

EAZA Best Practice Guidelines

Javan Green Magpie

Cissa thalassina



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EAZA 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.

Citation:

EAZA Best Practice guidelines for the Javan Green Magpie *Cissa thalassina*.
Edition 1. Andrew Owen April 2019.

Summary

This first edition of the Best Practice Guidelines for the Javan Green Magpie *Cissa thalassina* is based on the husbandry experiences of a small number of dedicated aviculturists and institutions.

This species has only been in aviculture for a very short time, (since 2011) and has only officially been a managed EEP species since December 2016. The basis of the current conservation-breeding population originated from a relatively small number of wild-caught founder birds, which were rescued or acquired from illegal wildlife markets or private keepers in West Java, Indonesia by the Cikananga Conservation Breeding centre and Taman Safari Indonesia.

Many of the husbandry techniques contained herein have been developed by the author and a small number of contributors experienced in working with this or other closely related members of the genus.

The taxonomy used in this document follows: del Hoyo, J. & Collar, N.J. (2016) *HBW and BirdLife International Illustrated Checklist of the Birds of the World*. Volume 2: Passerines. Lynx Edicions, Barcelona.

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All photographs by Andrew Owen, unless otherwise stated.

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Section 1: Biology and field data Contents

Biology

1.1 Taxonomy

Class: Aves
Order: Passeriformes
Suborder: Oscines
Family: Corvidae
Genus: *Cissa*
Species: *thalassina*
Subspecies: None (Monotypic)

Taxonomic notes: *Kitta thalassina* Temminck, 1826.

The Javan Green Magpie *Cissa thalassina* was re-categorised and re-named following the publication of the Bird Conservation International paper; Biology, taxonomy and conservation status of the Short-tailed Green Magpie *Cissa [t.] thalassina* from Java (Van Balen *et al.* 2011).

Prior to this it was thought to be the nominate form of Short-tailed Green Magpie with *Cissa jeffereyi*, a species now re-named the Bornean Green Magpie.

English synonyms

Short-tailed Magpie, Short-tailed Green Magpie (when treated as conspecific with *C. jeffereyi*).

1.2 Morphology

Body size

Morphometric measurements from seven captive Javan Green Magpie

Sex	Bill Length	Bill Height	Skull	Wing	Tail	Tarsus
M	37.9	16.5	69.3	138	113.2	52.9
M	37.8	16.4	70.5	141	115.4	54.7
M	40.3	16.2	71.9	140	111.2	49.7
M	34.1	16.6	68.3	136	93.6	49
F	34	15.6	67.7	133	94.6	51.5
F	34.1	15	66.6	137	99.7	49.2
F	37.3	16	68.3	137	100.7	47.4

Variable	Male Average	Female Average	Species average
Bill Length (mm)	37.53	35.13	36.50
Bill Height (mm)	16.43	15.53	16.04
Skull (mm)	70.00	67.53	68.94
Wing (mm)	138.75	135.67	137.43
Tail (mm)	108.35	98.33	104.06
Tarsus (mm)	51.58	49.37	50.63

Weight

There are no weights recorded from wild birds.

The average weight for adult males in captivity was 130.1g (variable 121g – 146g) taken from 56 sample weights of 17 adult males in good body condition (with a pectoral muscle score of 4-5 and a subcutaneous fat score of 0-1) from three institutions.

The average weight for adult females in captivity was 124.7g (variable 118g – 133g) taken from 47 sample weights of 22 adult females in good body condition (with a pectoral muscle score of 4-5 and a subcutaneous fat score of 0-1) from three institutions.

Higher weights have been recorded in this species (maximum 158g in males and 155g in females), however, heavier than average birds often have large amounts of sub-cutaneous fat and are considered over-weight or obese.

(See appendix for pectoral muscle and fat score).

Description

The Javan green magpie is 24.5-30 cm in length, weight 124-130g. The sexes are alike. Although there are no photographs of this species in the wild, based on freshly caught individuals, in nature it is a bright apple or pea-green colour. The fore-crown is bright yellowish-green or lime green, forming a short crest.

A black band extends from base of bill, across sides of head, enclosing the eye and crossing at the nape under the crest. The black feathers above the eyes can be raised to form “eyebrows” when the bird is excited, alarmed or in display. In addition to the raised eyebrows, when excited or in display the slightly paler green feathers on the flanks are raised to give a puffed-up appearance.

The rest of head, body plumage, scapulars, lesser upper-wing coverts are a bright (apple) green. The relatively short, bluntly graduating tail is uniformly darker green above, paler greyish-green below with no black or white markings.

The primary and secondary feathers are a rich reddish-chestnut brown, the tertiary feathers are pale opaline whitish-green.

This species has a distinctly large coral-red bill which has a hooked tip on the upper mandible. The legs, feet and toes are orange-red.

The eye is surrounded by a coral-red orbital ring, the iris is a bright reddish-brown surrounded by a white sclera. This latter point has not been noted in descriptions for this species, possibly due to its rarity and lack of sightings in the wild and given that its features are describes from museum skins, which do not have eyes.



Adult Javan Green Magpie (Steve Rawlins)



Note reddish-brown iris with distinctive white outer eye colour (Steve Rawlins)



Adult Cikananga Conservation Breeding Centre 2017 with raised flank feathers



Cissa thalassina (left) *Cissa jefferyi* (right) Natural History Museum, Tring



Comparative photographs *Cissa thalassina* (top) *Cissa jefferyi* (bottom) Natural History Museum, Tring



Cissa thalassina (left) *Cissa jefferyi* (right) Natural History Museum, Tring. Diagnostic feature for *Cissa thalassina* plain underside of tail



Cissa thalassina (left) *Cissa jefferyi* (right) Natural History Museum, Tring. Diagnostic feature for *Cissa thalassina* complete white tertiary feathers



Adult Cikananga Conservation Breeding Centre 2016

1.3 Vocalisation

On Java, the Sundanese names èkèk gèling, kèkèt gèlèng, dèrèt dèt kèlèng, kèrèkèk kèlèng, cucak keling (West Java), and Javanese names dingdingbak (Central Java), and kekek kelang (Yogyakarta) and variations (Bartels 1897-1931, Koningsberger 1907, van Oort 1910, S. v. B. unpubl. data) closely describe the most stereotypic call of its large repertoire, which also includes mimicking, and is accurately described as “a nasal chiuu – chiuu – kèkèng ê ngliéng”, also “uttered in flight” (Bartels 1897-1931, J. H. Becking unpubl. data).

Mimicry plays a part in its repertoire with captive birds at Cikananga conservation breeding centre copying other species in adjacent aviaries including Black-winged Myna *Acridotheres melanopterus*, Sumatran Laughingthrush *Garrulax bicolor* and Rufous-fronted Laughingthrush *Garrulax rufifrons* as well as Crested Serpent Eagle *Spilornis cheela* which often fly over the area. Additionally at least one bird was known to copy to sound of the aviary alarm system.

1.4 Longevity

There are no longevity records for this species in the wild. As this species has only been kept in captivity for a short period of time, (since 2011) no longevity data is available.

An adult wild-caught individual of the closely related Indochinese Green Magpie *Cissa hypoleuca* lived in captivity for 18 years. As corvids in general are relatively long-lived birds it may be expected to live for at least 15-20 years.

Field Data

1.5 Zoogeography and Ecology

Distribution



Historical range of Javan Green Magpie

BirdLife International (2018) Species factsheet: *Cissa thalassina*. Downloaded from <http://www.birdlife.org> on 12/02/2018

Habitat

The species inhabits mainly foothill and montane tropical/sub-tropical forest at 500-2,000 m, occasionally ranging into lowland areas, and may be seen in adjacent cultivated areas and at the edge of forest (van Balen *et al.* 2011 and references therein).

During the afternoon of 2nd November 2013, we found an overgrown disused road, which lead to a forest clearing.

At 16.45 two Javan Green Magpies were heard calling from adjacent dense vegetation approximately 20 metres from our position. The first call was a fast, loud three note *Ka ka ka* from one bird, followed a few seconds later by a rising metallic *Kaeeng* alarm call from a second bird that appeared to be approximately 10 metres away from the first bird.

The birds made no further calls and remained hidden in thick vegetation.

We remained at the site until 17.30, when the light was beginning to fade.

The area where the birds were encountered was in sub-montane forest in a steep-sided valley, adjacent to a small clearing and a noisy, fast flowing stream approximately 1-2 metres wide.

A Garmin Dakota 20 GPS was used to record the location and altitude of the site. The altitude was 1084 metres above sea level. The location has been withheld for security reasons.

Weather conditions were dry and the temperature was approximately 28°C.

(A.Owen, A. Tritto pers. Obs.)



Natural habitat of Javan Green Magpie (Location where two birds were heard November 2013 by Owen and Tritto).



Typical Javan green magpie habitat

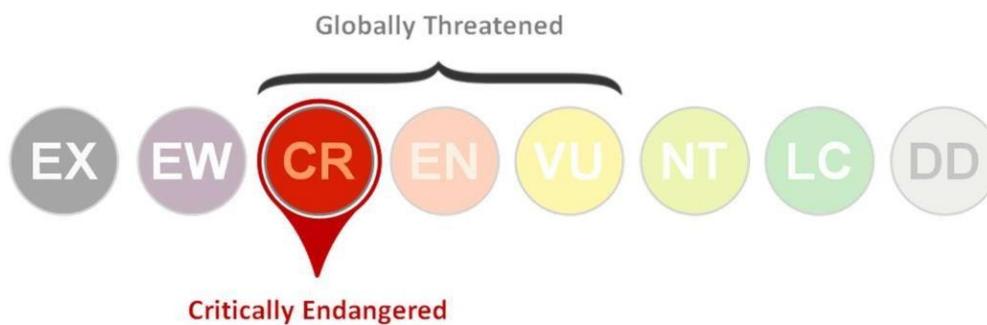
1.6 Population and conservation status

Red List Category

Family: Corvidae (Crows and jays)

Authority: (Temminck, 1826)

Red List Category



Criteria: C2a (i)

Justification of Red List category

This recently-split species qualifies as Critically Endangered because it is thought to have an extremely small and fragmented population, which is suspected to be in rapid to very rapid decline owing to on-going trapping pressure and the continued loss and degradation of suitable habitat. Research and informed conservation actions are now urgently needed to increase the chances of this species' survival.

Population size: 50-249

Population trend: Decreasing

Extent of occurrence (breeding/resident): 41,200 km²

Country endemic: Yes

Population justification

The Javan green magpie appears to have an extremely small population, which is likely to number fewer than 250 mature individuals, with each subpopulation probably containing 50 mature individuals or fewer (van Balen *et al.* 2011). It has also been suggested that the total population probably does not exceed 100 individuals and could number fewer than 50 individuals, as there may be only one or two dozen birds at each of up to four sites where the species was recorded from 2001 to 2011 and may still be extant (van Balen *et al.* 2011); however, surveys should be conducted to confirm whether this is the case.

Trend justification

It has been suspected by van Balen *et al.* (2011) that the species is undergoing a decline of at least 80% over ten years (although this would preferably be estimated for a period of three generations = 20 years [BirdLife International unpubl. data]), based on the paucity of recent

records, a fall in numbers seen in bird markets, and rapid rates of habitat loss and fragmentation. However, there is currently little evidence on which to base a suspected population decline of 80% or more over the past and next three generations, despite the likelihood of the species' population now being extremely small and localised. Although the numbers of birds on sale in markets are said to have decreased markedly (van Balen *et al.* 2011), more supporting data are required on the rates of habitat loss in the species' suspected range. In addition, the threat of future habitat destruction is alleviated somewhat by the protected area status of the four locations with records in 2001-2011, including three national parks and one protection forest/nature reserve, although encroachment is occurring along the borders of at least two of these national parks (van Balen *et al.* 2011). On this basis, the population is suspected to have undergone a decline of 50-79% over the past three generations, and is expected to decline by 30-49% over the next three generations owing to the incursion of trapping, agricultural encroachment, timber harvesting and mining into at least two of the four protected areas that appear to represent the species' remaining strongholds.

Distribution and population

Cissa thalassina is endemic to western Java, Indonesia, where there are few recent records and the species now appears to be very rare and localised (van Balen *et al.* 2011). Since 2001, the species has been recorded in only four protected areas: the national parks of Mt Merapi, Mts Halimun-Salak and Mts Gede-Pangrango/Megamendung, and South Parahyangan Protection Forest/Nature Reserve. In the 1990s, it was also recorded at Pembarisan Mts Protection Forest and Dieng Mts Protection Forest, with records earlier in the 20th century from Jampang Kulon (not protected), Mt Slamet Protection Forest and North Parahyangan Protection Forest/Nature Reserve (van Balen *et al.* 2011). The paucity of recent records implies that there are probably fewer than 250 mature individuals remaining, and the population is suspected to be in on-going decline.

Ecology

The species inhabits mainly foothill and montane tropical/sub-tropical forest at 500-2,000 m, occasionally ranging into lowland areas, and may be seen in adjacent cultivated areas and at the edge of forest (van Balen *et al.* 2011 and references therein). Its diet comprises mostly invertebrates and small vertebrate prey. Breeding appears to take place throughout the year, with a preference for the months with highest rainfall (October-April). Clutch size is one or two (van Balen *et al.* 2011 and references therein).

Threats

On Java, most forest below 1,000 m, and in some areas up to 1,500 m, has been cleared, which is suspected to have caused serious declines in this species population (van Balen *et al.* 2011). Habitat loss and degradation is driven primarily by agricultural expansion, logging and mining. Excessive trapping for the cage-bird trade is also thought to be a significant threat, although only relatively small numbers have ever been recorded in bird markets (van Balen *et al.* 2011). Bird-catchers tend to specialise in particular species, suggesting that remnant populations are at increased risk of local extirpation through targeted trapping pressure (van Balen *et al.* 2011). A search of bird markets in West Java in 2011 found just ten birds, some of which had been caught in the wild relatively recently (Collar *et al.* 2012).

Conservation Actions

Conservation and Research Actions Underway

The species is probably still extant in four protected areas, including three national parks; however, despite their designations, at least two of these national parks (Halimun-Salak and Mts Gede-Pangrango) suffer encroachment along their borders, resulting in habitat loss and degradation and trapping pressure, whilst Mt Merapi National Park has lost habitat to volcanic eruptions (van Balen et al. 2011). Eight surviving birds found in trade in 2011 were acquired and taken to the Cikananga Conservation Breeding Centre where a breeding programme has been established, although experience of successful captive breeding of *Cissa* species is limited (Collar *et al.* 2012), the first chick ever bred in captivity hatched in March 2013 (Richter 2013). Following increased successful breeding at Cikananga Conservation Breeding Centre, two pairs were sent to Taman Safari Indonesia, a wildlife park near Bogor in an effort to create a regional network of zoological institutions helping to conserve the species.

In late 2015, six pairs of Javan Green Magpies were sent from Indonesia (Cikananga Conservation Breeding Centre with the assistance of Taman Safari Indonesia) to Chester Zoo, UK, forming a satellite assurance EAZA EEP population in Europe. From these 12 birds, a pair was each sent to Prague Zoo in the Czech Republic and Jersey Zoo, Channel Islands and four pairs were retained at Chester Zoo.

Chester Zoo reared four young in 2016 and again in 2017 and Prague reared three young in 2017, with Jersey Zoo rearing a single chick in 2017. In two seasons the European population has doubled, allowing new pairs to be established within the EAZA population.

Cikananga Conservation Breeding Centre continues to breed the species regularly and the current global captive population was 71 individuals at the time of writing (April 2019).

Conservation and Research Actions Proposed

Conduct range-wide surveys in order to generate an improved population estimate. Closely monitor rates of habitat loss and degradation within the species' range. Protect the species by law, but manage awareness to avoid encouraging increased trapping pressure (van Balen et al. 2011). Protect any remaining substantial fragments of suitable habitat not already covered by a designation. Increase and improve enforcement measures in protected areas within the species' range (see van Balen et al. 2011). Consider a programme of recovering captive birds for release into the wild, where possible, or recruitment into a captive breeding programme (van Balen et al. 2011). Intensify awareness-raising activities within and around protected areas to reduce trapping pressure and encroachment, and amongst the wider public to discourage trade in the species (see van Balen et al. 2011). List the species in international trade management agreements.

Conservation Actions Proposed or underway

1. Review the species' status in trade and consider listing under CITES.
2. Support measures to regulate the cage bird industry nationally in Indonesia and internationally.
3. Surveys are urgently required to determine whether additional sub-populations still persist within the historical range.

- An 18 month ornithological and habitat survey of the 20 most important mountains in West and Central Java commenced in September 2018.
4. Grant full legal protection for the species under Indonesian law. (The Javan Green Magpie was included in the updated list of Protected Indonesian species in June 2018).
 5. Support the development of captive breeding programmes with the aim of future reintroduction.

