records and sexing records (including method used) are to be entered onto a relevant records programme (ARKS or other where applicable) and specimen reports
-

Best Practice Standard 5 – Identification

- In addition to DOC metal banding, all kea held in captivity should be individually identified with a coloured plastic band to allow for accurate distance identification
 - All kea in captivity should be DNA feather sexed to ensure accuracy of records
 - The use of Trovan pit tags should be adopted where possible.
-

6.0 RECORD KEEPING

(Adapted from Fraser, 2004)

Record keeping is a crucial element of managing all species in captivity. Specific care should be taken to ensure that all records are accurate and up to date.

6.1 Individual records

General records of each kea must be maintained detailing individual identifiers (visual and non-visual), gender, birth date/death, transfer date/s and details, sire and dam etc.

Daily records recorded in a daily diary should detail the following for each bird where applicable: Weekly weights, other training outcomes, behaviour (reproductive, changes in, abnormal behavioural expression etc), food consumption, general condition, veterinary treatments, any concerns etc.

Animal records should be maintained electronically to make it easier to maintain a backup copy of all records and to facilitate their transfer to other holders and the captive coordinators. Ideally the software provided by the International Species Information System (ISIS) should be used. This is currently the Animal Records Keeping System (ARKS), but will soon become the Zoological Information Management System (ZIMS).

An example of a manual animal inventory system is available to ZAA members from the members' resources section of the ZAA website (www.zooaquarium.org.au) or from the captive management coordinator.

6.2 End of breeding season reports

Holders should inform the Captive Management Coordinator as soon as practicable about any deaths, hatches, plans to increase enclosure size etc. At the end of the breeding season a summary of information collected by the holder during the season is submitted to the Captive Management Coordinator in the form of an end of season report. A template for this report will be provided by the Captive Management Coordinator.

Minimum Standard 6 – Record Keeping

(refer Internal Audit Document in Appendix 1).

An individual record must be maintained for every kea ever held at an institution. This record must include the following information:

- Individual identifiers (e.g. band numbers, transponder numbers)
- Sex (if known)
- Sexing method (if known)
- Identity of Parents (if known)

- Origin (if wild caught or birth/transfer facility)
- Hatch date (if known)
- Arrival date at your institution
- Departure date from your institution (if applicable)
- Death date (if applicable)
- Cause of death (if applicable and known)
- Weights
- Notes on when faecal (or other) samples were taken and the results.
- Notes on health problems and treatments offered (if applicable)
- Important behavioural notes

An end of season report must be submitted to the Captive Management Coordinator for kea by April 7th each year, detailing developments for the period April 1 – March 30. A template will be provided by the species coordinator for this purpose.

Information required includes:

- Records of kea hatches, deaths and transfers at your institution.
- Numbers of eggs produced by each breeding pair and the fate of those eggs.
- Confirmation that the transfers, releases and breeding recommendations made in the previous year's Annual Report and Recommendations (ARR) were achieved (or at least attempted)
- Information on planned holdings and requests for more (or less) birds

All records sent to the Captive Management Coordinator and entered onto ZAA and ISIS databases (where appropriate).

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9.0 Appendices

9.1 Appendix 1- Internal Audit Document

9.2 Appendix 2 – Important Links

9.3 Appendix 3 – List of Appropriate Enclosure Materials

9.4 Appendix 4 – Massey University (Huia) Wildlife Submission Form

9.5 Appendix 5 – Quarantine Protocol

9.6 Appendix 6 – Example of diet and feeding regime – Franklin Zoo

9.7 Appendix 7 – Hand raising Techniques and Dietary Requirements (Woolcock, 2000)

9.1 Appendix 1- Internal Audit Document

This audit document has been developed to provide kea holders with a practical means to assess their facility standards in regards kea housing and husbandry and to aid them in moving towards the new minimum standards. The audit document is also a tool for Department of Conservation to ensure these standards are met within realistic timeframes whilst taking into account individual facilities annual fiscal planning requirements (where applicable).

