



# EAZA Best Practice Guidelines

White-backed woodpecker (*Dendrocopos leucotos*)



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Toucan and Turaco TAG



## **EAZA Best Practice Guidelines**

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## **Preamble**

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the “Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria”. These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country.

Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.

## Summary

The information in this first edition of the Best Practice Guidelines for the white-backed woodpecker (*Dendrocopos leucotos*) summarises the husbandry experiences of Nordens Ark from 1995 to 2022. As the white-backed woodpecker had not been actively bred in captivity before, the methods for rearing and breeding the species have been developed by Nordens Ark, and the soft-release methods have been developed jointly by Nordens Ark and the Swedish Society for Nature Conservation (SSNC). The breeding program was initiated by Nordens Ark and the SSNC as an attempt to save the white-backed woodpecker, a critically endangered species in Sweden.

The population of white-backed woodpeckers for the ex-situ breeding programme is entirely based on founder birds collected as nestlings in Norway. Nestlings were regularly collected during periods to ensure a sustainable breeding population. In this breeding programme, we present methods developed at Nordens Ark of breeding white-backed woodpeckers in captivity as well as releasing young fledglings through soft-release into the wild. All data regarding breeding referred to in this manual originates from this breeding programme, unless otherwise stated.

The white-backed woodpecker is quite a hardy species, that is suited to live outdoor all year round. To successfully reproduce the species, there are some requirements that need to be fulfilled. Pairs of adult birds have been held in large aviaries moderately separated from each other, with large tree trunks that need to be changed on a regular basis. As they prefer to make their own nesting holes, several suitable nesting trees with a sufficiently decayed core must be available before each breeding season. As the white-backed woodpecker has proven to be sensitive to internal parasites, gapeworms in particular, a proper parasitological monitoring routine must be implemented as well as daily observations by qualified staff.

The white-backed woodpecker has been the subject of an EAZA *Ex situ* Programme (EEP) since 2025, and the studbook is kept by Nordens Ark.

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## Section 1: Biology and field data

### Biology

#### 1.1 Taxonomy

**Class:** Aves

**Order:** Piciformes

**Family:** Picidae

**Genus:** *Dendrocopos*

**Species:** *Dendrocopos leucotos* (Bechstein, 1802)

**Common name:** White-backed woodpecker

#### **Sub-species:**

- *Dendrocopos leucotos fohkiensis* (Buturlin, 1908) - Mountains of southeast China (Fujian)
- *Dendrocopos leucotos insularis* (Gould, 1863) - Taiwan
- *Dendrocopos leucotos leucotos* (Bechstein, 1802) - Northern Europe (Norway, Sweden, Finland and Poland), south to eastern Switzerland, Austria, northern Serbia, the Carpathian Mountains, east through southern Russia to Kamchatka, Sakhalin, northeastern China, and Korea
- *Dendrocopos leucotos lilfordi* (Sharpe & Dresser, 1871) - Pyrenees to Asia Minor, Caucasus and Transcaucasia
- *Dendrocopos leucotos namiyei* (Stejneger, 1886) - Southern Honshu, Kyushu, Shikoku and Cheju-Do Islands
- *Dendrocopos leucotos owstoni* (Ogawa, 1905) - Amami-O-Shima I. (n Ryukyus)
- *Dendrocopos leucotos quelpartensis* (Kuroda & Mori, 1918) - Jeju Island (Quelpart), off southern South Korea
- *Dendrocopos leucotos stejnegeri* (Kuroda, 1921) - Japan (n Honshu)
- *Dendrocopos leucotos subcirris* (Stejneger, 1886) - Northern Japan (Hokkaido)
- *Dendrocopos leucotos takahashii* (Kuroda & Mori, 1920) - Ullung I., off east Korea
- *Dendrocopos leucotos tangi* (Cheng T, 1956) - Western China (Sichuan)
- *Dendrocopos leucotos uralensis* (Malherbe, 1861) - Western Siberia from the Ural Mountains east to Lake Baikal

The white-backed woodpecker was first described under the name *Picus leucotos* by Bechstein in 1802, but was later moved to the genus *Dendrocopos*, introduced by Koch in 1816.

## 1.2 Morphology

The white-backed woodpecker is the largest species in the genus *Dendrocopos*, measuring between 25 and 28 cm in length and weighing about 100 g. The wingspan is about 38 to 40 cm. There is no major size difference between the sexes, however males generally have a larger body mass to wing length ratio than females (Grangé, 2023).

The back is black with a distinct rib-like white pattern, which gives the species its name. The sides are white with black longitudinal stripes, and the rump is faintly red to pink. Sexes are distinguished by colouration of the crest, where the males have a red crest, and females a black crest (Figure 1). Young birds have a faintly red crest with hints of black (Figure 2). The beak is long and robust.

The call includes a soft *kiuk* and a longer *kweek* and the drumming is long (1.5-2 seconds) and accelerates with a fading finish.