CITES Status

This species is currently not listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

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Text account compilers

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Contributors

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Taxonomic note

Taxonomic source(s)

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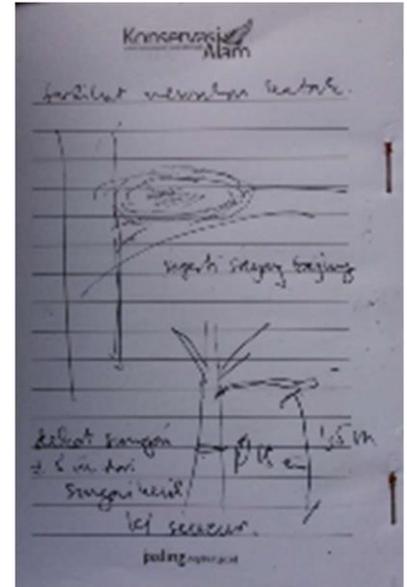
BirdLife International (2018) Species factsheet: *Cissa thalassina*. Downloaded from <http://www.birdlife.org> on 12/02/2018

Trapping pressure

Evidence of continued trapping for Javan Green Magpies was found during a field survey in Halimun Salak National Park in February 2016, when biologist Pupung Nurwatha met with National Park staff. “We meet Apud and Amir, the field staffs of Cikaniki Research Station. Formerly Apud was bird poacher who live near TNGHS forest at Citalahab Village. We also meet with Iding and Ucup, they are bird poacher who live in Ciaul Village.

- Gunung Kempul area. Apud and his colleague (Amir) have been working for searching of Leopard sighting at the National Park area. On 15 November 2015, 11 am, they heard JGM voice at Gunung Kempul area.”

Around the year 2004/2005, Apud has twice taken juvenile of JGM from their nest in the forest near Central Village, Citalahab. The position of JGM nest was about 1.5-2m high from ground level. The JGM nest found at small tree branch (the diameter of tree about 15cm). The local name of the nest tree is Kiseueur (*Antidesma* sp). Nest made from twigs, with moss and dried leaves in the central of nest. The location of nesting tree is not far from the river, about five meters away from a small stream. First time, Apud take two juvenile from the nest. Two months later, the adult JGM was build nest again in the same tree but different branch, and generate one juvenile. The next juvenile was also taken away by Apud.



Apud inform us that there is one JGM caged by a local people in Cisalimar village.

Iding and his son (M Yusuf/Ucup) are non-intensive bird poachers from Ciaul village. We invite them to go to the JGM site with their JGM as “jontrot/pemikat” (decoy).

- Cipanggulaan. This location is reached from the Ciaul village about 4 hours by walk. JGM information on this site is provide by Iding who heard from his neighbors (Holik, bird poacher). Holik said he saw 3 JGM about 20 days ago at this location. This location is the origin of JGM in his cage now as a decoy bird (jontrot). The JGM *jontrot* was catch by Holik in the nest when the bird still juvenile. Holik said the name of JGM nesting tree is kiseueur (same as mentioned by Apud). The current age of JGM *jontrot* is about 15 months old. Along two days in Cipanggulaan together with *jontrot*, we did not saw or heard the sound of JGM.
- Tanjakan Jangkar. At this location, on August 2015, the *jontrot* (decoy) has attracted the wild JGM and captured by Edo (local people from Desa Mekarjaya). In this survey periods, we did not successfully found or heard of JGM at this location.
- According to Iding and Ucup, JGM capture events is a news that will quickly spread in the village. That is, if there is JGM captured from the forest surrounding their village, the news will spread and they (Iding and Ucup) will sure it would have heard the story. Since 20 days ago, there was no news someone successful capture JGM. They believe JGM still in the forest but the place was changed.
- Iding and Ucup mention that in Desa Mekarjaya there are only three people who keep JGM in the cage i.e. Ucup (1 individual), Edo (1) and Indra (2). JGM that he and Edo keeps

come from the forest surrounding their village (Cipangaulaan and Tanjakan Jangkar). JGM in Indra house came from Jampang, South Sukabumi.

- Based on all the information collected, at least 5 Javan Green Magpie are kept in cages at Kabandungan area of TNGHS, one individual in Cisalimar village, 4 individual in Desa Mekarjaya.

Photographs of survey activities at Ciaul Village and Cipangaulaan using Javan green Magpie decoy bird



Javan Green Magpie decoy bird known locally as "jontrot"



Javan Green Magpie bird trappers in Halimun Salak National Park 2016. Note caged decoy bird suspended in tree. (Pupung Nurwartha)



Capture for the cage bird trade is the main threat to the Javan Green Magpie. A faded bird in a local bird shop, West Java February 2018 (Jonathan Beilby).

1.7 Behaviour

The Javan Green Magpie is an extremely rare and secretive species, surviving only in the remotest mountain forests of West and Central Java. Very little is known about its natural behaviour in the wild and there are no published data on activity, locomotion, predation, social behaviour, seasonal behaviour, social structure or territoriality.

Very little is published on the natural history of the distinct Javan Green Magpie (Madge and Burn 1994, dos Anjos 2009), and its specific name *thalassina* (meaning sea-green or bluish-green, the general colour of preserved skins or of birds kept in captivity) given by its describer, C. J. Temminck in 1826, is symptomatic of the status of knowledge of these birds in their natural environment, described as rugged and inaccessible (de Visard de Bocarmé 1829).

Bartels (1931) described its habitat in and around a tea plantation on the south-western slopes of Mt Patuha, where during their raiding parties the magpies venture out far into the tea gardens; they prefer the forest fringes along the rivers. (S. van Balen *et al.*).

1.8 Diet and feeding behaviour

The old names Hunting Crow or Hunting Cissa (Madge and Burn 1994) very aptly describe its voracious nature. They are found in troops, or seasonally in pairs (Koningsberger 1915), not uncommonly accompanied by Rufous-fronted Laughingthrush *Garrulax rufifrons* (Koningsberger 1907), and often found near mixed bird parties (Delsman 1927).

The table below shows the items found in the stomach content of 34 specimens (Vorderman 1886, Bartels 1897-1931, Sody, in Becking 1989). Throughout the year, invertebrates form the most important component of the diet.

A variety of prey items has been found in stomachs: snails; crustaceans: crayfish *Astacidae* (*Decapoda*), pill bugs *Armadillidae* (Isopoda); insects: cockroaches *Blattidae* (*Dyctyoptera*), grasshoppers (*Orthoptera*), 'may-beetles' *Scarabaeidae*, weevils *Curculionidae*, *Chalcothea* spp. *Cetoniidae*, horned beetles *Cerambycidae*, click beetles *Elateridae* (*Coleoptera*), cicadas (*Homoptera*), caterpillars (*Lepidoptera*), large ants *Formicidae* (*Hymenoptera*). Larger vertebrate prey (small birds, lizards, including their eggs, tree frogs, and snakes) constitutes a large part in first three months of the year only, largely coinciding with the breeding season.

Food items in stomach content of *Cissa thalassina* (from Vorderman 1886; M. Bartels 1897-1931). (S. van Balen et al.).

	January-March	April-June	July-September	October-December
Number samples	10	11	2	12
Invertebrates	18	24	7	20
Vertebrates	13	1	1	5
Fruits	1	0	0	2

1.9 Reproduction

Sexual maturity

No data are available from the wild.

The youngest known bird to successfully raise young was a ten month old captive-bred male, paired to a four year old female at Chester zoo. These birds successfully raised a single chick during 2017.

Seasonality of breeding

Although data are scarce and conclusions cannot be reliably drawn, it appears that breeding takes place during most of the year with a preponderance for the wettest months, i.e. October –April in West Java (Voous 1950): Jan (3), Feb (1), Mar (1), Apr (3), Sep (1), Dec (2) (after data from Bartels 1897-1931, Hoogerwerf 1949, 1950, Hellebrekers and Hoogerwerf

1967, J. H. Becking unpubl. data). Birds are freshly moulted at the end and beginning of the year (Bartels 1902).

Courtship behaviour

Courtship behaviour has not been documented in wild birds. (See courtship behaviour in captivity).

Nesting

Meyer (1884) reported a "...cup-shaped nest on the thin twigs of a large-leaved tree, consists of a base of stronger stalks or branches, then tendrils and thin twigs, intertwined with many dry leaves of bamboo, rice etc.; inside lined with black thin roots; 80 mm high, 170-180 mm wide, inner cup 65 mm deep and 110 mm wide.". Bartels (1897-1931) "... found its nest twice on thin trees in a tree fork close to the trunk, of rather solid built, but not very large in relation to bird's size ...". Hoogerwerf (1950): "...usually not high above the ground (3-6 m)...in not thick branches...base and outside consists of dry leaves, both from trees and rattan etc. Nest cup lined with plant parts looking like thin, dark rootlets, and petioles, stems, etc..." Becking (unpubl. data) reported a nest in a *Tarennia incerta* tree at 2.5 m above the ground in a Manglietia experimental plot, another in a small tree in undergrowth at 3 m above the ground in primary forest.

Clutch size is one egg (n 5 1) or two (n 5 7) (Hoogerwerf 1949, Hellebrekers and Hoogerwerf 1967). The egg is described as "oval, coarse-grained, smooth, and moderately glossy, with yellowish-white ground colour with few grey violet primary stains, and marked on the entire surface with uniformly distributed smaller reddish-yellow secondary stains; also this egg shows the close relationship with *Cissa chinensis*" (Kuschel 1895). Eggs of *C. t. thalassina* (n 5 17; Hoogerwerf 1949, Hellebrekers and Hoogerwerf 1967, Becking unpubl. data) average 32.78 mm (31.1-34.3 mm) x 22.61 mm (range 22.0-23.30). It has been frequently reported that incubating birds with young or eggs are very steady, "... leaving their nest only when the nest tree is climbed..." (Bartels 1897-1931; J.H. Becking unpubl. data); this certainly makes them vulnerable to bird trapping. (S. van Balen *et al.*).



Eggs and nest lined with long pine needles Cikananga Conservation Breeding Centre 2014



Nest containing two eggs Chester Zoo 2016



Incubating female Cikananga Conservation Breeding Centre 2013 (Florian Richter)



Nestlings nineteen days old Cikananga Conservation Breeding Centre March 2013 (Florian Richter)



First Javan Green Magpie to fledge at Cikananga Conservation Breeding Centre March 2013 (Florian Richter)



Wild caught fledgling West Java 2012 (Photographer unknown) Note yellowish-green plumage compared to first captive-reared fledgling

Co-operative breeding

No evidence could be found to substantiate whether the Javan Green Magpie or other members of the genus are cooperative breeders.

Section 2: Captive Management

2.1 Enclosure

Outdoor aviary

Javan Green Magpies are normally kept in outdoor aviaries. This species lives in the wet sub-tropical montane forests of west Java, where temperatures can fall to 8°C at night and possibly to lower temperatures at higher altitudes. They are therefore hardy once acclimatised and are able to tolerate temperatures below freezing for short periods of time. They should always have access to a heated indoor accommodation with a minimum winter temperature of 15°C where they can be confined at night or during prolonged cold periods.

The aviary should be as large as possible to give these active birds sufficient room to fly and exercise. A minimum size for an outdoor breeding aviary should be 3m wide, 2.8m high and 6m long, however larger aviaries are preferable.

Higher aviaries (3m or more) give the aviary plants more space to grow, without growing through or damaging the aviary netting.

The aviary perimeter should have a predator/vermin anti-dig barrier a minimum of 50cm below ground. This can be made from a sturdy wire-mesh with holes no larger than 12mm which will prevent mice, small rats and small mustelids from entering.

For best results a 50cm deep and 50cm wide trench should be dug around the aviary perimeter and the mesh bent at a 90° angle outwards a further 30cm. Once firmly affixed to the aviary frame or concrete foundations, this will deter even the most persistent rodent or predator.

Alternatively the anti-dig barrier can be made from deep concrete foundations.

The aviary frame should be constructed from a metal (steel or aluminium) or treated timber frame built onto a low (40-60 cm) brick or concrete block-work wall. This wall will keep timber frames (if used) off damp ground, preventing rotting, it will also allow some security from outside predators and will allow a deep layer of substrate to be placed inside the aviary. The aviary should be covered in a strong heavy-gauge galvanised or stainless steel wire mesh which should have squares no greater than 12mm, which will keep out all predators and vermin including small mice.

20mm square mesh is not to be recommended as mice, young rats, weasels and small birds can access the aviary. To improve visibility into the aviary and prevent the mesh deteriorating, the mesh should be painted with a matt black paint.

Keeper access to the aviary should always be via a lockable safety porch or corridor. Alternatively the aviary may be entered from the indoor accommodation; however this is not ideal, as birds may become stressed if the keeper has to enter the same space once birds have been shut inside.

Part of the aviary roof at one end should be covered (above the netting) to provide the birds with some protection from heavy rain. Translucent plastic or polycarbonate sheeting is a suitable material to use, as it still lets some light enter, allowing aviary plants to grow beneath.

Given there is evidence to suggest that Javan Green Magpies may fade to a paler green or blue colour when exposed to direct sunlight, a layer of military camouflage netting can be firmly fixed to the aviary roof using cable ties to provide the birds with a shady environment. The camouflage netting can be removed or tied back to one side during winter periods (if in the northern hemisphere), when light levels are low.

Screening on the back and sides of the aviary will give the birds some seclusion and protection from strong winds.

This can be made from Bamboo or willow screening, timber planks, shade cloth or polycarbonate sheeting firmly fixed on the outside of the aviary mesh walls.

Electric “hot” wires may be fixed around the aviary perimeter at varying heights to prevent mammalian pests and predators (cats, rats, squirrels, martens, civets depending on location) from climbing onto the aviary roof. This is especially important at the top edge of the aviary. Over-hanging trees should be avoided if possible, as they will allow roosting wild birds to defecate into the aviary and predators to gain access above the aviary roof.



Electric “hot wire” predator prevention

Aviary divisions need to be of a solid material or double-meshed, as Javan green magpies may be aggressive towards aviary occupants in adjacent aviaries.

Perching

Javan Green Magpies spend a good deal of time in the natural vegetation and on the aviary floor, where they forage amongst the substrate. Consequently, if the aviary has sufficient established trees, shrubs and bushes additional perching need only be minimal. If natural perches are used, they should be of varying thicknesses and should be firmly fix to the frame of the aviary using thick wire or cable ties. As this species often perches on the vertical stems of saplings, some vertical perching should also be provided.



Javan Green Magpies often use vertical stems, vines and branches for perching



Off-show breeding aviary at Chester Zoo



Off-show breeding aviary at Chester Zoo



Breeding aviary at Cikananga Conservation Breeding Centre. Note dense planting and leaf-litter on the aviary floor and screening prevent visual contact with birds in adjacent aviaries.

Escapes

The most common cause for escapes are due to the lack of a safety porch, plants growing through and damaging the aviary mesh or keeper error (not securing safety doors properly). If an individual from a well-bonded pair does manage to escape, it is likely to remain in the vicinity of the aviary and may be re-captured. A method used to re-capture the escapee is to catch up its mate and place it in a cage within the aviary directly below the hole in the netting or to create a small hole in the netting on the aviary roof. Normally this is enough to entice the escaped bird back into the aviary, although the provision of a food dish and additional live insects is added encouragement to entice the bird back into the aviary. Once inside it should be shut into the aviary shelter and the damaged netting can be repaired.

Aviary substrate

Course sand, bark chippings, grass, soil or a combination of these have been used in outdoor aviaries. A deep layer of sharp sand may be the most suitable option as this substrate helps to prevent the spread of nematodes such as *capillaria* or *syngamus*, often prevalent in soil. A well-composted bark material has been used successfully and is probably the most aesthetically pleasing and natural looking substrate to use, particularly for on-show aviaries as it most closely resembles the forest floor. Care should be taken with this type of substrate however, as if it is used in poorly ventilated areas there may be a risk of *aspergillosis*.

Only well-rotted compost or bark chippings should be used, as fresh or non-rotted material will produce large amounts of fungal spores as it decomposes.

Some individuals may be prone to overgrown beaks and providing a substrate of an abrasive nature helps keep them in trim.

If leaves, fallen from the aviaries' trees and shrubs are present, the birds will spend a lot of time working through these and turning them over in search of invertebrates. Leaves can be collected from the surrounding environment however care should be taken where they are collected as they may be contaminated by wild bird droppings. A good option is to collect large quantities of freshly fallen leaves in autumn and store them in plastic bin bags or create a compost heap. Once fully rotted, this leaf-litter provides a very natural and enriching resource for the birds which will break down over time, providing nutrients to the aviary plants.



Javan Green Magpies foraging on the ground for invertebrates Cikananga Conservation Breeding Centre 2017

Outdoor furnishing, planting and maintenance

Javan Green Magpies are birds of dense sub-tropical forest and in captivity a heavily planted aviary will provide them with the privacy and seclusion they need.

Aviary planting is a very important consideration for this species and the provision of natural vegetation is a major contributory factor to continued and sustained breeding success.

Outdoor aviaries should be planted with a variety of different plants, climbers, shrubs and trees. These will provide cover and nesting opportunities for the birds.

A variety of different plants have been used in which Javan Green Magpies have nested successfully.