KEA (*Nestor Notabilis*) 6 MONTHLY INTERNAL AUDIT

Audit Dates: end of March and end of September

Audit Date _____ **Auditor/s signature** _____

Operators signature

Actions	Corrective action required from previous audit	Completed y/n/na	Comments	Correction action still required
Corrective action/s from previous audit.				

General	Evidence required	Completed y/n/na	Comments	Corrective action and date completed
Husbandry Manual/Captive Management Plan	To sight: the following: • Current documents accessible to kea staff • Documents signed off by kea staff			
DOC permit	Current DOC permit sighted			
DOC (external) audit	DOC (external) audit sighted			

4.1 Housing	Evidence required	y/n/na	Comments	Corrective action
-------------	-------------------	--------	----------	-------------------

/environment standards				and date completed
General Display	All birds are on public display unless: • In temporary holding facilities (up to 1 year); • Undergoing veterinary treatment; • Undergoing quarantine; • Involved in permitted research • Proven to have breeding difficulties on display (<i>evidence required to be documented</i>) • Held by private holders prior to 2009			
4.1.2 Enclosure Type	All birds held in public access enclosures are seen to have the following: • Well signed public barriers; • Safe double gating system; • Twice daily checks (on top of feeds).			
4.1.3 Size	Kea held in enclosures of the following size per number of birds (except for quarantine/medical reasons): 1 kea - 108m³ (e.g. 6Wx6Lx3m H) <i>(evidence to be sighted as to justification for single holding (to be documented))</i> 2 kea - 180m³ (e.g. 10x6x3m) 3 kea - 312m³ (e.g. 13x8x3m) 4 kea - 528m³ (e.g. 16mx11mx3m) 5 kea - 798m³ (e.g. 19mx14mx3m). 6 kea - 1122m³ (e.g. 22mx17mx3m) (Each additional kea = 3m³) Enclosure height to be a minimum of 3 metres.			

4.1.4 Materials for housing	Enclosure materials to be sighted are non-toxic, durable and of a strength to prevent containment breach by kea and entry of large vertebrate species.			
4.1.5 Shelter/screening	The following number of shelters, screens and barriers are sighted: • 1x undercover shelter area (approx 1m²) per bird; • 2x animal visual barriers per enclosure for each pair of birds; • 2x human visual barriers per enclosure for each pair of birds.			
4.1.6 Water	Water is seen to be accessible at all times as follows: • A main water source 1m² x 200 mm deep to allow bathing. • An additional water bowl must be provided at all times at another location in the enclosure (unless a large water source can be accessed without threat by subordinate birds).			
4.1.7 Furnishings , vegetation and substrates	A minimum of 3 different types of each are sighted in the enclosure as follows: • Movable substrates (1 of which is soil). • Ground vegetation (1 of which is grass). • Trees/shrubs. • Furniture (inclusive of rotten logs and perches).			

4.1.8 Multi species exhibit (multi species exhibits to be approved by DOC)	The following is seen to be evident in any enclosure which has different species: • All species are able to access species specific areas. • Acute and/or chronic aggressive interactions are not evident between species. • All species are seen to be in good physical health and exhibiting normal behaviours. • If exotic ungulate species (e.g. Thar, chamois, sheep) are held with kea, appropriate signage is provided to ensure correct advocacy message to public.			
4.1.9 Enclosure Siting	Enclosure is seen to be sited in such a way that enables the following: • Sunlight: access to full sunlight for a portion of each day. • Shade: accessible in multiple outdoor locations at all times. • Airflow: throughout external enclosure areas only. • Moisture: no obvious build up of pathogens, fungus and slime however environment should not be arid. • Ambient Air Temperature: variable throughout the enclosure with adequate cool areas available at all times. • Variety of gradients.			
4.1.10 Security	Enclosure is seen to fulfill the following security factors: • Materials are of a strength and quality that ensures containment.			