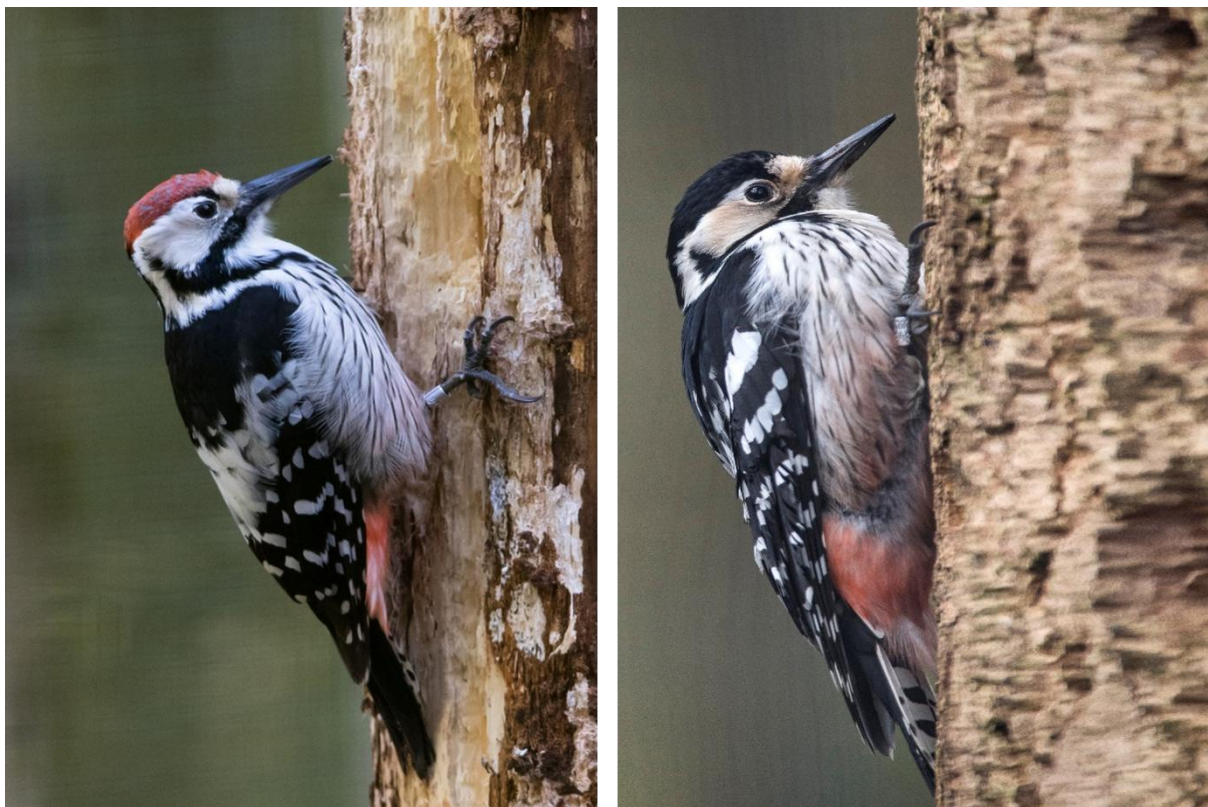


Figure 1. Adult male of white-backed woodpecker with the characteristic red coloured feathers on the head (left). Adult female of white-backed woodpecker with the characteristic black coloured feathers on the head (right).

### 1.3 Physiology

No specific physiology data is available for this species at the time of writing.

### 1.4 Longevity

The longevity in the wild is not known, but in captivity the longevity exceeds 20 years, with a bird still living in October 2025 at the age of 23 years (Retrieved from ZIMS, 2025). The generation time is estimated to be about 5-6 years (Carlson & Stenberg, 1995).



*Figure 2. Hand-reared chicks of white-backed woodpecker, two males (bottom) and one female.*

## Field data

### 1.5 Ecology and conservation status

#### 1.5.1 Distribution

The white-backed woodpecker has a wide distribution, ranging from Norway in the west to eastern Russia and Japan in the east (Figure 3).

According to a study by Aulén (1988), the best habitat for the white-backed woodpecker is boreal deciduous forests (75-93% deciduous trees), with the most

important tree species being aspen (*Populus tremula*), birch (*Betula* spp.), common alder (*Alnus glutinosa*), grey alder (*Alnus incana*) and goat willow (*Salix caprea*). Example of suitable habitats are deciduous rich riparian forest, post-fire deciduous dominated successions, former grazed areas, steep slopes, overgrown cultivated land and natural coniferous forests rich in deciduous trees (Aulén, 1988). The white-backed woodpecker usually avoids Norway spruce (*Picea abies*) monocultures as well as planted forest (Aulén, 1988; Carlson, 2000).



Figure 3. Global distribution of white-backed woodpecker (Retrieved from IUCN Red List, 2024).

The presence of deadwood is also important, with normally at least 15-20 m<sup>3</sup>/ha, as well as sun-exposed trees since these are important habitats for the main food source of the species, which is both larvae and imago of saproxylic and bark-dwelling insects (Aulén, 1988; Lindhe et al., 2005). In a study by Virkkala et al. (1993), the woodpecker never utilised a tree younger than 60 years old. Normally the trees are over 80 years old.

During the breeding season, the foraging area of white-backed woodpecker covers about 150 ha, while during winter the birds can cover 450-650 ha in their search for food. The species does not migrate.

It has been found that the white-backed woodpecker is suited as an umbrella species since its presence indicates a high probability of finding a suite of other species that are vulnerable to modern forest management (Roberge et al., 2008).

#### *1.5.2 Population*

The global population is assessed to be 1.3 to 3.3 million mature individuals. The population in Europe, which forms one third of the global range, is estimated at around 600,000 mature individuals. During 2024, 50 birds were counted in Sweden during extensive monitoring.

#### *1.5.3 Conservation status*

The white-backed woodpecker is classified as Least Concern on the IUCN Red List (BirdLife International, 2021), however it is classified as Critically Endangered on the Swedish Red List (SLU Artdatabanken, 2026).

The global population has a declining trend, with a massive decline observed in Scandinavia. In Sweden, the population has decreased more than 90% since the early 20th century (Carlson, 2000; Virkkala et al., 1993). From being a common species, today it is found in only two or three regions in south-central Sweden. Currently, the population is upheld by regular reintroductions and sporadic pulses of influx from stronger populations in the east.

#### *1.5.4 Threats*

The main threat to the white-backed woodpecker is habitat loss. The food and habitat specialization makes the species very sensitive to modern forestry, which fragments the population with smaller and fewer suitable habitats with long distances apart (Carlson, 2000). Fire suppression during the 20<sup>th</sup> century and regulation of water remines with fewer successional forests also reduces the number of suitable habitats for the white-backed woodpecker (Angelstam & Mikusiński, 1994).

### **1.6 Diet and feeding behaviour**

About 80% of the diet of the white-backed woodpecker consists of wood- and bark-dwelling insects, of which 50% consists of beetle larvae. Effectively all food is found on or in trees, by pecking. They have been shown to utilise foraging trees at distances up to 10 km from the nesting tree (Stenberg, 1990).

## **1.7            Reproduction**

The breeding season starts in February-March with drumming for claiming territories. Then follows the nesting in March-April. Usually, a new nesting hole is made every year. The eggs are incubated for 14-16 days. Both the female and the male help with the feeding of the chicks until they fledge and leave the nest in May-June, after about 28 days. In a clutch of 3-7 eggs, two chicks normally survive. They normally become sexually mature in their third calendar year.

## **1.8            Behaviour**

The white-backed woodpecker is active during daytime and stays in the nest hole during the dark hours all year round. Each individual uses a specific cavity for nocturnal roosting, arriving roughly 30 minutes before sunset and departing at dawn (Grangé, 2023).

They mostly move around by flying or climbing in and between trees but can also search for food on the ground. In captivity, white-backed woodpeckers vocalize both if they are kept in pairs and if they are kept alone.

Pairs cooperate from early courtship through fledging, after which they become largely solitary. During moult and the non-breeding season, individuals forage independently and roost separately. Social interactions outside the breeding period are minimal. The species defends a limited territory centred around the nest, with aggressive encounters rare and less intense away from the core area. Interactions with the great spotted woodpecker (*Dendrocopos major*) are frequent, with the latter usually dominant and occasionally usurping cavities excavated by the white-backed woodpecker. Principal predators include the European pine marten (*Martes martes*), edible dormouse (*Glis glis*), Northern goshawk (*Accipiter gentilis*), Eurasian sparrowhawk (*Accipiter nisus*), and common buzzard (*Buteo buteo*) (Grangé, 2023).

## Section 2: Management in Zoos

### 2.1 Enclosure

#### 2.1.1 Boundaries

The aviaries can be constructed with either a wooden (Figure 4) or metal frame (**Error! Reference source not found.**). To minimize the potential damage of the birds' pecking when opting for a wooden frame, it is advisable to cover all timbering with thin sheet metal for added protection. All sheet metal edges must be folded to avoid potential injuries to the birds.

In an off-exhibit area, the aviaries can advantageously be constructed of a metal frame of scaffolding (**Error! Reference source not found.**). These are both easy to build and to maintain.