Bamboos, evergreen shrubs, ferns, tree-ferns, palms and climbers all help to make the aviary enriching for the birds and attractive and aesthetically pleasing for zoo visitors, should the birds be on-show. In on-show aviaries, taller vegetation should be planted to the rear and along the sides of the aviary, while lower or more structural plants such as palms or tree-ferns can be grown more centrally or towards the front of the aviary.

An open space towards the front of the aviary will resemble a forest clearing and birds will spend a lot of time on the aviary floor, turning leaves over in search of invertebrates. Rotten or moss-covered logs will help to achieve a natural effect, but will need to be replaced regularly as the birds will soon tear them apart.

Living shrubs and trees will provide most of the perching opportunities required, but one or two thoughtfully placed natural branches will enhance the natural feel of the aviary.

A shallow pool at the front or a small stream (on a circulation pump) flowing through the aviary will complete the natural effect and provide bathing opportunities.

A tap and garden hose placed discretely at the back of the aviary will help facilitate cleaning and is also useful for watering the plants when necessary.

Maintenance of the outside aviary should be minimal and substrates should be raked or dug-over and any soiled furnishings washed once or twice a week, apart from periods when birds are nesting, when disturbance should be kept to a minimum.

An over-head sprinkler system attached to the roof of the aviary and connected to a simple timer clock can be used during hot weather. The rain shower the sprinkler provides will stimulate the birds into activity during hot periods.



Foraging on the ground and digging in coarse substrate helps to keep the bill in shape Cikananga Conservation Breeding centre 2016



Feeding on a spider found in aviary Cikananga Conservation Breeding Centre 2016

Indoor accommodation

The indoor accommodation (attached to a large outdoor aviary) needs to be functional and should have walls which are easy to clean. These may be covered in hard-wearing plastic sheeting or waterproof paint. Two sturdy straight perches (one at each end of the room) is sufficient and the use of straight perches will aid cleaning and prevent birds storing or caching food items (a behaviour which corvids have a habit of doing). By feeding the birds inside the shelter, they are normally easily encouraged inside with the use of a treat, such as a favoured insect. It is important to have birds conditioned to come inside, which is advantageous when they need to be caught.



Indoor accommodation connected to outdoor aviaries Chester Zoo



Indoor accommodation Chester Zoo

Indoor substrate

Concrete floors are the preferred indoor substrate, to which a layer of sharp sand, wood shavings or similar animal bedding has been applied. There are pros and cons to all of these substrates, sharp sand is useful for the birds' feet and it does not produce fungal spores. This

substrate must be sieved frequently (normally once a week) to remove any faecal matter and spilt food, the process of sieving causes dust, therefore good ventilation is required and a good quality face mask should be worn.

Wood-shavings or similar wood-based animal bedding needs to be spot-cleaned daily and changed regularly (at least once a week). If these materials become damp, they may produce fungal spores, which may lead to *aspergillosis*.

Indoor furnishing and maintenance

As the indoor accommodation is primarily used for feeding and roosting, the internal furnishings need to be kept to a minimum. Two simple straight perches, firmly affixed to the walls above head-height at either end using sturdy wooden, metal or plastic brackets should be sufficient. Perches should be replaced annually or sooner if necessary.

Food dishes should be replaced and water bowls thoroughly cleaned daily. Any spilt food should be removed and substrates sieved or changed at least once a week.

Corvids have a habit of storing or “caching” food items (normally a piece of mouse or fish) by wedging them in a branch or corner of the aviary. Keepers must be aware of this and remove any un-eaten food before it decomposes.

Indoor environment

Javan Green Magpies are relatively hardy birds and once acclimatized; do not require a high temperature, however indoor accommodation should be maintained at approximately 15-18°C during winter. Various heating methods have been used successfully including radiators, radiant panel heaters and tubular electric heaters fitted with a thermostat. Whichever method of heating is used, exposed heaters should be protected with a sloping cover and wire mesh sides to prevent the birds perching on or gaining access to the heater.

Indoor only accommodation

Although once acclimatized, Javan Green Magpies are considered hardy birds and the preferred option is to give them access to outside aviaries. One pair has been maintained in a tropical indoor aviary at Prague zoo since December 2015 without any issues and has successfully reared young on more than one occasion. The temperature in this enclosure ranges seasonally from a minimum of 18 - 30°C.



Electric heater with mesh protection and sloping metal cover Chester Zoo

A mesh covered skylight will provide some natural daylight, however artificial lighting fitted to a timer and dimmer should be employed during the winter months in Europe. Extending the day length to 12-13 hours closely replicates the photo-period in the wild and allows the birds' additional time to feed during the shorter winter months. Additional lighting fitted to timers to extend light levels into the evening will also encourage the birds to roost in the indoor accommodation.

Indoor dimensions

The indoor accommodation does not need to be particularly large, when connected to a large outdoor aviary. 2.5m - 3m wide, 2.5m deep and 2.5m high is adequate for one pair of birds. The indoor accommodation can be of brick or timber construction and should be insulated and lined with smooth interior walls to allow for easy cleaning.

Pop-holes should be 20cm x 20cm connected to the outside aviary and should be positioned as high as possible to encourage the birds to enter the shelter. Pop-holes on the corner or edge of the aviary will be more useful when attempting to shut birds inside than centrally positioned pop-holes. They can be manually operated sliding doors, which can be adjusted to keep the gap as small as possible or by a cable pulley system.

If the aviary has a low level pop-hole, the Javan Green Magpies will also use this lower level access point to and from the outside aviary.

There should always be a safety-porch or corridor adjoining the indoor accommodation to prevent escapes. Door self-closers and internal bolts attached to the safety-porch and aviary door will further minimize any chance of escapes.

2.2 Feeding

Method of feeding

In a captive environment Javan Green Magpies should be fed in stainless steel bowls or heavy ceramic dishes. These should be placed off the ground in such a position to prevent any rodents (which may have circumvented the anti-rodent defences) from accessing the food.

Alternatively a free-standing food platform on a smooth metal pole with a plate or baffle below the dish will prevent any determined mice from gaining access to the dish.

Each bird, even those in an established pair should have its own food dish and additional feeding points should be provided for new introductions into an aviary either as a temporary measure until birds are settled or to help eliminate any possibility of conflict around feeding sites.

An essential consideration in the welfare of captive animals is to provide a balanced diet that meets the natural feeding ecology as closely as possible. Healthy nutrition plays a big role in longevity, disease prevention, growth and reproduction.

In the wild Javan Green Magpies feed primarily on invertebrates, small vertebrates and occasionally fruit or berries, this diet should be replicated as closely as possible in a captive environment.

Live insects in the form of crickets, locusts and grasshoppers should form the bulk of the invertebrate part of the diet. Other invertebrate prey such as stick insects, cockroaches, moths, caterpillars and snails can be offered occasionally to add variety to the diet and provide enrichment for the birds.

Black cricket *Gryllus bimaculatus*, Brown cricket *Acheta domesticus*, Desert locust *Schistocerca gregaria*, Garden snail *Helix aspersa*, Cockroach *Blaptica dubia*, Madagascar hissing cockroach *Gromphadorhina portentosa*, Jungle nymph stick insect *Heteropteryx dilatata*, New Guinea spiny stick insect *Eurycantha calcarata*, New Guinea giant spiny stick insect *Extatosoma tiaratum*, Florida Katydid *Stilpnochlora coulouiana* have all been offered to and consumed by Javan Green Magpies.

Large insects are quickly dispatched by the bird, which holds the prey item under one foot, while dismembering it. Small insects, such as thin stick insects or ants eggs are often ignored by the birds.

As crayfish are known to be a food item in the wild, they have been offered to the birds at Chester zoo, but have not been popular with the species, perhaps due to the large size and hard exo-skeletons of the individuals offered.

One bird at Cikananga conservation breeding centre was seen to kill and consume a large scorpion *Heterometrus spp.* (A. Owen pers obs).

Vertebrate prey comprises of domestic mice *Mus musculus*, frogs, skinks (including *Sphenomorphus sp.*), Fish (mainly *Synbranchus bengalensis*, a species of swamp eel found in the flooded rice fields) are offered at Cikananga conservation breeding centre.

Small trout *Salmo trutta*, Roach *Rutilus rutilus* and Guppy *Poecilia reticulata* have all been offered in European institutions.

Depending on its size, normally only one vertebrate item per bird is offered daily. This may be increased when the birds are rearing young.

Vertebrate prey is normally offered dead, however frogs and Guppy's have been offered alive and are a good form of enrichment for the birds.

It is not recommended that any birds, including dead day old chicks are offered to Javan Green Magpies, due to the risk of disease cross-contamination.

The indigestible components of vertebrate and invertebrate food items such as bones, hair and insect wing casings are cast as pellets by the birds.

During the 2018 breeding season in two European institutions, a large number of eggs failed to hatch or were broken before they hatched. This may be due to an inadequate amount of digestible calcium in the diet, resulting in the production of thin-shelled eggs.

This problem has not been seen at Cikananga where frogs and lizards form a large proportion of the vertebrate diet.

These items may be more digestible than mice.

Additional calcium in the diet may be required, either through the addition of frogs and lizards in the diet or through supplementation.

Fruit is offered daily, this normally comprises piece of ripe papaya, which is spiked to a branch. Prague zoo have offered their birds berries, such as blueberries, raspberries and blackberries and other ripe fruit including melon.



Javan Green Magpie dispatching a frog Cikananga Conservation Breeding Centre 2012



Adult with eel Cikananga Conservation Breeding Centre 2017 (Jonathan Beilby)



Juvenile with large skink Cikananga Conservation Breeding Centre (Jonathan Beilby)



Wild-caught grasshoppers and other invertebrates form part of the diet at Cikananga Conservation Breeding Centre

All insects and larvae should be properly gut-loaded with a gut-loading formula and suitable vegetables prior to feeding.

Crickets and cockroaches should be offered in smooth-sided deep dishes to prevent escapes. 20 cm stainless-steel dishes and plastic washing-up bowls are preferable.

A pair of birds should have two separate dishes, spaced as far apart as possible to avoid one bird dominating the food, for example a steel dish off the floor at one side of the indoor accommodation and a large plastic bowl on the floor on the other side of the room.

During the breeding season when birds have chicks, they will receive an *ad-lib* supply of insects. The adult or large hard-bodied insects and larvae will be replaced with smaller soft-bodied insects such as small crickets, locusts and cockroaches when the nestlings are young.

Javan Green Magpie Lutein routine – Chester Zoo

Lutein is a yellow plant-based pigment, which helps Javan Green Magpie maintain their green plumage (See Appendix 1).

Morning. Per Pair - 20g live Crickets, 1/8 t/spoon Yellux dusted (Crickets lightly dampened)

Afternoon. Normal adult diet. (Mouse, Locust, Fish etc.)

When rearing young, crickets offered ad lib, 1st afternoon cricket feed dusted as above with Yellux

NB: All crickets (used for the magpies only), are gut loaded using curly Kale, Dandelion leaves and Thistle, also Yellux added as drinking water for the crickets to further increase lutein content of crickets.

Mix 5 spoons of Yellux (the small spoons in Yellux container) with 50ml hot water, stir vigorously, fold several layers of paper towel and sit on top of mixture allowing liquid to soak into paper, turn paper over and place in cricket tank, repeat every other day

Yellux crickets are rotated, tank 1 contains pre-loaded insects, tank 2 holds crickets which are being gut-loaded and are transferred to tank 1 ready for feeding after 24 hours

Javan Green Magpie daily feeding calendar – per pair

Day	Time	Food items offered
Monday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	2 adult Mice, 8 adult Locusts, 1 Fish, Crickets
Tuesday	am	Crickets ad lib, 2 Pink Mice 1 slice Papaya
	pm	8 adult locust, 1 fish, 2 Pink Mice, Crickets
Wednesday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	8 Adult Locust, 1 fish, 2 Pink Mice , Crickets
Thursday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	8 adult locust, 2 Pink Mice, 1 fish, Crickets
Friday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	2 adult Mice, 4 adult locusts, 1 fish Crickets
Saturday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	8 adult locust, 2 Pink Mice , 1 fish, Crickets
Sunday	am	Crickets ad lib, 2 Pink Mice, 1 slice Papaya
	pm	8 Adult Locust, 2 Pink Mice , 1 fish, Crickets

Crickets (Adults and Mediums) to be provided ad lib at 07.00, 10.30, 12.30, 14.30 and 17.00, try not to leave the Cricket dish empty
Quantities may increase as chicks grow

Post fledging Javan Green Magpie daily feeding calendar – per bird

NB: All Crickets gut-loaded and dusted with Yellux prior to feeding

Day	Time	Food item to be offered	Record quantities eaten
Monday	Am 08.00	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	1 Adult Mouse, 4 adult locusts 10g Crickets	
Tuesday	Am 08.00	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	2 Adult locust, 2 adult locust 10g Crickets	
Wednesday	Am 07.30	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	1 Small Trout, 4 Adult Locust 10g Crickets	
Thursday	Am 08.00	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	2 adult locust 2 adult locust 10g Crickets	
Friday	Am 08.00	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	1 Adult Mouse, 4 adult locusts 10g Crickets	
Saturday	Am 0.800	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	2 adult locust, 2 adult locust 10g Crickets	
Sunday	Am 07.30	10g Adult Crickets 1/4 slice Papaya	
	Pm 14.00 16.00	1 Small Trout, 4 Adult Locust 10g Crickets	

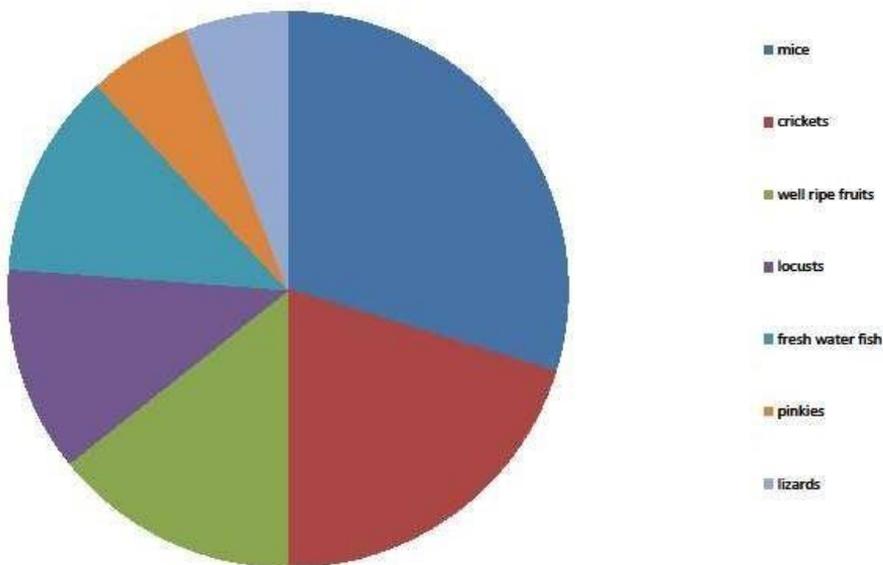
Daftar Makanan Ekek Geling

Schedule Javan Green Magpie Food

	Minggu <i>Sunday</i>	Senin <i>Monday</i>	Selasa <i>Tuesday</i>	Rabu <i>Wednesday</i>	Kamis <i>Thursday</i>	Jum'at <i>Friday</i>	Sabtu <i>Saturday</i>
Makanan <i>Food</i>	Kadal <i>Lizards</i>	Tikus <i>Mice</i>	Bancet <i>Frogs</i>	Kadal <i>Lizards</i>	Tikus <i>Mice</i>	Belut <i>Eels</i>	Bancet <i>Frogs</i>
	Kalau tidak ada kadal, memberikan tikus If lizards are not available, give mice			Kalau tidak ada kadal, memberikan bancet If lizards are not available, give frogs			
	* Untuk anak ekek, kamu bisa memberikan anak tikus (tikus merah muda) dengan jangkrik!! * For chicks, you can give pinky mice with the crickets!!						

Rotation of vertebrate prey offered at CCBC

Diet sheet for Javan Green Magpie in Prague ZOO



28% mice, 22% crickets, 8% pinkie, mice, 12% locusts, 12% fresh water fish, 8% Lizards
10% well ripened fruit



Digital weighing scales. A few insects provided in the deep food bowl with perch attached will encourage the bird to use the scales and regular weights can be collected.

Recommendations

- Weigh, body score and photograph your birds at least twice a year – before and after the breeding season
- Measure the amount of food consumed
- Keep your birds in large planted aviaries
- Feed lower fat insects such as crickets, Locusts and Cockroaches
- Gut-load all insects

Water

Fresh water should be available at all times. A small bowl off the ground and adjacent to a perch in the aviary shelter is suitable for drinking. Javan Green Magpies are avid bathers and will take a bath even during cold winter days. A large shallow dish 5cm deep made from stainless steel, ceramic or sturdy plastic can be used for bathing, however a shallow concrete pool or water feature such as a small stream will be more aesthetically pleasing for an on-show aviary.



