VKM Report 2026: 07

Vitenskapskomiteen for mat og miljø
Norwegian Scientific Committee for Food and Environment

Risk assessment of animal welfare in exotic birds kept as companion and hobby animals

Janicke Nordgreen, Grete H. M. Jørgensen, Cecilie M. Mejdell, Ruth C. Newberry, Stephan A. Reber, Kristin Opdal Seljetun, Åsa Maria Espmark, Erik Georg Granquist, Ingrid Olesen, Sonal Patel, Sokratis Ptochos, Amin Sayyari, Marco Antonio Vindas, and Tor Atle Mo

Scientific Opinion of the Panel on Animal Health and Welfare of the Norwegian Scientific Committee for Food and Environment

VKM has assessed the welfare needs, welfare challenges, and mitigation measures for 27 exotic bird species kept as companion and hobby animals in Norway. VKM concludes that it is challenging to achieve good welfare for these exotic bird species in captivity. There is a high risk of poor welfare in these birds kept without conspecifics. Furthermore, inadequate housing lacking enrichment and without the possibility of free flying outdoors is detrimental to the welfare of all species. Feather clipping and hand-rearing are other high-risk factors, as is feeding a seed-based diet. VKM has also compiled an overview of mitigation measures.

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Scientific Opinion of the Panel on Animal Health and Welfare of the Norwegian Scientific Committee for Food and Environment
19.06.2026

ISBN: 978-82-8259-462-2
ISSN: 2535-4019
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Cover photo: Mostphotos

Suggested citation: VKM, Nordgreen, J., Jørgensen, G. H. M., Mejdell, C. M., Newberry, R. C., Reber, S. A., Seljetun, K. O., Espmark, Å., Granquist, E. G., J., Olesen, I., Patel, S., Ptochos, S., Sayyari, A., Vindas, M. A., Mo, T. A. (2026). Risk assessment of animal welfare in exotic birds kept as companion and hobby animals. Scientific Opinion of the Panel on Animal Health and Welfare of the Norwegian Scientific Committee for Food and Environment. VKM Report 2026:04, ISBN: 978-82-8259-462-2, ISSN: 2535-4019. Norwegian Scientific Committee for Food and Environment (VKM), Oslo, Norway.

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Risk assessment of animal welfare in exotic birds kept as companion and hobby animals

Preparation of the opinion

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) appointed a project group to draft the opinion. The project group consisted of two VKM members, one VKM staff, and three external experts. Three referees commented on and reviewed the draft opinion. The Committee, by the Panel on Animal Health and Welfare, assessed, and approved the final opinion.

Authors of the opinion

The authors have contributed to the opinion in a way that fulfils the authorship principles of VKM (VKM, 2023). The principles reflect the collaborative nature of the work, and the authors have contributed as members of the project group and/or the VKM Panel on Animal Health and Welfare.

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Acknowledgement

VKM would like to thank Marita Heinz (Norwegian Institute of Public Health, the library) for valuable help in designing and performing the literature searches.

VKM would like to thank the hearing experts Morten Haug and Harald Akselvoll (The National Federation of Norwegian Tropical Bird Associations) and Svein A. Fosså (The Norwegian Pet Shop Association) for providing up-to-date information on the status of exotic birdkeeping in Norway (section 1.7).

VKM would also like to thank the referees Oliver Burman and Anna Wilkinson (University of Lincoln, UK) and Jean-Loup Rault (NexWelfare consulting, Austria) for their valuable comments through critical review of the draft opinion. VKM emphasises that the referees are not responsible for the content of the final opinion. In accordance with VKM's routines for approval of a risk assessment (VKM, 2024), VKM received their comments before evaluation and approval by VKM Panel on Animal Health and Welfare and before the opinion was finalised for publication.

The expertise of VKM experts

Individuals working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third-party interests. The provisions on impartiality in the Norwegian Public Administration Act apply to all work carried out by VKM.

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Summary

Background

In Norway, many exotic bird species are kept as companion and hobby animals. According to the Animal Welfare Act, animals can only be kept in ways that meet their welfare needs. While legislation restricts the keeping of most exotic animals, it does not include birds. Furthermore, the governmental report to the Storting on animal welfare (2024-2025) highlighted that there is limited knowledge about the welfare of exotic birds kept as companion and hobby animals. Therefore, the Norwegian Food Safety Authority commissioned the Norwegian Scientific Committee for Food and Environment (VKM) to assess the welfare needs, challenges, and mitigation measures for 27 parrots and toucans from the genera *Amazona, Anodorhynchus, Ara, Cacatua, Eclectus, Eolophus, Nymphicus, Platycercus, Primolius, Psephotus, Psittacula, Psittacus, Pteroglossus, Pyrrhura, Ramphastos*, and *Trichoglossus* (Appendix I). The assessment was requested to cover the optimal living conditions, feeding, activities, supervision, care, and other welfare-relevant factors.

Methods

VKM appointed a working group of experts in animal welfare, behaviour, environmental enrichment, veterinary medicine, and cognition. A literature search was conducted, supplemented by other relevant articles and reports.

The risk assessment followed the EFSA template for risk assessment for animal welfare including exposure assessment, consequence characterisation, and risk characterisation. VKM also identified welfare needs and different risk mitigating measures.

Key findings

VKM has identified several challenges to the welfare of exotic birds kept as companion and hobby animals. The welfare challenges concern nutrition, housing and physical environment, health, cognition, and behaviour.

Nutrition: Malnutrition is a serious welfare challenge to birds in captivity and can lead to obesity, atherosclerosis (narrowing of the arteries), and fatty liver. Feeding mainly seed-based diets will lead to excessive amounts of calories and deficiencies in several essential nutrients. Hence, VKM assesses that a formulated diet supplemented with fruits and vegetables best meets the birds' dietary needs. While they need a balanced diet, they also need opportunities for the development and use of foraging-related skills.

Housing: Inadequate housing will result in poor welfare. Parrots and toucans fly several kilometres during the day in the wild. They need an environment with sufficient vertical and horizontal space with several tens of meters to accommodate their need to fly. To keep the birds in a cage or indoors without the possibility of proper flight will be detrimental to the welfare of all species. Housing in spacious aviaries may partly meet the birds' behavioural needs but free, unrestricted flight is necessary to allow for a full range of flying behaviour.

UV light exposure is fundamental for birds' welfare, and they need full-spectrum daylight. At the same time, the birds need shaded areas where they can avoid direct sunlight, facilitating thermoregulation. Weather protection and gradual acclimation to changes in temperatures are necessary to ensure the birds' welfare.

Management: Caretaker knowledge and skill profoundly impact the birds' welfare and health. Positive handling and training methods will improve the caretaker-bird relationship and is essential for the birds' behavioural and cognitive development. In case of disease or injury, expedient contact with a veterinarian is essential.

Hand-rearing is sometimes practiced socialising the birds to humans. VKM concludes that hand-rearing poses a high risk of poor welfare as it deprives the birds of parental contact and the development of normal, species-specific behaviour, including social skills. This will lead to abnormal behaviours.

Feather clipping reduces the risk of escape but hinders movement and impairs balance and natural flying. VKM concludes that feather clipping carries a high risk of poor welfare.

Enrichment: Parrots and toucans need substantial cognitive and social stimulation. All species in this report are highly social and spend most of their life in flocks in the wild. Keeping them alone is a very strong deprivation leading to chronic stress and lifelong negative effects. VKM concludes that there is a high risk of poor welfare in birds that are kept without conspecifics. Housing all species in appropriately composed flocks (multiple pairs) in spacious aviaries is vital for their welfare in captivity.

Deficiencies in the physical environment can lead to boredom and chronic stress and have been associated with stereotypies, feather damaging behaviour, low physical activity, and altered preening. A high variety and frequent refreshment of enrichment objects and materials are crucial. This will motivate exploration, play, and problem-solving, and contribute to continued cognitive development. A variety of perches of different sizes and in different heights is fundamental for welfare. Baths or showers, tailored to the birds' water-bathing behaviour in the wild, are also important environmental enrichments.

Reproduction: During breeding, aggression due to territorial behaviour (especially in cockatoos and toucans) and mate trauma are welfare challenges. A temporary separation of pairs might be necessary to reduce territorial behaviour. Regarding mate trauma, careful observation of the pair is essential, so that the male and female can be separated if problems arise. Provision of nest boxes appropriate for the species is necessary to fulfil the birds' behavioural needs.

Health: Good health is a prerequisite for good welfare. Inadequate nutrition and unhygienic conditions increase the risk of gastrointestinal diseases. High amount of airborne dust and low humidity increase the risk of respiratory diseases. Ensuring a clean environment is essential, together with frequent change of water and cleaning of water containers. Parrots and toucans use their beak for multiple tasks including feeding, defence, courtship, and preening. Thus, beak disorders can have a major impact on the welfare of the birds.

Conclusion

VKMs assessment shows that the welfare needs of all 27 species are challenging to meet when kept as companion and hobby animals. In addition, seven species are at particularly high risk for poor welfare in captivity, and the suitability of the white cockatoo (*Cacatua alba*), sulphur-crested cockatoo (*Cacatua galerita*), galah (*Eolophus roseicapilla*), Moluccan eclectus (*Eclectus roratus*), chestnut-eared aracari (*Pteroglossus castanotis*), toco toucan (*Ramphastos toco*), and white-throated toucan (*Ramphastos tucanus*) as companion and hobby animals is therefore questionable. Furthermore, due to lack of studies, VKM cannot conclude whether the green-

cheeked parakeet (*Pyrrhura molinae*), ochre-marked parakeet (*P. cruentata*), and eastern rosella (*Platycercus eximius*) are suitable as companion and hobby animals.

Data gaps and uncertainties

There is a general lack of scientific documentation on how to ensure positive animal welfare for parrots and toucans. Some species are little studied in captivity, such as toucans, *Pyrrhura* spp., and *Platycercus* spp. For many species, there is also a paucity of literature describing their lives in the wild.

Sammendrag på norsk

Bakgrunn

I Norge holdes mange arter av eksotiske fugler som selskaps- og hobbydyr. Etter dyrevelferdsloven kan dyr kun holdes hvis de kan tilpasse seg miljøet på en dyrevelferdsmessig forsvarlig måte. Forskriften som regulerer hold av eksotiske dyr som selskaps- og hobbydyr inkluderer ikke fugler. Stortingsmeldingen om dyrevelferd (2024-2025) fremhevet at det er begrenset kunnskap om velferden til eksotiske fugler i fangenskap. Mattilsynet har derfor bedt Vitenskapskomiteen for mat og miljø (VKM) om å vurdere velferdsbehov, utfordringer og risikoreduserende tiltak for 27 papegøyer og tukaner fra slektene *Amazona, Anodorhynchus, Ara, Cacatua, Eclectus, Eolophus, Nymphicus, Platycercus, Primolius, Psephotus, Psittacula, Psittacus, Pteroglossus, Pyrrhura, Ramphastos* og *Trichoglossus* (Appendix I). Vurderingen ble bedt om å dekke optimalt levemiljø, ernæring, aktivisering, tilsyn, stell, og andre forhold som påvirker fuglenes velferd.

Metoder

VKM oppnevnte en arbeidsgruppe med eksperter innen dyrevelferd, dyreatferd, miljøberikelse, veterinærmedisin og kognisjon. Det ble gjennomført et litteratursøk, supplert med andre relevante artikler og rapporter.

Risikovurderingen fulgte EFSAs risikovurderingsmal for dyrevelferd, inkludert eksponeringsvurdering, konsekvenskarakterisering og risikokarakterisering. VKM sammenfattet også artenes velferdsbehov, og beskrev ulike risikoreduserende tiltak.

Hovedfunn

VKM har identifisert flere utfordringer for god dyrevelferd hos eksotiske fugler i som holdes som selskaps- og hobbydyr. Velferdsutfordringene er relatert til ernæring, oppstalling og fysisk miljø, helse, kognisjon og atferd.

Ernæring: Feilernæring er en alvorlig helseutfordring for fugler i privat eie og kan føre til fedme, aterosklerose (innsnevring av blodårer) og fettlever. Ensidig fôring med frø vil gi for mye kalorier og mangel på flere essensielle næringsstoffer. VKM vurderer derfor at en balansert diett av pellets, supplert med frukt og grønnsaker, er best egnet til å dekke fuglenes ernæringsbehov. Selv om de trenger en balansert diett, har de også behov for utvikling og bruk av matletingsrelaterte ferdigheter.

Oppstalling: Utilstrekkelige oppstallingsforhold gir dårlig velferd. Papegøyer og tukaner flyr flere kilometer om dagen når de lever i det fri. De trenger et miljø på flere titalls meter i lengde som gir tilstrekkelig vertikal og horisontal plass til å oppfylle flyvebehovet. Å holde fuglene i et bur eller innendørs, uten mulighet for å utøve naturlig flyveatferd, utgjør en høy risiko for dårlig velferd for alle artene. Oppstalling i romslig voliere (stor innhengning) kan dekke deler av fuglenes atferdsbehov, men de må ha mulighet for fri flyving for å oppfylle naturlig flyveatferd.

Eksponering for UV-lys er grunnleggende for fuglers velferd, og de trenger dagslys med fullt spekter. Samtidig trenger fuglene skyggefulle områder hvor de kan unngå direkte sollys. Dette letter temperaturreguleringen i varmt vær. Beskyttelse mot vær og gradvis tilpasning til temperaturendringer er nødvendig for å sikre fuglenes velferd.

Eiers ansvar: Kunnskapen og ferdighetene til den som har ansvaret for papegøyer og tukaner er avgjørende for fuglenes velferd og helse. Positive håndterings- og trenings metoder vil styrke forholdet mellom fugl og eier, og er essensielt for fuglenes atferdsmessige og kognitive utvikling. Ved sykdom eller skade er det viktig med rask oppfølging fra veterinær.

Håndoppfostring av fugleunger gjøres for å sosialisere fuglene til mennesker. VKM konkluderer med at håndoppfostring medfører en høy risiko for dårlig velferd, fordi det fratar fuglene kontakt med foreldrene og muligheten til å utvikle normal, artsspesifikk atferd, inkludert sosiale ferdigheter. Dette vil føre til unormal atferd.

Klipping av flyvefjær reduserer risikoen for rømming, men hindrer normal bevegelse og forstyrrer balanse og naturlig flyveatferd. VKM konkluderer med at fjærklipping gir en høy risiko for dårlig velferd

Berikelse: Papegøyer og tukaner trenger betydelig kognitiv og sosial stimulering. Alle arter i denne rapporten er svært sosiale og tilbringer mesteparten av livet i flokker i naturen. Å holde fugler alene fører til kronisk stress og livslange negative effekter. VKM konkluderer med at det er høy risiko for dårlig velferd for en fugl som holdes uten artsfrender. Oppstalling i riktig sammensatte flokker (flere par) i store volierer er svært viktig for deres velferd i privat hold.

Et lite stimulerende fysisk miljø kan føre til kjedsomhet og kronisk stress, og har vært assosiert med stereotypier, fjærplukking, redusert fysisk aktivitet og endret fjærstell. Hyppig bytte og stor variasjon i miljøberikelende gjenstander og materiale er essensielt. Det vil motivere til utforskning, lek og problemløsning, og dermed bidra til kognitiv utvikling. Flere sittepinner av ulike størrelser og i ulike høyder er grunnleggende for velferden. Vann, som bad eller dusj tilpasset fuglenes naturlige atferdsbehov, er også viktige miljøberikelser.

Reproduksjon: I hekkesesongen kan aggresjon på grunn av territoriell atferd (spesielt hos kakaduer og tukaner) og skader fra partner gi velferdsutfordringer. En midlertidig separasjon i enkelt-par kan være nødvendig for å redusere territorial atferd. Når det gjelder skader fra partner, er det viktig med tett oppfølging slik at hunnen og hannen kan skilles fra hverandre hvis det oppstår problemer. Tilgang på redekasser tilpasset arten er nødvendig for å tilfredsstille fuglenes atferdsbehov.

Helse: God helse er en forutsetning for god dyrevelferd. Mangelfull diett, dårlig renhold og generelt uhygieniske forhold øker risikoen for mage- og tarmsykdommer. Mye støv og lav luftfuktighet øker risikoen for luftveissykdommer. Å sikre et rent miljø, sammen med hyppig skifte av vann og rengjøring av vannbeholdere, er essensielt. Papegøyer og tukaner bruker nebbet til flere oppgaver, som fôring, forsvar, kurtise og fjærstell, og nebbsykdommer kan derfor ha stor innvirkning på fuglenes velferd.

Konklusjon

VKMs vurdering viser at det er utfordrende å møte velferdsbehovene til alle 27 artene når de holdes som selskaps- og hobbydyr. I tillegg har syv av artene spesielt høy risiko for dårlig velferd i privat eie, og det er derfor tvilsomt om hvittoppkakadue (*Cacatua alba*), gultoppkakadue (*Cacatua galerita*), rosenkakadue (*Eolophus roseicapilla*), edelpapegøye (*Eclectus roratus*), brunkinntukan (*Pteroglossus castanotis*), tocotukan (*Ramphastos toco*) og vinnebbtukan (*Ramphastos tucanus*) er egnet som selskaps- og hobbydyr. Videre er det mangel på studier for flere arter. VKM kan derfor ikke konkludere om praktrosella (*Platycercus*

eximius), grønnkinnparakitt (*Pyrrhura molinae*) og blåstrupeparakitt (*P. cruentata*) egner seg som selskaps- og hobbydyr.

Usikkerheter

Det er generelt mangel på vitenskapelig dokumentasjon om hva som sikrer positiv dyrevelferd for papegøyer og tukaner som holdes som selskaps- og hobbydyr. Noen fuglearter, som tukaner, *Pyrrhura* og *Platycercus,* er lite studert i privat hold. For mange arter er det også en mangel på studier som beskriver livet deres i naturen.