*Figure 4. Breeding aviary with wooden frame for white-backed woodpecker with a safety gate to the left.*



*Figure 5. Breeding aviary with metal-frame for white-backed woodpecker with a safety gate to the left.*

The surrounding mesh of the aviaries should be welded metal mesh of galvanized steel wire, ideally with a wire thickness of 1.8-2 mm. The original aviaries were built with a mesh size of 2.5 cm x 2.5 cm, but as this allows smaller wild birds to get into the aviary, it is better to use a mesh size of 2 cm x 2 cm. This netting is small enough to keep most wild birds out, while still allowing the white-backed woodpeckers to climb in the netting without getting their claws caught in the meshing.

By experience, we have learned that trauma is the most common cause of death in large aviaries and therefore the use of a soft inner nylon netting is recommended. The inner netting mesh size can be between 2 to 2.5 cm. The inner and outer net should have a space of at least 10 cm between them. This arrangement has been shown to help reduce flight injuries and protect individuals resting on the inner nylon netting from being injured by predators from the outside, which happened on several occasions with only one layer of netting.

Along the bottom of the aviary there should be an anti-dig barrier. Using galvanised thick-gauge welded netting with a mesh-size of 2 cm should be enough to keep all potential predators from entering. The netting is attached to the foundational frame of the aviary and placed in a 1-m wide trench that should be

approximately 40 cm deep. When the trench is refilled with soil and gravel, the material should be firmly packed so it does not wash away during heavy rainfall.

The aviary is entered through a covered safety gate, where the cleaning equipment for each aviary is stored. Furthermore, the feeding station should be accessible through the safety gate without entering the aviary, in case of outbreaks of avian influenza. If needed, the safety gate should also be large enough to accommodate a change of shoes before entering the aviary.

### 2.1.2 *Substrate*

Natural substrate is recommended to allow trees and other vegetation to grow. Bark, grass, rocks, gravel and sand are all suitable substrates. To allow for more efficient cleaning, sand, gravel, or concrete can be placed under the feeding station.

### 2.1.3 *Furnishings and maintenance*

To encourage natural behaviour, tree trunks of various thickness should be placed in the aviary. In the metal-framed aviaries, tree trunks are secured with builders bands (metal straps) to the horizontal cross beams positioned at 2.5 m (Figure 6). In aviaries with a wooden frame, the tree trunks are attached with nail bands wrapped around a fencing post at approximately 1.5 m.



Figure 6. Attached tree trunks for nest building and enrichment in a metal-framed breeding aviary.

The trees should preferably be aspen (*Populus tremula*) and at least 4-6 of the trunks should be high-quality breeding trees, i.e. have a diameter of at least 20 cm and be decayed from the inside to a depth of at least 5 cm to facilitate a nesting hole (Figure 7). Other tree species suitable for the white-backed woodpecker are willow (*Salix* spp.), birch (*Betula* spp.), and alder (*Alnus* spp.). However, the birds rarely use young birch because of its smooth structure on the bark, which limits the climbing possibilities.



Figure 7. Decayed trees suitable as breeding trees.

As we have experienced in the project, the trees will quickly be perforated by the woodpeckers and must regularly be changed. All trunks, except for 2-3 with nest holes, should be replaced every other year after the breeding season is over or when they are completely striped of all bark.

In addition to the trunks, at least 3-4 nest boxes should be placed at 2-3 m height within the aviary to ensure that the chicks have a nest hole when they leave the nest (

Figure 8). This reduces the risk of injuries and even death to the chicks, as they otherwise could choose to rest on the net during the night. The nest boxes should be approximately 23 cm wide, 23 cm deep, and 50 cm high and have an opening of 5.5–6 cm. They should be constructed from thicker material than standard birdhouses, preferably with a thickness of 40 mm. This is to prevent them from

sounding “hollow” when the birds peck at them. The nest boxes should be filled with wood shavings to approximately 5 cm below the entrance opening. Additionally, the nest boxes should be cleaned and disinfected twice a year: once before and once after the breeding season.



*Figure 8. Nest box in breeding aviary.*

#### *2.1.4 Environment*

The species is well adapted to a temperate climate, thus it is not necessary to have indoor aviaries, if they are provided with adequate shelter from rain and places for the birds to hide from human view. Extreme weather in any form does not influence the species' well-being, breeding success or survival. In bad weather, the woodpeckers simply shelter in their nest holes.

The aviaries should be placed in an as natural habitat as possible, preferably with surrounding trees. The trees provide shading from the sun and protect the birds from strong wind.

#### *2.1.5 Dimensions*

A pair of white-backed woodpeckers kept for breeding can be housed in an outside aviary of 50-60 m<sup>2</sup>, but a larger aviary of 80 m<sup>2</sup> is recommended. This will provide a spacious habitat for the birds to breed and raise their young and also

for the chicks to learn to fly. A square-shaped aviary is preferable to a rectangular one, since it gives the birds the opportunity to fly more. We recommend a minimum aviary height of 4 m as it allows the birds to perch high and feel secure.

## 2.2 Feeding

### 2.2.1 Basic Diet

Since the white-backed woodpecker is a strictly insectivorous bird, they are offered live insects such as meal worms (*Tenebrio molitor*), larvae of *Zophobas morio* and crickets (*Gryllus bimaculatus*). However, crickets are only offered during warmer months since they otherwise quickly die outdoors during winter. For recommended amounts, see Table 1. The woodpeckers will also catch and eat wild insects in the aviary if available.

The white-backed woodpeckers are offered a manufactured feed for insectivorous bird (e.g. *DK Zoological: Insectpate*; Appendix 1). Apart from that, it is not recommended to offer the white-backed woodpeckers any animal protein other than insects.

Small amounts of fruit such as apples or pears are also provided. The fruit is available year around, but the birds have been observed to only eat very small amounts in winter and more in summer. Berries, such as blueberries, raspberries, lingonberries and blackberries, are also offered in small amounts (see Table 1) to the birds during summer.

Table 1. Daily maintenance diet for white-backed woodpecker.

| Amount of food per adult individual fed twice per day (maintenance)                     |
|-----------------------------------------------------------------------------------------|
| Ca 0.5 dl food for insectivorous bird                                                   |
| Ca 0.5 dl of meal worms ( <i>Tenebrio molitor</i> )                                     |
| Ca 0.5 dl of <i>Zophobas morio</i>                                                      |
| Additionally: between May and Aug they are also offered ca 0.5 dl of berries and fruits |

Vitamin supplements are also given on a daily basis. The live food is given a gut-load formula (e.g. Repashy Superfoods: Superload; Appendix 1). The powder is mixed with water and fed to the insects 1-2 days before they are presented to the birds, which ensures sufficient levels of calcium in the insects. A calcium carbonate powder (e.g. Nutrobal; Appendix 1) is also an option if gut-loading cannot be used. If supplements are used, the overall recommended ratio of calcium (C) and phosphorus (P) in the diet for white-backed woodpecker, is anywhere between 1:1 and 2:1, with a preference towards 2:1

### 2.2.2 *Special Dietary Requirements*

During the breeding season, from May to mid-July, white-backed woodpeckers require significantly more energy to successfully raise their chicks. In winter, the birds specialize in feeding on larvae found in deciduous trees, however their diet expands considerably during breeding. To meet their increased nutritional needs, small-sized crickets are offered in addition to their regular daily diet during these months. Before the chicks hatch, the adult birds are given 10-15 crickets each per day. Once the chicks hatch, they are given unlimited access to crickets until the chicks are old enough to be moved from the parents or released into the wild.