Bathing in a shallow water tray Cikananga Conservation Breeding Centre (Stephan Bulk)

2.3 General behaviour

Basic Social Structure

Javan Green Magpies should be maintained in pairs for breeding purposes. However, they may be kept in single-sex pairs or small single-sex groups of 3-4 individuals. Juveniles of either sex have been grouped together in spacious aviaries with individuals from broods from different pairs for up to six months, before being paired for breeding.

Pair formation

New pairs should be formed as early as possible prior to the onset of the breeding season. In Europe where Javan Green Magpies normally commence nesting in April or May, it would be prudent to ensure birds are paired together and established in their breeding aviary by late February.

Care should be taken when forming new pairs.

Ideally new pairs should be introduced to each other in a neutral environment out of vocal and visual contact of conspecifics.

If a neutral aviary is not possible, it is better to allow the female to become established in the breeding aviary, before introducing the male.

Close observations should be made of the birds for several days after introduction to ensure they have bonded. If chasing or fighting is observed, the birds should be separated immediately. However aggression seems to be rare within pairs of Javan Green Magpies and no fatalities have been recorded between male/female pairings.

Courtship Display

During courtship, both the male and female erect the black “eyebrow” feathers above the eyes and raise the flank and vent feathers. With these feathers erect, head lowered and tail raised, the male will hop back and forth over the female. Perching close together and the offering of food items by the male are signs that the pair has bonded.



Display pose Cikananga Conservation Breeding Centre 2017 (Jonathan Beilby)

Interactions between different pairs

If more than one pair are kept at the same institution, it is important to keep them as far apart as possible and ideally out of vocal range from each other. Pairs should not be housed in adjacent aviaries as direct aggression through the aviary mesh is likely to occur.

Additionally this may cause distress to the birds and reduce the chances of successful breeding.

Intra-specific tolerance

Due to the rarity of the species, unrelated groups of mature birds should not be housed together in the same aviary.

Inter-specific tolerance

These birds should not be mixed with other species.

Parent/sibling tolerance

Due to the rarity of Javan Green Magpies and the importance of each individual young bird to the breeding programme, young are normally removed from their parents' aviary once they are fully independent. Young birds have been seen to feed themselves as early as 45 days after fledging, however young birds may solicit food from their parents for several additional months (up to five months have been observed) if not removed from the aviary.

At Chester Zoo, one pair re-nested and laid a second clutch of eggs when the single fledgling from their first clutch was only 45 days old (only 22 days post fledging) and not independent. The decision was made to leave it with its parents, who went on to successfully rear two further chicks. There was no interference to the eggs or aggression towards the younger chicks from the older fledgling. It was seen to sit in the nest with the mother as she incubated the eggs and brooded the young, but was not seen to play any part in incubating or rearing the second brood.

However, two fledglings at CCBC aged 52 and 53 days respectively were thought to be complicit in the disappearance of a second clutch of eggs when they were left with their parents. (J.Beilby *pers comm.*).

Co-operative breeding and understanding the role of extended family groups of birds in our care is an area requiring further study and as breeding rates improve within the population, may be carried on well-represented pairs in the future.

Coexistence with other species

Given the scarcity of the species, Javan Green Magpies should not be housed with other species.

2.4 Breeding

The first substantiated breeding of Javan Green Magpie in captivity was at the Cikananga Conservation Breeding Centre in West Java in 2013.

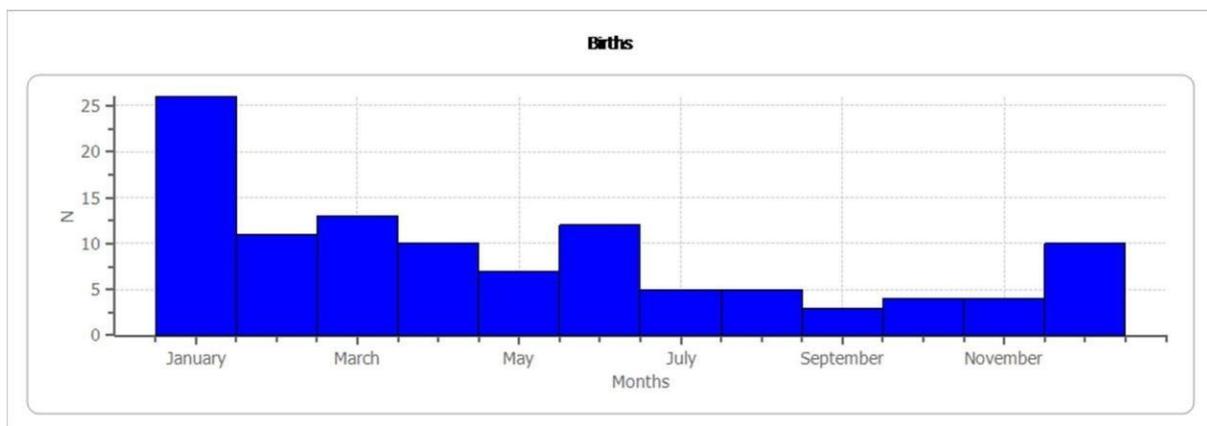
This first breeding has been followed by further breeding successes at CCBC and by four other institutions participating in the global conservation breeding programme (Taman Safari, Indonesia, Chester Zoo, UK, Prague Zoo, Czech Republic and Durrell Wildlife Conservation Trust, Jersey Channel Islands).

Seasonality of breeding in captivity

In Europe where birds are normally housed in outdoor aviaries, breeding is seasonal and coincides with the increased day length and temperature of the European spring and summer months. Most nesting activity takes place between the months of March and September with a peak in nesting in the months of May, June, July and August.

At Cikananga Conservation Breeding Centre where most breeding has occurred and where the climate remains at a fairly constant and warm temperature, this species has nested in almost every month of the year.

The pair at Prague zoo, housed in an indoor tropical aviary have successfully reared young in December 2016.



Seasonality of hatches in all institutions across two regions (Europe and Indonesia).

Hatches for the last 3 years (taken August 2018) are shown in the figure above. Because this represents two different regions (Europe and Indonesia), and different management strategies (tropical or temperate / indoor or outdoor housing), the graphs shows a number of peaks. Indoor European hatching in January (e.g Prague) similarly to peak breeding season in Indonesia (October to March). Outdoor European hatching season March to October.

Nest-building

A variety of materials have been used in nest construction, including sturdy twigs, thin, flexible twigs, plant stems, rootlets and fibres, bamboo leaves, long pine needles and coconut fibres.

It is important to provide the birds with an abundant fresh supply and variety of these materials prior to and throughout the breeding season. Any twigs collected from the natural environment should be disinfected and rinsed before use. Nesting material should be placed around the aviary in clumps at different levels and scattered on the aviary floor. If sufficient nesting material is provided, nest construction is usually completed within 4-5 days. Inclement weather such as strong winds or heavy rain may delay completion of the nest for several days.

The exterior of the nest is built using the thicker twigs, rootlets and fibres and the nest cup is usually lined with finer material such as bamboo leaves and coconut fibres.

If only coconut fibres are provided, the birds will construct a nest using this material, however nests of this material may lose its shape unless built in a basket.



Female attending nestling in large nest built in small tree Cikananga Conservation Breeding Centre March 2013 (Florian Richter)

One pair at Chester zoo built a sturdy nest 2.8m up in the forked branches of a Horse chestnut tree *Aesculus hippocastanum*. Twigs approximately 30-50 cm long and up to the thickness of a pencil formed the outer structure of the nest, finer twigs, such as those of the Silver birch tree *Betula pendula* were used to form the cup of the nest, which was lined and inter-woven with dry bamboo leaves, finer twigs and plant fibres with an inner lining of coconut fibre.



Natural nest built in a Horse chestnut tree 2.8m above ground Chester zoo 2016



Nest built in sapling Cikananga Conservation Breeding Centre 2014



If insufficient sturdy sticks are provided to form the base of the nest, there is a risk of collapse.

At Cikananga several nests built in small saplings have had to be repaired using cable ties or wire mesh



A scruffy nest of twigs, lined with long pine needles containing 2 eggs Cikananga Conservation Breeding Centre 2014

Artificial nest sites

A Variety of different receptacles of varying dimensions including wicker, bamboo, plastic or wire mesh baskets have been used by this species to build its nest.

Wicker baskets appear to be the most appropriate and should be approximately 25cm in diameter and 15cm deep.

Baskets should be fixed firmly to the tree or shrub using cable ties.

As wicker or bamboo baskets rot quickly and their bases may fall out, they normally only last for one season and should be replaced annually. For additional security, they may be placed in a wire mesh frame to avoid nest losses.



Female incubating in bamboo rice basket placed in wire mesh frame Cikananga Conservation Breeding Centre 2015



Typical deep rice basket often used at Cikananga Conservation Breeding Centre for Javan Green Magpies



Wicker nest basket used at Chester Zoo

Positioning of nest baskets is crucial to the birds accepting them. Javan Green Magpies favour a secluded location in a tree, shrub or climbing plant at the back or sides of the aviary, where they feel secure. However they also like a clear view of the surrounding aviary allowing them sight of approaching keepers, whilst still feeling hidden. If nest baskets are not placed in or amongst living plants, they need to be camouflaged with some form of cover, conifer branches being the most ideal as it keeps its colour for a longer period than most other cut foliage.

Mating

Mating has not been observed in this species.

Incubation period / egg laying sequence

Egg Description

Eggs are pale greenish-blue, lightly speckled with brownish speckles, with heavier speckling at thick end.

	Egg length (mm)	Egg width (mm)
	33.9	23.5
	33.5	23.6
	29	20.5
	29	20
	30.2	22.4
Average	31.12	22

Sizes of 5 Javan Green Magpie eggs

The fresh weight for two eggs was 10.06 grams and 9.995 grams



First two (infertile) eggs laid at Cikananga Conservation Breeding Centre 2013 (Stephan Bulk)

Clutch size

Two eggs form the normal clutch size for this species. Occasionally three eggs are laid. One clutch at Prague zoo contained four eggs.

Hatching

Eggs hatch after a 20-21 day incubation period. Incubation is carried out by the female. Indication of hatching is normally detected by the behaviour of the parent birds who may be observed carrying food items (insects or their larvae) in their bills or the presence of eggshell fragments (normally half shells from hatched eggs), removed from the nest by the adult birds and deposited at the furthest point from the nest. This is often at the front of the aviary, as nests are often situated at the rear of the aviary, but may be found in the birds' indoor accommodation or in a food dish. Through nest camera observations it is possible to observe hatching times, without disturbing the nesting pair.

Clutch Recycling

Javan Green Magpies may lay a replacement clutch if earlier eggs fail or after earlier broods have fledged. Recycling can be very rapid, with replacement clutches being laid as little as 10 days after the failure of an earlier nest. At Chester Zoo, one pair laid a second clutch of eggs 7 days after the chick of a first brood fledged. The fledgling continued to return to the nest where it was fed by the incubating female. As it was felt there may be a risk to the juvenile (from its parents) or to the eggs (from the juvenile), the juvenile was removed from the aviary the day before the eggs were due to hatch. The second clutch of two eggs hatched and were reared successfully.

On a separate occasion, a juvenile from a different pair was left in the aviary when its parents re-laid, however the eggs were broken by the juvenile during one of its frequent visits to the nest.

Number of clutches

Normally Javan Green Magpies will lay one or two clutches during a breeding season, however if early clutches fail, repeated clutches may be laid. One pair at Chester Zoo laid four infertile clutches in one season, before successfully rearing a chick.

During 2018 a large number of unsuccessful clutches were produced at Chester zoo, with most pairs producing 4-5 clutches. It is unclear why so many failed nesting attempts were made, however one hypothesis is that the birds were not receiving sufficient digest-able calcium in the diet and as a result were producing thin-shelled eggs that were being broken before hatching. (See diet).

Nest inspection

Due to the rarity of the species, nest inspections should be avoided wherever possible, as anecdotally at least, corvids have a reputation of abandoning nests or killing small nestlings if disturbed. At Prague zoo a nesting pair broke an egg when there was unavoidable disturbance in an adjacent aviary (Vaidl pers. comm. 2018).

To avoid disturbance, a closed-circuit camera may be used to record nesting behaviour if the camera can be installed above a reliable nesting site. This has been used with great success at Cikananga and Chester zoo and allows nests to be monitored closely without disturbing the nesting birds.

Closed ringing of parent-reared chicks has to date not been attempted. Given the rarity of the species it is currently felt that it is not necessary to carry out this procedure due to the potential risk of birds throwing out or abandoning chicks. Young birds can be fitted with split leg rings and micro-chip transponder at a later date.

Development and care of the young

Young are naked on hatching. The male delivers food items to the brooding female, who then feeds the recently hatched chicks. Insects and their larvae is taken whole to the chicks, vertebrate prey, such as pinkie mice may be manipulated into small pieces before being fed to the chicks. Some birds will take only one item at a time, normally when the nestlings are young. After a few days, the parents carry larger quantities of food at each feed to their growing brood.

As the chicks grow, the male plays an increasing role in feeding the chicks directly.

The parent birds will stand on the edge of the nest while feeding the chicks. Faecal sacs are either eaten by the parents or removed from the nest as it leaves. The female will usually continue to brood the nestlings until they are 15 days old, after which the chicks are too large to brood.

Nestlings start to stretch and exercise around the nest from 18-20 days old and fledge between 21 and 23 days of age.



*Nest containing one day old chick and un-hatched egg at Chester Zoo (video screen grab. Blast Films)
Note yellowish skin pigment*



Female brooding one day old chick at Chester Zoo (video screen grab. Blast Films)



Javan Green Magpie nestlings 8 days old at Chester Zoo (video screen grab. Blast Films)



Adult female attempting to brood fifteen day old nestling at Chester Zoo (video screen grab. Blast Films)



Fifteen day old nestling being fed by adult at Chester Zoo (video screen grab. Blast Films)



Adult female feeding 15 day old nestling at Chester Zoo (video screen grab. Blast Films)



Fledgling Cikananga Conservation Breeding Centre 2017 (Jonathan Beilby)



Adult pair with first fledgling reared at Chester Zoo 2016



Adult with recently fledged young Cikananga Conservation Breeding Centre 2017 (Jonathan Beilby)



Juvenile approximately 3 months old Cikananga Conservation Breeding Centre 2017 (Jonathan Beilby)



Juvenile approximately 5 months old at Cikananga Conservation Breeding Centre



Female on large nesting basket Prague Zoo 2016 (Antonin Vaidl)



Three fledglings Prague Zoo December 2016 (Antonin Vaidl)

Food provision during nesting

Live insects should be offered regularly or *ad-lib* throughout the day to Javan Green Magpies which have nestlings. It is recommended that only small soft-bodied insects such as 3rd instar crickets, small locusts and small soft cockroaches should be provided for the first week of life. Soft-bodied white mealworms that have recently shed their skins, medium-sized crickets, small locusts and cockroaches can be offered once the chicks are over a week old. Before this age gut compaction from tough insects or their skins may be a risk to young chicks.

Young pinkie mice or rats are given at regular intervals throughout the day.

Large wax moth larvae should not be offered to Javan Green Magpies with newly hatched chicks, as there is a risk of these tough-skinned larvae causing impactions in the nestlings' gut.

Crickets and cockroaches should be offered in deep, smooth sided containers or bowls to avoid escapes.

It is important to ensure all insects have been gut-loaded with a nutritionally balanced insect gut-loading formula and have been dusted with a multi-vitamin powder.

Chick loss

Insufficient or inappropriately sized live food during the critical chick rearing period are possible causes for chick loss as is disturbance from staff or zoo visitors. Cold or wet weather conditions may also be a problem, although by encouraging birds to nest in dense vegetation or under cover, losses will be reduced. Heavy parasite burdens, coccidia or atoxoplasmosis

may also be a factor affecting chick survivability, although more research is needed in this area.

Unfortunately young dead chicks are often too decomposed for an accurate post mortem diagnosis.

Fledging

Javan Green Magpies fledge between 21 and 23 days old.

Fledglings move little in the first few days after leaving the nest and tend to sit quietly in dense vegetation, where they are attended to by both parents, who provision them with regular food deliveries. At which time the normally quiet fledglings will become noisy as they beg for food. Their bodies appear to be only half the adult size whilst the feet and legs give the appearance of almost being fully developed. After a few days out of the nest the fledglings become more adept at flying and will flutter towards parents as they approach with food. This behaviour increases as they become more confident in their surroundings and controlled flights usually occur seven to ten days after fledging, becoming stronger and longer as time passes.

Fledglings have been seen to return to the nest occasionally for a few days after fledging and may accompany the adult female on the nest if re-laying occurs.

Juvenile Javan Green Magpies have been observed feeding themselves at approximately 45-50 days old, but will continue to solicit the parents for food for considerably longer, if not removed from the parent's aviary. One juvenile was seen to still beg for food three months after fledging.

2.4 Artificial incubation

If passerine eggs are to be artificially incubated, they should be set in an incubator as soon as possible and should not be cold-stored prior to incubation. If eggs are laid during cold temperatures it may be beneficial to bring them to approximately 20°C for an hour prior to setting in the incubator.