	• Locks and latches attached to all doors accessing the enclosure. • No public access areas clearly visible. • Public standoff barriers to boundary fence. • External perimeter boundary fence is present (if required by MAF).			
4.2 Behavioural Enrichment	Evidence required	y/n/na	Comments	Corrective action and date completed

4.2.2 Behavioural needs	The following basic behavioural needs are seen to be catered for in the keas environment: Large flight area: a minimum of 1/3rd of the enclosure area with perches to encourage flight between areas. A variety of perches of varying composition, levels, angles and stability between flight areas. A variety of complex large enclosure furniture pieces (rotting log/s, stream, trampers hut, ponga logs, climbing apparatus, rock wall/pile) which encourage manipulation. A minimum of two new browse or small furniture items introduced into the enclosure per week (substrate, logs, straw, human objects (tent/swandri etc). A minimum of two feeds per day presented in different ways (ie scatter versus main feed spread out in enclosure trays, furniture holes etc) to encourage foraging over an extended period of time.			
4.2.3 Behavioural Enrichment Programme	Daily (unpredictable) enrichment programme to be sighted which includes: A minimum of 1 item from 3 different types of enrichment per day (ie nutritional, occupational, physical/sensory or nutritional, social and occupational etc) on a rotational basis.			
4.3 Training and	Evidence required	y/n/na	Comments	Corrective action

Conditioning				and date completed
4.3.2 Methods	Evidence that positive reward techniques used only (no food or social deprivation). State evidence. Training conducted at least twice weekly for 5 -10mins/bird (or 30mins for a group of birds which ever is less) unless adequate reasons sighted e.g. Breeding season, quarantine bird etc.			
4.3.3 Relevance	Training to include basic management techniques including stationing, body presentation, weighing and crating. All other behaviours sought are seen to be relevant to captive management, to aid in behavioural research or to send important advocacy messages rather than for pure public entertainment value.			
4.3.4 Staff	Minimum of 2 staff trained in training methods to ensure continued training when primary trainer away. Up to date training records sighted			

4.4 Social Structure	Evidence required	y/n/na	Comments	Corrective action and date completed
General	Kea are not held singly except in the following circumstances: • Where birds have been held singly for the entirety of their lives and are proven to be unable to be integrated with other kea (cite evidence) • Undergoing medical treatment • Undergoing quarantine			
4.4.2 Life Stages and Gender Requirements	• Females: are housed in male/female pairs or in mixed sex exhibits with equal male/female ratio or more males than females represented where possible. If females are held in single sex groups, and until such time that evidence shows welfare is not compromised, birds should be placed by the authority of the CMC, in facilities with appropriate expertise and standardised monitoring in place to ensure undesirable levels of aggression and/or stereotypies do not occur. Records to this effect must be documented. Juveniles: housed together in mixed sex situation where possible until sexual maturity at 3-4 years. Juveniles may also be housed with other sub-adults or adults. Current non-reproductive pairs: current			

	pairs engaged in normal pair behaviours should not be separated unless a particular bird is required for important pairing at another facility (justification for this required and evidenced).			
4.4.3 Development of new social groupings	If introductions are taking place the following should be sighted: • Kea introductions are seen to take place in appropriate area as per introduction protocol. • Personnel monitoring introductions are experienced in procedures (name of person to be recorded). • Daily records are up to date.			

4.5 Health Care Standards	Evidence required	y/n/na	Comments	Corrective action and date completed
4.5.1 Environmental hygiene and cleaning	The following basic hygiene protocol is observed: • Daily cleaning of bowls. • Daily removal of gross matter in enclosures. • Cleaning of water sources (if not daily state reasons why not).			
4.5.2 Health problems	All staff are seen to be aware of what constitutes behaviour indicative of ill health in kea (evidence to be stated). Records of ill birds are reported to DCC's Wildlife Database http://www.doc.govt.nz/wildlifehealth			
4.5.3 Preventative measures	The following information to be sighted in daily and veterinary records: • Daily distance observations			

	• Weights • Quarterly worming regime • Enclosure checks Additionally: • All staff are aware of procedure in the event of a sick kea. • Any staff who come into contact with wild parrots must follow proper hygiene protocol to prevent cross contamination. • Any staff who come in contact with pet parrots at home must follow proper hygiene protocol as above.			
4.5.4 Treatments and veterinary care	• All birds to have access to vet (contact name and details to be sighted).			
4.5.5 Dead specimens	Sight records of any dead birds (the following information to be included): • Specimens to be sent to Massey University for full post mortem. • PM report to be sent to CMC and DOC. • Full reporting system to include cause of death, and physical, environmental and behavioural factors leading up to death			
4.5.6 Quarantine procedures	Sighting of appropriate facilities quarantine procedures.			
4.5.7 Handling/physical restraint	Procedures for handling and restraint understood by kea staff.			