In case of sickness, the birds are caught and taken indoors. They are then hand-fed using live insects (mealworms, *Zophobas*, and crickets) until they have recovered. Crop-feeding is also possible when needed, using a specialized hand-feeding formula (e.g. *Harrison's: Recovery formula*; Appendix 1) mixed with water to a viscous liquid. When hand-feeding, the same formula can also be used as a supplement to the insects. Insects are ideally dipped in this formula and then fed to the bird.

This hand-feeding protocol also applies to wild caught chicks that are hand-reared. For further details on hand-rearing, read section 2.4.6 *Hand-rearing*.

### 2.2.3 *Method of Feeding*

The feeding station should be located near the entrance, with both the food and water bowls designed to be removable for easy feeding and cleaning. It should be sheltered from rain and unfavourable weather conditions. To minimize disturbance, a hatch providing direct access to the feeding station from the safety gate is recommended. This can also be used to increase biosecurity if needed.

Outside the breeding season, white-backed woodpeckers are fed twice a day, mornings and afternoons. During breeding season, feeding occurs 3-4 times a day. It is important that they are provided with food early in the morning, at lunch and late afternoon/early evening, thus ensuring that the birds have access to food during the whole day.

*Food is presented in stainless-steel bowls, which are replaced each day (*

*Figure 9).* Fruits are cut and attached to the perches at the feeding station. Small amounts of crickets are offered in the bowls at the feeding station. Larger amounts are offered in plastic boxes on the ground with some gravel as substrate at the bottom of the boxes, to prevent them from escaping.



*Figure 9. Feeding station for white-backed woodpeckers with a smaller water bowl and a larger food bowl, both in stainless steel. The fruit is attached to the perch by a nail.*

#### **2.2.4**      *Water*

The white-backed woodpecker will drink several times a day, therefore access to clean water is essential, preferably in a stainless-steel bowl. From March to November, they regularly bathe, for which a large plastic dish is ideal. Water should therefore be offered in two ways in the enclosure, i.e. a water bowl and a water bath. The water containers should be cleaned and refilled twice a day.

### **2.3**          **Social structure**

#### **2.3.1**      *Basic social structure*

White-backed woodpeckers can be kept either in breeding pairs or individually. All young birds, both destined for release into the wild and for captivity, are separated by the end of July, at approximately 2 months of age, from their parents as they are fully independent at that time. Those destined to stay in captivity are placed in a new aviary either by themselves or with a partner.

Since the rearing of white-backed woodpeckers has been conducted almost exclusively at Nordens Ark, with nearly all fledglings released into the wild, little is known about how their social structure would evolve if they were to stay with their

parents beyond the end of July. Due to the lack of competition for food and shelter in captivity, it is believed that keeping fledglings with their parents for a longer period might not cause significant issues. Chicks from the same clutch have however been shown to develop aggressive and dominant behaviour towards siblings if not separated when they fledge. However, this needs to be more thoroughly studied before any conclusions can be made.

There are no records of white-backed woodpeckers being kept in bachelor groups. However, given the territorial behaviour of the species it is not recommended to keep birds of the same sex in one aviary (except for juvenile birds), as it might lead to aggressive behaviour and potential injuries to the birds.

### **2.3.2**      *Changing group structure*

When introducing a new potential breeding pair, it is crucial to introduce the birds at least two months before the breeding season begins, allowing them to acclimatize to one another. For further details on establishing a new breeding pair, read section 2.4.1 *Mating*.

### **2.3.3**      *Sharing enclosure with other species*

There are no records of white-backed woodpeckers being kept with other species. No specific advantages or disadvantages are known to keeping the species together with other species in captivity.

## **2.4**      **Breeding**

### **2.4.1**      *Mating*

Each aviary should house only one breeding pair of white-backed woodpeckers. It is recommended to introduce new pairs during autumn or winter, allowing them to bond well before the breeding season. White-backed woodpeckers show little active courtship behaviour. As the breeding season approaches, the pair will typically create a new nesting hole, with the male often initiating the process. However, if both the male and female participate in nest building, it is seen as a positive indicator for successful breeding.

Pairs of white-backed woodpeckers should not be kept side by side with conspecifics as they easily stress each other. To have successful breeding, pairs should be kept in separate aviaries, approximately 50-100 m apart. More importantly is visual and acoustic separation through vegetation, terrain, or other physical barriers to minimise disturbance from other woodpeckers.

Observing the birds during the breeding season is essential in order to monitor their compatibility and behaviours. New pairs should be observed 3-6 times daily for 15-20 minutes per session, both at the beginning and throughout the breeding season. Observations should be made from a distance that allows for clear viewing without disturbing the birds. These observations will help assess the likelihood of successful mating and we have noticed that without regular observations it is hard to keep track of the breeding in general. Observations with cameras could complement staff observations but should not replace it.

Mating behaviour is subtle. If the female is receptive, she will perch on a branch, and the male will position himself on top of her (Figure 10). Mating is brief, typically lasting less than 3 seconds, but is repeated frequently. Vocalizations and interactions prior to mating indicate communication between the pair.



*Figure 10. Mating of white-backed woodpecker on a tree log in captivity.*

If no chicks are born, it is crucial to evaluate each step of the process, i.e. whether they built a nest together, mated successfully, laid eggs, or had eggs that failed to hatch. A new pair should be given two breeding seasons to succeed before considering a change of partners.

Established pairs, once successfully breeding, tend to maintain successful reproduction in subsequent years.

#### 2.4.2 *Egg laying and incubation*

The nesting hole typically takes 7-10 days to construct, with an entrance hole of 5-



6 cm and usually at a height of 3-5 m (

Figure 11). The birds use the wood shavings left from the excavation as nesting material. The white-backed woodpecker lays 3-5 white eggs, approximately 28x21 mm in size, directly on the wood shavings. Both the male and female participate in incubating the eggs, which lasts for 12-14 days. Chicks fledge at around 28 days after hatching.

Although human disturbance should be minimized, limited observation is possible and needed to ensure proper care. It is important to confirm that one parent is brooding at a time and that they are switching turns at the nest entrance. This typically occurs every 30 minutes or more. Daily observation of both parents is essential to verify they are displaying correct behaviours and maintaining good health.

As far as we know, artificial incubation has not yet been attempted for this species and has never been necessary in the breeding programme.



*Figure 11. Nesting hole of white-backed woodpecker.*

#### 2.4.3 *Contraception*

The option to use contraception has not been evaluated for this species.