Prior to setting, weight, length and breadth measurements should be taken for each egg.

Eggs should be carefully set in a reliable incubator at a temperature of 37.5-37.8°C and at a relative humidity of approximately 50%.

The eggs should be turned a minimum of 5 times a day. This is normally done using an automatic turning system within the incubator, however eggs may be turned by hand and many aviculturists choose to turn the eggs an additional 3-5 times a day even if an automatic turner is used.

Eggs must be handled very carefully and candled 3 days into incubation to determine fertility. Care should be used when candling eggs to ensure they are not held close to a hot light, which may damage the developing embryo.

Candling is normally carried out every 2 or 3 days to evaluate chick development.

Once the egg has internally pipped, normally at day 19, turning should be stopped. The humidity may need to be increased to 70-80% which may aid hatching of the chick and prevent it from becoming stuck to the drying membrane of the egg.

Hatching times seem to be very variable, once externally pipped chicks may take between 1 to 8 hours to hatch.



Incubator

2.6 Hand-rearing

Wherever possible, parent-rearing is the rearing method of choice as this tends to produce better quality young birds which go on to breed sooner and more reliably than their hand-reared counterparts.

Parent-reared birds exhibit a full repertoire of natural behaviours, something that some hand-reared birds may not.

However parent-rearing is not always an option and particularly if breeding pairs have failed to hatch clutches of eggs or to rear their young on more than one occasion, if they are old birds, those that are un-represented in the population or if a clutch of eggs has been abandoned or laid late in the season, hand-rearing should be considered.

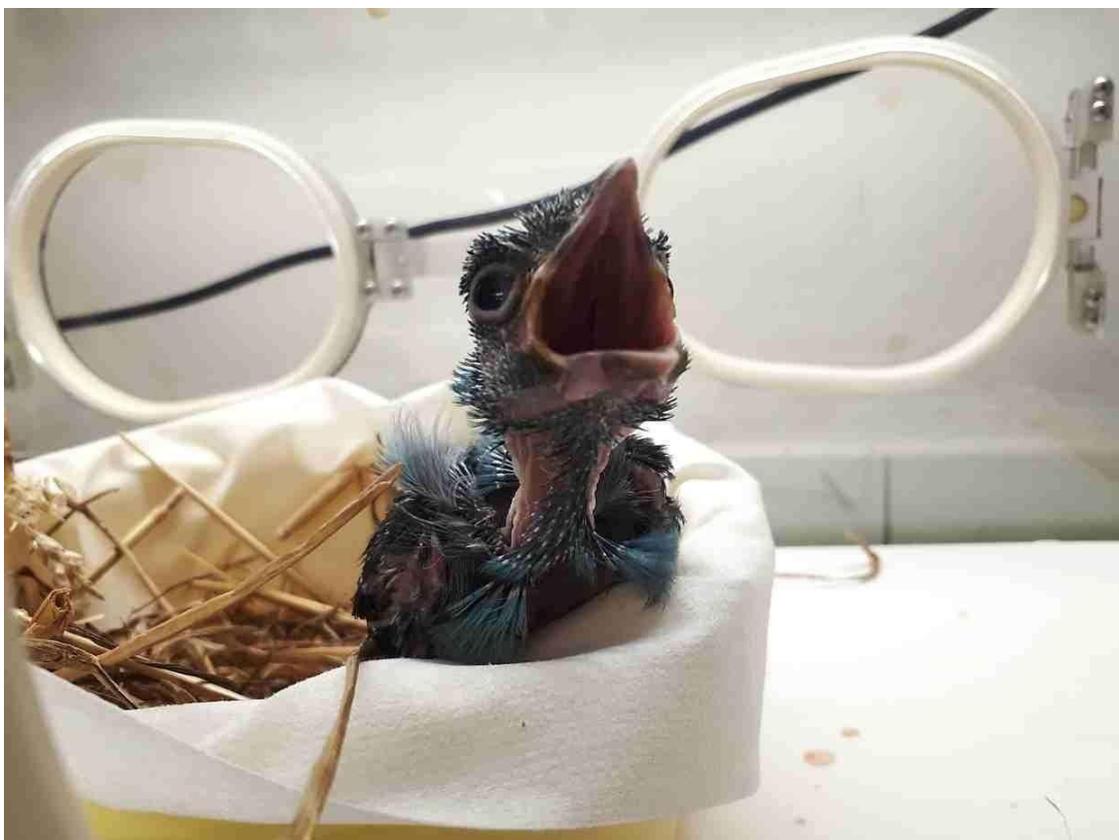
The general rule of thumb when hand-rearing any bird (that is intended to be a future breeding bird) is to keep human interaction with it to an absolute minimum, particularly after the chicks' eyes have opened.

Wherever possible it is always preferable to hand-rear a chick with nest mate/s.

As these birds are very intelligent, they can easily become tame and imprinted if too much time is spent with them during the rearing process, which can make them less suitable as breeding birds in the future.



Hand-reared Javan Green Magpie, Prague Zoo 2018 (Antonin Vaidl)



Hand-reared Javan Green Magpie, Prague Zoo 2018 (Antonin Vaidl).

Javan Green Magpie Hand-rearing notes Chester zoo

Chicks weigh 6-7g on hatching. Placed in brooder at a temperature of 37.5 °C and 60% humidity. Temperature lowered by 0.5 °C every other day. Humidity was kept at 50% for the first week.

Fed on a diet of baby mice and papaya at a ratio of 70:30 (mouse: papaya). Batches of food were freshly made daily and kept refrigerated between feeds. A pinch of Avimix multi-vitamin powder was added to food with each prepared batch. Avipro pro-biotic was added for the first three of days. From day 0 to day 8 the chick was fed every 2 hours (6am-10pm). This was increased to every 2 ½ hours from day 9 and to 3 hours from day 10 until fledging (7am-10pm). Cricket guts/abdomens were added to the diet at day 15-16.

For the first few days extreme care was taken with the amount of food given to the chick in order to avoid compaction. Ideally the chick should still be begging when placed back in the brooder after each feed. The first faecal sac was produced after the first two feeds. During the subsequent few days (day 1-3), the chick didn't defecate regularly after every feed and would go 2-3 feeds without producing a faecal sac. After days 4-5 the chick would produce a faecal sac at every feed.

The chick responded to whistling or tapping on the nest. From day 2 it would use its tongue to clean sides of beak/ gather up any leftover food.

Once the chicks' eyes were fully open (at day 10). In an effort to avoid imprinting the keeper covered face and head while feeding the chick. The brooder was always covered or the viewing window was facing a wall. A hand-puppet resembling the green head/red beak of an adult was used to feed the chick once its eyes had opened. When feeding with the puppet the chick was fed in the brooder. The light of the brooder was switched on and the external environment was made as dark as possible.

Day 0: Chick naked. Orange/yellow in colour. Eyes closed.

Day 2: Orange/yellow in colour. Pins emerging under skin on wings. Beak pale pink and nails white.

Day 3: Pins showing under skins on shoulder, along back and on flanks.

Day 4: Pins emerging on flanks and nape.

Day 6: Pins erupting on wings. Skin colour changing from orange to pink. Chick seemed to be peeling old skin?

Day 8: Pins emerging on top of head. Beak darkening. Eyes starting to open.

Day 9: Pins erupting on back and flanks. Pins emerging on legs. Nails starting to darken.

Day 10: Eyes fully opened.

Day 13: Pins erupting on wings and nape. Pins emerging on top of head, eyebrows and tail.

Day 16: Pins erupting on head. Leg colour darkening.

Day 18: Blue/green feathers on crown, band of black feathers on back of head and blue/green feathers on nape. Primary feathers are black, with secondaries a mixture of pale blue and black. Feathers on back are green/blue. Feathers on flanks are greyish, breast feathers are blue/green. Feathers on legs are white. Tail feathers are greying blue.

Day 21: Chick fledged from the nest this morning but went back in nest and stayed there for the rest of the day.

Day 22: Chick has fledged properly. Was getting restless in brooder, moved to a small fledgling cage in a warm room. Fed on crickets and small locusts as well as the pinkie/papaya mix.

Produced first pellet at this age. Bird was perching up well in fledgling cage and moving around.

Day 23: Given access to small indoor aviary

Chick Development



Hatch day



Day 1



Day 2



Day 3



Day 4



Day 5



Day 6



Day 7



Day 8



Day 9



Day 10



Day 11



Day 12



Day 13



Day 14



Day 15



Day 16



Day 17



Day 18



Day 19



Day 20



Day 21



Day 22



Day 23



Day 24



Day 25

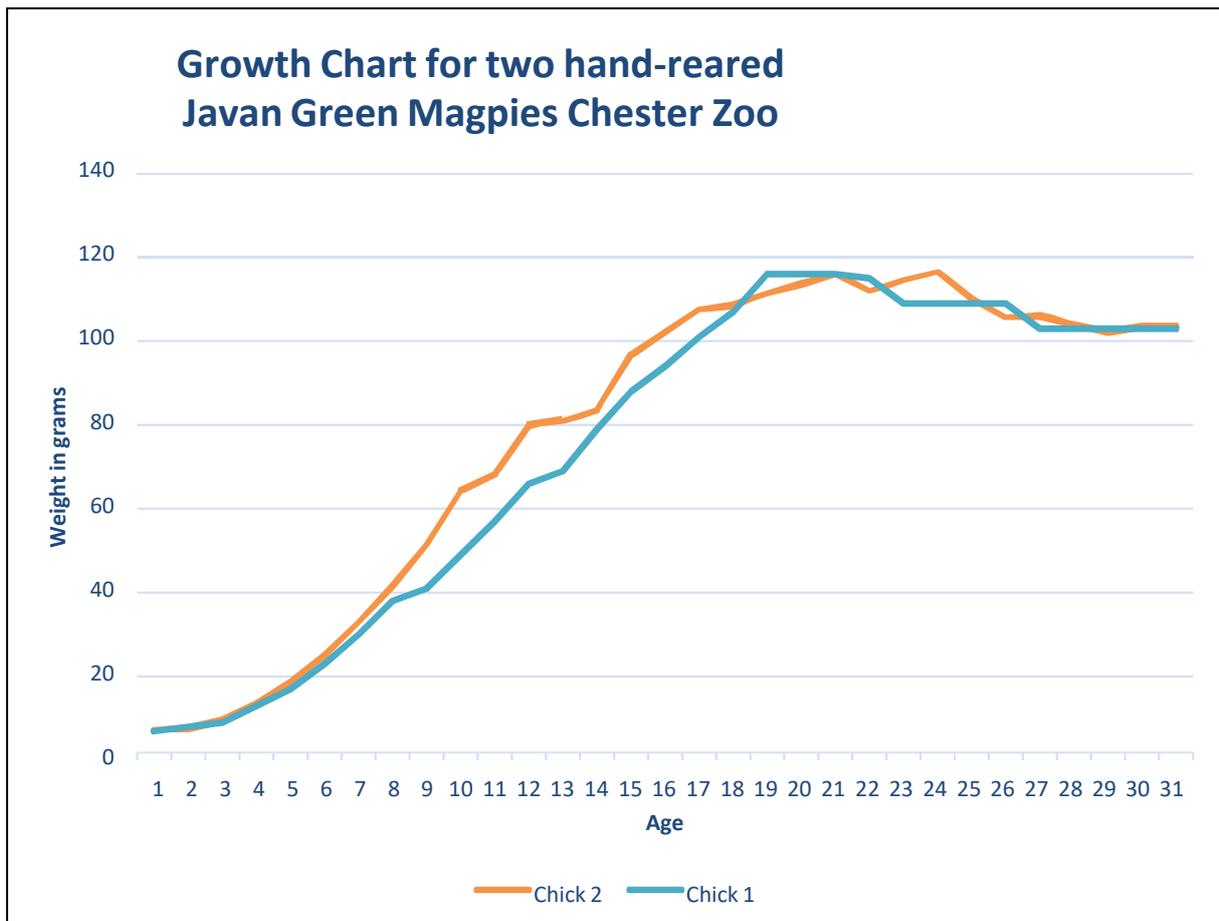


Day 29

AGE	DAILY SUMMARY
0	Hatched AM, Given first feed at 11.30. Vocal and strong. 2 good faecal sacs produced. Average amount of feed = 0.5g
1	Skin is orange/pink. No feathers showing. Strong and vocal. Has white gape flanges. Faecals are sporadic Average amount food per feed = 0.7g
2	Very vocal, rests between tweezer feeds. Faecals sporadic. No pins showing. Uses its tongue to clean around its gape and bill. Average amount food per feed = 0.9g
3	Dark pins showing through skin on wings and back. Eye slits visible. Faecals sporadic. Very vocal. Average amount food per feed = 1.15g
4	Pins appearing on head. Clicking noticed as it breathes. Not as vocal. Faecals produced at each feed. Average amount food per feed = 1.65g
5	Eye slits starting to open. Feathers erupting on wings and tail. Beak becoming darker. Clicking sound still heard. Average amount food per feed = 2.35
6	Pins are 1-2mm emerged on wings. Skin dark and pink. Eyes starting to open. Moved to larger nest. Breathing improved. Average amount food per feed = 3.53g
7	Feathers breaking from sheaths on wings at tips. More feathers coming through on body. Toe-nails darker. Eyes nearly fully open. Breathing good. Average amount food per feed = 3.93g
8	As eyes almost fully open, puppet now being used for all feeds. Face of keeper left un-covered. Skin on legs and feet darkening. Good appetite and good faecal sacs. Average amount food per feed = 4.81g
9	Eyes now fully open, so keeper's face covered during feeds. Still being removed from brooder to feed. Feeds reduced to every 2.5 hours. 7 feeds a day. 6 AM - 9.30 PM. Average amount food per feed = 5.81g
10	Chick is starting to focus on the puppet and now responding to the sight of it. Beak, legs and feet almost completely grey. White fluffy feathers emerging on flanks. Feathers developing well. Starting to produce faecal sacs additionally to feed times. Average amount food per feed = 6.8g
11	All feathers have emerged on head and neck. Tail feathers are 2mm long and wing tips are starting to break out of the sheaths. Chick is strong and up on its hocks when feeding. Chick slow to wake. Produced a couple of loose faecal sacs. Average amount food per feed = 7.05g
12	Feathers continue to emerge from sheaths. Nest becoming very dusty. Black facial mask starting to emerge with feathers emerging on forehead. Weight gain is reducing Average amount food per feed = 7.87g
13	Feathers which are breaking through sheaths are a turquoise-blue colour. Moved to bigger nest containing coco-nut fibre for extra grip. Average amount food per feed = 8.45g
14	More coloured feathers emerging on the head and neck. Less responsive to the hand and now focusses on puppet. Gets very excited when puppet is introduced. Average amount food per feed AFA = 8.79g
15	Most feathers emerging are now greenish-blue in colour. Starting to exercise wings and preen. Standing and flapping wings when being fed. Average amount food per feed = 9.08g

16	Starting to look more green than blue. Up on feet when begging. Nesting material changed to cleaned twigs, as was seen to be eating coconut fibres. Increased vocalisation and using different calls. = 10.01g
17	More feathers on head and body. Tail 10mm emerged. Wing feathers still mostly sheathed. Chest feathers pale green. Food starting to be offered in larger pieces. Average amount food per feed = 11.54g
18	Feathers continuing to emerge green. Cricket abdomens (5 per feed) added to the mix. Appear to be helping the consistency of the faecal sacs produced. Weight gain is slowing down as well as food consumption. Average amount food per feed = 9.37g
19	All feathers nearly out now. Tail is 2cm long. Is starting to jump in and out of the nest. Close to fledging. Lots of wing flapping. Insects increased in diet. Faecal sacs a good consistency. Amount of food per feed = 10.44g
20	Is in and out of the nest, so is close to fledging. Preening a lot, wing flapping and stretching its legs. Amount of food per feed = 9.49g
21	Still hopping in and out of nest, but continues to return to nest, so not fully fledged yet. Starting to peck at the tweezers. Amount of food per feed = 8.28g
22	Continues to stretch and flap a lot more. Given a larger nest bowl with larger twigs for gripping. Amount of food per feed = 8.39g
23	Chick has fully fledged today. By 1800 seen on a high perch, sleeping with its head under its wing. Starting to pick up food items by itself. Eating less during tweezer feeds. Amount of food per feed = 6.68g
24	Attempting to feed itself, but not able to pick up pieces of food by itself. Strong and active. Feeds reduced. Last feed at 1900. Amount of food per feed = 7.20g
25	Last feed at 1800. Amount of food per feed = 7.44g
26	Moved to a fledging cage. Nice and steady and hopping around the cage calmly. Responding to the puppet, but not the keeper. Making less chick-like begging calls. Offered a variety of food ad-lib during the day in a shallow dish. Left at work overnight. Last feed at 1700. Amount of food per feed = 6.52g
27	Not very interested in feeding from the tweezers. Cut down tweezer feeds during the day to four to encourage self-feeding. Screaming at the puppet. Amount of food per feed = 7.58g
28	Becoming difficult to weigh, as will not sit still on scales. Only offered a few bits of food from the tweezers to encourage self-feeding. Amount of food per feed = 9.44g
29	Majority of food offered today consumed by self-feeding. Only a few bits taken from the tweezers. Amount of food per feed = 12.00g
30	Produced its first pellet after consuming a whole dead cricket yesterday. Moved to a small indoor aviary, next to another juvenile Javan Green magpie. Steady and flying well. Seen taking food from the food bowl provided. Amount of food per feed = Ad-lib . Fully independent.