Abbreviations

BMR	Basal metabolic rate
BSAVA	British Small Animal Veterinary Association
EFSA	European Food Safety Authority
NFSA	Norwegian Food Safety Authority
NTL	Norske Tropefuglforeningers Landsforbund/The Norwegian Federation of Tropical Bird Societies
NZB	Norges Zoohandleres Bransjeforening/The Norwegian Pet Shop Association
PAW	Positive Animal Welfare
ToR	Terms of Reference
UV	Ultraviolet
VKM	Norwegian Scientific Committee for Food and Environment
WOAH	World Organisation for Animal Health

Glossary

Anhedonia	The lack of ability to experience pleasure from everyday activities and from activities or interactions that are typically considered pleasurable (Cambridge Dictionary, n.d.-a).
Allofeeding	A social behaviour where one bird feeds the other by regurgitation of food. This can be done in connection with courting or feeding of chicks by a parent (Spoon, 2006).
Allopreening	A social behaviour where one bird grooms or cleans the feathers of another (Bradshaw & Engebretson, 2013).
Disease	Any harmful deviation from the healthy structural or functional state of an organism, generally associated with certain signs and symptoms and differing in nature from physical injury (Burrows, 2026).
Environmental enrichment	Modifications to the environmental of captive animals that improve their biological functioning (Newberry, 1995) and promote positive animal welfare (Rault et al., 2025). These include structural, sensory, foraging, cognitive, and social stimuli that facilitate species-specific natural behaviour.
Extra-pair interactions	Interactions between one member of a mated pair with a conspecific of the opposite sex that is not the partner.
Feather damaging behaviour	Abnormal feather-directed plucking, chewing, or biting with the beak that results in feathers becoming frayed, torn, broken, or removed. The behaviour can be directed either to own feathers or to the feathers of other birds. The behaviour is also referred to as feather plucking or feather picking (van Zeeland et al., 2009).
Five Domains Model	A framework for animal welfare assessment. It consists of three domains essential to survival: nutrition, physical environment, health; one situational domain, social interactions; and a mental/affective state domain (Mellor, 2016; Mellor & Reid, 1994).
Five Freedoms	The Farm Animal Welfare Council's framework for assessment of welfare of livestock (FAWC, 1993). In brief, they are: (1) freedom from hunger, thirst and malnutrition, (2) freedom from thermal and physical discomfort, (3) freedom from pain, injury and disease, (4) freedom from fear and distress, (5) freedom to express normal behaviour.
Formulated diet	A commercial, pelleted food.
Frugivorous	Birds with a fruit-based diet.
Granivorous	Birds with a grain-based diet.
Hand-rearing	The practice of separating chicks from their parents for long periods of time, where they are fed and handled by human

	caretakers. In this report, we have focused on total separation of the chicks from the parents.
Moulting	The process of losing existing feathers and replacement with new ones.
Neophilic	Personality trait of being curious and attracted to novelty.
Nectarivorous	Birds with a nectar-based diet.
Pair fidelity	A socially monogamous breeding pair is considered to exhibit pair fidelity when the female repeatedly mates exclusively with her male partner (i.e. there is evidence that the pair is genetically monogamous) (Eastwood et al., 2018).
Positive Animal Welfare	'The animal flourishing through the experience of predominantly positive mental states and the development of competence and resilience. Positive Animal Welfare (PAW) goes beyond ensuring good physical health and the prevention and alleviation of suffering. It encompasses animals experiencing positive mental states resulting from rewarding experiences, including having choices and opportunities to actively pursue goals and achieve desired outcomes' (Rault et al., 2025, p. 1).
Preening	A maintenance behaviour of arranging or cleaning the feathers by use of the beak (Cambridge Dictionary, n.d.-b).
Stereotypies	'Repetitive, invariant behaviour patterns with no obvious goal or function' (Mason, 1991, p. 1015).
Toucans	In this report, toucans include all members of the Ramphastidae family, both genera *Pteroglossus* and *Ramphastos*.
Tripedal	Moves with the use of three appendages (i.e. both feet and the beak), as seen during climbing in some species.
'True parrots'	All members of the superfamily Psittacoidea; Psittacidae and Psittaculidae.

Background as provided by the Norwegian Food Safety Authority

The Animal Welfare Act applies to all keeping of animals and includes provisions on the competence of animal keepers, living environment, supervision, and care (Animal Welfare Act, 2009). The law also states that animals can only be kept if they can adapt to the method of keeping in a satisfactory way with regard to animal welfare (§ 22). The keeping of exotic animals is regulated in a specific regulation that prohibits most species, but this regulation currently does not include birds. The regulation on import, export, possession, etc., of endangered species of wild fauna and flora (CITES Regulation), managed by the Norwegian Environment Agency, regulates legal species based on the consideration of nature conservation (endangered species).

In Norway, many species of exotic birds are kept as companion and hobby animals. In a report to the Storting (white paper) no. 8 (2024-2025) about animal welfare, it is estimated that approximately 400 tropical bird species are kept. The report highlights there is limited knowledge about the welfare of birds kept as companion and hobby animals in Norway, including their suitability as pets, space requirements, and social needs, and that some of the species must be regarded as challenging to keep.

The Storting agreed to regulate the keeping of large exotic birds based on animal welfare considerations, which was one of the proposed measures in this report. The Ministry of Agriculture and Food has assigned the Norwegian Food Safety Authority to examine which bird species should be covered by a potential regulation, and which issues are of utmost importance to regulate, such as living environment, breeding, feeding, social needs, and activation.

Terms of reference as provided by the Norwegian Food Safety Authority

The Norwegian Food Safety Authority requests an overview of available knowledge (research and other relevant knowledge) concerning:

1. Welfare-related needs of species of exotic birds kept as companion and hobby animals in Norway.
    a. By welfare-related needs, we mean physical, physiological, behavioural, social, and cognitive needs, as well as other needs that affect the welfare of the birds.
    b. Initially, the assignment is limited to the largest species of parrots kept privately in Norway, but some medium-sized parrot species and other exotic bird species are also included. The bird species included in the assignment are listed in the Appendix.
    c. By keeping, we mean all private keeping of such birds for companion or hobby purposes, including breeding and any activities the birds are used for or subjected to.
2. An assessment of the risk of reduced welfare for these birds when kept as companion and hobby animals.
3. A description of relevant mitigation measures (how the bird species included in the assignment should be kept to ensure good welfare). This includes a description of an optimal living environment, feeding, activation, supervision, and care, as well as other conditions that affect the welfare of these birds.

The Norwegian Food Safety Authority will use the VKM report as a basis for the recommendations to the Ministry of Agriculture and Food about the need for regulatory measures on this type of bird keeping and the scope of such regulations.

1 Introduction

This risk assessment and knowledge synthesis concerning exotic birds kept in private care includes 27 species-specified by the Norwegian Food Safety Authority (NFSA). These species belong to the orders Piciformes and Psittaciformes. The species list can be found in Appendix I. Within the order Piciformes are the toucans (family Ramphastidae, three species), while the remaining 24 species are found within the Psittaciformes, hereafter referred to as parrots. Table 1 shows the taxonomy of the species. When describing species-specific features and facts, we place the birds in systematic order corresponding to this table.

Table 1. Taxonomy of the species included in the report.

Class	Order	Family	Genus	Species
AVES	Piciformes	Ramphastidae	*Pteroglossus*	*P. castanotis*
			Ramphastos	*R. toco*
				R. tucanus
	Psittaciformes	Cacatuidae	*Cacatua*	*C. alba*
				C. galerita
				C. leadbeteri
			Eolophus	*E. roseicapilla*
			Nymphicus	*N. hollandicus*
		Psittacidae	*Amazona*	*A. aestiva*
				A. amazonica
				A. oratrix
			Anodorhynchus	*A. hyacinthinus*
			Ara	*A. ararauna*
				A. chloropterus
				A. macao
				A. militaris
				A. severus
			Primolius	*P. maracana*
			Psittacus	*P. erithacus*
			Pyrrhura	*P. cruentata*

				P. molina
		Psittaculidae	*Eclectus*	*E. roratus*
			Platycercus	*P. eximius*
			Psephotus	*P. heamatonotus*
			Psittacula	*P. krameri*
			*Trichoglossus**	*T. haematodus*
				T. ornatus

Data from Ostrow et al. (2023) and Smith et al. (2024).
*Trichoglossus is sometimes placed in the family Loriinae rather than Psittaculidae. Others consider Loriinae a subfamily of Psittaculidae. We have followed Billerman et al. (2020) and placed it in family Psittaculidae.

1.1 Animal welfare in exotic birds kept in captivity

The structure of this report and of the risk assessment of animal welfare challenges for exotic birds kept in captivity are based on several animal welfare definitions. The different welfare needs, challenges, and mitigating measures have been evaluated in light of the definitions below.

Animal welfare has been defined by The Research Council of Norway as 'The animal's subjective experience of its mental and physical state with regards to its attempts at coping with its environment' (Norges Forskningsråd, 2005, p. 4). Environment is defined here by the conditions in which the animal lives and dies. In line with the Five Domains Model, World Organisation for Animal Health (WOAH) defines good animal welfare as a healthy, comfortable, well-nourished, and safe animal without suffering from pain, fear, and distress (WOAH, 2016). The animal should not only be able to express normal behaviour, but it should also have positive animal welfare, defined as flourishing through the experience of predominantly positive mental states and the development of competence and resilience (Rault et al., 2025).

In this report, the principles in the Five Freedoms and Five Domains Model of animal welfare are combined with the animals' subjective experience, as highlighted by Broom (1986), Norges Forskningsråd (2005), and Rault et al. (2025). The aim is to focus on basic needs such as appropriate nutrition, health care, and shelter, while also placing weight on ensuring meaningful lives for exotic birds kept in captivity so that positive experiences outweigh negative experiences. The welfare description used in this report is reflected in the structure of the assessment questions, where nutrition, the physical environment, behavioural needs, health concerns, and cognitive needs are all included. The evaluation of exotic bird welfare rests on the premise that birds are sentient beings, they have a subjective experience of their lives, and this should be of ethical concern to us (Birch, 2024). Thus, when their needs for food, water, shelter, companions, flying, and cognitive stimulation are met, their affective state and perceived quality of life will be good. Exposure to brief, controllable stress can also be positive by increasing resilience. However, chronic stress which the birds cannot control, or deprivation of behavioural needs, will lead to poor welfare. Under section 3.5, the concept of behavioural

needs, their importance for animal welfare, and link with subjective state are described in more depth.

Parrots and toucans are long-lived species, and this adds a dimension to the concerns about their welfare: They can potentially suffer for as long as a human lifetime, and they may also outlive their owners so that special considerations and planning is needed to ensure that they are cared for their whole lives. Parrots and toucans differ from companion animals such as cats and dogs in that they are not domesticated (Baldrey & Rogerson, 2024; Meehan & Mench, 2006). Their behaviours and needs are thus very similar to what is seen in the wild. For example, complex social interactions, long flights between resting and feeding grounds, and several hours of foraging behaviour make up the daily life of wild parrots (Billerman et al., 2020; Meehan & Mench, 2006). In captivity, these opportunities are restricted to a smaller or larger degree.

Parrots can develop problem behaviours such as feather damaging behaviour, excessive fearfulness, and stereotypies when their needs are not met (Gaskins & Bergman, 2011; Meehan & Mench, 2006; Stelow, 2021; Wilson, 2022a). The caretakers' understanding of the natural behaviour of parrots is therefore essential for ensuring their welfare. As outlined by Meehan and Mench (2006), the elements of their natural life in the wild that are necessary for their welfare must be identified. Then those elements must be introduced into the captive environment in the form of environmental enrichment, sufficient space for all behavioural needs, social partners, and welfare-friendly husbandry. In the following, key elements of biology, physiology, and behaviour in exotic birds that have a bearing on their welfare needs and challenges when kept in captivity, are summarised.

1.2 Biology, physiology, and behaviour in exotic birds

1.2.1 Biology

Parrots (order Psittaciformes, Table 1) are an evolutionarily young branch of the bird family tree and most closely related to songbirds (Passeriformes). There are approximately 400 parrot species, which primarily originate from tropical and subtropical regions around the globe. They range in size from twelve grams to more than three kilos (Billerman et al., 2020). Parrots are highly social and are typically found in flocks or pairs.

The family Ramphastidae (order Piciformes) includes five genera encompassing 43 species. Among these are the toucans, aracaris, and toucanets, all of which live in the tropics and subtropics of the Americas (Powers, 2014). The behaviour of wild toucans is insufficiently researched, but they are social, exhibit extensive vocal communication, and are highly inquisitive (Billerman et al., 2020; Hernández & Barja, 2024).

1.2.2 Anatomy

Flying is a very complex way of moving, involving highly specialised functions. The birds' anatomy and physiology are adapted to flying. Their skeleton is light with hollow (pneumatised) bones, and their pectoral muscles are very strong (Harcourt-Brown & Chitty, 2005). Fine manoeuvring, such as hovering in the air, also requires the coordinated action of muscles beside the pectorals. The parrot wing is anatomically specialised not only for horizontal but in some species also for vertical flight, probably reflecting their adaptation to

living in tropical forests (Beaufrère, 2009; Harcourt-Brown, 2009). The wings are shaped as aerofoils (i.e. curved on top and flatter underneath) so that air moves faster over the top, creating lower pressure, and thus lifting the bird upward. Likewise, the respiratory system and brain are adapted to flying. The gaseous exchange in birds is more efficient than that of mammals. Air enters the lung from the primary bronchus and then moves into the air sacs. Gaseous exchange happens both during inspiration and expiration. The blood flow through the lungs is constant for the whole respiratory cycle (Harcourt-Brown & Chitty, 2005). Some of the air sacs connect with vertebrae and the humerus. Furthermore, birds do not have sweat glands but rid themselves of excess heat through the respiratory tract and feet, especially when flying (Harcourt-Brown & Chitty, 2005).

The avian heart is larger relative to body size compared to the mammalian heart, and cardiac output is higher (Harcourt-Brown & Chitty, 2005).

The digestive tract of parrots consists of the beak, tongue, oropharynx, oesophagus, crop, proventriculus, gizzard, intestine, rectum, cloaca, and vent. Species with a large proportion of grains in their natural diet have a larger crop and more muscular gizzard than species relying more on nectar (Koutsos et al., 2001a). The ceca of parrots are small or non-existent, and there is little hindgut fermentation of poorly digestible carbohydrates (Koutsos et al., 2001a). Ramphastidae have a relatively short gastrointestinal tract, and they lack a crop and cecum. Their faeces are voluminous, smelly, and moist, often with small amounts of undigested food (Powers, 2014).

Psittacines have a short and thick beak (Fecchio, 2021). In contrast, the beak of toucans is long and thick and constitutes one third of the bird's length (Powers, 2014). Birds use their beak for multiple tasks including feeding, defence, courtship, and preening. The beak of toucans also has an important role in thermoregulation (i.e. as a thermal radiator to get rid of excessive heat) (Powers, 2014; Tattersall et al., 2017). Their beak has teeth-like serrations, making it good for taking hold of food items, and the tongue is long (Billerman et al., 2020). Furthermore, their beak is very light and only weighs 1/20 of the bodyweight (Billerman et al., 2020). The bite force of toucans has been measured at 270 N (Fecchio, 2021).

Parrots and toucans have zygodactyl toes with the outer toes (toe 1 and 4) pointing backward and the inner toes (toes 2 and 3) pointing forwards (Mikich et al., 2001).

1.2.3 Habitat

The majority of parrot species, as well as toucans, are forest dwelling birds in subtropical and tropical climate zones (Juniper & Parr, 2010). Some species also live in temperate zones. Cockatoos, particularly, frequently inhabit more open and arid habitats. According to Jackson et al. (2015), some generalist parrot species can handle a wide range of temperatures and have therefore become successful invasive species in regions without natural parrot populations (e.g. *Psittacula krameria*).

1.2.4 Nutrition

The diversity of the diet of parrots in the wild has been recognised for a long time (Kollias & Kollias, 1995; Ullrey et al., 1991). Most parrots eat plant material, for example (but not limited to) seeds, fruits, flowers, and buds (Table 2). Some species incorporate animal protein in their diet by eating adult arthropods and their larvae (Billerman et al., 2020). Within the species

included in this report, there are also nectar-and pollen-foragers in the genus *Trichoglossus*. Water is the most essential nutrient, and the need varies with temperature, species, diet and age (Harcourt-Brown & Chitty, 2005).

Forest dwelling species almost exclusively forage in trees, while species in open habitats also forage on the ground. Parrots may ingest clay to offset toxic effects of plant alkaloids in unripe fruit. The clay also acts as a source of minerals (Ferdinand et al., 2023; Forshaw, 2010).

Toucans will eat animal protein both by ingesting arthropods, but also eggs and small vertebrates such as bird nestlings, in addition to foraging on plant material (Mikich et al., 2001). Psittacines are sometimes classified as granivores (grain-eaters, including *Nymphicus hollandicus*), frugivores (fruit-eaters, including macaws), nectarivores (nectar-feeders, including lories) and omnivores (e.g. cockatoos) (Koutsos et al., 2001a). However, as the birds also consume other foodstuffs, these categories must not be interpreted too strictly.

Table 2. Habitat, size, diet, and lifespan of the species included in the assessment.