#### 2.4.4 *Hatching*

Since this species has never been artificially incubated or hatched, there is limited information about the hatching process and potential challenges.

A key indicator that the chicks have hatched is a noticeable change in parental behaviour. The adults become visibly more active and stressed, frequently flying in and out of the nest. After hatching, the parents increase their food deliveries to the nest, which may be hard to observe initially. However, as the chicks grow, the parents can often be seen with their beaks full of food.

Another clear sign of hatching is the sound of the chicks' begging calls, which can usually be heard from about 5 m away. Parents may also be seen removing eggshells or chick faeces from the nest, further confirming that hatching has occurred.

#### 2.4.5 *Development and care of young*

The chicks fledge at around 28 days. About a month later, when they reach 55-60 days of age, they are separated from their parents and can be prepared for release into the wild. By this time, the chicks are fully independent and capable of surviving on their own. During the period between fledging and becoming completely self-sufficient, the parents continue to feed the chicks, but as the chicks grow, they gradually become less reliant on their parents. The fledglings then start to refuse food from the adults, signalling their increasing independence.

#### 2.4.6 *Hand-rearing*

All founder birds from Norway used in the breeding program were collected as nestlings (12-16 days old) and were hand-reared until they fledged. Chicks should be kept together (2-4 individuals) in transport boxes (read section 2.6.5 *Transportation*), mimicking a natural nest cavity, and should also be released together in small aviaries once they fledge. White-backed woodpecker chicks do not imprint easily on humans when hand-reared using this method, and they will rear their own chicks successfully with no apparent behavioural problems.

Hand-rearing white-backed woodpeckers is a labour-intensive procedure, especially as the chicks near fledging. The feeding schedule runs from 06 am until 10 pm with feeding intervals of 2 hours. In order to record the weight of each chick before and after feeding, they are taken out of the transport box and fed individually. Young chicks will accept this readily, but, as they grow older, they will become more averse to handling.

Weights are recorded before and after each feeding to register the feed intake. Smaller chicks can eat a couple of grams per feeding and larger can eat up to 5 g. However, the larger they get, the trickier it gets to feed them, since they start to resist. Consequently, at first, they increase in weight with about 3-8 g per day, but after a while this number decreases (Appendix 2).

Gut-loaded mealworms and *Zophobas* larvae are cut in appropriate sizes and wings and legs are removed from the crickets to prepare them for feeding. Everything is then dipped in a neonate formula (e.g. *Harrison's: Recovery formula*), which is mixed with water to a viscous liquid and fed to the chicks using a tweezer (Figure 12). At the end of every feeding, extra care is taken to clean their beaks and inspect their eyes for residue to avoid potential eye infections.

Once the chicks are fully developed they normally weigh 80 g or more. At this stage they are also more active and will try to leave the transport box when it is opened. At this stage they are ready to be introduced to an outdoor aviary over a period of 2-3 days. This aviary is smaller than the breeding aviaries but has the same double netting and furnishing (Figure 13). It is recommended that the juvenile aviary is covered with a plastic roof over the netting to protect the birds from heavy rain. It is also important that the chicks are offered individual nest boxes (Figure 14). When the fledged young are introduced to the outdoor aviary, they are presented with a large amount of gut-loaded live mealworms and crickets at clearly visible feeding stations. The birds will then be naturally attracted to the live insects and start to eat.



*Figure 12. Hand-feeding of a white-backed woodpecker chick.*



*Figure 13. Aviary for group holding of juvenile birds.*



*Figure 14. Individual nest boxes for group holding of juvenile birds.*

During the first 2-3 days, the chicks are caught in the morning and afternoon to monitor their weights. At first, most individuals will decrease in weight but they should not lose more than 10% of their body weight. After weighing, an extra hand-feeding is recommended to keep their weights more stable. As soon as the birds gain weight while eating on their own, they are left in the aviary under observation. Dedicating time for observation is crucial during this period to determine if the individuals are foraging independently or not on a consistent basis.

#### *2.4.7 Population management*

The White-backed Woodpecker Project has been managed by the Swedish Society for Nature Conservation (SSNC) since 1990, with the goal of protecting both the species and its habitat. The species has been kept at Nordens Ark since 1995, when the first founder birds were captured as chicks and imported from Norway, approved by both governments. The wild population in Norway was chosen as founder population based on a genetic study which demonstrated no significant genetic differentiation between the populations in Norway, Latvia, Poland, and Sweden (Ellegren et al., 1999). The population is also listed as LC on the Norwegian Red list (Artsdatabanken, 2021), which can allow a certain removal of individuals from the population.

Since 1995, the zoo population has steadily increased, partly due to the recruitment of wild birds and partly through breeding in captivity. In 2017, the population reached its highest number with 38 individuals, but it has since declined (Figure 15). As of January 2025, the population consists of only 16 birds, with an equal distribution between the sexes.

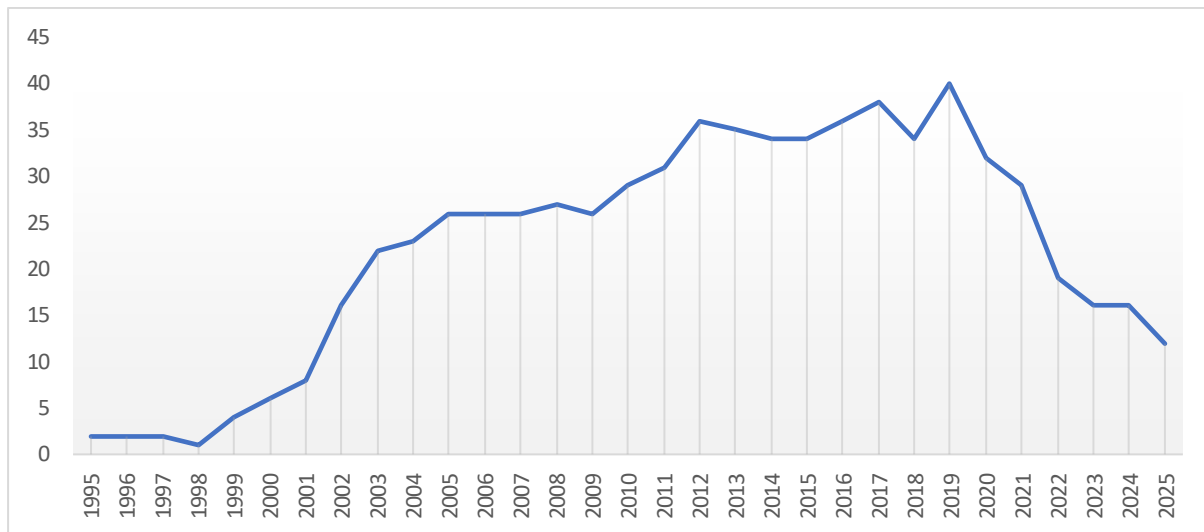


Figure 15. Population trend for the ex-situ population of white-backed woodpeckers from 1995–2025. (Retrieved from ZIMS, 2026).