Age	Chick 1 weight in grams	Chick 2 weight in grams
0	7	7.5
1	8	8
2	9	9.9
3	13	14.15
4	17	19.1
5	23	25.4
6	30	33.4
7	38	42.05
8	41	51.7
9	49	64.55
10	57	68.6
11	66	80.25
12	69	81.45
13	79	84
14	88	97
15	94	102.4
16	101	107.8
17	107	108.8
18	116	111.5
19	116	113.95
20	116	116.05
21	115	112.45
22	109	114.9
23	109	116.7
24	109	110.7
25	109	105.9
26	103	106.4
27	103	104.4
28	103	102.4
29	103	103.9
30	103	103.9



2.7 Population management

The aim of the Javan Green Magpie EEP (European Endangered Species Programme) is to maintain a physically and genetically healthy population of Javan Green Magpies in captivity to act as an assurance population for the species' wild counterparts. Although this is an EEP, all known birds held in captivity are included in this managed programme. This includes the birds maintained by the Cikananga Conservation Breeding Centre and Taman Safari Indonesia, with both of these Javan-based institutions participating in the programme as non-EAZA institutions. Although to-date no reintroductions have taken place or are yet planned, this is likely to be a vital tool for the long-term recovery of this species in the future. The conservation-breeding population will be integral as an integrated Species Recovery Plan is developed.

The Javan Green Magpie was the first bird species to be evaluated through the new EAZA Regional Collection Planning (RCP) process (in 2018). The conservation-breeding population also provides opportunities for research, an invaluable resource for such a little-studied species. The genetic goal of the EEP is to maintain 90% of the genetic diversity of the founders over 100 years and the population is on track to reach this goal. However there are

only a small number of Javan Green Magpies in the EEP and in order to reach this goal we must continue to breed and increase the population. Pairs are selected due to their mean kinship and inbreeding coefficient.

The target population within EAZA zoos is approximately 100 individuals, whilst the global assurance population is approximately 200 individuals.

Further genetic research is required to truly determine the kinship of the founder population.

The presence of the Javan Green Magpies in zoos also allows us to highlight the threats faced by this species and conservation efforts being made to save it from extinction. It was chosen as the flagship species for the 2018/2019 EAZA Silent Forest campaign.



Silent Forest campaign logo

2.8 Catching and Handling

Catching

Frequent catching of Javan Green Magpies should be avoided to reduce stress and disturbance and should only be caught when essential, such as when moving birds to a new enclosure, removing independent young birds from their parent's aviary or for health checks.

Health checks should be carried out at least one month before the start of the breeding season.

Catching birds during the breeding season should be avoided unless it is essential. Only aviculturists experienced in catching passerines should attempt to catch this species.

Unless it is an emergency situation, catching Javan green Magpies should always be planned in advance, as a little preparation can make the process go more smoothly.

Javan green Magpies should be caught in a light-weight hand-held net with an approximate 30cm diameter opening. The bag should be made from a dark silk or smooth nylon material,

a depth of 40-50cm is deep enough to be twisted around once the bird has been caught to prevent it escaping. A foam-padded rim will reduce the risk of injuries if the bird flies into it. Stitching on the outside of the bag will prevent injuries to claws as the bird is removed. Mesh nets should not be used as the birds can easily get their heads, bills, wings and legs caught in the mesh, risking injury and making removal difficult. In taller aviaries, longer handled nets or those with extendable handles may be required.



Long and short-handled padded nets suitable for catching Javan Green Magpie. (Gary Ward)

Javan Green Magpies move quickly and can prove difficult to catch, even in confined spaces. If inside quarters are available with pop-holes, the birds can usually be encouraged to go inside with the offer of a favoured food item such as a few insects or alternatively, food may be withheld for an hour until the birds are hungry, making them more willing to enter the inside shelter. Once the birds are inside, quick reactions are needed to make sure pop-holes are closed before the birds go back out. Any hesitation and the birds may come out, making a second attempt to catch more difficult.

Some individuals can easily be encouraged inside, but not all birds are as co-operative.

In a relatively confined space of an indoor accommodation, normally one person is sufficient to catch the bird. If perches can be taken down this will make catching easier.

The catcher should closely watch the movement of the bird as it flies from one end of the shelter to the other. An experienced catcher can usually predict the birds' flight path and can quickly lift the net in front of the bird. As soon as the bird is in the net, the net bag should be held closed with the other hand.

Catching birds against hard aviary mesh should be avoided as there is a greater risk of injury.

Catching this species in a heavily planted aviary without thought and planning can be a long and frustrating process and quick reactions on the part of the catcher are needed.

In these situations, more than one person is needed. Normally two people are sufficient, however a third person may be helpful in chivvying the bird towards the catcher/s, particularly in large aviaries.

A clear space along one side of the aviary or one corner with less perches and plants will give the catcher an advantage. If the catcher positions his or herself at one end of the aviary, close to the open space, the second person can carefully encourage the bird to fly in their direction. Normally it is best to let the bird fly the length of the aviary at least once, so that the catcher can pre-empt its flight path and swiftly lift the net in front of the bird as it passes.

This is often easier said than done and a great deal of skill, experience, quick reactions and a good deal of luck is needed to perfect this technique. If catching more than one bird, it is always better to place the first caught bird in a securely tied cloth bird bag before trying to catch the second bird.

Bagged birds remain calm when hung from a convenient perch or ideally on a nail or hook in the safety corridor. They should never be placed on the floor.



Cloth bird bags approximately 20 cm x 20cm securely tied with a draw string are best used to hold birds for weighing and prior to processing.

Handling

Javan Green Magpies have strong feet and sharp claws and very powerful bills, which can administer a painful bite. Care must be taken when removing the bird from a net or cloth bag to avoid injuries to the bird and the handler.

The bird should be grasped in one hand, with the sides of the neck placed between the index and middle fingers with its back resting against the palm of the hand. The thumb, ring and little fingers should gently, but firmly cradle the birds' chest. The hold should be firm, but

never too tight as to restrict the birds' breathing. The legs and feet should be restrained using the other hand to prevent the bird from grasping and scratching the handler or injuring itself.



Correct handling position head and neck between index and middle finger, palm of hand on back, second hand holding feet (Jonathan Beilby)



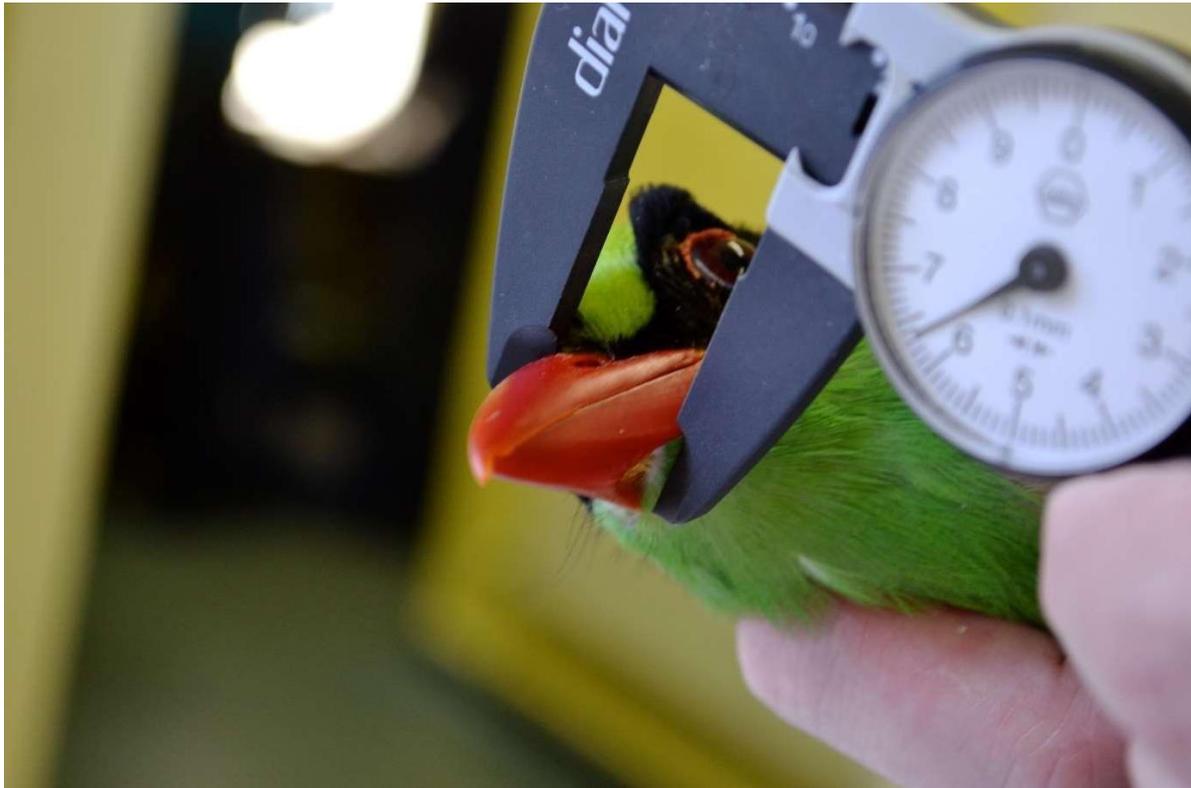
Javan green magpies have powerful bills and can give a painful bite – care should be taken when handling.



Checking wing plumage condition (Jonathan Beilby)



Correct handling method avoiding powerful bill (Jonathan Beilby)



Measuring bill height (Jonathan Beilby)

When a bird is in the hand always:

1. Check and record existing leg ring details
2. Fit leg rings if bird has not been ringed. An aluminium size N (5.33mm) split ring on one leg and a coloured plastic ring size FC1 (5.5mm) on the other leg. Place a small drop of super-glue between the bands of the ring to secure it in place, otherwise the magpie may be able to remove the ring. Before carrying out this procedure, note ring colours already used for this species to avoid using the same coloured rings. This procedure should only be carried out by experienced personnel
3. Ensure existing rings are fitted properly and are of the correct size
4. If rings are too tight, too loose or ill fitting, carefully remove (using circlip pliers) and replace.
5. Record any ring changes
6. Check transponder and record micro-chip number.
7. Fit micro-chip if bird does not have one (this procedure should only be carried out by trained personnel or an experienced veterinarian)
8. Check legs and feet. Record any abnormalities, overgrown or missing claws
9. Trim any overgrown claws (this should be carried out by trained experienced personnel only)
10. Check eyes. Eyes should be open and bright and not cloudy, opaque or congested.
11. Record plumage condition and moult pattern

12. Take biometric measurements if it is a planned move and you have sufficient time (using accurate callipers and wing rule, record bill, skull, wing, tail and tarsus measurements). This only needs to be carried out once on adult birds.
13. Check body condition (pectoral muscles and subcutaneous fat), take photographs and give scores for pectoral muscle and subcutaneous fat (see appendix 2: Body condition scoring)
14. Record the birds weight. Place the bird carefully in a cloth bird bag, tie the bag securely, weigh the bird using a 300g Pesola spring balance
15. If the bird has not been DNA sexed, remove feathers for DNA sexing. (this should only be carried out by trained experienced personnel)
16. Medicate if necessary
17. Blood or feather samples may be collected (by a qualified veterinarian) and stored in the EAZA Biobank for future genetic or research work

Birds should always be fitted with the correct size leg ring. An open leg ring can lead to injuries or death if the bird gets trapped in aviary vegetation.

2.9 Behavioural enrichment

The best enrichment for Javan Green Magpies is providing them with a large well-planted aviary. A deep layer of well-rotted mulch, bark chippings and or sharp sand as the aviary substrate will be used by the birds to dig and forage in. Leaf litter placed in well-ventilated aviaries, will be investigated and tossed about as the birds search for insects and other invertebrates. Some of the birds' live insect ration can be scattered amongst the vegetation, encouraging them to forage. Rotten logs or those covered in moss will be investigated by the birds as soon as the keeper has left the aviary, and the moss and rotten bark will soon be ripped apart as the birds search for insects.

2.10 Transportation

It is recommended that Javan Green Magpies should always be transported individually. They can be quite restless when placed in carrying cages or wooden boxes and there is a risk of injury during transit if care is not taken.

For short internal moves, carrying them in securely tied cloth bird bags is the preferred option. When the bag is held from the top, the bird remains still and calm. Bags also have the advantage over boxes of reducing the chance of injury when the bird is removed by hand. For journeys of more than one hour, it is recommended that wooden travel boxes are used. These should have 1 cm diameter ventilation holes along the sides of the box at a height of 15 cm from the floor and a fine wire mesh sloping front, which is covered on the outside with hessian sacking or similar material to darken the box, while still allowing air to flow. Failure to do this can result in birds damaging their bill and forehead in transit.

A 2 cm layer of sponge or soft foam padding securely glued to the internal roof of the box will also reduce the chances of head injuries.

Suitable dimensions for a single bird are 30 cm long at the bottom, 18cm at the top, 18cm wide and 18cm high. A 2 cm diameter perch should be firmly fixed 4 cm from the floor halfway along the length of the box. 2 cm wide wooden spacers should be screwed to the sides of the box to ensure good ventilation.

For journeys of over 3 hours, a small amount of food should be provided in case of delays. It is not necessary to provide water for these relatively short journeys, as this will inevitably spill and soak the box, however a small water dish should be fixed at the front of the box and water can be provided in the event of delays. A piece of clean sponge can be glued inside the water dish, which will soak up most of the water and help to prevent spillages.

Transportation by air is governed by IATA regulations, and these are enforced. Precautions as recommended above need to be taken, with the addition of a low perch. A perch placed too high in a confined space may inflict injury or cause the bird to become trapped.

Car or Van: Travelling boxes should be placed securely in the back of the vehicle and should be secured using rope ties or bungee straps. If the box is placed on a soft material such as an old clean duvet or sponge padding, this will avoid knocking and rattling and will give the bird a smoother journey.

Boxes should not be kept in the cabin of the vehicle, as noise (talking or radio) will cause disturbance. The vehicle should be climate controlled to avoid problems in extreme hot or cold temperatures.

Airplane: The International Air Transport Association (IATA) has made the IATA Live Animals Regulations (LAR). These Live Animal Regulations are a worldwide standard for transporting live animals by airlines. The objective of the IATA Live Animals Regulations is to ensure that all animals are transported safely and humanely by air, whether it is to transport a pet, an animal for zoological or agricultural purposes or for any other reason (*IATA, 2007*).

The IATA Live Animals Regulations are applicable to members of the International Air Transport Association according to the provisions of Cargo Services Conference Resolution 620 and to airlines being parties to the IATA Multilateral Interline Traffic Agreement-Cargo (*IATA, 2006*).

The IATA Live Animals Regulations are accepted by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Office International de Epizooties (OIE) as guidelines in respect to transportation of animals by air. These regulations have been used by the Council of Europe as a basis for its code of conduct for the international transport of farm animals. The European Union has adopted the IATA Live Animals Regulations as the minimum standard for transporting animals in containers. As an increasing number of countries adopted or accepted these regulations as a part of their national legislation, shippers are warned that shipping live animals in violation of the regulations may constitute a breach of the applicable law and may be subject to legal penalties.

Transport box / crate:

Material and dimensions: 1.5cm thick Plywood 30cm long, 18cm high, 18cm wide. A sloping front viewing panel should be made of 1.2cm weld mesh. This should be loosely covered with a piece of clean muslin or hessian cloth while the bird is in transit.

1.5 cm wooden spacer-bars should be fitted along both sides of the box to aid ventilation.

Floor: A double layer of newspaper or rubber matting or dense carpet should be used to line the bottom of the box. Wood shavings or sawdust should be avoided as they may find their way into the birds' food and water dishes, preventing access to the food and water.

Perch: A smooth wooden perch 2cm in diameter should be firmly fixed 15cm from the back of the box and 4 cm from the floor

Roof: The roof should be lined with 2cm of sponge or soft foam material to avoid head injuries.

Doors: A sliding access door 10 cm wide and 18 cm high should be fitted to the back of the box. This should be secured using screws.

Ventilation: 1cm holes drilled 5 cm apart along both sides of the wooden transport box 15 cm from the bottom of the box.

Feed and water containers: Small, shallow food and water containers must be fixed in the front of the box. They should be made of stainless steel or plastic and should be approximately 8 cm long, 5 cm wide and 4 cm deep.

The bird must be fed and watered before shipment. Birds can be provided with additional food items in small shallow dishes during transits of longer than 4-5 hours. Favoured items, such as insects or berries should be included as well as other food items. If additional feeding or watering is required due to an unforeseen delay, full instructions must be supplied by the shipper (IATA, 2006).