4.5.8 Transport	Sighting of transport procedure documentation to include the following: • Appropriate transport containers available • Compliance with IATA container requirements where relevant • DOC transfer permit • Appropriate hygiene protocol during transfer			
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4.6 Feeding Standards	Evidence required	y/n/na	Comments	Corrective action and date completed
4.6.2 Toxic foods	The following information to be sighted: • List of toxic species listed and signed off by staff. • List accessible to staff in appropriate area.			
4.6.3 Diet	The following information to be sighted: • Diet sheet/s available to staff. • Foods should include all food groups as per minimum standards. • All food groups are represented daily in decreasing amounts. • Browse provided daily. • Kea weights recorded to monitor food intake as per training standards.			

4.6.4 Presentation of food	Records to be sighted showing the following: • A minimum of 2 feeds per day (not including browse) presented in at least 2 different ways. • Food enrichment and browse is provided during and at the end of the day.			
4.6.5 Seasonal requirements	Written evidence of supplementation during colder months/reproductive season etc.			
4.6.6 Food hygiene	• All foods are stored appropriately to ensure they remain fresh and free of pests. • All food preparation areas are kept clean and hygienic.			

4.7 Reproductive Standards	Evidence required	y/n/na	Comments	Corrective action and date completed
4.7.2 Forming new breeding pairs	• Formation to be as per species coordinators recommendations. • Introduction of pairs to be monitored and documented by trained staff.			
4.7.3 Nesting/breeding requirements	The following is seen to occur for both breeding and non-breeding groups: • All enclosures are seen to			

	have appropriate nesting areas and material (tunnels, nest box, straw etc) available to their kea. • All nesting material (straw) checked to exclude mould spores • Breeding seen to occur with recommended pairs only • Non-breeding pairs have any eggs produced replaced with dummy eggs.			
4.7.4 Requirements of young	• Young are parent raised. • Hand-rearing to occur only under specification of species coordinator.			
4.7.5 Methods of controlling breeding	• Kea held in single sex groups (male only unless under observation (records to be sighted)). • Non –breeding pairs to have eggs removed and replaced with dummy eggs. • Breeding pairs to have eggs surplus to breeding requirements removed and replaced with dummy eggs.			
4.7.6 Breeding recommendations	Facilities breeding their kea must show the following information: • CMC current			

	recommendation to breed and numbers of offspring allowed.			
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5.0 Identification	Evidence required	y/n/na	Comments	Corrective action and date completed
5.2 Individual ID	To sight the following: • All kea are individually identified by band combinations as per DOC requirements and records sent to DOC. • ID records are current and entered onto relevant programme where possible (e.g. ARKS).			
5.3 Sexing methods	• All kea hatched in captivity or brought in from the wild have been DNA feather sexed within four months. • All other kea are accurately sexed using morphological and behavioural methods. • Accurate records are maintained and sexing method recorded.			

6.0 Record Keeping	Evidence required	y/n/na	Comments	Corrective action and date completed
6.1 Individual kea records	Individual kea records to be sighted and include the following: • Individual identifiers (e.g.			

	- band numbers) • Sex (if known) • Sexing method (if known) • ID of parents (if known) • Origin (wild caught or birth/transfer facility) • Hatch date (if known) • Facility arrival date • Facility departure date (if applicable) • Death date (if applicable) • Cause of death (if applicable and known) • Weights • Notes on when faecal (or other) samples were taken and the results. • Notes on health problems and treatments offered (if applicable). • Important behavioural notes.			
6.2 End of year report (to be completed by 7 th April) to cover the year April 1 st – 30 th March of the previous year.	The following information to be sighted and signed off: • Records of kea hatches, deaths and transfers at your institution. • Numbers of eggs produced by each breeding pair and the fate of those eggs. • Confirmation that the transfers, releases and breeding recommendations made in the previous year's			

	Annual Report and Recommendations (ARR) were achieved (or at least attempted). Information on planned holdings and requests for more (or less) birds			
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The following information, although not part of the husbandry manual as a separate section, is a requirement of the permit application and as such is included in the audit.