In 2025, the breeding programme for the white-backed woodpecker was proposed for a EAZA Ex-situ Programme (EEP). Today, three institutions are keeping the species in their collection, two EAZA (Nordens Ark and Vildriket) and one non-EAZA institution (Avesta) within the EEP. In the EAZA Regional Species Plan, the following direct and in-direct conservation roles as well as non-conservation roles were assigned to the *ex-situ* management of the white-backed woodpecker:

#### *Direct conservation roles:*

- **Insurance:** This role entails creating a long-term *ex-situ* population as a backup for future conservation actions. The goal is to have a potential source population for genetic and demographic support in case the wild population declines. However, this role requires a sustainable population that is viable in terms of genetics and demography. The population in Norway is healthy, but its genetic diversity is unknown. Genetic research is planned if new founders join the captive population. New founders are regularly added to the project. The population is healthy in terms of genetics and demography.
- **Population restoration:** This role involves enhancing the species in its historical range where its population has declined. This role means supplying

individuals that are behaviourally and genetically suitable for release into the wild. This role is highly beneficial for the Swedish population. The Swedish population has some links with birds from Finland/Russia. The southern population is more isolated and needs more reinforcements. The population is healthy in terms of genetics and demography.

*Indirect conservation roles:*

- Conservation education: White-backed woodpeckers are an umbrella species that can help raise awareness about habitat restoration for other wildlife. This role does not require keeping the species in the collection, but rather informing and connecting with the Nordens Ark project. This role also involves developing educational materials and programmes, ideally with the support of an education advisor.
- Model: This role involves maintaining white-backed woodpeckers in collections and creating BPGs for their welfare and reproduction. It also sets an example for other woodpecker species and for other species with limited breeding holders within the TAG. This is the only woodpecker project in Europe, and it can be useful for other regions or continents as well. It enhances the knowledge and skills on woodpecker husbandry.

*Non-conservation roles:*

- Avicultural capacity building: This role aims to develop and implement BPGs as well as training existing and new holders on how to care for and breed woodpeckers. It also involves increasing the number of successful breeding holders, which will enhance the genetic diversity and viability of the *ex-situ* population. The feasibility of this role depends on the contribution and willingness of the holders to follow the BPGs and participate in the training.

## **2.5 Behavioural enrichment**

Enrichment can be provided for white-backed woodpeckers in the form of invertebrates hidden in dry leaves. This can be provided in a tray filled with leaves. Scatter feeding live food such as mealworms and crickets around the aviary will encourage the birds to carry out normal foraging behaviours. Alternating feeding sites can also stimulate exploratory behaviour.

## 2.6 Handling

### 2.6.1 *Animal training*

In the context of the white-backed woodpecker programme, no animals were trained other than being fed live food to encourage and enable a natural feeding behaviour. A feeding method that can be used for this purpose, is hollow logs where live insects can be placed, and then the openings are plugged for the birds to peck for their own food. Principally, woodpeckers have the ability to be trained if requirements and/or enrichment options would make this a benefit. However, expertise for BPG on this species are limited and therefore not included in these guidelines.

### 2.6.2 *Individual Identification and sexing*

The male and female white-backed woodpecker exhibit clear sexual dimorphism through distinct morphological characteristics. As adults, males are easily recognized by their bright red plumage on the head, while females have black heads. This difference is visible even in juveniles, making DNA sexing through blood or feathers unnecessary. However, around the age of 50–60 days, the distinction temporarily becomes less apparent as some females develop a number of red feathers on their heads, which eventually revert to black. These red feathers differ in hue from the males', and experienced personnel can still distinguish between the sexes.

*For identification, 4.2-mm (inner diameter) plastic or aluminium split rings can be used, marked with numbers, letters, or colours (Figure 16). Coloured rings are especially useful as they can be identified from a distance. Ringing must be performed by skilled staff to ensure proper fitting and avoid issues like overly tight rings, improper closure, or overlap (*

*Figure 17).*

### 2.6.3 *General handling*

*Handling of white-backed woodpecker must be done by experienced staff to avoid mishap during manipulation. During handling, birds should be gently cupped in the hand without applying pressure to breast and belly, as this can inhibit breathing, but enough to avoid the bird escaping (*

*Figure 17).* The bird should not be held by the wings or only the head or legs.

### 2.6.4 *Catching and restraining*

Woven nets work best for catching individuals, since they move more easily through the air than cloth nets and are less visible. Nets (40 cm in diameter) with a flexible and padded rim must be used to prevent injury to the birds if accidentally knocked with the net (Figure 19). Once caught, birds can be put into a pillowcase

or light cotton bag with the seams outwards to prevent damage to claws. This same method can be used for weighing.



*Figure 16. Two coloured plastic rings and a metal ring are used for individual identification.*



*Figure 17. Ringing of white-backed woodpecker.*



*Figure 18. Correct handling of a white-backed woodpecker.*



Figure 19. Net with flexible and padded rim (40 cm) for catching white-backed woodpeckers.

### 2.6.5 Transportation

Transporting birds should be kept to a minimum as travelling can cause a great deal of stress.

*Transport boxes should not be too large and allow the birds to fly around but should allow enough space for birds to move around. Box sizes of 22 x 25 x 25 cm (W x D x H) are ideal (*

Figure 20). These cages should be kept as dark as possible, with a dark cloth covering that does not restrict ventilation, e.g., jute fabric or similar. The bottom of the box should be covered with a layer of wood shavings (4-5 cm deep). The wood shavings are preferably lightly sprayed with water before use to reduce dust particles. No other furnishing is needed. No water or food is provided in the box. These transport boxes are suitable for transport for up to a maximum of 6-7 hours. For longer journeys or for air travels, transport boxes should follow the IATA guidelines, and food and water should be available.

When transporting white-backed woodpeckers in a vehicle, the transport box should be securely fastened. It is recommended to use some kind of padded material under the transport box to reduce the box from rattling during transport. Any unnecessary noise can cause undue stress; hence this should be reduced. Temperature fluctuations should be kept under control.



Figure 20. Wooden box for transporting white-backed woodpecker.

#### 2.6.6 *Safety*

Safety risks for the staff is limited as the species is not known to be aggressive, even during the breeding season. The safety and welfare of birds must always be ensured, especially during the introduction of individuals or during any aviary maintenance work while birds are still present. Safety also includes preventing their potential escape, so keepers must always ensure doors are kept closed at all times.

### 2.7 **Veterinary: Considerations for health and welfare**

#### 2.7.1 *Injury / Trauma*

The main causes of injury or death for white-backed woodpeckers are trauma-related. The most common traumas with fatal outcome are head and neck injuries and non-fatal traumas includes fractures of the wing, furcula, leg, foot, and toes. Radiography is recommended to assess the extent of the injury. If anaesthesia is necessary, induction with an open mask or in an induction chamber is used, the latter often resulting in less stress for the bird (especially if the chamber is dark). Gas anaesthesia with sevoflurane or isoflurane is recommended, without pre-medication but with pre-oxygenation, providing oxygen before introducing the anaesthetic gas. Complications are not common, but careful monitoring and minimizing stress throughout the procedure are critical for a successful outcome.