A suitable wooden travel box for a Javan Green Magpie (IATA 2006)



Side view



Rear showing sliding door



Internal view showing sponge padding and low perch

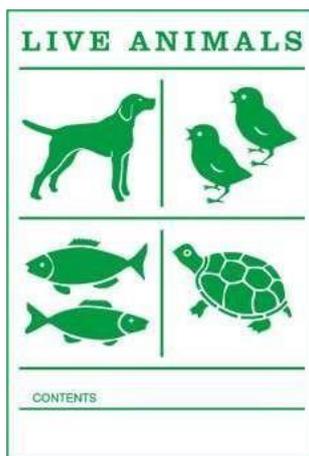
Labels on transport container: The labels on the transport box must be durable and printed or otherwise marked on or affixed to the external surface of the live animal container. They should be fixed in such a way as to not cover any air or ventilation holes. English must be used in addition to the language which may be required by the state of origin (IATA, 2006).

Unless otherwise specified in these Regulations, each live animal container must be marked, durably and legibly on the outside of the container, with each of the following:

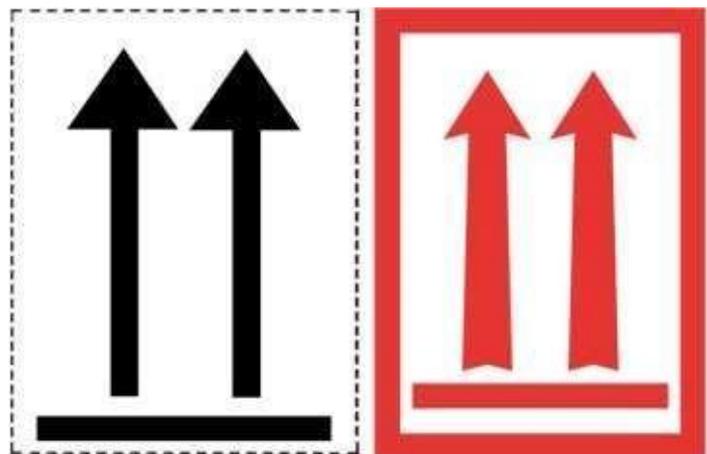
1. The full name and address and contact number of the shipper, consignee and a 24-hour contact (if it is not one of the aforementioned persons responsible for the shipment).
2. The scientific and common name of the animal(s) and quantity of each animal contained in the container, as shown on the shipper's certification.
3. Affix special feeding and watering instructions to the container.

4. A copy of the record must be attached to the documents relating to that shipment. Any further feeding and watering instructions must be included and accompany the shipment (IATA, 2006).

It is mandatory to attach at least one IATA “Live Animals” label or tag, properly completed, to each live animal container, unless otherwise stated in the individual container requirements. Animal containers may have the appropriate labelling imprinted (IATA, 2006). The label for live animals should have the following header “Live Animals”, the colour should be bright green on a light background. The minimum dimensions of the label are 10 cm x 15 cm and letters of 2.5 cm (IATA, 2006). In Figures below the label for live animals is shown.



Live animals label (IATA, 2006).



This way up label (IATA, 2006).

In addition to the “Live Animals” label, it is mandatory that the “This Way Up” labels or markings be placed on at least two opposite sides. Labels may be imprinted on the container. The label for “This way up” should be black or red on a contrasting background. The minimum dimensions of the label are 74 mm x 105 mm and letters (IATA, 2006).

The bird may be very stressed after transportation and may be reluctant to feed. On arrival in its isolation or quarantine cage or aviary the bird should be provided with some cover and several food dishes containing ample amounts of favoured food items, such as insects. Once the bird has settled, food dishes and quantities can be reduced.

2.11 Veterinary: Considerations for Health and Welfare

A Preventative Medicine Plan

Good health goes hand in hand with good husbandry and many of the components of a preventative health care plan are already taken care of in other parts of these Best Practice Guidelines. A summary of various components is given here.

Goals:

1. Prevent disease entering animal collection
2. Maintain health of collection
3. Prevent dissemination of disease to other institutions / release programmes

Importance:

4. Difficulty of diagnosis and treatment of overt disease
5. Often too late once show signs of overt disease
6. Difficulty in eliminating many organisms once established in the collection
7. General improvement of condition / performance of stock
8. Stock selection: Need for pre import husbandry, reproductive and medical history for individual and its group of origin
9. Quarantine: Imports + isolation of resident sick animals (facilities, carers, duration)

Quarantine

In terms of disease transmission birds are at most risk from conspecifics. It goes without saying that the best way to prevent the spread of infectious disease from one bird to another is to isolate any affected birds. However the risks posed by apparently healthy birds are often neglected. Many diseases can remain dormant for long periods only coming to the fore at times of stress. Hence it is good practice to quarantine all new stock entering the collection even if it appears healthy and there has been no history of infectious disease at the collection of origin. A suggested protocol is given below:

Facilities: Quarantine areas should be well separated from the main collection. They must be able to provide a physical environment suitable for the holding of these birds and be secure from pest species (rodents, wild birds, and invertebrates) and be easily disinfected between batches of birds. Depending on the collection of origin certain legal requirement detailing the nature of the facilities required may be enforced. For example DEFRA requires that all birds imported into the UK from non EU (and in future all non-BALAI approved collections) must be quarantined in a DEFRA approved facility. DEFRA give detailed specifications as to the structure and running of these.

Staffing: birds in quarantine and birds already in the collection that are sick and are in isolation should be cared for by staff other than those looking after the healthy stock. Only dedicated protective clothing and footwear should be worn.

Duration: again the government of the importing country may stipulate these. A quarantine period of a minimum of 30 days is recommended irrespective of the source of the bird.

All birds should be wormed and subsequently test negative for parasites before release from quarantine.

Disease Screening and Prophylaxis

This protocol applies to birds moving from other known collections within the EU. Additional testing may be required for birds from non EU or unknown sources. Before acquisition every effort should be made to get a full clinical history including diet sheet, medical history, worming regime and relevant diseases of note diagnosed in the sending collection in the last 5 years. This should be made available to the curator and consulting vet for comment. This history will help determine the quarantine protocols required to protect both the receiving collection and the incoming bird. EAZA and BIAZA require a certain amount of pre-export testing. Although this is mandatory it is rarely fully observed. If the pre-export testing is complete then quarantine requirements may be reduced from those set out below.

Pre-export screening:

1. no cases of avian influenza within previous 30 days
2. zoos must not be subject to or in an area that is subject to restrictions applied to combat Newcastle disease
3. where requested tests for bacteriology and parasitology which may include Salmonellosis, Chlamydia, toxoplasmosis should be carried out within 30 days prior to transportation
4. Yersiniosis – the receiving institution must be notified when this disease has affected the sending institution within 60 days before transport
5. the receiving institution should be notified if there is any clinical or pathological evidence within the last year of any of the following diseases: AvianTB, avian pox, avian diphtheria

Post-export screening:

1. Main diseases of concern:
 1. Chlamydia, Salmonella, Enteric parasites (additional disease screening may be indicated depending on the disease history at the animal's previous home)
2. Samples which may be required:
 1. Blood (heparin and serum), cloacal/choanal swab, 3 day pooled faecal sample, serum sample stored for future reference
3. Tests required:
 1. Physical Examination
 2. Basic haematology and biochemistry screen: PCR Chlamydia (faeces)
 3. Faecal culture and parasitology, non-infectious diseases:

Routine Treatments:

Routine health monitoring should include:

1. Opportunistic health screening - testing (basic haematology and biochemistry, serology)
1. Full post-mortem examinations on all dead birds and dead but fertile eggs, further diagnostic tests performed if there is any suspicion of infectious disease.

2. Parasite control – worm and ectoparasite treatment before arrival, the frequency and type of parasite control required will depend on the individual collection however as a minimum faecal egg counts should be performed for each pair of birds at least on a quarterly basis. If parasites are present a worming programme can be instituted in consultation with the consulting veterinarian. Faecal sample once or twice yearly if no history of parasites. Control of intermediate hosts where appropriate.
3. Preventative worming treatments for passerines.
 1. Beak and claw problems – investigate and reduce predisposing factors.
 2. Dietary records / evaluation.

Biosecurity

Keepers should be aware that disease agents could also be transferred to the birds with which they work on their hands, clothing, foot ware and any equipment they bring into the birds' enclosures. Where feasible it is recommended that anyone entering a bird's enclosure or handling the birds in anyway should wear clothing and use equipment that has not come in contact with any other birds.

Zoonotic diseases

Zoonotic diseases are those transmissible to humans from other species. Diseases that can potentially cross between birds and humans include chlamydiosis (more commonly known as Psittacosis), Salmonellosis and, in immune-suppressed individuals, Avian Tuberculosis. Protection against exposure should take a two-pronged approach. Birds are most likely to shed potentially zoonotic organisms when they are stressed hence it is good practice to routinely screen all new birds during quarantine and any bird that is unwell (see preventative medicine section for more details).

Hygiene

This is the mainstay for prevention of disease transmission. All bird food bowls and cleaning equipment should be kept strictly separate from those used by humans (preferably have a separate kitchen for and dedicated equipment). Keepers should wash their hands thoroughly with soap and water after cleaning out or handling the birds and should not eat or drink in animal areas. If a bird is suffering or suspected to be suffering from Chlamydiosis special precautions should be taken.

This section briefly outlines any physical conditions or complaints commonly associated with the species. Requirements for behavioural as well as physical well-being are considered. Symptoms, treatment and prevention of common diseases/conditions are outlined. Required vaccines may be specified, though the appropriate inoculation schedule should be left to the discretion of each collection's veterinary surgeon and not specified here. Common parasites, screening and treatments are outlined (again detailed information on medical procedures not included). Information on causes of adult mortality is also included.

Specific problems

As a group, corvids generally appear to be relatively trouble-free and many seem to live a long and healthy life. As they are very active birds, their well-being benefits greatly from a large planted aviary with suitable furnishings to keep them active and occupied.

The few post-mortem reports to hand reflect a range of causes of death with no particular malady prominent,

Internal parasites are a problem for many passerines and regular screening and a routine worming regime should be employed twice yearly.

The presence of internal parasites can be checked easily by sending a faecal sample to a specialised bird vet for analysis. Advice can then be sought on suitable treatment should it be necessary.

Atoxoplasmosis and Coccidia

Atoxoplasmosis does appear to be a considerable health concern for a number of passerine birds, and this protozoan may be a significant factor in the cause of death for young birds, particularly in late nestling stage and fledged young. However, to date, it has not been detected in Javan Green Magpie. Further research is needed in this area.

Adult birds can be treated in the drinking water with the following:

Toltrazuril (Baycox)

25mg per litre of drinking water for 2 days with treatment repeated in 5 days' time.

Adult birds can be treated when they lay. Baycox does not affect the development of eggs.

Chicks may be treated pre-emptively whilst still in the nest with the first treatment at approximately 7 days old. The following dose rate applies:

Toltrazuril (Baycox) 12.5 mg per ml solution.

0.01 ml per 10g body weight given orally for 2 days with treatment repeated in 5 days' time.

Coccidia can be treated with Toltrazuril at the same dose rate as that given for *Atoxoplasmosis*.

Aspergillosis is an infectious but not contagious fungal infection (mycotic disease), primarily of the respiratory tract. Chronic disease is the most common form and often follows a stressful event or immunosuppression. Good hygiene and well-ventilated enclosures aid the prevention of this infection.

As *Aspergillosis* has been diagnosed as a cause of death in a number of Javan Green Magpies, Itraconazole is recommended for prophylaxis and as a precaution, may be of value to administer prior to and after transportation between institutions or when birds are moved between enclosures within the same institution.

Itraconazole should be given at a dose of 10 mg/kg once daily in a live food item such as a wax moth larva for the three/four days prior to transport and for 7 days after transportation.

Iron storage disease (*Hemosiderosis*) does not appear to affect Javan Green Magpies and there does not appear to be the need to provide particularly low iron diets for this species, however a recent case of *Hemosiderosis* was found in a recently post-mortemed Red-billed Blue Magpie *Urocissa erythroryncha* (Lopez *in litt.* 2018).

Following faecal parasitology one bird at Durrell Wildlife Conservation Trust had *Dicrocoelium* ova. The bird was treated with praziquantel. This institution had issues getting parenteral praziquantel previously when they decided to treat trematodes in avian species, so an alternative oral praziquantel/pyrantel combination such as drontal could be used.

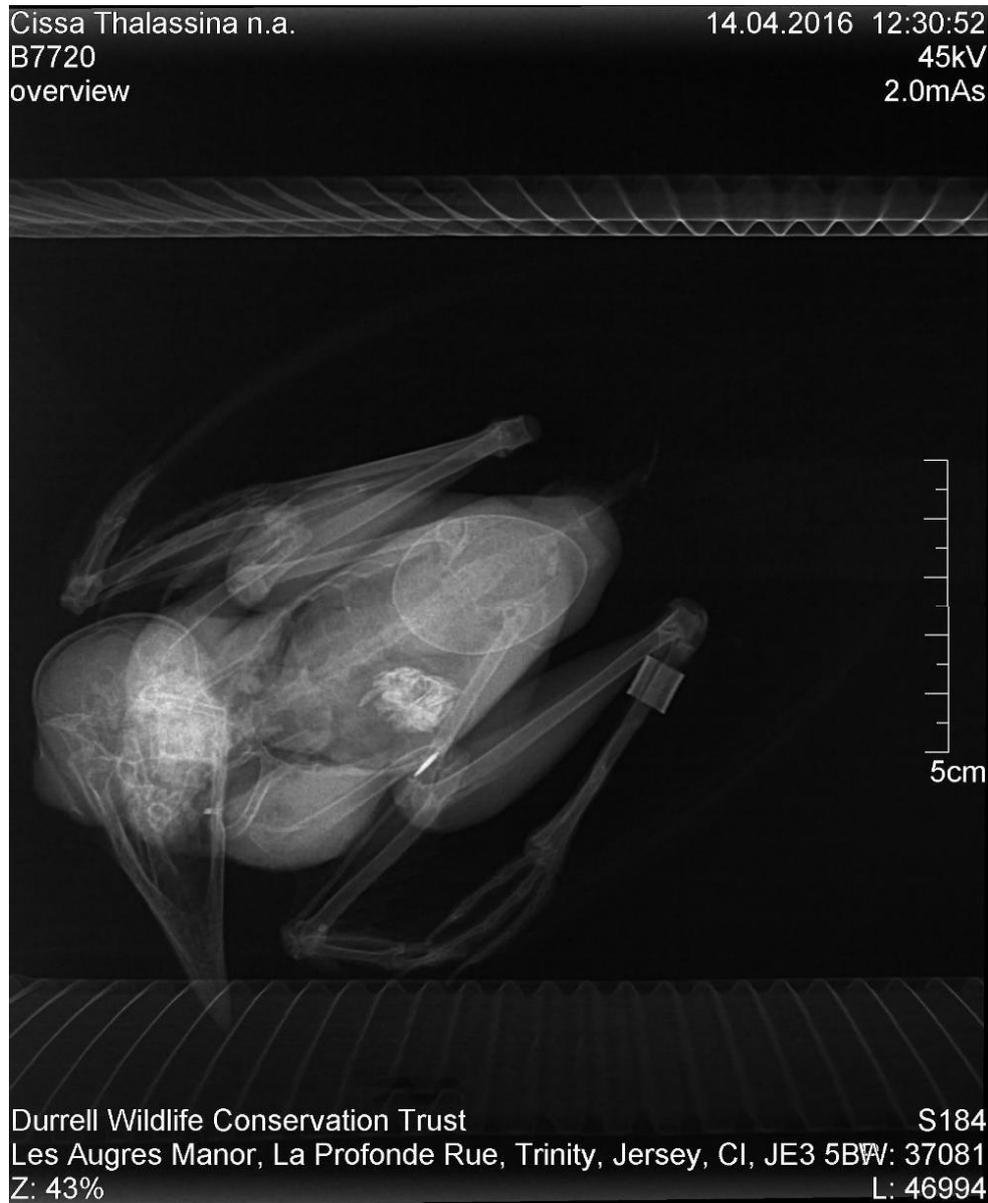
Javan Green Magpie deaths within the EEP population

Location	Studbook #	Local ID	Date	Age	Sex	Cause of Death
Chester	28	C15763	16/4/16	2Y 7M 25D	M	Bacterial infection/Encephalitis
Chester	55	C16166	24/4/16	6D	U	Yolk sac infection
Chester	82	C17423	29/6/17	16D	U	UNK
Chester	47	C16442	22/11/17	1Y 5M 9D	F	Aspergillus
Chester	107	C18637	2/7/18	3D	U	UNK
Chester	43	C15761	16/8/18	4Y 7m 22D	M	Aspergillus/reaction to Doxycycline injection
Chester	112	C18955	22/9/18	7D	U	UNK
Prague	73	160109	4/6/16	2M 20D	U	Infection
Prague	25	160108	4/6/16	2M 21D	U	Infection
Prague	80	P1631	12/6/16	3M 7D	U	Multi-centric lymphosarcoma
Prague	79	P1629	12/6/16	3M 8D	U	Multi-centric lymphosarcoma
Prague	102	180100	24/4/18	11D	U	UNK
Prague	103	180101	24/4/18	10D	U	UNK
Prague	105	180210	4/6/18	12D	U	UNK
Prague	106	180211	4/6/18	8D	U	UNK
Waddesdon Manor	76	2195	15/9/18	1Y 8M 20D	F	UNK sudden death, Bacterial infection suspected
Waddesdon Manor	83	2196	16/9/18	1Y 2M 15D	M	UNK sudden death, Bacterial infection suspected