Advocacy Standards	Evidence required	y/n/na	Comments	Corrective action and date completed
Advocacy Strategy	Facility kea advocacy strategy to be sighted and understood by keeping staff.			
Public information	At least one form of signage must be clearly visible at the enclosure which may include the following information; - Taxonomy and bio-data - Natural habitat and range - Population estimates - Why are kea held in captivity? - What are the wild issues? - What can the public do to help the species? - Links to outside organisations for more information (KCT, DOC)			

Contacts:

DOC Captive Management Coordinator(CMC) – Tony Pullar (DOC appointed) - tpullar@es.co.nz

Zoo Aquarium Association (ZAA) members - Stephanie Behrens (ZAA Member Kea Contact) - steph@zooaquarium.org.au

9.2 Appendix 2 – Important Links

- Captive Management Coordinator (CMC) (DOC appointed) – Tony Pullar
Email: tpullar@es.co.nz
- Department of Conservation (DOC) – www.doc.govt.nz
- Kea Conservation Trust (KCT) – www.keaconservation.co.nz
Email: n.notabilis@xtra.co.nz
- ZAA Member Species Contact – Steph Behrens
Email: steph@zooaquarium.org.au
- Conservation Management Group (CMaG:ARAZPA NZ) – www.cmag.nz.org
- World Association of Zoos and Aquaria (WAZA - (WZSACS)) – www.waza.org
- Massey University Wildlife Database - <http://www.doc.govt.nz/wildlifehealth>
- ZAA – www.arazpa.org.au

9.3 Appendix 3 – List of Appropriate Enclosure Materials

** This section to be added to by holders*

Framing:

Mesh:

- Stainless steel mesh (used in Orana Parks walk through aviary) - 1.6 mm gauge with approximately 11 mm aperture. Locker Group (NZ) Ltd call free 0800 285 837; <http://www.lockernz.co.nz/index.asp>. (Orana Park enclosure details provided by Tara).

9.4 Appendix 4 – Massey University (Huia) Wildlife Submission Form

WILDLIFE SUBMISSION FORM

Forwarding Instructions

This animal is the property of the Department of Conservation. Please send a copy of test results to: Wildlife Mortality Database Manager, c/- Pathobiology, IWABG, Massey University, Private Bag 11-222, PALMERSTON NORTH

Submitter Details

Surname: _____
 First name: _____
 Organisation: _____
 Address/Box: _____
 Suburb: _____
 City/Town: _____
 Phone (bus.): _____
 Phone (home): _____
 Mobile: _____
 Fax: _____
 Email: _____

Submission Details

Date submitted: ____/____/____ Submitter ref: _____
 Date found: ____/____/____ Number dead: _____
 Number of rats: _____ Number rats: _____
 (If contacted)

Mortality

Date animal died: ____/____/____
 Death circumstances:
 Injured dead ☐ Invertebrate ☐
 Road strike and died ☐ Rattensawed ☐
 Trapped and died ☐ Struck ☐
 Capture or release ☐

Specimen Details

Animal Details
 (Please use separate page for additional animals)
 Species/communal name: _____
 Animal ID: _____
 Identification trace:
 (e.g. wing measurement, head length, etc.) _____
 Individual name: _____
 Sex: Male ☐ Female ☐ Unknown ☐
 Age/Classification: Adult ☐ Subadult ☐ Juvenile ☐
 Immature ☐ Embryo ☐ Egg ☐
 Date of birth/mating: ____/____/____
 Age/Classification (optional): _____
 (e.g. 1st year, 2nd year, etc.) _____
 Where born/hatched: _____
 Weight: _____ g/m/kg

Location Type

Wild
 National/Regional Park ☐
 National Reserve ☐
 National Private Land ☐
 National Park ☐
 Island ☐
 Coastline ☐
 Sea ☐
 River ☐
 Other: _____

Captive
 DC Facility ☐
 Private Breeding Facility ☐
 Rehabilitation Facility ☐
 Zoological/Volunteer Park ☐
 Other: _____

Location name: _____
 Consistency: _____
 Description: _____
☐ Animals are being used in the project. Please include details of the tests.