If they are not too extensive, most non-complicated fractures can usually be treated by bandaging and resting for a period in a small indoor cage to minimize mobility. The cage should be easy to clean and furnished with small logs (Figure 21). It is important to keep in mind that proper leg and foot function is essential for the species. Even minor impairment can have a major impact on the bird's quality of life, as they must be able to perch on vertical surfaces, climb, and maintain a firm grip while drumming. For this reason, we strongly advise against any form of amputation. If a fracture is not fully recovered and results in altered bone angles, make sure to provide climbing opportunities around the aviary and to the feeding station. Such malalignments may allow the bird to live well in captivity but make it unsuitable for release. Any chronic change affecting how the bird holds its legs or wings should be considered a contraindication for release.



Figure 21. Indoor cage for treatment of sick birds.

### 2.7.2 Predation

As the birds are kept in large outdoor aviaries, they are susceptible to birds of prey that can attack the aviary (sparrow hawk, goshawk and tawny owl). All woodpeckers will frequently climb on the netting to forage for insects, and this leaves them vulnerable to attacks from birds of prey. Newly fledged birds are especially vulnerable to predators if they are climbing or resting on the netting. Young birds are also more likely to fly into the netting, before they have fully developed their flight skills, and they are also more likely to suffer from trauma when attacked or scared by predatory birds. In cases where a raptor attack is suspected, it is important to note that puncture wounds are often extremely deep and can easily lead to secondary infections. Constructing aviaries with double netting, where the inside net is a soft mesh netting, is the safest way to protect the birds from these types of injuries. Also, all furnishing in the aviary should have a minimum distance of 30-40 cm to the netting in order to minimise risks. These precautions will also greatly reduce the risk of injury when catching the birds with nets.

### 2.7.3 Parasitic Infection

As white-backed woodpeckers are sensitive to internal parasites, it is important to have a faecal analysis programme and experienced staff to recognize symptoms

when they occur. It is possible to take a faecal sample directly from the aviary by e.g. using a sampling paper under the feeding station. However, to avoid collecting droppings from wild birds, staying in the aviary, and to have individual samples, it is recommended to do faecal sampling in an indoor cage. To minimise stress and risk of injury, the birds should be handled as little as possible, therefore, at Nordens Ark this is commonly done one to three times per year. Whenever they are handled, a routine medical check-up is done, including faecal analysis. Gapeworm (*Syngamus* spp.) has proven to be the most common parasite. The symptoms are quite visible, with birds that are obviously irritated and repeatedly open their mouths and can easily be detected with daily observations of the birds. Suspicion of infection shall immediately warrant more observation and a decision to quickly catch the bird and move it to an indoor cage for treatment if needed. From our own experience, we know that the condition of the birds can quickly get worse once they have become infected. Some individuals, especially females during the breeding season, who have been previously treated for gapeworm, seem more susceptible to be reinfected. For these individuals it is advisable to perform a faecal analysis and preventative deworming treatment. Gapeworm has been successfully treated by using *ivermectin* (Appendix 3) for adult white-backed woodpeckers, but literature suggests *fenbendazole* (Appendix 3) to be more effective against adult stages of gapeworm.

Normally, white-backed woodpeckers have very few concerns with external parasites.

White-backed woodpeckers destined for release are checked and treated for parasites a week before being transported. Veterinary staff and keepers should check the birds as they are moved to temporary aviaries before being transported to release aviaries. The birds are treated for gapeworms and *Coccidia* spp., as younger birds are more susceptible to coccidiosis than older birds. Toltrazuril (Appendix 3) is used to treat coccidiosis. This is a purely preventative measure due to the stress associated with transport and the new environment which the birds are exposed to. There have been very few cases with *Coccidia* in the breeding population, however those that have been affected and not treated have died.

Incoming chicks for hand-rearing are placed in quarantine for a period of at least a month. Checking faecal samples during the period of hand-rearing is quite easy to do on a regular basis. If any treatments are necessary, e.g. deworming, it is important to do so before the chicks fledge and gain independence and avoiding unnecessary handling of the newly fledged chicks.

## 2.8 Recommended research

**Physiology:** Since there is little information about the physiology of the white-backed woodpecker, which is caused by the minimal handling, we recommend that a protocol for physical parameters (heartrate, body temperature etc.) is developed, which can be used when the birds are handled for other purposes.

**Mate choice:** There is also little research on the pair bonding in this species, e.g. how the white-backed woodpecker chooses their partners. An incompatible pair can ruin one or two years of breeding if not registered in time, and this can have a significant impact on the total number of chicks born.

**Nest observation methods:** Except for the information we have collected during hand-feeding of chicks collected from the wild, little is known about the development of chicks inside the nest due to the risk of disturbing the birds. A development of an observation method that can monitor the chicks inside the nest, would greatly improve this knowledge and give valuable information of the demographic data, such as clutch sizes, chick survival etc.

**Veterinary:** Another area of improvement is the knowledge about parasites and the susceptibility to repeated infections. We have for example seen that birds that have had gapeworms seem more susceptible to repeated infestations. There is also a lack of knowledge about how these parasites spread to the birds in the first place, and how they can spread between the aviaries.

## 2.9 Reintroduction methods

More information about the Swedish release strategy for the white-backed woodpecker can be found here: [Utsättningsstrategi för vittryggig hackspett](#)

The white-backed woodpecker is released using a soft-release method, which involves gradually acclimating the fledglings to their new environment. The birds are released from aviaries situated in suitable habitats when they are approximately 2 months old. The exact timing of the release depends on the chicks' development, though it typically occurs in the beginning of July. Prior to transportation to the release site, the birds are weighed, dewormed, and fitted with identification rings.

The release aviaries measure 3 x 5 m with a height of 3 m, providing a total volume of 45 m<sup>3</sup> (Figure 22). They are equipped with nest boxes, tree trunks, food and water bowls, and "wooden feeders" (hollow wooden cylinders filled with mealworms). One corner of the aviary is covered to provide a sheltered area for the birds. The number of aviaries at each release site is adjusted based on the

number of birds being released, with each aviary accommodating a maximum of four birds.



*Figure 22. Soft-release enclosure for white-backed woodpeckers.*

The birds remain in the release aviary until they are settled and are used to their new aviary, normally for 7–10 days. They are fed and monitored in the morning and afternoon daily during this period. After release, supplemental feeding is provided outside the aviary, following the same feeding schedule as earlier for an additional 2–3 weeks. In the end, they are fed once daily until the birds stop visiting the feeding sites. Throughout the following autumn and winter, food continues to be supplied near the release site to support the birds during their first year. Also, this encourages the birds to stay in the area of the release site. This methodology is continuously refined and evolved as additional practical experience is gained.