Genus	Example species	Habitat	Continent	Body length (in cm)	Diet	Maximum measured lifespan in captivity (in years)*
Amazona	*A. aestiva*	forest, savannah, woodland	South America	37	flowers, fruits, seeds	49
	A. amazonica	forest, savannah, woodland	South America	31-32	N.A.	30
	A. oratrix	forest, savannah, woodland	Central America	35-38	buds, fruits, leaves, seeds	41.5
Anodorhynchus	*A. hyacinthinus*	forest, savannah, woodland	South America	100	fruits, nuts, snails	38.8
Ara	*A. ararauna*	forest, savannah	South America	81-86	flowers, fruits, leaves, nuts, seeds	43
	A. chloropterus	forest, savannah, woodland	South America	90-95	fruits, leaves, seeds	50
	A. macao	forest, savannah, woodland	Central and South America	84-89	flowers, fruits, insects, leaves, seeds	33
	A. militaris	forest, woodland	Mexico, South America	70-71	fruits, leaves, seeds	46

	A. severus	forest, swamp, woodland	South America	46-51	flowers, fruits, leaves, seeds	28.5
Cacatua	*C. alba*	forest	Indonesia	46	fruits, insects?, seeds	26.9
	C. galerita	forest, woodland	Oceania/ Australasia	45-55	buds, fruits, seeds	57
	C. leadbeteri	shrubland, woodland	Australia	33-40	fruits, grains, insects, larvae, seeds	77
Eclectus	*E. roratus*	forest, savannah, scrubland	Indonesia	35-42	buds, flowers, fruits, leaves, nectar, nuts, seeds	28.5
Eolophus	*E. roseicapilla*	grassland, woodland	Australia	35-36	grains, seeds	40
Nymphicus	*N. hollandicus*	savannah, woodland	Australia	29-33	Seeds	20+
Platycercus	*P. eximius*	forest, savannah, woodland,	Oceania/ Australasia	30	berries, flowers, grains, insects, leaves, seeds	27.4
Primolius	*P. maracana*	forest, woodland	South America	36-43	flowers, fruits	30-50
Psephotus	*P. haematonotus*	mangroves, savannah, woodland	Australia	27	flowers, grasses, plants, seeds	12.2
Psittacula	*P. krameri*	forest, jungle, savannah, woodland	Africa, Asia	37-43	flowers, fruits, nectar, nuts, seeds	34
Psittacus	*P. erithacus*	forest, savannah, woodland	Central Africa	28-39	buds, flowers, fruits, nuts, seeds	49.7
Pteroglossus	*P. castanotis*	forest, woodland	South America	43-47	eggs, flowers, fruits, invertebrates, nectar, nestlings	17
Pyrrhura	*P. cruentata*	forest	South America	30	fruits, insects, larvae, nectar, seeds	20.4

	P. molinae	forest, woodland	South America	26	fruits, insects, larvae, nectar, seeds	8.34
Ramphastos	*R. toco*	forest, savannah, woodland	South America	56	eggs, fruits, insects, nestlings	N.A.
	R. tucanus	forest	South America	53-58	eggs, birds, flowers, fruits, insects	N.A.
Trichoglossus	*T. heamatodus*	forest, savannah, woodland	Australasia	25-30	flowers, nectar, pollen, seeds	16.1
	T. ornatus	forest, woodland	Indonesia	25	flowers, pollen, seeds	19.4

N.A. Not Available
Data from Billerman et al. (2020), *Kinkaid (2015)

1.2.5 Locomotion

All parrot and toucan species included in this assessment stay within relatively consistent home ranges and can fly considerable distances (multiple kilometres) during the day (Meehan & Mench, 2006). Parrots and toucans do not only fly horizontally but also vertically (Razmadze et al., 2018). Forest dwelling birds need to move to different heights to find food, access nesting cavities, and to quickly seek the shelter of trees when threatened by predators during flight above the tree canopy or foraging on the ground. Parrots typically cruise above the tree canopy when moving between roosting grounds and feeding grounds (Gilardi & Munn, 1998; Symes & Marsden, 2007). They have flight speeds in the range of 30-40 km/h, e.g. *N. hollandicus* 35 km/h (Bundle et al., 2007) and macaws 40 km/h (Brightsmith et al., 2021). In general, parrots exhibit a bimodal activity budget, with a large morning peak, a smaller afternoon peak, and roosting at night (Gilardi & Munn, 1998; Symes & Marsden, 2007). Forest species often have smaller home ranges than birds inhabiting open areas, yet they still cover considerable distances every day to find food (e.g. in trees currently bearing ripe fruit). For instance, non-migratory *Psittacus erithacus* may cover 30 km in one day (Harcourt-Brown & Chitty, 2005).

Tracking studies indicate that the pattern of movement for parrots over the course of a year is complex with some being residents (staying in one home area) and others being partially migratory or fully migratory, and that this pattern varies within populations and on the individual level throughout life (Brightsmith et al., 2021). This variation occurs more frequently in species inhabiting subtropical and temperate areas, as well as in those with wide geographic distribution. Depending on the availability of resources, some parrots may alter their home range seasonally throughout the year (Curiel, 2006). This can, for example, be seen in certain *Psittacula* species, which come down from the mountains during the colder parts of the year (Juniper & Parr, 2010). The habits of toucans are less well described, but *Ramphastos toco* has been reported to move among habitats seasonally in search of ripe fruit (Ragusa-Netto, 2006).

1.2.6 Social structure

Parrots are obligatory social birds, with perhaps the only true exception being the kākāpō (*Strigops habroptilus*). Most adult parrots form pair bonds with their reproductive partner for life, feeding and roosting together throughout the year (Harcourt-Brown & Chitty, 2005). Several pairs form groups and in some species large flocks (Billerman et al., 2020). Many parrot species roost with their larger group, and the time just before roosting is marked with high levels of activity, flying, and vocal communication within the group (Juniper & Parr, 2010). In general, parrots coordinate group cohesion, recruitment to feeding grounds, and sentinel behaviours via vocalisations. Family groups stay together for one breeding season, and juvenile birds fly with and learn from older individuals. Toucans live in small groups or in pairs (Mikich et al., 2001).

1.2.7 Cognition

Parrots are widely considered to be amongst the most cognitively complex birds, alongside corvids. Besides having relatively large brains, they also have high numbers of brain neurons for their body size (Olkowicz et al., 2016). The areas in which parrots excel are physical cognitive skills, such as foraging ingenuity, and social cognition. In addition to using tools, parrots also manufacture them (Auersperg et al., 2016). They are excellent destructive foragers and show insight into the physical characteristics of the objects they manipulate (Laumer et al., 2017). They have a concept of numbers (Pepperberg & Carey, 2012). Parrots are excellent vocal mimics and open-ended vocal learners (i.e. they can learn to produce novel vocalisations throughout life), and some species are famed for their ability to imitate human speech. They can learn new vocal signals, and produce them, to denominate novel objects (Pepperberg, 2010). This ability most probably relates to their complex social environment that requires the maintenance of social bonds of differing quality (e.g. pair partners versus other flock members). For instance, in some species, parrots appear to copy the individual contact calls of other flock members to address each other (Balsby et al., 2012). This is typically most pronounced in fission-fusion societies (i.e. flexible social systems where group size and composition change frequently), as parrots in such flocks are confronted with more diverse inter-individual relationships and ever-changing subgroup compositions (Balsby et al., 2012). It is hence not surprising that *Psittacula* spp., which are considered the best vocal mimics among parrots, live in such fission-fusion societies and have a higher tendency to show prosocial behaviours compared with macaws, which do not live in such social systems (Brucks & von Bayern, 2020).

P. erithacus is also often colloquially referred to as the ‘most intelligent parrot’. However, the scaling relationships of brain neuron numbers compared with brain and body size is rather consistent across psittaciformes. For example, *Ara ararauna* has almost exactly double the body mass, brain mass, and number of whole brain and telencephalic neurons compared to *P. erithacus* (Olkowicz et al., 2016). Hence, there is no neurological indication that *P. erithacus* parrots are overall of higher cognitive complexity than other similarly sized species, although they are confronted with highly complex social environments. Overall, parrot species with relatively large brains are more likely to exhibit stereotypic behaviours in captivity, which strongly suggests that larger parrot species are exceedingly challenging to cognitively stimulate at an appropriate level in human care (Mellor et al., 2021).

The cognition of toucans is critically understudied. They are very social birds, displaying extensive play behaviours and allopreening, e.g. observed in *R. tucanus* (Billerman et al., 2020). There are also findings suggesting that toucans are neophilic (Hernández & Barja, 2024) and that environmental enrichment (e.g. requiring the development of complex skills to access food), can drastically increase captive wellbeing (Alaniz et al., 2022). Hence, similarly to parrots, toucans appear to have the capacity for advanced physical and socio-cognitive skills.

1.2.8 Reproduction

A vast majority of Psittaciformes (78%) are either facultative or obligate nesters in tree cavities (Renton et al., 2015). They use wood shavings, leaves, and even pebbles as nesting substrate (Billerman et al., 2020). The pair usually maintains and renovates the nest together, and the female then lays the eggs. The clutches are relatively small, rarely exceeding five eggs (Table 3).

Courtship includes allopreening and allofeeding (Wilson, 2006). During the incubation period, one pair partner incubates the eggs, the other forages and provides for the one sitting in the nest. In most 'true parrots', only the female incubates the clutch, while in cockatoos the roles are more often flexibly switched. The incubation period takes around three weeks to a month, and after hatching both parents eventually forage to feed the offspring. The young fledge after a little over a month in smaller species or up to three months in larger ones (Table 3). Out of the nest, the parents provide for their young for several more months (Billerman et al., 2020). *Amazona amazonica* has been observed to communicate using gestures during the most vulnerable time of their nestlings' development, probably to avoid alerting predators (Moura et al., 2014).

Table 3. Reproductive parameters of the species included in the assessment.

Genus	Example species	Clutch size	Incubation period (in days)	Nestling period (in days)
Amazona	*A. aestiva*	1-5	23-25	58-60
	A. amazonica	2-5	21	60-62
	A. oratrix	2-3	28	57
Anodorhynchus	*A. hyacinthinus*	2-3	27-30	105-110
Ara	*A. ararauna*	1-3	N.A.	N.A.
	A. chloropterus	2-3	N.A.	N.A.
	A. macao	1-4	24-28	97-140
	A. militaris	2-3	N.A.	N.A.
	A. severus	2	28	< 63
Cacatua	*C. alba*	2-3	27-28	98

	C. galerita	2-3	25-27	63-84
	C. leadbeteri	2-5	23-26	53-66
Eclectus	*E. roratus*	2	26	84
Eolophus	*E. roseicapilla*	2-6	22-26	45-59
Nymphicus	*N. hollandicus*	1-7	20	35
Platycercus	*P. eximius*	4-9	19	35
Primolius	*P. maracana*	3	26-27	70
Psephotus	*P. haematonotus*	4-8	19	28
Psittacula	*P. krameri*	3-7	22	49
Psittacus	*P. erithacus*	1-5	21-33	80-150
Pteroglossus	*P. castanotis*	2-4	N.A.	N.A.
Pyrrhura	*P. cruentata*	2-4	22-25	45
	P. molinae	3	22-24	49
Ramphastos	*R. toco*	2-4	17-18	43-52
	R. tucanus	2-3	15-16	48-49
Trichoglossus	*T. heamatodus*	1-3	25	49-56
	T. ornatus	2	27	80

N.A. Not available
Data from Billerman et al. (2020).

The following provides an overview of each of the families included in this report. VKM has aimed to include information on all the species requested by the NFSA, but where this information has not been available in the literature, information about other species in the same genus has been collected.

1.3 Cacatuidae

1.3.1 Cacatua

In this report, the genus *Cacatua* is represented by *C. alba* (white cockatoo/umbrella cockatoo), *C. galerita* (sulphur-crested cockatoo, four subspecies), and *C. leadbeateri* (pink cockatoo, two subspecies).

C. alba lives in pairs or small groups in the wild but can aggregate in larger flocks (Billerman et al., 2020; Juniper & Parr, 2010). *C. leadbeateri* travels in flocks outside of the breeding season (Juniper & Parr, 2010). *C. galerita* parrots are adaptable and may be highly territorial as a

breeding pair, defending large breeding territories very aggressively. This contrasts with their very sociable behaviour outside of the breeding season when they live in flocks of hundreds (Gilardi & Munn, 1998). Families remain bonded for several months after breeding season, while already flying in larger flocks (Billerman et al., 2020). Similarly, *C. leadbeateri* pairs are territorial during breeding season and sociable during the remainder of the year, joining vagrant flocks of hundreds (Juniper & Parr, 2010).

C. galerita cockatoos learn novel foraging skills quickly and readily from each other (Klump et al., 2021).

Every year during the breeding season, *C. leadbeateri* pairs leave their flocks, often returning to the same nesting hole and renovating it (Juniper & Parr, 2010). The nests of *C. galerita* are far apart from other cockatoo nests (Billerman et al., 2020).

1.3.2 Eolophus

Eolophus roseicapilla (galah, three subspecies) is a strong flyer. This species lives in flocks of up to 1000 conspecifics and often also flies in mixed flocks with other parrot species. Young birds leave their natal flock and roam in large nomadic flocks over areas as great as 1000 km^2 (Doneley, 2003).

E. roseicapilla travels over very large areas every day and roosts communally in tree patches (Billerman et al., 2020). These birds can spend up to 50% of the day foraging (Rozek et al., 2010).

E. roseicapilla forms lifelong bonded breeding pairs. Pairs nest within 10-80 meters of each other in tree patches (Doneley, 2003).

1.3.3 Nymphicus

In this report, the genus *Nymphicus* is represented by *N. hollandicus* (cockatiel), a smaller representative of the cockatoo family (Cacatuidae).

In the wild, *N. hollandicus* is a strong flyer (Juniper & Parr, 2010). Outside the breeding season, these birds appear to lack stable home ranges. They are nomadic and can travel in flocks of up to 1000 birds (Juniper & Parr, 2010). The flocks follow the availability of seeds and water, and they may cross the entire continent of Australia over the course of a year.

N. hollandicus forms pairs within the flock. While these pairs are often monogamous, this is not as strict as in other parrots and extensive extra-pair interactions are observed (Spoon et al., 2004).

1.4 Psittacidae

1.4.1 Amazona

The genus *Amazona* includes about 30 species of medium-sized, short-tailed parrots. In this report, the genus is represented by *A. aestiva* (turquoise-fronted amazon, two subspecies), *A. amazonica* (orange-winged amazon, two subspecies), and *A. oratrix* (yellow-headed amazon). *A. oratrix* has two major taxonomic groups, a monotypic island group and a polytypic

mainland group. They are also found in several feral populations far from their natural range (Billerman et al., 2020).

A. aestiva migrates in specific seasons (Billerman et al., 2020). In Argentina, a great majority of the Chao-nesting population of *A. aestiva* moves to the eastern foothills of the Andes from mid-March to mid-September (Billerman et al., 2020). There is a lack of information on migration for *A. amazonica* and *A. oratrix* (Billerman et al., 2020).

Amazona spp. tend to be highly social during their foraging and roosting activities, as observed in *A. aestiva*, *A. amazonica*, and *A. oratrix* (Enkerlin-Hoeflich et al., 2006).

Common for the amazons is that they build nests in holes in trees (Billerman et al., 2020). High pair fidelity has been described in *A. oratrix* across mating seasons (Enkerlin-Hoeflich, 1995). Furthermore, helpers at the nest have also been observed. A higher proportion of non-reproductive pairs is observed in *A. amazonica* compared to other *Amazona* spp., with approximately 40% of pairs laying eggs (Enkerlin-Hoeflich, 1995).

1.4.2 Anodorhynchus

In this report, the focus is on one species in the blue macaw genus, *Anodorhynchus hyacinthinus* (hyacinth macaw). This is the world's largest flying parrot species with a wingspan of up to 1 meter (Scherer-Neto et al., 2019).

A. hyacinthinus flies over large distances depending on seasonal availability of food plants in different areas, as these birds are dependent on specific palm species for food (Billerman et al., 2020).

A. hyacinthinus is highly social, living in pairs, families, and flocks that vary from 3 to 100 individuals (Scherer-Neto et al., 2019). They are monogamous, mating for life, and mated pairs spend most of their time together. Allopreening is common. Juveniles perform somersaults and dangle during play and gently peck at each other (Schneider et al., 2006). In contrast to other parrots that are diurnal, *A. hyacinthinus* may be active during bright moonlit nights (Juniper & Parr, 2010).

1.4.3 Ara

The genus *Ara* is represented in this report by *A. ararauna* (blue-and-yellow/blue-and-gold macaw), *A. chloropterus* (red-and-green/green-winged macaw), *A. macao* (scarlet macaw/red-and-yellow/red-and-blue/red-breasted macaw, two subspecies), *A. militaris* (military macaw, three subspecies), and *A. severus* (chestnut-fronted/severe macaw).

The home ranges of *A. ararauna* and *A. macao* differ throughout the season. During breeding season, they have relatively small home ranges, but during the non-breeding season, the macaws have been reported to fly as far as 160 km from their nests (Brightsmith et al., 2021). Myers and Vaughan (2004) describe the behaviour of *A. macao* following fledging at 72-79 days of age. The fledglings stayed within 1 km of their nest site for the first 12 days but broadened their range to 2-7 km^2 in weeks 5-7 post-fledging and more than 10 km^2 thereafter, with daily flight paths of more than 20 km and single flights of up to 15 km. *A. militaris* moves over large areas to forage during certain seasons, and inhabits a relatively diverse range of forest types, including both humid and dry environments (Billerman et al., 2020). There is a

lack of information on migration for *A. chloropterus*. There is an indication that *A. severus* is a seasonal wanderer (Billerman et al., 2020).

The diet of *A. macao* is predominantly seeds, as reported in Costa Rica where seeds accounted for 73% of their diet (Matuzak et al., 2008). *A. militaris* has a more varied diet but prefers foods that are rich in protein and lipids (Billerman et al., 2020).

Both *A. macao* and *A. chloropterus* fly in pairs or as part of family groups (Gilardi & Munn, 1998). Several pairs of *A. militaris* can nest in the same tree (VKM, 2020).

1.4.4 Primolius

This report focuses on one species in the mini-macaw genus, *Primolius maracana* (blue-winged macaw/Illiger's macaw).

P. maracana is non-migratory but may occasionally fly into transitional woodland areas (Billerman et al., 2020).

These macaws are usually found in pairs and flocks of up to 15 birds (Pichorim et al., 2014).

1.4.5 Psittacus

Psittacus erithacus (grey parrot/African grey parrot, two subspecies) mainly lives in Africa and can be confused with the smaller *P. timneh* (Timneh parrot).

P. erithacus can apparently restrict themselves to rather small areas under favourable conditions (Dranzoa et al., 2011). In a study from Cameroon, the estimated average home range of *P. erithacus* was 10.3 km^2 (Tamungang & Cheke, 2012).