☐ Special requirements for disposal of body parts, e.g. return to submitter for live requirements, genetic, or forward to Te Papa etc.
 Please state details of which body parts required and in case submitter for return costs.

History

Include any information which you think may be relevant to this case.

Previous health history:
 Clinical signs, external examination, individual treatments, observed behaviour (feeding, reproduction, agonistic), breeding history, diet with any changes, exposure to (toxin), toxicological details, previous clinical pathology (attach relevant reports)

Environmental Conditions (including climate)
 (e.g. weather conditions, ground conditions, etc.) (e.g. contact, clutch details, if relevant - see ID/Species, date/Location, number of eggs, egg size/interval, season/number, season/condition, incubation temperature and humidity)

Expert/Date over test

Invoice Instructions

Invoice submitter ☐ National Wildlife Surveillance Fund ☐

(Refer to "Guidelines for the use of the National Wildlife Surveillance Fund" for eligibility on the WILDLIFE HEALTH PAGE - WGNCR-37/LTR)

9.5 Appendix 5 – Quarantine Protocol

Export

Timeframe: 14 days

Holding:

As isolated as possible from rest of resident animals without compromising the animals welfare.

Testing/examination:

- 2 faecal tests, one week apart
- Where possible, weights at beginning and end of isolation.
- Where required, a physical exam by a vet.

Barrier techniques:

- Servicing of isolated animal(s) **prior** to servicing of other animals within the same Order (Psittaciformes).
- Signage at all entrances to isolation enclosure clearly stating the isolation status, procedures required and authorised personnel.

Import

Timeframe: 30 days

Holding:

Within designated isolation enclosure separated from non-isolated animals by solid barrier or at least 3 meters.

Testing/examination:

- 2 faecal tests, two weeks apart
- Where possible, weights at beginning and end of isolation.
- Where required, a physical exam by a vet and standard blood screen.

Barrier techniques:

- Servicing of isolated animal(s) **after** servicing of other resident animals within the same Order (Psittaciformes).
- Signage at all entrances to isolation enclosure clearly stating the isolation status, procedures required and authorised personnel.
- Use of dedicated equipment within isolation area.
- Dedicated boots to be used within isolation area (work boots to be left outside isolation area)
- Where required by veterinary personnel, use of mask, overalls and gloves.

9.6 Appendix 6 – Example of diet and feeding regime (Franklin Zoo)

Kea 2 birds daily: 1 Apple, 1 pear, 1 carrot, 1 corn cob, 1 banana (vary presentation from cut in quarters or whole). Additional seasonal fruit and vegetables keep aware of too many calories and high sugar foods (Kiwifruit, tree tomatoes, tomatoes, passion fruit, oranges, mango, pineapple etc) If birds are overweight use low GI fruit and Vegetables. For example remove the banana from fruit offering.

1 cup of seed mix each at main feed (mid morning) and a half a cup each at a scatter feed either first thing in the morning or late afternoon (when kea most active).

2 or 3 pieces of silver beet, or bunches of spinach, half or whole cabbage or lettuce. Useful as enrichment and low calorie.

Daily protein in addition to seeds vary between following either

- 3 roasted in shells peanuts cooked each
- Selection of other raw nuts in shells or shelled (hazel, almond, walnut, brazil)
- Bones with marrow and a small amount of meat on them (1- 2 x a week)
- 10 mealworms or wax moth larvae (5 each) in enrichment (e.g. hidden in cabbage or in toy, ball, coconut)

Browse

Daily Pouha, willow, poplar rotten logs from safe trees.

Additional calories if birds low weight or in very cold weather:

- Whole meal bread toasted or plain one piece each
- Meaty bones (beef, mutton- not chicken or pork)
- Additional raw nuts

Do not feed avocados, chocolate, onions, mushrooms, caffeine, dried beans or pulses.