Causes of death in Javan Green Magpie *Cissa thalassina* at Cikananga Conservation Breeding Centre

CCBC Local ID	Sex	Date of Arrival or Hatch	Date of Death	Cause of death & Post-mortem Notes.
CT001	M	A - 20/07/2011	07/01/2012	Suspected Kidney Failure which has led to the death.
CT011	F	A - 16/01/2012	22/02/2015	(suspected or confirmed): Airsacculitis – Unknown aetiology
CT017	F	A - 20/10/2012	01/08/2013	Unknown
CT020	F	A - 22/10/2012	05/06/2016	The bird present multiple severe wounds, likely caused by rats or by a trauma on the cage equipment. The infliction by mate is unlikely due to the position of the wounds.
CT030	M	H - 22/11/2013	30/11/2015	Trauma around the right shoulder of the bird that led to internal bleeding and death.
CT045	F	A - 20/09/2014	02/02/2017	Obstruction of the large intestine by a potential harden urea that led to a digestive failure.
CT049	F	H - 05/02/2015	11/03/2016	Severe haemorrhage on the skull
CT052	U	H - 31/03/2015	02/06/2015	Euthanized due to broken leg. Otherwise, healthy bird
CT055	U	H - 19/04/2015	11/05/2015	Death by trauma, big wound on the right side of head, probably made by the parents.
CT060	M	H - 28/10/2016	21/12/2016	The ulcers in the gizzard due to the ingestion of sharp food item (or papaya seed) led to some difficulty for the bird to eat and caused the death by starvation. General pale coloration of organs.
CT070	U	H - 13/12/2017	06/02/2018	Decomposed specimen so hard to draw conclusions. Very thin so potentially dominance from cage mate or not eating once removed from the parents. The cause of the death appears to be a lung infection.
CT022	U	H - 06/03/2013	11/04/2013	Suspected Starvation due to poor parental care

Medical procedures



X-Ray of egg-bound Javan Green Magpie Durrell Wildlife Conservation Trust 2016

Bird was found in a weak condition. Suspected to be egg-bound and this was confirmed on x-ray. In addition to antibiotics, she received calcium injections and by the afternoon looked considerably brighter. Left in a heated cage overnight, but despite more calcium and oxytocin she still had not passed the egg after 12 hours. She was anaesthetised and the egg was surgically removed. All went very well, egg contents were drained, shell came out whole and cleanly and she passed a second soft-shelled egg.

The following year this bird laid a clutch of eggs and reared the young successfully.

Blood collection:



Drawing blood from a wing vein should only be carried out by a qualified veterinarian



Micro-chipping should only be carried out by trained personnel

Section 3: References

Collar, N. J., Gardner, L., Jeggo, D. F., Marcordes, B., Owen, A., Pagel, T., Pes, T., Vaidl, A., Wilkinson, R. & Wirth, R. (2012) Conservation breeding and the most threatened birds in Asia. *BirdingASIA* 18: 50-57.

Collar, N. J.; Butchart, S. H. M. (2013). Conservation breeding and avian diversity: chances and challenges. *International Zoo Yearbook* 48(1): 7-28.

Hill, Geoffrey. E. (2010) Bird Coloration National Geographic, Washington, D.C.

MacKinnon, J.; Phillipps, K. (1993). *A field guide to the birds of Borneo, Sumatra, Java and Bali: The Greater Sunda Islands*. Oxford University Press, Oxford.

Owen, A., Wilkinson, R. and Sözer, R. (2014) In situ conservation breeding and the role of zoological institutions and private breeders in the recovery of highly endangered Indonesian passerine birds. *International Zoo Yearbook* 48: 199-211.

Products mentioned in the text

Avimix multi-vitamin powder. Vetark Animal Health, PO Box 60, Winchester, Hampshire SO23 9XN, UK

Yellux Lutein bird food colour supplement, Versele laga Oropharma, Belgium

Section 4: Appendices.

Appendix 1: Plumage and Pigmentation

Pigmentation and the effects of lutein and sunlight

Since the start of the captive breeding programme in 2011, a number of Javan Green Magpies have been brought to Cikananga Conservation Breeding Centre from private keepers or bird markets and many have very faded colours compared to those which would be expected to be seen in wild individuals, with the bright green plumage faded to a pale, washed-out green or turquoise-blue in birds that have been long-term captives. The rich reddish-chestnut feathers of the wings had often faded to a washed out greyish-brown. The vibrant red bill, legs and feet also fade to a paler red or orange in some instances. It can be speculated that the amount of fading is dependent on the length of time the birds have spent in captivity since being caught from the wild.



Some of the birds received by Cikananga still had vibrant green body plumage, reddish wings and bright red bills, legs and feet indicating they had recently been trapped from the wild.

It has long been known that the plumage of magpies of the genus *Cissa* fade from green to pale turquoise-blue in captivity and that this is caused when the birds are exposed to direct or excessive amounts of sunlight.

Dietary information for the Javan Green Magpie is sparse and relies primarily on historical analysis of stomach contents of collected specimens. Throughout the year invertebrates form the most important component of the diet.

A variety of prey items has been found in stomachs; snails; crustaceans; crayfish Astacidae (Decapoda), pill bugs Armadillidae (Isopoda); insects; cockroaches Blattidae (Dyctyoptera), grasshoppers (Orthoptera), 'may-beetles' Scarabaeidae, weevils Curculionidae, *Chalcothea* spp. Cetoniidae, horned beetles Cerambycidae, click beetles Elateridae (Coleoptera), cicadas (Homoptera), caterpillars (Lepidoptera), large ants Formicidae (Hymenoptera). Larger vertebrate prey (small birds, lizards, including their eggs, tree frogs and snakes) constitute a large part of the diet in the breeding season. Fruits were recorded in stomachs on just 3 occasions.

An ex-bird trapper familiar with the species in the Bandung mountains stated berries were also recorded as being eaten, although large insects, frogs and crayfish (the latter hunted for in mountain streams) were more frequently eaten. (Imatt *pers com.* 2014).

It can be assumed that the diet for this species is likely to be very similar to that of the more widely observed members of the genus.

The diet of the Common green magpie *Cissa chinensis* is known to include beetles (*Coleoptera*), crickets (*Orthoptera*), mantises (*Mantidae*), moths, caterpillars, small frogs, snakes, lizards and birds' eggs and nestlings as well as probably taking some fruits and berries. (ref: HBW Alive, Madge and Burn). The author has seen this species eat large green katydids, large moths and cicadas in Fraser's Hill Malaysia. (Owen *pers. obs.* 1991).

The Bornean green magpie *Cissa jeffreyi* has been observed eating moths, Katydids, cicadas, frogs and a small snake.

Many of the invertebrates consumed are green in colour and are likely to contain the carotenoid lutein.

Lutein is a xanthophyll and one of 600 known naturally occurring carotenoids. It is synthesized by plants and is found in high quantities in leafy green plants. Lutein (*Lutea* meaning yellow in latin) is a natural colorant due to its orange-red colour, lutein absorbs blue light and therefore appears yellow at low concentrations and orange-red at high concentrations.

Lutein is obtained by animals directly or indirectly, from plants and its yellow pigment is absorbed in living organisms which eat it, including birds. (Hill 2010).

The green plumage of the Javan Green Magpie and other *Cissa* species is made up of blue structural feathers, which become green when the yellow lutein pigment is absorbed into

the birds system through the food that it eats and is transferred to the freshly growing feather follicles during the birds' moult.

As the yellow lutein pigment is not part of the structure of the feathers or stable in the birds' system, a lack of it being consumed over time will result in the birds' green feathers progressively fading to blue.

Birds caught from the wild and held in captivity by local bird keepers are likely to be fed on an un-natural diet of fruit (banana, or papaya), insects in the form of commercially bred mealworms or crickets, a commercial cage-bird pellet and possibly some meat. None of this diet is likely to contain lutein at levels adequate to maintain the green plumage.

It appears that this carotenoid is so unstable in the birds' system that it fades from green to blue even in death, as noted by observing specimens in the collection of the Natural History Museum in Tring.

Cissas are one of only a few Asian, mostly obligate insectivores, including Broadbills, Leafbirds and Trogons, who's green and yellow plumage fades to bluish and whitish respectively in captivity or after death. (Prys-Jones *pers. comm.*)

There is also evidence to substantiate the old avicultural theory that these birds do also bleach to some extent when exposed to direct sunlight.

Birds historically held in European or North American collections would probably have been fed on diets lacking in lutein, such as minced meat, mice, day old chicks and commercially raised insects such as mealworms. If housed in aviaries exposed to high levels of natural sunlight, a combination of insufficient lutein and an over-exposure to sunlight contributed to the fading effect.

It is likely that a large proportion of prey items consumed by Green magpies in the wild, particularly green insects contain significant quantities of lutein, which in turn once eaten, are absorbed into the birds system and are taken up by the feathers during moult. In captivity it is likely that foods offered would contain little or no lutein.

Yellux, manufactured by Versele-Laga Oropharma™, Belgium is a colorant based on lutein, extracted from the petals of Marigold flowers *Tagetes erecta* which is used as a food additive to enhance the yellow colour of canaries.

When Yellux is added to the food it is absorbed into the birds' system and utilized by newly developing feather follicles where the newly growing feather takes on the yellow colour.

The structural feathers of the *Cissa* magpies are blue, when these birds consume animals that contain lutein, over time, this builds up in the birds system including the feathers and combined together the blue feathers with the yellow pigment create green plumage.

At Cikananga Conservation Breeding Centre, the diet offered to the Javan green magpies replicates the species' natural diet as closely as possible, with the birds receiving wild-caught frogs, lizards, eels and invertebrates, particularly grasshoppers, stick insects and mantises

harvested from the surrounding countryside. Although it is likely these food items contain some lutein, the birds generally maintained a pale greenish-blue colour, suggesting there was insufficient lutein in these food items to create the intense green hues found in wild birds. The addition of the lutein supplement to the diet (dusted onto crickets) of the Javan Green Magpies in 2013, resulted in birds becoming brighter green following their subsequent moult. The intensity of the green varied between individuals and seemed to depend on the timing of their moult and how green or blue they were before the lutein supplementation began. Birds which had come into Cikananga as fresh wild-caught individuals faded less and maintained their intense green plumage following moult. Birds which had apparently been long-term captives and arrived at Cikananga in pale turquoise-blue plumage became pale green after moulting, which suggests there needs to be a sufficient quantity of lutein built-up in the birds system in order to achieve full vibrant colours. With the continued provision of the lutein supplement, these birds attained the natural bright colours over subsequent moults.

The first captive-bred Javan Green Magpie was reared at Cikananga in 2012. However on fledging it was a pale powder-blue with a whitish underside, indicating that it had not received sufficient lutein in the food provided by its parents to produce green plumage. At a similar time there was a report of a wild fledgling being caught by a bird trapper and although the bird unfortunately could not be rescued, a photograph showed it having far greener and yellower plumage than the captive-bred bird, suggesting it had been reared on a diet rich in lutein. Although unsubstantiated, it may also be hypothesised that sufficient lutein may be stored in the wild adult female's system to allow it to be passed through the egg to the developing chick.



Wild-caught fledgling 2012



Faded Javan Green Magpie after exposure to direct sunlight

Within three months this Chester Zoo females' plumage dramatically deteriorated from a vivid green with bright chestnut-brown primaries to a pale blue with washed out grey-brown primaries, with feathers on back and underside becoming curly and dishevelled.

It is thought that this is due to this pair of magpies' aviary and nesting site being exposed to intense direct sunlight.

Normally, during the spring and summer months, this aviary is covered with camouflage netting to create a shady environment, however, as the pair nested early and due to the risk of disturbing the incubating bird, keepers were not able to cover the aviary.

During the exceptionally hot 2018 breeding season, this pair produced 3 clutches of eggs in quick succession, resulting in the incubating female being exposed to intense sunlight for over 3 months and causing her plumage to fade and curl dramatically.

Once the breeding season had ended, the aviary was re-covered in camouflage netting and following a moult, this bird re-gained its normal colouration. (See photograph below).



Female Javan Green Magpie following moult Chester Zoo 2018



81 days after arrival from bird market with totally blue plumage. Note green tail and green shoulders after the provision of lutein supplement in the diet. Although moult start date not recorded, the development of green plumage would indicate a minimum of 2 weeks before this photograph was taken and the synthesis of lutein into the system was rapid 1-2 months. (Cikananga Conservation Breeding Centre 2016).



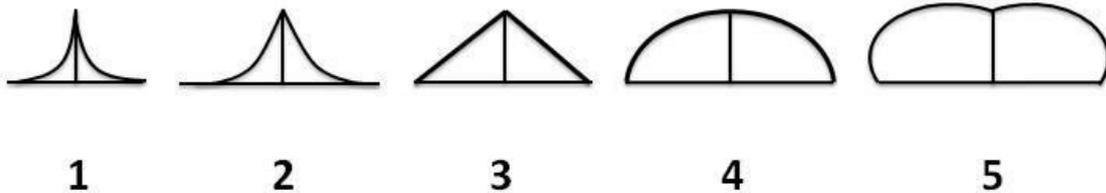
Fresh green tail feathers

Appendix 2: Body condition scoring

The body condition score should be recorded at least twice yearly (before and after the breeding season) and additionally opportunistically whenever a bird is the hand. As well as using the scoring system below, the birds' pectoral muscle and any fat should be photographed and an accurate weight should be taken for future reference. Moistening the breast feathers with damp tissue paper and gently brushing them away from the breast bone will make photographing the area easier.

Pectoral muscle score

The pectoral muscle score is a good indicator of the physical condition of the bird. The pectoral muscle score ranges from 1 to 5. A pectoral muscle score of 4 or 5 for a Javan Green Magpie represents a healthy bird which has well-developed muscle tone.



Score Class	Prominence of sternum	Pectoral muscle shape
1	Sternum sharp	Very thin. Very little muscle. Indicative of a sick bird
2	Sternum sharp. Easy to distinguish	Muscle depressed, concave in shape
3	Sternum easy to distinguish	Triangular in shape. Muscle neither depressed nor rounded
4	Sternum difficult to distinguish	Muscle slightly rounded, level where it joins sternum
5	Sternum difficult to distinguish	Muscle well-rounded and raised higher than sternum

Subcutaneous fat score

Small amounts of subcutaneous fat visible under the skin may be considered normal in most species.

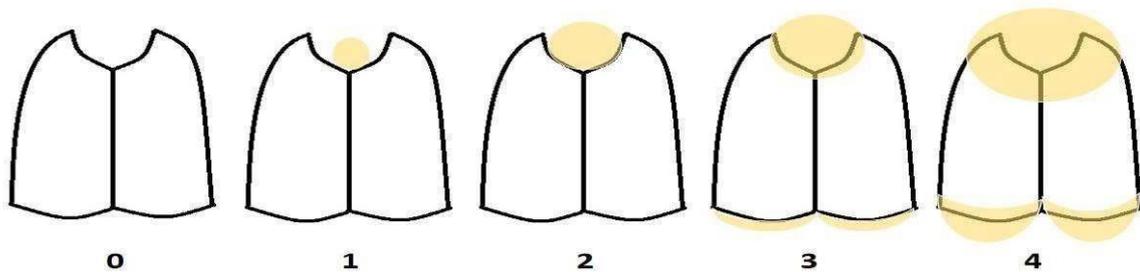
Larger amounts of subcutaneous fat may be seen in the V shaped cavity (inter-clavicular) between the clavical (wishbone) and may also be seen in the ventral cavity directly below the sternum.

The amount of subcutaneous body fat should be recorded when birds are handled.

Use the amount of fat present in the inter-clavicular area to gauge the condition of a bird and use the following five-step 0-4 scale.

1. No fat visible
2. Some fat visible in inter-clavicular area
3. Inter-clavicular area nearly filled with fat
4. Inter-clavicular area completely filled with a bulging pad of fat and fat deposits visible elsewhere - Fat
5. Large swollen mass of fat in Inter-clavicular, ventral cavities and other areas of the body - Obese

A bird is considered fat when the subcutaneous fat score reaches 3 and obese when it reaches 4.



Subcutaneous fat score

A bird with good body condition will have a pectoral muscle score of 4-5 and a subcutaneous fat score of 0-1.



Assessing pectoral muscle score (Jonathan Beilby)



Checking pectoral muscle condition. This bird has a pectoral muscle score of 5 (Jonathan Beilby)