Like most larger parrot species, *P. erithacus* forms monogamous pairs and lives in flocks of several pairs. However, their social cognition appears to be complex, as their flocks can consist of up to 1200 individuals when roosting at night (Gilardi & Munn, 1998). During the day, they fly in flocks of varying compositions and sizes (Fastré et al., 2024). They live in fission-fusion societies, in which they also form close bonds with non-pair partners. While detailed observations from the field are sparse, experimental evidence shows that *P. erithacus* displays substantially more prosocial behaviours (‘selfless’ acts) and reciprocity towards social partners than *Primolius couloni* (blue-headed macaws) (Brucks & von Bayern, 2020).

1.4.6 Pyrrhura

The genus *Pyrrhura* is represented in this report by *P. cruentata* (ochre-marked parakeet) and *P. molinae* (green-cheeked parakeet, six subspecies). There is limited literature on this genus.

Other *Pyrrhura* species have been reported to fly in flocks of up to 10 individuals (Gilardi & Munn, 1998). Some *Pyrrhura* conures roost together in small groups in tree hollows (Juniper & Parr, 2010).

1.5 Psittaculidae

1.5.1 Eclectus

The genus *Eclectus* is a complex of five species: *E. roratus* (Moluccan eclectus, two subspecies), Papuan eclectus *(E. polychloros*), Sumba eclectus (*E. cornelia*), and Tanimbar eclectus (*E. riedeli*) (Billerman et al., 2020). In this report, the genus is represented by *E. roratus*, also known as the grand eclectus parrot.

The home ranges differ between the sexes of *E. roratus*. During the breeding season the females remain at the nest, dependent on the males to provide food (Heinsohn et al., 2024), whereas the males have large home ranges of 30-70 km^2 and visit females in nests separated by over 7 km.

E. roratus can circle in flocks of up to 80 individuals (Billerman et al., 2020). They often go on long flights in morning, traveling from roosting sites above 400 meters in elevation down to lowlands to forage and returning in the evening (Billerman et al., 2020). The species typically forages in flocks that remain in the canopy but will sometimes travel lower, even picking up food from the ground (Billerman et al., 2020; Juniper & Parr, 2010).

1.5.2 Platycercus

The genus *Platycercus* is represented in this assessment by *P. eximius* (eastern rosella*,* three subspecies).

P. eximius is non-migratory, i.e. usually staying in the same locality (Billerman et al., 2020).

These rosellas are usually found in pairs, as singletons or in small flocks, the mean being about four birds, but may be seen in large flocks (Woon et al., 2002). They can hybridise with related species and can be found in mixed-species flocks (Billerman et al., 2020).

1.5.3 Psephotus

The genus *Psephotus* is represented in this assessment by *P. haematonotus* (red-rumped parrot, two subspecies).

Little information is available on *P. haematonotus*, but it has been successful in expanding its habitat into suburban and urban Australian areas (Billerman et al., 2020; Lowry & Lill, 2007).

When observed in Melbourne parkland, flocks consisted of an average of 10 individuals, but with considerable variation (range 1-139 birds). *P. haematonotus* seems to prefer areas with tall trees and good canopy cover (Lowry & Lill, 2007). *P. haematonotus* is reported to forage between 40-75% of the day (Rozek et al., 2010). Like most other parrot species, they roost together at night.

1.5.4 Psittacula

The genus *Psittacula* is represented in this report by *P. krameri* (rose-ringed parakeet*,* four subspecies).

Some *Psittacula* parakeets move from mountains to lower altitudes during the winter (Juniper & Parr, 2010).

Parakeets have a large feeding niche that includes agricultural crops (Khan, 2002).

P. krameri may live in flocks of several hundred individuals. They may use a nocturnal roost for sleeping and a communal roost for daytime activities such as nest building, preening, and socialising (Khan, 2002). Such communal roosts may be maintained for decades.

1.5.5 Trichoglossus

The genus *Trichoglossus* is represented by *T. haematodus* (coconut lorikeet, with up to 20 subspecies) and the closely related *T. ornatus* (ornate lorikeet). There is less information about *T. ornatus* than *T. haematodus* (Billerman et al., 2020).

The lorikeets have a brush-like tongue (their genus name means 'hairy-tongue'), with elongated papillae at the tip of their tongue that aid in feeding on pollen and nectar (Cabana & Lee, 2019; McDonald, 2003).

T. haematodus can fly between smaller islands daily when travelling between foraging and resting grounds (Billerman et al., 2020). They can also move between higher altitudes and lowland.

T. haematodus forms large flocks with peaks of activity in the morning and afternoon and shows communal roosting (Gilardi & Munn, 1998). They forage in large flocks (Billerman et al., 2020).

1.6 Ramphastidae

The lifespan of toucans has not been well documented but is reported to be up to 25-30 years in captivity (Louisville zoo, n.d.).

Toucans are active and curious birds, e.g. investigating cavities with their beak (Dislich, 2023). During the day they often have inactive periods resting in the treetops (Billerman et al., 2020). Larger toucans usually sleep on branches while the smaller species prefer nest cavities (Powers, 2014).

Toucans are obligatory cavity nesters. They often use cavities made by woodpeckers or natural cavities in decaying wood. If there is no suitable vacant cavity, they take over occupied ones from other species (Perrella & Guida, 2019).

1.6.1 Pteroglossus

The genus *Pteroglossus* is represented in this report by *P. castanotis* (the chestnut-eared aracari, two subspecies).

P. castanotis gathers in flocks for feeding. Furthermore, nesting is frequently cooperative with groups caring for offspring, seldom only one pair alone (Billerman et al., 2020).

1.6.2 Ramphastos

The species included in this report are *Ramphastos toco* (toco toucan, two subspecies) and *R. tucanus* (white-throated toucan, three subspecies).

R. toco is considered resident but can have nomadic movements during foraging (Billerman et al., 2020). *R. tucanus* seldom flies more than 100 meters at a time, but these birds have large home ranges and may move long distances (Billerman et al., 2020). GPS tracking of two species of Ramphastos toucans (*R. swainsonii* and *R. sulfuratus*) indicated daily kernel home range sizes of 0.2 km^2 to 0.9 km^2, with total distances covered ranging from 0.3 to 5 km per day (Kays et al., 2011).

R. toco usually forages individually or in small groups (Billerman et al., 2020). *R. tucanus* forages in pairs or small flocks up to 20 individuals. However, this species can also move in large flocks (Billerman et al., 2020).

Allopreening is prevalent among paired mates of *R. toco*, as is allopreening among other family group members (Billerman et al., 2020).

1.7 Exotic birdkeeping in Norway

In 2023, approximately 195,000 exotic birds were kept in Norway (FEDIAF, 2025). The Norwegian Federation of Tropical Bird Societies (NTL) had 372 registered members in 2024 (H. Akselvoll, personal communication, January 14, 2026). Birds are sold through pet shops but also increasingly through online platforms such as Finn.no. The Norwegian Pet Shop Association (NZB) states that there are probably only 15-20 pet shops that currently offer a larger assortment of bird species (S.A. Fosså, personal communication, January 14, 2026). According to the NZB, all the species included in this report are kept as companion birds in Norway, with *N. hollandicus* being the most commonly sold via pet shops. However, according to the NTL, *P. erithacus* is relatively frequently kept, but keeping larger species is increasingly rare (M. Haug, personal communication, January 14, 2026).

Over the last 50 years, the number of birds kept is not believed to have changed much. However, according to the NZB, fewer caretakers keep birds solitarily and the focus on pair and/or group-housing has increased (S.A. Fosså, personal communication, January 14, 2026). Furthermore, the NTL states that knowledge sharing through the internet, including courses and lectures, has improved bird caretakers' understanding of their pets, resulting in improved bird welfare. The NTL highlights the importance of ensuring that the needs of the birds, such as the possibility to fly, spend time outside the cage, and receive relevant environmental enrichment are met by the caretakers (M. Haug, personal communication, January 14, 2026). Furthermore, the NZB has the impression that caretakers' awareness of the birds' need for space has increased (S.A. Fosså, personal communication, January 14, 2026).

NTL states that the health of exotic birds in Norway has improved during the last decades. NTL also states that bird veterinarians report fewer severely ill birds. Respiratory diseases are still common, whereas gastrointestinal diseases have become less prevalent, mainly due to better nutrition and management.

In hand-rearing, the breeder assumes the responsibilities of the parent birds (Harcourt-Brown, 2009). This is still practiced in Norway, mostly for large species. However, there is a growing number of breeders who let parrots rear their chicks (M. Haug, personal communication, January 14, 2026).

Feather clipping to prevent flight is a controversial procedure (Stanford & Lill, 2008). This is not supported by the NTL (M. Haug, personal communication, January 14, 2026).

The last 50 years has seen an increase in availability of specialised food as well as fruits and vegetables on the Norwegian pet market, and a growing number of veterinarians with knowledge of exotic species (S.A. Fosså, personal communication, January 14, 2026). However, access to specialised veterinary care outside office hours can still be challenging (M. Haug, personal communication, January 14, 2026).

2 Methodology and data

2.1 Literature search and selection

The literature search was conducted and peer-reviewed by head librarians at the Norwegian institute of Public Health December 5, 2025. Searches were done in the databases of Ovid MEDLINE, Embase, CAB Abstracts, Scopus, and Web of Science Core Collection and the search strategy was tailored to each database's thesaurus and search interface.

The literature search was based on a modified version of the search string utilised in the study by Piseddu et al. (2024). The search was designed to update and supplement this systematic review; hence, the search was limited to literature published after the search performed by Piseddu et al., i.e. between May 16, 2022 and the present (December 5, 2025). Additional searches were conducted to include more search terms of movement (fly, flying, flight, restriction, movement, locomotion) and the additional species in this report (*Eolophus, Anodorhynchus*, galah, *Primolius, Nymphicus, Ramphastos*, toucan*, Platycercus, Rosella, Psephotus, Pteroglossus, Pyrrhura*, aracari, *Trichoglossus*). These searches were conducted without time limitations. Publications not peer-reviewed (e.g. opinions, letters, conference proceedings) were excluded. A complete overview of the search strategy is included in Appendix II. The searches yielded a total of 1313 articles, which were all subject to title and abstract screening.

Furthermore, the search was supplemented by including additional references from the citation lists of relevant articles or a manual search checking for subsequent citations of key articles, searching web sites by governmental organisations and universities, and including previous articles, books, and reports the project members were aware of due to their expertise on the subject. The supplemental searches resulted in a total of 168 relevant reports and articles included in this report.

2.1.1 Primary screening

The result of the literature search was screened using the literature review software Rayyan (Ouzzani et al., 2016). Screening of title and abstract was performed by project members independently according to predefined inclusion and exclusion criteria with blinding activated (i.e. the members could not see each other's evaluations). Titles and abstracts were excluded from further analysis if they did not fulfil the inclusion criteria. In order to harmonise the screening, an initial screen of 100 articles was done by all members. After completion, conflicting decisions were discussed and resolved by consensus for better alignment. In cases where inclusion was uncertain, the articles were included for further full-text screening. After harmonisation, the remaining articles were evaluated by pairs from the project group with blinding activated, followed by discussion of conflicts after completion of the screening. The primary screening resulted in 220 records, which were subject to full-text screening.

The literature search in Piseddu et al. (2024) resulted in 1848 articles, of which 96 studies were included in their review. Of these, 75 articles included species relevant for this report and were subject to full-text screening.

2.1.2 Secondary screening

Each full-text article was screened and assessed for relevance and quality by one reviewer from the project group. The selection was based on the predefined inclusion and exclusion criteria. The full-text screening resulted in 122 articles included in the report.

2.2 Risk assessment methodology

Welfare needs and challenges are closely related. A welfare challenge arises when a welfare need is not met. The NFSA requested an overview of welfare needs, a risk assessment regarding welfare challenges, and a description of mitigation measures. Therefore, the welfare needs are described in section 3. The risk assessment regarding welfare challenges is carried out in section 4.1-4.3 and includes exposure assessment, consequence characterisation, and risk characterisation based on the guidelines from EFSA on risk assessment for animal welfare (2012). Finally, mitigation measures are addressed in section 5. Sections 3 and 4 are grouped under the headings nutrition, physical environment, health, husbandry practices, behaviour, and cognition, whereas mitigation measures are organised according to action points: nutrition, physical environment, health, and husbandry practices. The risk assessment is conducted for each species where this is possible based on the available literature.

2.2.1 Description of exposure assessment

In the hazard identification section, the specific duration and intensity of the welfare challenges in question and the variability of exposure are described. Examples include nutrition and health risks which birds could be exposed to.

2.2.2 Description of consequence characterisation

Under consequence characterisation, the welfare consequences are described. Examples include malnutrition and abnormal behaviour. If data are absent or inadequate, expert judgement is used.

2.2.3 Description of risk characterisation

The risk is defined as a combination of the likelihood of welfare consequence (exposure assessment) and the magnitude of the welfare consequence (consequence characterisation), as assessed by VKM. The risk is categorised as Low, Medium, or High. This characterisation is presented in figures, such as Figure 1. Thus, risk characterisation integrates the results from exposure assessment and consequence characterisation. The consideration is done by assessing the occurrence of welfare consequences factor by factor for each species.

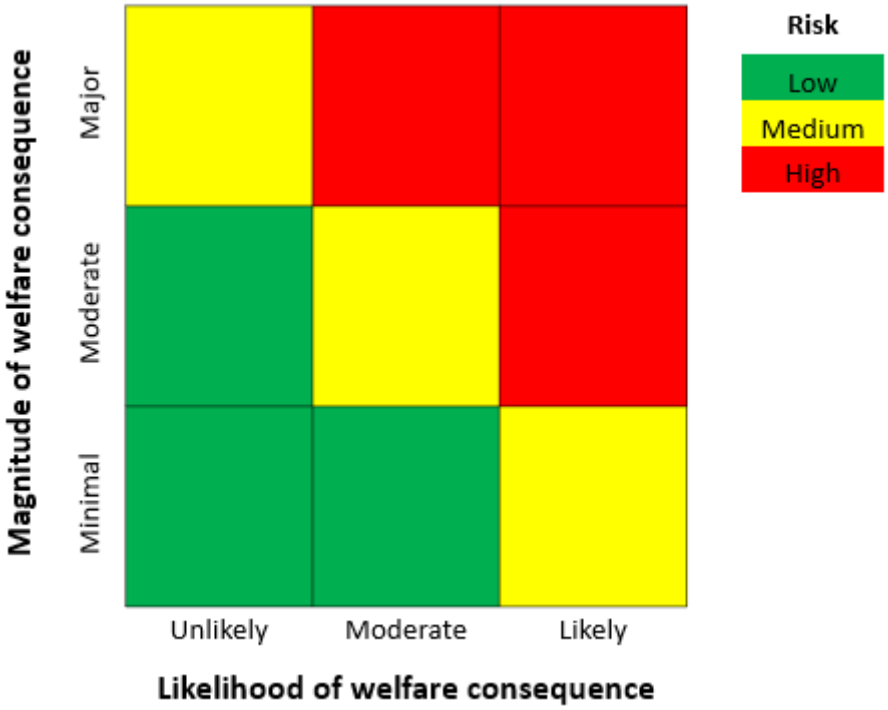

Figure 1. The risk characterisation (Low, Medium, High) is based on the likelihood of a welfare consequence once the welfare hazard has taken place, and the magnitude of the welfare consequence.

2.2.4 Description of confidence levels

The confidence level for each estimate is rated as detailed in Table 3. The level of confidence is based on both the relevance, and quality of the information available on the subject, and to what degree expert judgement is used. All the involved VKM experts have contributed to evaluating ratings of the level of confidence, ending with a consensus on each separate question.

Table 3. Ratings used for describing the level of confidence.

Rating	Confidence descriptors
Low	There is limited information on the subject, and no or little literature is available. Subjective expert judgements may be used without supporting evidence.
Medium	Some relevant information on the subject is available, but only limited information from comparable settings. Some subjective expert judgements are used. Both grey literature and peer reviewed literature are used and there are some data to support the assessment.
High	There is extensive information on the specific subject. Primarily peer reviewed literature and international reports are used. Little or no subjective expert judgements are used.

3 Overview of welfare needs

3.1 Nutrition

A suitable diet and free access to water is fundamental for good health and welfare.

3.1.1 Water

Parrots and toucans need free access to clean water of a high quality. The amount of fresh fruits and vegetables in the diet (often containing more than 85% water) will affect the water requirements (Koutsos et al., 2001a). Environmental temperature will also influence water need (MacMillen & Baudinette, 1993). At high temperatures, water intake may increase 12-fold (Koutsos & Speer, 2024). Water requirement is higher in younger birds, especially in newly hatched chicks, compared to older birds, and smaller birds have a proportionally greater need for water than larger birds due to higher evaporative loss (Koutsos & Speer, 2024). Birds prefer to drink more than their calculated minimum requirement for water and there is also high individual variability in the amount of water consumed (Koutsos et al., 2001a). Hence, it is important that parrots and toucans always have free access to water.

3.1.2 Nutrient needs

The diet given to companion parrots and toucans must fulfil the birds' needs for energy, nutrients, vitamins, and minerals, and allow for the expression of foraging behaviours. The diet needs to be tailored to the species in question, and it should support a healthy gut microbiota which can protect the birds from diseases. The nutritional requirements for parrots have been estimated based on published nutritional requirements for poultry (National Research Council, 1994). The Association of Avian Veterinarians adapted these guidelines in 1996 to make them better suited to psittacines, as described in the BSAVA Manual of Psittacine Birds (Harcourt-Brown & Chitty, 2005). However, different species may vary in their needs (e.g. vitamins, minerals, and essential fatty acids), and these demands may also change with metabolic state and life stage.

Different life stages, activities, and thermoregulation will influence energy requirements (Buttemer et al., 1986; Koutsos & Speer, 2024). Flying can increase energy needs six to eleven times the basal metabolic rate (BMR). In addition, the need for thermoregulation can increase energy needs by up to eight times the BMR when in cold weather and twice the BMR when in high temperatures (Koutsos & Speer, 2024). This should be kept in mind when using maintenance recommendations. As described in the introduction, wild parrots and toucans have a varied menu including plant material such as seeds, fruits, flowers, buds, and animal protein from insects and larvae. Parrots may ingest clay to offset toxic effects of plant alkaloids in unripe fruit. The clay also acts as a source of minerals (Forshaw, 2010). This behaviour has also been described in toucans (Matinata & Perrella, 2020).