### Section 3: References

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## Section 4: Appendix

### Appendix 1

*Products mentioned in the text*

s. 17 *DK Zoological: Insectpate* –

<https://www.kiezebrink.eu/public/attachments/Droogvoer/DK%20Zoological/DK%20Insectpate.pdf>

s. 17 *Repashy Superfoods: Superload* –

<https://www.shop.repashy.com/products/repashy-superload>

s. 17 *Nutrobal* – <https://www.vetark.co.uk/products/reptile/nutrobal>

s. 18, 22 *Harrison´s: Recovery formula* –

<https://www.harrisonsbirdfoods.com/product/recovery-formula-2oz/>

## Appendix 2

*Daily weight gain (in g) in 22 hand-reared white-backed woodpeckers of different starting weights and age, with each row representing one individual.*

| <b>Approx. age in days:</b> |   | <b>11</b> | <b>12</b> | <b>13</b> | <b>14</b> | <b>15</b> | <b>16</b> | <b>17</b> | <b>18</b> | <b>19</b> | <b>20</b> | <b>21</b> | <b>22</b> | <b>23</b> | <b>24</b> | <b>25</b> | <b>26</b> | <b>27</b> | <b>28</b> |
|-----------------------------|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Sex</b>                  | f | 49        | 57        | 60        | 63        | 67        | 70        | 80        | 89        | 89        | 85        | 92        | 92        | 87        | 92        | 89        | 88        | 84        | 90        |
|                             | m | 46        | 54        | 60        | 63        | 66        | 70        | 78        | 82        | 90        | 89        | 89        | 90        | 93        | 83        | 89        | 85        | 89        | 81        |
|                             | f |           | 58        |           | 63        | 72        | 78        | 83        | 84        | 88        | 90        | 91        | 92        | 93        | 90        | 85        | 83        | 81        | 81        |
|                             | m |           | 65        |           | 71        | 77        | 87        | 91        | 95        | 100       | 103       | 101       | 99        | 100       | 98        | 93        | 94        | 94        | 96        |
|                             | f |           |           | 80        | 85        | 89        | 87        | 91        | 94        | 92        | 94        | 92        | 91        | 90        | 88        | 90        | 95        | 88        | 88        |
|                             | f |           |           | 82        | 85        | 89        | 88        | 87        | 87        | 88        | 90        | 89        | 89        | 88        | 88        | 87        | 87        | 86        | 88        |
|                             | m |           |           | 85        | 92        | 94        | 90        | 96        | 97        | 93        | 96        | 95        | 96        | 96        | 94        | 94        | 97        | 94        | 93        |
|                             | m |           |           | 88        | 92        | 96        | 96        | 95        | 96        | 97        | 98        | 98        | 96        | 97        | 93        | 95        | 96        | 91        | 92        |
|                             | f |           |           |           |           | 69        | 79        | 84        | 86        | 86        | 85        | 85        | 84        | 81        | 84        | 87        | 85        | 86        | 83        |
|                             | f |           |           |           |           | 70        | 76        | 81        | 82        | 84        | 82        | 87        | 84        | 83        | 81        | 86        | 81        | 84        | 81        |
|                             | f |           |           |           |           | 71        | 82        | 90        | 93        | 94        | 88        | 93        | 96        | 92        | 90        | 93        | 94        | 91        | 91        |
|                             | f |           |           |           |           | 66        | 74        | 79        | 83        | 86        | 91        | 97        | 93        | 90        | 92        | 87        | 84        | 87        | 89        |
|                             | m |           |           |           |           | 61        | 69        | 74        | 80        | 84        | 88        | 86        | 93        | 90        | 85        | 81        | 80        | 80        | 84        |
|                             | m |           |           |           |           | 64        | 74        | 80        | 83        | 88        | 91        | 96        | 93        | 93        | 99        | 90        | 87        | 89        | 90        |
|                             | m |           |           |           |           | 74        | 78        | 85        | 89        | 87        | 90        | 95        | 89        | 86        | 83        | 79        | 76        | 72        | 74        |
|                             | m |           |           |           |           | 65        | 73        | 78        | 83        | 87        | 88        | 92        | 95        | 90        | 87        | 84        | 91        | 89        | 88        |
|                             | f |           |           |           |           |           |           |           |           |           | 81        |           | 81        | 84        | 88        | 85        | 86        | 85        | 85        |
|                             | m |           |           |           |           |           |           |           |           |           | 85        |           | 85        | 82        | 89        | 89        | 91        | 91        | 93        |
|                             | m |           |           |           |           |           |           |           |           |           | 86        |           | 82        | 86        | 89        | 88        | 89        | 88        | 93        |
|                             | f |           |           |           |           |           |           |           |           |           |           |           | 80        | 84        | 88        | 91        | 91        | 87        | 89        |
|                             | m |           |           |           |           |           |           |           |           |           |           |           | 75        | 82        | 82        | 86        | 86        | 86        | 88        |
|                             | f |           |           |           |           |           |           |           |           |           |           |           | 80        | 84        | 88        | 91        | 91        | 87        | 89        |

## Appendix 3

List of drugs used for captive white-backed woodpeckers.

|                             |                                                               |                                                                  |                          |                                |                              |
|-----------------------------|---------------------------------------------------------------|------------------------------------------------------------------|--------------------------|--------------------------------|------------------------------|
| <b>Drug name (example)*</b> | Ivomec® vet                                                   | Axilur® vet                                                      | Baycoxine® vet           | Metacam®                       | Bactrim®                     |
| <b>Active substance</b>     | Ivermectin                                                    | Fenbendazole                                                     | Toltrazuril              | Meloxicam                      | Sulfametoxazol + trimetoprim |
| <b>Manufacturer</b>         | Boehringer Ingelheim                                          | MSD Animal Health                                                | Bayer Animal Health GmbH | Boehringer Ingelheim           | EumedicaPharmaceuticals GmbH |
| <b>Treatment of</b>         | Several endoparasites, including gapeworm larval stages       | Several endoparasites including gapeworm adult and larval stages | Coccidiosis              | Inflammation/pain management   | Bacterial infection          |
| <b>Concentration</b>        | 10 mg/ml                                                      |                                                                  | 50 mg/ml                 | Several good options available | 40 mg/ml + 8 mg/ml           |
| <b>Dose (mg/kg)</b>         | 0,5 mg/kg**                                                   | 50 mg/kg                                                         | 12-20 mg/kg              | 0,5 mg/kg                      | 25 mg/kg                     |
| <b>Oral/injection</b>       | SC injection                                                  | Oral                                                             | Oral                     | SC injection or oral***        | Oral                         |
| <b>Frequency</b>            | SID                                                           | SID                                                              | SID                      | BID                            | BID                          |
| <b>Duration</b>             | Treatment is one injection that is repeated after 10-14 days. | 5 days                                                           | 2-3 days                 | As needed                      | As needed                    |

\*Any brand name with the same content can be used

\*\* This dose is higher than commonly recommended. We have found *Ivomec* difficult to dilute in a stable and reproducible manner, and to minimize the risk of underdosing we therefore increased the concentration to 0.5 mg/ml. This corresponds to approximately 0.05 ml, which is the smallest volume that can be reliably measured using a 0.3 ml insulin syringe. No adverse effects have been observed.

\*\*\* SC injection with solution for injection (usually 2 mg/ml), or oral with oral suspension (usually 0,5 mg/ml)