Seed mix recipe

Kea and Parrots = 5 parts dove mix 1 Part Sunflower seeds

Dove mix = 1 part sorghum, 1 part wheat, 1 part poultry pellets (laying with calcium), 1 part mixed millet, 5 parts kibbled maize)

Our Timetable is scatter feed at 7am, main feed at 10am, enrichment at 3pm (with food)

Browse in afternoon.

Additional foods can also be supplemented in small quantities:

- Porridge
- Yogurt
- Nectar

9.7 Appendix 7 - Hand raising techniques (Woolcock, 2000)

Method

Eggs should be maintained in forced air incubators at 37.2 degrees C with an initial humidity of 50% which is reduced in accordance with decrease of mass of the egg over time. The incubation period is usually 23-26 days and the mean mass at hatch is 18.0g (range 15.5-20.53g). Kea chicks grow quickly and only require a high temperature of 30-35 degrees C in a heated brooder for a short period of time. The chicks hatch with a white down but quickly develop a dense dark down. This insulating layer is undoubtedly an asset in the high altitude wild habitat but in the warmth of a typical parrot rearing unit if the temperature is too high at this stage of development (c10-25 days) the chick may die.

When the chicks reach c25-30 days of age they are transferred to a box measuring 120cm x 60cm x 60cm high which has a dull emitter infra red lamp suspended over one end allowing the highly mobile chicks to select the part of the box which best meets their temperature requirements.

Hand rearing diet (Woolcock, 2000)

The diet fed to chicks has been developed over a number of years (J. Heath). The high levels of animal protein or fat which are present in a typical hand rearing diet which probably result in high levels of Clostridium bacteria are not suitable for kea chicks. The diet developed by Heath takes this into account and comprises 250g Nectar blend, 250g Budgie Protein Food, 150g Fruit salad (infant dessert), 120g vegetable hotpot (infant dinner), one level tsp Ace-High, one level tsp Nutrobal and 3 level tsps Avipro Paediatric. It is also possible to use EMP or CEDE eggfood or a similar parakeet rearing food with or instead of the Nectarblend and/or Budgie Protein Food because they all contain c. 16% protein. The vegetable Hotpot (infant dinner) has a suitable protein content for this hand rearing diet but if other products are used in its place the protein should comprise at least 18% of the dry mix (4.7% wet mix) for most parrot chicks although this may be less important for kea. Whatever mix is provided it is important that vegetable rather than animal protein is used. To prepare the diet the Nectarblend, Budgie food, and infant foods are sieved and the residual coarse material is ground to a powder in a coffee grinder. The powder is sieved again and any coarse material remaining is discarded. The powder and the Ace High, Nutrobal and Avipro Paediatric are mixed thoroughly and stored in a sealed plythene container at 4 degrees C. The feed is prepared by mixing about 2 parts powder with 4 parts warm water at 40 degrees C. The mixture is fed until the crop is 2/3rds to 3/4s full. The first few feeds after hatching the mixture must be extremely watery but after the first 2 days it can be slightly thicker. Any unused food should be discarded. When the chicks are c. 15-20 days old the initial mixture can be supplemented with 250g hulled sunflower seed and flower kernels, 125g sesame seed and 62.5g hulled pumpkin kernels and this mix may be offered until the chicks are weaned. Since 1996 Pretty bird 19/8 hand rearing formula has been fed to the chicks at 7 days of age with no detrimental effects. However attempts to feed this diet from hatching have resulted in problems with crop clearing and the subsequent death of chicks.

Adult kea have been observed taking food in the nest box well before the chicks are ready to fledge and therefore hand reared chicks are offered seeds and fruit at 6-7 weeks of age.

Weaning

Weaning is comparatively straightforward and can usually be accomplished in 14-21 days if chicks have access to seeds and fruit. If they do not weaning can take up to 6 weeks. Weaning has also been encouraged by maintaining the chick with an independent kea which can act as a teacher. Chicks are fully feathered at 9 weeks. Young kea will exhibit a begging response for up to 6 months after weaning when they see a familiar person. At the end of the season the young are introduced into a communal aviary with the adults.