3.1.2.1 Protein

In birds, twelve amino acids are classified as essential or conditionally essential and must be provided through the diet (Koutsos & Speer, 2024). These include phenylalanine, valine, threonine, methionine, alanine, tryptophan, histidine, isoleucine, leucine, lysine, glycine, and proline. Moreover, sufficient nitrogen must be available to facilitate the synthesis of non-

essential amino acids (Harcourt-Brown & Chitty, 2005). Protein requirement differs between the species and is also influenced by life stage and physiological state, in addition to the source and digestibility of the protein (Frankel & Avram, 2001). The recommended level of protein in the diet can vary three-fold depending on the digestibility of the added protein, as demonstrated in an experiment on protein digestibility and nitrogen needs in lorikeets (Frankel & Avram, 2001). Recommendations thus vary between approximately 12% to 20% of the diet, depending on species, life stage, and not least digestibility and amino acid composition (Harcourt-Brown, 2009; Saldanha et al., 2023). Parrots feeding mostly on grains or seed have a higher protein requirement compared with mainly frugivorous or nectarivorous birds (Perpinan, 2015). Furthermore, granivorous birds show different preferences based on their size: Smaller birds (under 100 g) typically choose grass seeds with high carbohydrate concentrations, while larger birds often consume seeds from shrubs that have higher protein levels (Koutsos et al., 2001a; MacMillen & Baudinette, 1993). Animal protein has a more optimal amino acid composition and is more digestible compared to seeds (Perpinan, 2015). The digestibility of protein in pollen, one of the main protein sources for *Trichoglossus* spp., is low (Koutsos et al., 2001a). In addition, the digestibility of pollen protein differs between species, as adult *T. haematodus* digested less than 7% of one plant species compared to adult *N. hollandicus* that digested 17% (Brice et al., 1989). Hence, accurately determining the specific percentage of protein required for each species is challenging.

3.1.2.2 Lipids

Lipid is required for energy and for enabling uptake of fat-soluble vitamins. A level of 4% in the diet is the general recommendation for psittacines (Harcourt-Brown & Chitty, 2005), but 5-12% has been recommended by other sources, depending on species, body condition, physiological, and reproductive state (Nijboer et al., 2025a). Dietary fat provides energy, hormone precursors, and essential fatty acids. At least 1% of the dry diet should consist of polyunsaturated fat (Nijboer et al., 2025a).

3.1.2.3 Minerals and Vitamins

The calcium requirement for psittacines is suggested to be between 0.3-1.2% of the diet (Kollias & Kollias, 1995; Rowland et al., 1973) and phosphorus should be a maximum of 0.3% calculated as a percentage of the weight of the food (Kollias & Kollias, 1995). Iron has been recommended to be provided at 80 ppm and zinc at 50 ppm (Harcourt-Brown & Chitty, 2005; Kollias & Kollias, 1995).

Vitamins B and C are water soluble and are not stored to any extent in the body. There is therefore less of an issue with toxicity than with the fat-soluble vitamins A, D, E, and K. Vitamin C is reportedly produced in the liver and a need for supplementation has not been demonstrated in adult parrots (Harcourt-Brown & Chitty, 2005). Vitamin A is essential for vision and cellular differentiation, vitamin D for bone mineralisation and immune function, vitamin E is an important antioxidant, and vitamin K plays a role in blood clotting and bone mineralisation. A level of vitamin A of 5000 IU/kg food and vitamin D of 1000 IU/kg food has been suggested (Harcourt-Brown & Chitty, 2005). However, there are also lower vitamin A recommendations for *N. hollandicus* (2000 IU/kg) and lorikeets (1000 IU/kg) (Park, 2006). A study on *N. hollandicus* found that vitamin A at 2800 ug/kg of food (approximately 10 000 IU) was associated with severe toxicity (Koutsos et al., 2003). Many parrot species rely on carotenes for their vitamin A synthesis in the wild, rather than preformed active vitamin A

from food, and they may be susceptible to vitamin A toxicosis when given supplements with active forms of vitamin A (Park, 2006). Vitamin D is synthesised in the skin when exposed to UV-B light (ideally, daylight) or can be given through the diet. It must be provided as D3, as there is no evidence that D2 is bioactive in birds (Orosz, 2014). Vitamin D is essential for calcium metabolism, and even on a diet fortified with vitamin D, parrots can develop deficiencies if they are not exposed to UV-light. However, macaws have been reported to show signs of vitamin D toxicity at a dietary level of 1000 IU/kg D3, so there might be species differences in sensitivity (Harcourt-Brown & Chitty, 2005).

Recommendations for other vitamins, minerals and trace minerals, can be found in Kollias & Kollias (1995) and in the BSAVA Manual of Psittacine Birds (Harcourt-Brown & Chitty, 2005).

3.1.3 The influence of life stage and physiological state on energy and nutritional needs

The need for nutrients and energy varies with life stage and physiological state. Temperate species also have a higher basal metabolic rate than species from the tropics (Harcourt-Brown & Chitty, 2005). During the breeding season, the female needs more calcium, protein, lipids, and energy. The energy and nutritional requirements of females increase a few days before egg production and stay higher until the clutch is laid (Koutsos et al., 2001a). Hence, several parrot species will eat more invertebrates during this time, probably to increase the protein and calcium content of their diet (Ahmed et al., 2022). The energy, protein, and amino acid needs for reproduction depend on the number of eggs per clutch, the intensity or frequency of egg laying, and the protein content of the eggs (Koutsos et al., 2001a). Furthermore, the energy requirement is higher during winter compared to summer for birds kept outdoors (Koutsos et al., 2001a).

Other changes in physiological status that affect the dietary needs include growth, moulting, and disease. During growth, birds require more calcium compared to a maintenance diet due to bone calcification (Koutsos et al., 2001a) and protein need increases up to almost 30% (see species-specific information below). The nutritional and energy needs for growth are highest just after hatching and gradually decrease as the growth rate decreases (Koutsos & Speer, 2024). The estimated calcium need for growing hatchlings, nestlings, and laying females is approximately 1% of their diet (Perpinan, 2015). In *A. aestiva*, the ability to digest fibre has been demonstrated to increase with increasing age (Vendramin-Gallo et al., 2001). Parrots usually have their first moult at 3-10 months, and then once a year. Moulting can take a considerable amount of time, e.g. 160 days to complete wing moulting in *E. roseicapilla* (Harcourt-Brown & Chitty, 2005). Moulting increases the need for protein by 4-8%, specifically for the amino acids' methionine, lysine, and cysteine. Energy needs during moulting increase up to 20%, and water requirements double for many species (Harcourt-Brown & Chitty, 2005).

3.1.4 Species – specific diet information

The diet of the species covered in this report was briefly described in the introduction and Table 2. Below follows a more detailed description of dietary needs for the species for which this information was available in the literature.

Cacatuidae

In the wild, *N. hollandicus* selects seeds with 8.8-14% crude protein (Koutsos et al., 2001b). In captivity, the protein requirement for *N. hollandicus* is suggested to be 11% or less if the diet contains a high-quality protein source (Koutsos et al., 2001a). However, if seed protein sources are used without amino acid supplementation, a higher amount of protein is necessary. Chicks require a higher protein amount with a diet consisting of 20% protein (Koutsos et al., 2001a).

Psittacidae

Amazons in captivity have an estimated protein requirement of 6-7% providing a balanced amino acid pattern (Westfahl et al., 2008). However, a higher requirement has been demonstrated in growing birds with 18-24% for *A. aestiva* (Carciofi et al., 2008).

A. hyacinthinus forages mainly on palm seeds and fruits and needs more fat in the diet than other parrots (Nijboer et al., 2025a). The strong beak is adapted to cracking open very hard nuts (Juniper & Parr, 2010). They use leaves and sticks as tools to hold nuts while feeding on them and manipulate small objects such as stones to sharpen the beak (Schneider et al., 2006). They have also been observed feeding on the stony endocarp of palm fruits eliminated in the faeces of cattle that had been foraging on the fruit (Schneider et al., 2006). To increase their protein intake, *A. hyacinthinus* can ingest larvae and termites (de Paula et al., 2017). Schneider et al. (2006) studied *A. hyacinthinus* plucking almost ripe palm fruits and dropping them on the ground below the tree. A month later, the macaws returned to the same tree and fed on the dropped fruit that by then contained growing insect larvae. Furthermore, these macaws can feed on aquatic molluscs (Juniper & Parr, 2010).

During the dry season, *A. ararauna* plucks the flower buds of certain trees, tilts the head up and squeezes the liquid from them, obtaining water as well as other nutrients (Silva et al., 2015). In the wild, *A. chloropterus* has a predominantly seed based diet, with lesser amounts of fruits, leaves, flowers, nectar, bark, and insects (Ragusa-Netto, 2024). Similarly, large seeds constitute a significant portion of the diet of *A. araraunas* (Cornejo et al., 2022; Koutsos et al., 2001a). *A. macao* has a more diverse diet including more fruit (Cornejo et al., 2022; Koutsos et al., 2001a). Growing *A. macao* have a protein requirement of 12–29% (Perpinan, 2015).

P. erithacus requires 10-15% protein in the diet to maintain plasma protein levels (Koutsos et al., 2001a).

P. molinae is described as a generalist when it comes to diet. Living in deciduous and semi-deciduous forests, it utilizes different plant species and different food items from these plants, including nectar, seeds, pulp, and aril. When available, figs are a valued food resource (Ragusa-Netto, 2007).

Psittaculidae

P. krameri is known to adapt to different food sources and even exploit nonnative plant matter in the wild, like grain crops and introduced plants (Ganpule, 2011). However, in experiments they have demonstrated a strong preference for sunflower seeds (Saldanha et al., 2023). This can cause problems in captivity, as both large and small sunflower seeds have a high fat content. It is suggested that species from temperate climate regions, such as *Psittacula* spp., have a 20% higher metabolic rate compared to tropical species, and hence a higher energy requirement (Perpinan, 2015).

Lorikeets eat insects and fruits, but nectar and pollen are the main components of their diet. In captivity they need a diet which can mimic their pollen and nectar intake. Nectar consists of simple sugars, but also amino acids and insect secretions (i.e. plant secretions that have gone through the insect alimentary tract) (McDonald, 2003). Importantly, nectar contains raffinose in addition to sucrose (McDonald, 2003). Raffinose cannot be digested by lorikeets, but it may act as a probiotic, promoting the colonisation of beneficial, protective bacteria. A commercial diet mimicking nectar must therefore contain not only simple sugars but also raffinose (McDonald, 2003). Their main source of protein is pollen, as pollen contains 16-30% of crude protein (Cabana & Lee, 2019). However, lorikeets have a low digestibility of pollen protein. Adult *T. haematodus* did not digest more than 7% of the pollen of one plant species, while the nestlings digested 24% (Brice et al., 1989; McDonald, 2003). *T. moluccanus* are reported to need as little as 2.9% protein in their diet if that protein is easily digestible with an optimal amino acid profile (McDonald, 2003). Insects may provide methionine, which pollen lacks. Insects can make up to 9% of the diet of *T. haematodus* and will also contribute with protein, while flowers (nectar and pollen) can make up 87% (Cabana & Lee, 2019; Cannon, 1983). In addition to the elongated papillae on the lorikeet tongue, the tongue is also longer and more mobile than in other parrots. Their crop is not so well developed and the gizzard not very muscular, but the small intestine has a great variety of carbohydrate-digesting enzymes (Cornejo & Clubb, 2005).

Ramphastidae

Toucans are primarily frugivorous but also feed on leaves and flowers in the wild. During breeding season, toucans also consume arthropods and small vertebrates (Mikich et al., 2001). For example, *R. toco* consume eggs, nestlings, and other birds (Oliveira & Tubelis, 2023). Toucans do not digest seeds, and small seeds pass through the digestive system unchanged and are excreted in the faeces, while larger seeds are regurgitated. Toucans' susceptibility to accumulation of iron in the liver and other tissues when kept in captivity is commonly reported (Cork, 2000). The aetiology is suggested to be due to a very efficient gut absorption of iron adapted to the low content of iron in their natural diet, combined with a high iron content in the captive diet (> 30 ppm), and genetic susceptibility (Sheppard & Dierenfeld, 2002; Stanford, 2010). Toucans are therefore recommended to be fed on a low iron pellet and with a variety of fruits offered daily (Dorrestein, 2009). The pellets should contain tannins which bind iron, making it less available for absorption, and the level of C-vitamin given through the diet is recommended to be < 500 mg/kg/day (Nijboer et al., 2025b).

3.2 Physical environment

3.2.1 Housing

In social groups, birds need space to choose their level of proximity when performing different behaviours and to avoid aggression. Furthermore, parrots and toucans need to be kept in an environment with enough vertical and horizontal space to perform highly motivated behaviour such as climbing, flying, and aerial play (see 3.5.1). While young birds can fly when first emerging from the nest at fledging, their flight can be clumsy and there is a need for rapid development of flight skills if they are to avoid injury. For example, Skutch (1958) describes the clumsy early flights of a toucan, with difficulty gaining height and in returning to the nest, and flights ending up on the ground rather than in the safety of high perches. However, the young

bird appeared to gain flight skills within a few days. Similar observations have been made on *A. macao*, with some fledglings falling to low branches or to the ground during early flights (Myers & Vaughan, 2004). In captivity, it is likely that sufficient unimpeded space for flight and access to suitable landing perches is especially important during fledging.

Very limited research has been conducted on space needs for parrot and toucan flight in captivity, but the distances flown during the day and their home ranges in the wild indicate that these birds need considerable space to express natural flying behaviour. Phillips et al. (2018) observed budgerigars kept in groups of four in small, medium, or larger cages. Flights averaged only 0.34 s in duration. Although flights were more frequent and faster in the largest cages, flight speeds were still less than half those reported when able to cruise over longer distances. In a wind tunnel, budgerigars flew at a rapid energy-efficient speed of approximately 34 km/h in spaces wider than 2.5× their wingspan (Schiffner & Srinivasan, 2016). While the budgerigar is smaller than the species included in this report, the results give an indication of the space needed for full expression of flight. Broom (2002) recommended that animals kept in captivity should have enough space so that all locomotor behaviours could be fully expressed for at least five seconds. For birds flying at speeds of 30-40 km/h, this would translate to a need for 42-55 meters of horizontal space for a single uninterrupted flight in one direction. Parrots and toucans also fly vertically, as many have their natural habitats in forest-areas with tall trees. A considerable height is therefore also needed to allow for vertical flying.

The birds need a variety of perches of different sizes and heights, allowing them to rest and survey activities in their surroundings from above. For example, a study of wild-living *A. macao* confirmed their preference for staying high in the tree canopies. They rarely came lower than 10 meters (de Figueiredo & Chappell, 2024).

In the wild, most parrot species live in areas with approximately 12 hours of light and 12 hours of darkness. A dark night period, protected from light and noise, is needed to ensure undisturbed sleep and proper eye function. Birds need ultraviolet (UV)-B (280–315 nm) exposure during daytime to support vitamin D production. Parrots and toucans have tetrachromatic vision, enabling them to see red, blue, green, and UV-A (315–400 nm) wavelengths. Hence, exposure to full-spectrum daylight is important for visual perception of their environment, including mate choice, food detection, and possibly egg detection in dark holes (Arnold et al., 2002). In a study involving a variety of bird species, UV-A was added to one side of the aviaries (Ross et al., 2013). When comparing behaviour in the presence or absence of supplemental UV-A light, members of patchy-light-adapted species (including *R. toco*) spent more time in close proximity to each other, suggesting that the UV-A light enhanced their sociability. Furthermore, parrot feathers exhibit patches of UV reflectance, resulting in plumage patterns visible to the birds in full-spectrum daylight though undetectable by the human eye (Mullen & Pohland, 2008). In addition, their feathers contain fluorescent pigments that absorb UV light and emit it at longer frequencies, resulting in a glowing appearance as seen by the birds (but not humans) under full-spectrum daylight.

While light is important, the birds also need shaded areas where they can avoid direct sunlight, facilitating thermoregulation (Luescher & Wilson, 2006; Nijboer et al., 2025a).

A well-ventilated and regularly cleaned enclosure is needed to ensure good air quality and avoid the build-up of ammonia and dust. An air filter is useful for controlling dust levels, as

many species of parrots produce copious amounts of dust from 'powder down', an adaptation that helps to keep their feathers in good condition (Harcourt-Brown, 2009).

3.2.2 Physical enrichment

Examples of environmental enrichments provided to parrots and toucans include toys, puzzles, ropes, and foraging-stimulating materials (Rodríguez-López, 2016). Parrots need access to an abundance of enrichment objects and materials that support exploration, play, problem-solving, physical dexterity, and cognitive development (Meehan & Mench, 2006). Given that all structures and objects in the housing environment are likely to be chewed, they must be constructed of safe materials (e.g. avoiding toxicity from lead and zinc) (Harcourt-Brown, 2009).

Parrots and toucans also need access to water for feather cleaning and preening behaviour (Meehan & Mench, 2006). Many species enjoy bathing in a rain shower, with some species hanging upside down with wings spread to allow soaking of the feathers (Murphy et al., 2011). Some species also foliage bathe by rubbing against wet foliage (e.g. *P. krameria*) (Tomás & Senar, 2021). In nature, toucans bathe in water-filled cavities high in trees (Skutch, 1958).

3.2.3 Foraging enrichment

Parrots and toucans engage in hopping, climbing, and dangling on branches, vines, and ropes made of natural materials, mimicking their habit of foraging in tree canopies (Meehan & Mench, 2006). Branches, vines, and ropes are manipulated in various ways with the beak, feet, and tongue, contributing to foraging skills and beak sharpening and are important welfare needs. Hiding the ration in different places or implementing puzzle feeders can prolong foraging time and provide cognitive stimulation and the fulfilment of behavioural needs (Lumeij & Hommers, 2008; van Zeeland et al., 2013).

3.2.4 Temperature and humidity

The species of parrots and toucans included in this report all originate from tropical and subtropical regions, where temperatures typically range from around 15 to 35 °C. Nevertheless, well-feathered, adult parrots can adapt to lower temperatures if allowed to acclimatise gradually. Evidence for parrot thermoregulatory adaptability comes from wild-living urban breeding colonies established in colder climates outside their traditional range, such as *P. krameri* in Germany, the Netherlands, and the UK (Jackson et al., 2015), and *A. aestiva* and *A. oratrix* in Germany (Harcourt-Brown, 2009; Martens et al., 2013). Harcourt-Brown (2009) observed UK-acclimated parrots in outdoor aviaries bathing happily in sleet and snow during winter. In a study of captive *P. krameri* housed in outdoor aviaries, temperatures ranged from a high of 40 °C in summer to a low of –0.3 °C in winter (Thabethe et al., 2013). Signs of heat stress were observed at 35 °C while there were no signs of hypothermia down to 5 °C. Apart from *P. krameri*, scientific evidence on cold adaptation is lacking. (Harcourt-Brown & Chitty, 2005). While most parrot species are adapted to mesic tropical forests, some species such as *E. roseicapilla* and *N. hollandicus* can survive under hot, arid conditions with less than 250 mm of rain annually and temperatures that may exceed 47 °C. These birds show a remarkable capacity to minimise evaporative water loss (Tattersall et al., 2009). *R. toco* adults exhibited effective thermoregulatory capacity across the range from 10 to 35 °C. However, juvenile toucans, which are not brooded during the daytime, may begin to shiver at

temperatures of 26 to 27 °C (Tattersall et al., 2009). This species conserves heat at night by tucking their beak under their wings and laying their tail forward over the wings and head.

Shelter is needed to facilitate thermoregulation and allow the birds to control their exposure to weather conditions. It is important that they are able to move between sun and shade, and protect themselves from heat, cold, wind, and storms (Harcourt-Brown & Chitty, 2005).

Systematic research on appropriate humidity ranges for different species of parrots and toucans in captivity is limited. However, practical guides recommend maintaining the humidity between 40-60%, as lower humidities are reported to cause dry, itchy skin, respiratory issues, and an increased risk of feather damaging behaviour (Harcourt-Brown & Chitty, 2005; White, n.d.).

3.3 Health

Good health is an important prerequisite for positive animal welfare. The health status of an animal is influenced by host-specific factors, the environment it lives in, and for infectious diseases, properties of the pathogens to which the animal is exposed (Scholthof, 2007). The host-specific factors include conformation, genetics, age, and immune status. Environmental factors include temperature, humidity, draft, air quality regarding content of dust and gases, quality of drinking and bathing water, amount of feed and its nutrient content, but also factors which may cause chronic stress or represent dangers. The pathogenic properties and the contagion pressure of microorganisms (including bacteria, virus, fungi, and parasites) will contribute to whether they cause clinical disease or not. There is an interplay between the host, the environment, and microbes (e.g. a poor nutritional state or chronic stress hamper immune function) (Alotiby, 2024; Korver, 2012; Morales et al., 2023). Furthermore, susceptibility or resistance to specific pathogens varies between bird genotypes (Kwok et al., 2021).

Birds often show subtle signs of disease (Hoppes, 2024), and these are not necessarily noted by the caretaker. It has been suggested that species with an evolutionary history as prey have evolved to minimise or mask signs of pain to reduce the risk of predation (Ashley et al., 2005). Thus, birds may already be severely ill when the signs become evident to the caretaker.

3.4 Husbandry practices

Parrots are not classified as domesticated species (Davis, 1998; Engebretson, 2006). Although the definition of domestication is debated (Sossinka, 1982), the species featured in this report are not usually bred to produce traits that distinguish them significantly from individuals living in the wild, and they do not show evolutionary adaptations to thrive in captivity (Bradshaw & Engebretson, 2013).

It is important that husbandry practices do not hamper the birds' behavioural development or opportunities to perform highly motivated behaviours, and do not induce fear or lead to chronic stress. Rearing, taming, and training must be performed in a way that makes healthy behavioural and cognitive development possible. This requires the caretaker to have a wide knowledge base.

Tameness has been defined as the general absence of aggression towards humans and tolerance of handling. Tameness is central for birds to thrive in a captive environment where they rely on close human contact to have their needs met. Hand-rearing of chicks is practiced to produce tame birds, but this is a risk factor for poor welfare (Fox, 2006). On the other hand, chicks may be handled occasionally by humans to socialise them to humans while being parent reared, sometimes referred to as neonatal handling. A study in *A. amazonica* demonstrated that neonatally handled birds were significantly tamer than non-handled birds (Aengus & Millam, 1999; Fox, 2006).

Other husbandry practices important for accommodating welfare needs of birds in captivity are social contact with conspecifics, opportunity to practice flight outside their enclosure, and the general knowledge of the caretaker to know if and when beak and claws should be trimmed.

3.5 Behaviour

A good understanding of animal behaviour and how it relates to welfare is central in the evaluation of welfare needs. In this section we will describe highly motivated behaviours, i.e. behaviours that are very likely to be important to the birds and are often referred to as behavioural or ethological needs (Keeling et al., 2018; Mason & Bateson, 2002). The expression of highly motivated behaviours often increases fitness (foraging, flying, socialising), but behaviours can also be highly motivated without this evident link to fitness. Wild birds that can interact freely with their environment will spontaneously chose to perform behaviours that they experience as rewarding in themselves (i.e. not including fleeing from predators or other forced, high-stress situations). The basis of this assessment is such behaviours performed in the wild. Expressing these behaviours results in positive emotions, while being prevented from doing so will result in negative emotions (Mason & Bateson, 2002). Many emotions are also motivators that drive the expression of specific behaviours. Some highly motivated behaviours are performed and sustained over longer periods, such as flying and foraging, while others occur for a shorter amount of time, such as preening. Regardless of duration, the performance of highly motivated behaviours is a welfare need, and deprivation causes suffering (Jensen & Wright, 2022). Hence, a bird without the opportunity to fly, forage, or engage in social behaviour is highly likely to experience frustration, boredom, and chronic stress, in addition to impaired health from lack of physical activity and social contact (Harcourt-Brown & Chitty, 2005; Mason & Burn, 2018).

The importance of performing natural behaviours for animal welfare was recognised by the members of the Brambell Committee (1965, p. 13) where they concluded that 'The degree to which the behavioural urges of the animals are frustrated under the particular conditions of the confinement, must be a major consideration in determining its acceptability or otherwise'. The Farm Animal Welfare Council used this as the basis for the 'Freedom to express normal behaviour by providing sufficient space, proper facilities and the company of the animal's own kind' in its Five Freedoms (FAWC, 1993, p. 4), also included as part of the theoretical framework for this report.

3.5.1 Flying and locomotion

Flying is clearly a welfare need for all flying birds. All species included in this report fly considerable distances (several kilometres) during the day in the wild (Andersson, 2025).

A. ararauna and *A. macao* have a home area of up to several thousand square kilometres (Brightsmith et al., 2021). Distances of 13-80 km were recorded when their daily movement patterns were tracked, with a reported speed of 40 km/h (Brightsmith et al., 2021). Male *E. roratus* has a home range of more than 30 km^2 (Heinsohn et al., 2024) and *P. krameri* have been reported to fly both 1.7 km (Strubbe & Matthysen, 2011) and 15 km (Strubbe, 2009) daily, differences possibly caused by abundance and dispersal of food. *P. erithacus* may fly far, covering 30 km in one day (Harcourt-Brown & Chitty, 2005). Parrots are flexible and can alter their home ranges seasonally depending on availability of resources (Curiel, 2006).

Physical activity is recognised as beneficial for physical and mental health, increasing longevity, and quality of life (WOAH, 2020). Not only are stress and boredom reduced by the opportunity to fly but flying also increases the experience of agency and competence (Špinka & Wemelsfelder, 2018), the feeling of control of the environment (Englund & Cronin, 2023), maintains muscle mass, and lowers the risk of obesity (Harcourt-Brown & Chitty, 2005). Flying includes slower aerial manoeuvring, vertical movement, and faster, long-distance flight which demands a flying area that allows for full speed to be reached. Parrots also climb to move around trees, and this is also a beneficial physical activity. In some species, such as *A. macao*, climbing is tripedal (i.e. involving use of the beak) (de Figueiredo & Chappell, 2024).

As described in the introduction, the parrot and toucan species included in this assessment mainly move between roosting and feeding grounds (Gilardi & Munn, 1998). The separation of resting places from feeding places and places to socialise and preen seems quite general for this group of birds (Harcourt-Brown & Chitty, 2005). More details can be found under each species in the introduction (section 1.3-1.6).

3.5.2 Maintenance behaviour

Grooming and foraging are both welfare needs of birds. They need to perform these activities with social companions, and they may also have preferences for when different activities should be carried out during the day.

Grooming and other comfort behaviours are major activities for all parrot species (Bergman & Reinisch, 2006). In an observational study of free-living *A. macao*, most observations were of active behaviours, such as feeding, locomotion, self-maintenance, object manipulation, and socialising (de Figueiredo & Chappell, 2024). Grooming is essential as well-maintained feathers are necessary for flying, thermoregulation, waterproofing, camouflage, and communication (de Figueiredo & Chappell, 2024). In the wild, parrots groom in the morning before flying to the feeding grounds, and then they groom again after their first bout of feeding. This grooming often takes place in a tree close to the food. They also clean their feet and legs with their beak, stretch, yawn, and rub or grind their beak (de Figueiredo & Chappell, 2024). They are flexible and can use their feet to scratch and groom their head, and they also stretch wings and feet, often after resting and before starting a new activity. By chewing at inedible objects, they sharpen and trim their beak (de Figueiredo & Chappell, 2024). Bathing is also an important part of parrot self-care, and they will bathe both in puddles and in rain as described for *A. macao* (de Figueiredo & Chappell, 2024).

All birds included in this report spend up to 90% of waking time engaged in foraging, foraging-related behaviour, and preening (Péron & Grosset, 2014). Many of the species feed in the morning and afternoon. The species differ in how they prefer to eat. *Nymphicus* spp. is a

ground feeder while *Ara* spp., *Amazona* spp., and *Cacatua* spp. may also hold the food with one foot (Cummings et al., 2022), and it is important that they receive food in such a manner and of a texture and size that makes it possible for them to eat like they would in the wild (Rozek et al., 2010). Like all other species, the nectar- and pollen-eating lorikeets need a diet which allows them to perform natural feeding behaviour, not merely fulfilling their nutritional needs. In general, psittacines prefer eating together, another example of the importance of social companions (Cummings et al., 2022).

Exploration but not neophobia was found to be correlated with several ecological variables (Mettke-Hofmann et al., 2002). Species from islands, from a more complex habitat, and with a high proportion of foods that are difficult to find, in their diet (buds, fruits, nuts), explored a novel object faster and/or for longer. Albeit being carried out on a very low number of birds per species, the results in this 76-species investigation indicate that the habitat, diet, and predation pressure in the wild influence expression of exploration. How this translates to different welfare needs is not known.

Drinking behaviour differs between species (Koutsos et al., 2001a). Cockatoos scoop water with the lower beak and flush it back with the tongue, whereas lorikeets lap water with their special tongue. On the other hand, psittacines ladle water on their tongue and press it up to the palate to move the water back. Toucans need a wide water bowl to allow space for their beak (Nijboer et al., 2025b).

3.5.3 Social behaviour

All parrots and toucans are social species, which means that their social environment is an essential welfare concern. Most adult parrots have one reproductive partner for life, feeding and roosting together throughout the year (Harcourt-Brown & Chitty, 2005). The exclusivity and strength of these pair bonds vary considerably between different species and in some cases across the course of a year, but pairs are the most common base unit of parrot social life. Several pairs form groups and in some species large flocks. The dynamics in these flocks again substantially varies by species. Some only fly with a flock outside the breeding season and are territorial during the reproductive part of the year. Others permanently stay in flocks. *N. hollandicus* kept in a smaller flock showed a preference for one to two social partners (Seibert & Crowell-Davis, 2001). In some species, the flock composition is stable, while others live in fission-fusion societies (Maurice, 2023; Penndorf et al., 2024). Many parrot species roost with their larger group, and the time just before roosting is marked with high activity levels, flying, and vocal communication within the group (Juniper & Parr, 2010). A distinction can be made between a nocturnal and a communal roost. The nocturnal roost is a limited area used for sleeping, whereas the communal roost can be used for decades and is a larger area of trees where the birds gather during the day to preen, feed, build nests, and settle arguments as described for *P. krameri* (Khan, 2002). In general, parrots coordinate group activities (e.g. cohesion, recruitment to feeding grounds, and sentinel behaviours) via vocalisations. Family groups stay together for one breeding season, and juvenile birds fly with and learn from older individuals. In *A. macao*, fledglings showed a peak in social play two months after fledgling. Play involved chasing, sparring, and hanging upside down beating their wings against each other. Manipulatory behaviour directed towards twigs and leaves peaked at the same time, and they also began joining unrelated juveniles in flocks of 8-30 individuals in their movement between nocturnal roosts and diurnal foraging areas. Even when the juveniles foraged independently, the parents continued to provide care for a few more weeks (Myers &

Vaughan, 2004). This behavioural development highlights the social nature of parrots, in which each individual has multiple social relations each serving different functions. Parrots may also aggregate in mixed-species assemblages (Van Houtan et al., 2025). Housing parrots in mixed-species flocks may, thus, add an element of social enrichment as long as the species are compatible. However, studies documenting such benefits in captivity in the species included in this report are lacking.

Parrots and toucans perform allopreening (Billerman et al., 2020). They can preen their partner, offspring, or another member of their group. The behaviour is often reciprocal, and allopreening bouts can be long, as for example five-minute bouts described for *E. roseicapilla* (Bergman & Reinisch, 2006). Allopreening probably strengthens social bonds, and it also has a very practical function in that it allows preening of areas that cannot be reached with the beak by the bird itself. Allopreening is thus often directed towards neck, head, and face (Bergman & Reinisch, 2006). In free-living *A. macao*, allopreening was the most frequently observed social behaviour (de Figueiredo & Chappell, 2024).

In general, there is limited literature describing the social life of toucans. They live in small groups or in pairs, as mentioned in the introduction. However, Skutch (1958) observed groups squeezing into tree cavities to roost together at night, as well as cooperative breeding, whereby non-breeding group members brought food to the nestlings of the breeding pair.

3.5.4 Reproductive behaviour

During breeding, the birds' requirement for housing and social environment shift. It is important that the birds are able to choose from a larger group of mates and be allowed to form a pair with a preferred mate. This might be difficult to do in practice, as one seldom can bring the bird to a 'dating establishment' filled with birds of the same species of opposite sex. Each pair will need visual cover so as to be able to choose when they are within the line of sight for other pairs nearby. Because pairs are always, to some extent, artificially composed in captivity, they might not be fully harmonic which can lead to intra-pair aggression during the nesting season. Particularly *Cacatua* spp. can switch from very social to highly territorial behaviours and may even fatally injure their assigned partner. Therefore, measures must be available to ensure each birds' safety (e.g. the option to also separate the pair partners temporarily).

Psittacines are secondary cavity nesters which means that they utilise existing tree cavities for nests, though they can also nest in cavities in other structures (Spoon, 2006). A cavity gives protection from the environment and from predators (Martin & Romagnano, 2006), and access to a nest for birds breeding in captivity is a welfare need. The birds often cover the bottom with material of some kind, and the material provided needs to be adapted to the species' requirements. *E. roseicapilla* is the only cockatoo species known to use green material for this, while *E. roratus* uses wood chips and wood dust to cover its nest (Spoon, 2006). Some species can nest in colonies, but in others, such as *A. ararauna*, aggression towards other breeding pairs necessitates some distance between nests (Spoon, 2006). Sufficient privacy around the nest will thus be an important welfare need in some species. Eclectus parrots have been observed to practice polygynandry, which is a rare mating system among birds. Females are usually sedentary and spend much of their time in the nest hollow while multiple males bring them food (Heinsohn et al., 2024). Most broods of two nestlings have just one father, but

the likelihood of multiple paternity increases with number of males in the group (Heinsohn et al., 2007).

In the wild, toucans too nest in cavities in trees. In captivity, breeding is considered difficult (Mikich et al., 2001). Pairs often become aggressive towards other pairs/birds, and parents may kill or injure their own nestlings (Mikich et al., 2001).

3.6 Cognition

Parrots, alongside corvids, are considered to be the birds with the highest levels of cognitive complexity (Lambert et al., 2019). They have disproportionally large brains and many neurons (Olkowicz et al., 2016). Their strong beaks and zygodactyl feet that characterise parrots, allow for a level of object manipulation far beyond most birds (Auersperg et al., 2015). Indeed, many parrots maintain a lifelong propensity to play and explore objects (O'Hara & Auersperg, 2017). This intrinsic curiosity fosters the discovery of new food sources and innovation of foraging behaviours (Lefebvre, 2013). For instance, *Cacatua goffiniana* (Goffin's cockatoos) can extract nutrition from hard-shelled fruits by manufacturing and using several different tools in sequence (O'Hara et al., 2021). This behaviour is only shown by a subset of the wild populations suggesting that, while some degree of social learning certainly occurs, individuals innovate and hone their skills through intense object exploration. Some parrots also reach the highest form of object permanence, the skill to understand invisible displacement (i.e. they can track an object when it is moved to a new location even if they do not directly see the object) (Pepperberg & Funk, 1990; Pepperberg & Kozak, 1986). Because wild parrots are haptically exploring objects for several hours every day, can easily represent invisible objects, and constantly train their manipulation skills, they do require extensive physical enrichment in captivity.

All parrot species in this report are highly social, usually living in monogamous pairs within groups of pairs or large flocks (Emery et al., 2007). They recognise individuals (Wanker et al., 1998), demonstrate other-regarding preferences (Brucks & von Bayern, 2020), preen other individuals (Spoon et al., 2006, 2007), and share food (Lambert et al., 2019). Parrots also show reconciliation and third-party affiliation, meaning that positive interactions with individuals outside their pair bond can be very important, particularly after conflicts with their partner (Ikkatai et al., 2016). Due to their diverse socio-cognitive skills, they require daily contact with at least one close social partner and ideally with a network of other individuals. The degree of the latter may vary substantially depending on the ecology of the specific species. For example, *P. erithacus* are exceptional vocal imitators and open-ended learners; in the wild they were found to imitate the calls of nine other bird and a bat species (Cruickshank et al., 1993). It is therefore suspected that this species shows regional dialects, although no empirical studies exist (Billerman et al., 2020). *C. galerita* parrots are known for their ability to synchronise their movements to varying music beats (Patel et al., 2009). *P. erithacus* has shown abilities to count, form new call-meaning pairs (i.e. a vocal signal is associated with a specific object or action), and use human language meaningfully (Pepperberg, 2006). Their cognitive skills (including vocal communication) are most probably the result of, and a necessity for, their complex social environment, which in many aspects resembles human society. This makes this species suitable for living in human care, but at the same time it requires substantial social stimulation.

Parrots can learn to produce novel vocalisations throughout life, and while some songbirds share this ability to a degree, parrots even have an additional cortical pathway nucleus, absent in songbirds, for vocal learning (Chakraborty et al., 2015). Parrots can acoustically match their group to convey membership to said group but can also mimic calls of other individuals to 'address' them (Balsby & Bradbury, 2009; Balsby et al., 2012). This further demonstrates that parrots have a need to closely bond with social partners.

Because the scaling relationship between brain volume and brain neuron number appears to be rather constant in parrots (Olkowicz et al., 2016), and the species with relatively large brains show a higher tendency to display stereotypic behaviours (Mellor et al., 2021), higher cognitive complexity seems directly linked to the risk for negative welfare. In crude terms, smarter parrots are more likely to suffer if their needs are not met. This does not only concern physical and social cognition. For instance, a species with a better long-term memory can remember negative experiences for a longer period of time and has hence a higher propensity to suffer. Therefore, parrots, and particularly large brained ones, require ample opportunities to develop and use cognitive abilities in order to have predominantly positive experiences.

No detailed studies on the cognition of toucans were found. A single study found evidence that toucans are rather neophilic and explorative birds particularly in response to olfactory enrichment (Hernández & Barja, 2024). Being Piciformes, toucans are most probably unable to learn to produce novel sounds.

4 Risk assessment for welfare challenges

4.1 Exposure assessment

4.1.1 Nutrition

The main hazards are insufficient access to water and a diet that fails to meet the nutritional needs of the birds. Contamination of the water could also be a hazard. Lack of water can quickly lead to dehydration and death, while nutritionally inadequate diets can have long-lasting negative effects on health and welfare. The negative effects of obesity, malnutrition, and metabolic disorders often accumulate over time. Seed-based diets have traditionally been used for psittacines, likely because they are perceived as 'natural'. However, in reality, the seeds fed in captivity often differ substantially from those encountered in the wild (Péron & Grosset, 2014; Ullrey et al., 1991). Furthermore, seed-based diets are associated with giving excessive amounts of calories while being deficient in several essential nutrients. Obesity and metabolic disorders are common in parrots in captivity (Di Santo et al., 2019). The exposure to the hazard of an inadequate diet is thus continuous, unless the caretaker seeks advice and improves the diet. Parrots are reported to feed selectively if they get the opportunity, picking out the most calorie-dense part of their food, with malnutrition and obesity as consequences (Péron & Grosset, 2014; Stanford, 2010).

4.1.2 Physical environment

Hazards related to the physical environment may be life-long if not corrected, and they will have major welfare impacts. Examples include lack of space, improper bar spacing, improper perch sizes, barren cages, and lack of opportunity for privacy (Harcourt-Brown & Chitty, 2005; Meehan & Mench, 2006). These deficiencies in the physical environment can lead to chronic stress in birds in captivity (de Almeida et al., 2018). There are also hazards of a briefer duration such as escape or exposure to dangerous objects (e.g. a hot stove) which can nevertheless have a high-intensity welfare impact on the bird.

Lack of environmental enrichment has been associated with emergence of stereotypies and feather damaging behaviour, low physical activity, and reduced preening (Lumeij & Hommers, 2008; Piseddu et al., 2024).

Lack of outdoor access and thus UV light exposure in captivity can result in vitamin D deficiency, as documented for e.g. amazons (West et al., 2019). Other challenges might be found in improper light and dark cycles (Meehan & Mench, 2006). A normal day/night rhythm is a prerequisite for proper night sleep and essential for health and welfare (Bergman & Reinisch, 2006; Harcourt-Brown & Chitty, 2005). The hazard is keeping birds in enclosures that are not completely dark during the night, and if this practice is continued the exposure and consequences are chronic.

Inappropriate temperature and humidity are hazards to birds in captivity (Meehan & Mench, 2006). Studies in hens have demonstrated increasing aerial dust concentrations indoors with higher temperatures and reduced relative humidity (David et al., 2015). The bird species included in this report come from the tropics or subtropics. Low humidity indoors during the winter can be a challenge by increasing sensitivity to respiratory pathogens and contributing to

poor feather quality (Harcourt-Brown & Chitty, 2005). They can however thrive with outdoor access all year round as long as they have permanent access to a protected area indoors with optimal temperature and humidity. The birds need acclimatisation to new climatic conditions, hence abrupt transitions should be avoided (Harcourt-Brown & Chitty, 2005).

4.1.3 Health

Birds may develop a range of diseases and disorders. Disease can be defined as any harmful deviation from the healthy structural or functional state of an organism, generally associated with certain clinical signs, and differing in nature from a physical injury (Burrows, 2026). In the following, diseases are categorised as infectious if they have a causal relationship with an infectious agent, non-infectious if they are not caused by an infectious agent (e.g. cancer, degenerative disease, and metabolic disease), injuries if they are caused by physical or thermal trauma, or as intoxications in the case of exposure to a poisonous substance. Diseases related to nutrition are further described in section 4.2.1.

A retrospective study assessed 1850 post-mortem reports from 1998 to 2017 covering 45 genera of psittacines (Gibson et al., 2019). The most diagnosed primary diseases were non-infectious (58.2%), including degenerative (25.1%), metabolic (21.2%), haemodynamic (14.6%), and neoplastic (7.8%); while infectious diseases were diagnosed in 44.5% of all cases with viral infection being most common (23.1%), followed by bacterial (15.4%), fungal (8.7%), and parasitic (2%). However, several of the birds had more than one disease diagnosed.

Infectious diseases. Infectious diseases in exotic birds are caused by microorganisms like viruses, bacteria, fungi, or parasites (Hoppes, 2024). Some infectious diseases have an acute course, others are chronic. Acute disease appears suddenly and lasts for a short period of time (i.e. days or weeks). Subacute diseases develop more slowly, with less dramatic clinical signs. Chronic diseases develop gradually and persist longer. Acute and subacute illnesses can have a relatively quick and full recovery, if properly treated, but may in some cases become chronic. Chronic conditions require long-term, and sometimes life-long treatment. The pathogen causing these diseases may or may not be directly transmissible between birds. Not all birds exposed to a pathogen become ill, as development of a disease also depends on environmental factors, infection pressure, and the birds' genotype and immune status.

Bacterial diseases are common in companion birds. Inadequate nutrition and suboptimal husbandry are frequently contributing factors, and neonates and young birds are particularly vulnerable (Hoppes, 2024). Gastrointestinal infections are common. The normal bacterial flora of companion birds is Gram positive, whereas Gram negative bacteria may cause gastrointestinal problems, and even systemic disease. Respiratory infections are also common and may lead to systemic disease. Psittacosis (avian chlamydiosis/ornithosis) can infect all companion birds and is common, especially in *N. hollandicus* and smaller psittacines (Hoppes, 2024). Asymptomatic carriers occur. Avian tuberculosis (*Mycobacterium avium*) can affect all companion birds, and has a chronic course (Wernick, 2016).

Viral infections occur in birds, but in general, psittacines appear somewhat resistant and are less likely to spread virus or to become fatally ill (Hoppes, 2024). Viral infections include paramyxovirus causing Newcastle disease, avian influenza virus which infect both birds and mammals, and West Nile virus which is transmitted by a mosquito vector and not transferred directly between birds. Some viral infections are more common in certain species or age

groups of birds (Hoppes, 2024). Avian polyomavirus causes acute death in nestlings and young psittacines (< 4 months of age). Circovirus causes beak and feather disease, mostly affecting juvenile psittacine birds. Cockatoos and most species of parrots may be infected, but rarely *P. erithacus*, *Eclectus* spp., and lorikeets. Psittacine herpesvirus (Pacheo´s disease) is mostly seen in amazons, macaws, and conures (Hoppes, 2024). Avian bornavirus (Macaw wasting disease) causes proventricular dilatation disease, which is chronic and fatal. It mainly infects macaws, *P. erithacus*, and conures but can infect all birds.

Mycotic diseases are prevalent among companion birds, often secondary to poor husbandry with unhygienic conditions, or in birds that are already ill or have compromised immune systems. Among mycotic diseases of exotic birds, candidiasis is relatively common, affecting the gastrointestinal system. This disease mostly affects nestlings, other young birds, immunosuppressed birds, and birds treated with broad-spectrum antibiotics (Hoppes, 2024). Aspergillosis is another opportunistic mycotic infection occasionally occurring in companion birds, mostly affecting the respiratory system (Wernick, 2016). *P. erithacus*, amazons, macaws, and *N. hollandicus* seem to be most susceptible. There are many contributing risk factors, such as poor environmental conditions, malnutrition including vitamin A deficiency, underlying diseases, and corticosteroid treatment (Hoppes, 2024). *Macrorhabdus ornithogaster*, now classified as a fungus (earlier called megabacteria), causes disease in the gastrointestinal tract. It can be fatal, but is treatable, and some birds are asymptomatic carriers.

Parasite infections have become less common during the last decades (Hoppes, 2024). Still, nematodes may be transmitted from wild birds to companion birds which are kept outdoors. Tapeworms have been found in cockatoos and *P. erithacus*. Scaly face mites (*Knemidocoptes pilae*) cause scaly face and legs in budgerigars but are rare in the psittacine species included in this report. Feather mites are also uncommon. Red mites (*Dermanyssus gallinae*) are found in poultry houses in Norway and in the nests of many wild birds frequently nesting in buildings (FHI, 2024) and may also affect companion birds. Protozoa (single-celled parasites) may cause disease, such as giardia in the gastrointestinal tract of *N. hollandicus* (Hoppes, 2024). Sarcocystosis, affecting the respiratory system, is a major cause of death in larger parrots housed outdoors in the southern USA (Hoppes, 2024).

Respiratory disorders, with or without infection, are common in birds in captivity (Harcourt-Brown & Chitty, 2005). In general, birds are more sensitive to unhygienic conditions compared to mammals, probably due to their unique respiratory system (Maj et al., 2025). Infections in the respiratory system may be caused by fungi found in the environment (e.g. *Aspergillus* spp.). Suboptimal air quality with low humidity (especially indoors in winter) and dust particles are a contributing factor. Chronic obstructive pulmonary disease (COPD) is seen in macaws (Hoppes, 2024).

There are international and national regulations regarding notifiable severe contagious animal diseases and how they should be managed (Dyrehelseforskriften, 2022). The most important diseases are listed according to severity and their economic importance. Notifiable disease list 1 includes the viral diseases avian influenza and Newcastle disease. Both these may affect different bird species, parrots included, and avian influenza may also cause disease in humans. Norway has an additional national list including psittacosis (*Chlamydia psittaci*) and salmonellosis (*Salmonella* spp.), both being zoonotic, avian mycoplasmosis (*Mycoplasma gallisepticum, M. meleagridis,* or *M. synovia*), and avian tuberculosis (Dyrehelseforskriften, 2022).

Individual birds kept in stable social groups in private homes and not or seldom in contact with other birds are generally not exposed to pathogens causing severe infectious diseases. Thus, newly acquired birds, birds exposed to individuals from other households, or wild birds are most likely to be affected by infectious diseases (Hoppes, 2024). However, some microorganisms such as mould (e.g. *Aspergillus* spp.), and bacteria (e.g. *Salmonella* spp.) may be introduced via contaminated feed (Maj et al., 2025). Participation at shows, exhibitions or other gatherings where birds from different households meet will expose the bird to new microorganisms, including those which may cause disease. Furthermore, susceptibility may be increased due to stress from transportation and new environments.

Non-infectious diseases. Birds in captivity may develop a range of non-infectious diseases, and the course of the illness is usually chronic. They include musculoskeletal and metabolic disorders such as diabetes mellitus (more common in toucans than psittacines), disorders of internal organs such as the liver (e.g. iron storage disease) and gastrointestinal system, urinary (e.g. gout - deposition of uric acid in joints or viscera), circulatory and respiratory systems, reproductive and hormonal disorders (e.g. in *N. hollandicus*), cancer, as well as disorders of the eyes, feathers, beak, and claws (Hoppes, 2024). Cardiovascular disease is described as very common in psittacines, however mostly diagnosed by postmortem examination (Cornelia & Krautwald-Junghanns, 2022). Atherosclerosis (i.e. proliferative lesions in arteries) is an underlying condition in many cardiovascular diseases (Hoppes, 2024). Amazons, macaws, and *P. erithacus* are particularly susceptible. Although mainly a problem in elderly birds, the disease has been described in very young *P. erithacus* (Hoppes, 2024).

Many birds in captivity live long lives and have increased incidence of geriatric-onset diseases, including cataracts, neoplasia, arthritis, and cardiovascular diseases (Hoppes, 2024). There is an association between some disorders. For example, high plasma cholesterol and lipoprotein levels (Beaufrère et al., 2014) as well as *Chlamydia psittaci* antigens (Pilny et al., 2012) are associated with atherosclerosis.

Self-injurious behaviour such as feather damaging behaviour is described in section 4.2.5.2. Some non-infectious and infectious conditions are associated with feather damaging behaviour, such as giardiasis (in *N. hollandicus*), hepatic disease, malnutrition, zinc toxicosis, and neoplasms (Hoppes, 2024). Feather damaging behaviour may lead to skin inflammation (acute) or dermal scars (chronic) in affected areas (Garner et al., 2008).

Beak disorders may occur as a result of various factors, often connected to nutrition, management and/or infectious diseases (Fecchio, 2021). Causes include malnutrition (e.g. hypovitaminosis A causing hyperkeratosis, hypovitaminosis D/calcium imbalance causing rubber beak), infections, or biomechanical factors. Also, beak disorders may be congenital due to inappropriate temperature during artificial incubation or hereditary factors. Beak fractures due to physical trauma may also occur (Fecchio, 2021). Furthermore, beak disorders may develop following other medical conditions such as liver disease, allergy, or neoplasms. Factors influencing the biomechanics of the beak include irregular wear, beak overgrowth (prognathism), shortening of the beak (brachygnathism), scissor beak (common in macaws and cockatoos in captivity), malocclusion (improper bite), and fractures (Fecchio, 2021).

Injury. Traumatic physical injuries are common presentations in avian patients (Hoppes, 2024). Injuries include burns, puncture wounds, lacerations, fractures, overstretching, strangulation, and lost toes (e.g. due to frost bite during winter) (Martel-Arquette et al., 2016). Injuries can

result from the captive environment not being adapted to meet the birds' requirements (section 4.2.2). If the bird is flying freely in the caretaker's house, dangers include collisions (e.g. with windows, furniture), falls, and burns from landing on a hot surface such as a stove. Bites or scratches from cats or dogs in the household may represent a danger to these birds, as well as aggressive conspecifics causing injuries including biting of toes (Hoppes, 2024). Unless mitigated, exposure to such hazards may continue over the birds' lifespan.

Intoxication. Birds in captivity may ingest poisonous foods (e.g. avocado). Commercial feed may contain *Aspergillus* spp., including potentially aflatoxigenic *A. flavus* (Maj et al., 2025). Lead and zinc toxicoses are reported, stemming from ingestion (e.g. curtain weights, galvanised wire, toys, and other items containing these metals) (Hoppes, 2024). Free flying birds may consume potted plants or human food which could be toxic or unsuitable for birds. Kitchen utensils may have non-stick teflon coating, which when over-heated may form a lethal polytetrafluorethane vapour (Harcourt-Brown & Chitty, 2005; Stanford, 2010). Ingestion of tobacco products can cause poisoning, and tobacco smoke inhalation may cause chronic irritation of the airways (Hoppes, 2024). Aerosols (e.g. from scented candles, perfume, or melted plastic) may also be toxic to birds (Hoppes, 2024).

4.1.4 Husbandry practices

There are a range of husbandry practices that are hazards to the birds' welfare, such as poor nutrition and ill-fitted materials (see 4.1.2). Poor cleaning of the living environment and unsanitary conditions may also result in disease. If the caretaker fails to seek necessary veterinary care for their bird or does not recognise that the beak and claws need trimming, this entails a welfare hazard related to lack of caretaker's knowledge. Humans may impose a threat by being abusive towards the birds, or by using improper taming or training techniques (Meehan & Mench, 2006). The aftermath of neglect will probably result in chronically reduced welfare.

4.1.4.1 Social aspects of housing and husbandry

Social isolation is another factor related to the husbandry practices that have been identified in the review by Piseddu et al. (2024), leading to an increased risk of developing stereotypies, reduced preening, flying, and locomotor activities. Furthermore, both vocalisations and human avoidance increase in socially isolated birds. Some birds in captivity may live their entire lives in social isolation. The negative effects of social deprivation are apparent already after three months and the severity of these effects seem to increase over time (Meehan et al., 2003a). Also, the mere provision of conspecific partners may not sufficiently mitigate these issues, as the group also has to be harmonic, appropriately composed (e.g. of several pairs), and primarily provide positive social experiences.

4.1.4.2 Hand-rearing

Several studies have highlighted that birds that are hand-reared have higher probabilities of developing stereotypic behaviour (Williams et al., 2017), development of preferred interaction with humans, and feather damaging behaviour (Costa et al., 2016; Schmid et al., 2006). Tests with occasional neonatal handling of parent-reared chicks showed that handling later in life (from 35 or 40 days of age until fledging) produced tamer chicks than earlier handling experiences (Aengus & Millam, 1999). The effects of hand-rearing are also evaluated as

chronic, since sexual imprinting, stereotypies, and feather damaging behaviour have proven to be very difficult to reverse or 'cure'.

4.1.4.3 Feather clipping

To be able to perform flight and manoeuvre in the air, the role of feathers cannot be overestimated (Beaufrère, 2009). In order to increase control of the birds, different procedures exist in which the wing functions are altered. Pinioning is a permanent surgical alteration or amputation of the distalmost joint of the birds' wing, removing the possibility of flight for the lifetime of the bird. It is banned alongside other mutilations and operative interventions under the Animal Welfare Act (2009) and it will not be discussed further in this report. Feather clipping is another procedure in which the primary feathers of one or both wings are cut. This is performed on mature feathers and involves no pain for the bird (Wernick, 2016). However, the practice involves morphological and aerodynamic alterations that lead to loss of flight capacity and also loss of balance (Aguiar et al., 2026; Harcourt-Brown & Chitty, 2005). The effects of feather clipping last until new feathers have replaced the clipped feathers. Depending on how extensively the clipping was performed, the duration of the effects will vary.

The effects of restricted opportunity to fly will be described under the sections of behaviour.

4.1.4.4 Transport and exhibitions

There are national regulations for public exhibitions of exotic birds in Norway (Animal Welfare Act, 2009; Forskrift om dyrevelferd ved fremvisning av dyr, 2017). The regulation on animal welfare in display of animals describes the need for a suitable living environment and care (§8), that personnel handling the animals should have the necessary level of competence (§5), and that animals should be trained to be exposed to exhibitions (§7). However, both during the transport phase between the home and the exhibition and during such events, birds will be confined in smaller cages. This may result in transport stress and the stress of being in a noisy and unfamiliar environment. Furthermore, as discussed in 4.1.3, birds will be exposed to unknown birds during such events, increasing the risk of exposure to pathogens and spread of disease.

4.1.5 Behaviour

Loss of opportunity to fulfil highly motivated behaviours (described in section 3.5) will quickly lead to poor welfare (Mason & Burn, 2018). Foraging, flying, climbing, social interactions, preening, grooming, and manipulating the environment take up a considerable portion of the day for the bird. Boredom becomes a challenge when these opportunities are not present (Mason & Burn, 2018). The most important hazards are related to housing and management. They can be corrected, but if not, the exposure will be chronic and the consequences for welfare will be considerable and negative. One of the most serious examples concerns birds housed singly and without enough space to fly, which deprives them of two of the most important features of their environment. Problem behaviours such as aggression, fear, phobias, abnormal repetitive behaviours, feather damaging behaviour, and self-mutilation may be the result if their environment does not fulfil their behavioural needs (Harcourt-Brown & Chitty, 2005; Stelow, 2021; Tygesen & Forkman, 2023).

4.1.5.1 Flying and locomotion

The most important and obvious hazard is keeping the birds in too small cages, aviaries, or enclosures, and another is feather clipping. These practices will physically hamper the birds' ability to perform highly motivated locomotion and proper flight where they can vary their speed and direction (Harcourt-Brown & Chitty, 2005). Beaufrère (2009, p. 173) stated that 'Impaired flight can be viewed as an avian lameness'. Even a brief period without flying is expected to reduce welfare, and in the worst case, limitations on flight can last the entire life of the bird and thus be a chronic welfare challenge. Lack of perches and structures to climb on will also reduce welfare.

4.1.5.2 Maintenance behaviour

A major hazard is giving a feed where calorie needs are fulfilled fast, but with little variety of taste, size, structure, and colour, and not making a foraging-related activity part of the feeding routine. Birds spend up to 90% of waking hours foraging and preening in the wild, while in captivity, eating might take less than an hour (van Zeeland et al., 2013). Furthermore, the appetitive phase, i.e. the searching for food, catching of insects, plucking of fruits and buds, and manipulations to extract food (e.g. from hard nuts), are often more or less omitted in captivity (Péron & Grosset, 2014). This loss of behavioural opportunity and physical activity is a chronic welfare challenge (Bergman & Reinisch, 2006; Lumeij & Hommers, 2008; Meehan & Mench, 2006; Péron & Grosset, 2014).

4.1.5.3 Social behaviour

If the bird is kept without social companions, this is a very strong deprivation leading to chronic stress with effects that may persist throughout the bird's life. This also applies to birds kept in inappropriately composed groups (e.g. with no availability of a suitable mate or high levels of aggression). All the species in this report live in social constellations in the wild. A study in Sweden showed that at least 24% of birds in captivity were kept without a companion (Andersson, 2025). It can be assumed that smaller species are more commonly kept with a companion. However, due to space limitations and the costs of buying more than one larger exotic bird, it is reasonable to assume that true social interaction opportunities in the larger birds are very limited, if not non-existent.

4.1.5.4 Reproductive behaviour

Most of the bird species discussed here form pairs for mating. *E. roratus* performs cooperative breeding with flocks of up to eight individuals helping the nesting pair (Billerman et al., 2020). The main hazard associated with reproductive behaviour is lack of partners, which leads to social deprivation. Lack of nest-boxes will also reduce the possibility to perform reproductive behaviours. Another hazard is not having the required social context for mating, as this differs between species (Spoon, 2006); e.g. the pair bond is not strong enough or extra-pair helpers are absent. The welfare effects of not being able to perform reproductive behaviour are, however, not well documented.

4.1.6 Cognition

As attested in section 3.6, the primary cognitive needs of parrots are physical and social. Given that they spend many hours every day in the wild with object manipulation and social

interactions, even a single day without social contact or physical enrichment could cause severe negative stress (Tygesen & Forkman, 2023). Prolonged periods of social and physical deprivation can lead to feather damaging behaviour and eventually to severe self-mutilation (Jenkins, 2001). Keeping of birds without daily physical enrichment in the form of foods to process, natural materials to interact with, and novel objects to manipulate will result in hazards to the cognitive needs. In the social domain, the main hazard is being kept alone without social contact. Even if parrots are kept in pairs, they may still require other social partners, depending on the quality of the pair bond and the specific needs of the species. In contrast, exotic birds in private homes can very seldomly choose a preferred partner to pair with. A suboptimal match will increase the risk of social stress to the birds (de Almeida et al., 2018).

Like humans, parrots are open-ended vocal learners, and early ontogeny probably involves comparably crucial parental facilitation. Children require the back-and-forth social exchange with parents ('serve and return') to develop normal social behaviour and acquire expressive language skills (Donnelly & Kidd, 2021; Kuhl, 2007; Shonkoff & Bales, 2011). Similarly, parrots have extensive bi-parental care and learn calls in the very early stages of life (Berg et al., 2013). It is highly probable that parrots depend on such time with their parents to develop normal social and vocal behaviours (Schmid et al., 2006). An inappropriate social environment in early ontogeny, even for only a short amount of time, may hence irreversibly damage cognitive skills at maturity.

4.2 Consequence characterisation

4.2.1 Nutrition

Thirst, malnutrition, and starvation are all serious welfare challenges. Lack of water will quickly lead to dehydration and death, whereas malnutrition often takes longer manifesting in clinical signs. An inadequate diet can result in nutritional disease, often progressing into chronic illness and reduced quality of life.

The nutritional needs of psittacines have been deduced from what they consume in the wild, from knowledge of closely related species, from the anatomy and physiology of their alimentary canal, and from the nutritional requirements of poultry (Cummings et al., 2022). Commercial seed mixtures have been very popular, backed by the belief that because birds eat seeds, this would mimic their natural diet, and probably also because they are highly palatable and not costly. However, these seed-mixtures do not resemble the natural diet of parrots (Ullrey et al., 1991). Psittacines do not only eat seeds, but rather a mix of fruits, nectar, other plant material, and insects, and often change diet according to season and availability (Ragusa-Netto, 2007, 2024, 2025). In addition, the seeds they are fed in captivity are not the same seeds they would encounter in the wild, and seed-based diets (often dominated by sunflower seeds) are deficient in several vitamins (A, D, E, K, several B-vitamins), minerals (iodine, calcium (inappropriate calcium/phosphorus-ratio), manganese, iron, sodium, zinc, selenium), and essential amino acids (e.g. lysine, methionine), leading to malnutrition (Brightsmith, 2012; Harcourt-Brown & Chitty, 2005; Ullrey et al., 1991). Psittacines are also known to be selective eaters, picking out the tastiest, calorie-dense parts of their food (Chitty, 2023). When fed a seed mixture, this can lead to considerable difference between what the birds are being fed and what they actually ingest, as they have a strong preference for oilseeds such as sunflower

seeds, pumpkin seeds, and peanuts (Kalmar et al., 2010). Some seed-based diets come with a vitamin and mineral coating of the seeds, but as the parrots remove the seed hulls, such coating does not actually improve what the parrots ingest, even though it will improve the overall content of the food (i.e. what is written on the label) (Cummings et al., 2022). A formulated diet can improve nutrition, but it is important that it is tailored to the species. An example of a formula differing from the diet consumed in the wild has for example been found in *Ara* spp. and *Amazona* spp. nestlings. When comparing the crop content of these birds with the hand-feeding formula based on poultry requirements, the hand-feeding formulas contained lower fat, magnesium, arginine, valine, phenylalanine, and much higher levels of calcium and zinc compared to what the nestlings received from their parents in the wild (Cornejo et al., 2022).

Obesity and atherosclerosis are frequently discussed diseases brought about by malnutrition of psittacines in captivity. These will be described more fully below, as will other clinical signs of malnutrition, specific problems connected to calcium homeostasis, iron storage, hyper-, and hypo-vitaminoses. Though most focus has been on obesity, a too low body condition score can also be a welfare challenge as shown for *A. aestiva*. Being either too lean or obese were associated with altered echocardiographic parameters that could indicate reduced cardiac function, though the data were not conclusive (dos Santos et al., 2022). *P. erithacus* have also been reported to be lighter in captivity than in the wild, indicating malnutrition (see species-specific paragraphs below).

4.2.1.1 Deterioration of integument and plumage

Severe malnutrition will affect the skin and feathers. Feather discoloration is therefore a sign of a grave problem. As feathers take long to grow, improvement might not be seen before 18 months after the diet has been corrected (Harcourt-Brown & Chitty, 2005). Insufficient energy and amino acids impair feather growth and may affect a bird's ability to moult.

4.2.1.2 Obesity, atherosclerosis, and hepatic lipidosis

Obesity is described as a common problem in psittacines (Chitty, 2023). It will negatively affect quality of life, is a chronic condition, and can be difficult for caretakers to recognise and act upon. Malnutrition can co-occur with obesity, constituting an additional welfare challenge for the individual and adding to the different clinical signs the birds show (Harcourt-Brown & Chitty, 2005). Lack of knowledge of how much food the bird needs, and how nutrition might need to be adjusted for different life stages and activity levels may exacerbate the problem. A seed-based diet and limited opportunities for flying are risk factors for obesity (Chitty, 2023). In the wild, most psittacines will fly several kilometres per day, and this level of activity cannot be replicated when they are kept as companion animals. In fact, flying may increase energy requirements 6-11 times. Furthermore, wild psittacines might spend 50-90% of the day foraging and actively hopping in the tree canopy (Koutsos & Speer, 2024). In captivity, these activities are greatly reduced. Hence, there is a challenge not to overfeed companion birds. An increased amount of subcutaneous fat increases the prevalence of lipomas, xanthomatosis, osteoarthritis, hepatic lipidoses (discussed later in this paragraph), diabetes, renal disease, cardiovascular disease (atherosclerosis, hypertension), malnutrition, respiratory compromise, reproductive compromise, and herniation (Burns, 2024).

Atherosclerosis is a relatively common problem in companion birds, but with prevalences varying between species (Beaufrère et al., 2013; Koutsos & Speer, 2024). In atherosclerosis,

the walls of the blood vessels thicken and stiffen due to deposits of plaques containing white blood cells, fat, and fibrocytes. The consequence can be coronary heart disease, vessel rupture, and death. Diet is implicated as a risk factor. A study from 2013 estimated an overall prevalence of atherosclerosis to be approximately 7%, but *P. erithacus*, *Amazona* spp., and *Nymphicus* spp. had the highest odds of presenting with atherosclerotic lesions post-mortem, whereas *Cacatua*s spp. and *Ara* spp. had lower odds (Beaufrère et al., 2013). High calorie and fat diets, hypercholesterolemia, and limited physical activity were some of the risk factors identified (Beaufrère et al., 2013).

Hepatic lipidosis is often seen together with obesity and atherosclerosis and is believed to be linked to a high level of serum low-density lipoprotein (Harcourt-Brown & Chitty, 2005).

4.2.1.3 Vitamins

Of the fat-soluble vitamins, A and D have the highest potential to cause hypervitaminosis, as E and K have lower toxicity (Harcourt-Brown & Chitty, 2005). Toxicity and deficiencies of water-soluble vitamins B and C are not considered to be a problem in the same way as vitamins A and D.

Vitamin A toxicosis and deficiency are both frequently described as nutritional challenges in parrots in captivity (Harcourt-Brown & Chitty, 2005). Vitamin A can be added to food and ingested as retinol, or it can be converted from beta-carotene in the intestine as needed (Park, 2006). Parrots getting the majority of nutrients from plants rely largely on obtaining their vitamin A from beta-carotene and may therefore be more susceptible to vitamin A toxicity than omnivores or carnivores (Park, 2006). On the other hand, parrots fed a seed-based diet frequently suffer from vitamin A deficiencies. Both deficiency and toxicity lead to respiratory and alimentary disease and reduced reproductive performance (Park, 2006). Vitamin A deficiency can also cause night blindness and anorexia (Harcourt-Brown, 2009; Koutsos & Speer, 2024). Toxicosis can contribute to iron storage disease as has been reported in lorikeets and *N. hollandicus*, recurrent infections, and pancreatitis (Park, 2006; Péron & Grosset, 2014). *N. hollandicus* fed too high levels of vitamin A showed behavioural changes (vocalisations), pancreatitis, and splenic hemosiderosis (Koutsos et al., 2003). The welfare consequences of both deficiency and toxicity are severe.

The main challenge with vitamin D is deficiency. Birds can synthesise vitamin D3 from cholesterol when they are exposed to ultraviolet sunlight. D3 is then activated by hydroxylation in the liver and kidney (Harcourt-Brown & Chitty, 2005). However, many parrots in captivity may not be exposed to the sun at all or for sufficient duration to produce enough vitamin D3 and will need supplementation in their food. Furthermore, birds kept without exposure to sunlight can suffer from vitamin D deficiency even when this is added to the diet, as exemplified by amazons in captivity (Nightengale et al., 2022). Vitamin D3 deficiency is further described under calcium (4.2.1.4). Excess amounts of vitamin D3 will lead to soft tissue mineralisation (joints, blood vessels, heart) which can be deadly (Burns, 2024). Vitamin D3 toxicity was reported in macaws fed 1000 IU/kg food, which is the general recommended level (Harcourt-Brown & Chitty, 2005). This highlights the fact that species might differ in their requirements and sensitivity, and also that other factors such as exposure to sunlight can influence the levels of vitamins that can safely be added through the diet.

Vitamin E deficiency can reduce reproductive success and be seen as myopathies in young chicks. This has been reported to be more common in *N. hollandicus* than other birds

(Harcourt-Brown, 2009). Vitamin E toxicity is uncommon, but excess can lead to deficiencies in other fat-soluble vitamins (Harcourt-Brown & Chitty, 2005).

Deficiencies and toxicity of vitamin K have not been described for any of the species included in this assessment (Harcourt-Brown & Chitty, 2005).

4.2.1.4 Minerals

Iron deficiency is unusual, but iron storage disease is a severe problem in some species, especially toucans and lorikeets (Harcourt-Brown & Chitty, 2005). Their absorption capacity cannot be well adjusted, and dietary iron is rapidly absorbed and stored in the liver (Koutsos & Speer, 2024). See further details under toucans below.

Calcium is important for conductance in nerves, cardiomyocytes, and skeletal muscles, for the eggshell, and bone homeostasis. Thus, breeding females have a higher calcium requirement for eggshell production and growing chicks for bone growth. Calcium levels in the blood are regulated by vitamin D3, parathyroid hormone, and calcitonin. Hypovitaminosis D will lead to calcium deficiency, and diets lacking in calcium or with a suboptimal calcium to phosphorus ratio will also lead to calcium deficiency (Harcourt-Brown & Chitty, 2005). In chicks, this can result in osteodystrophy, and pathological fractures in birds of all ages. Adults can have hypocalcaemia associated seizures and reproductive problems (Harcourt-Brown & Chitty, 2005). Several of these conditions will be associated with severe pain and dysfunction and constitute a grave welfare problem.

Issues associated with iodine are less common than with iron and calcium, but birds on a poor-quality seed-only diet may develop hypothyroidism, which will then contribute to obesity due to reduced metabolic rate (Harcourt-Brown & Chitty, 2005).

4.2.1.5 Species particularly at risk for certain nutritionally caused challenges

Psittacidae

Macaws may be more sensitive to vitamin D toxicosis than other psittacines (Harcourt-Brown, 2009).

P. erithacus in captivity is prone to malnutrition and to getting hooked on a diet consisting exclusively of seeds (Harcourt-Brown, 2009). When hand-reared, they have been reported to have a higher incidence of osteodystrophy and clinically relevant hypocalcaemia than other species (Harcourt-Brown, 2009). Adults weigh 402–490 g in the wild (Benson et al., 1988). Lower weights were documented in birds in captivity (330 ± 20 g), probably indicating frequent nutritional issues (Flammer et al., 2001).

Psittaculidae

The correct feeding of lories and lorikeets (here *Trichoglossus* spp.) in captivity is complicated (McDonald, 2003). Lories and lorikeets have often been reported to suffer from obesity and hepatic lipidosis, leading to reduced lifespan (Kalmar et al., 2009). Commercial nectar substitutes may have higher vitamin A levels than what the birds need, causing vitamin A toxicity and haemochromatosis (McDonald, 2003). Nectar diets with iron levels below 100 ppm are recommended to avoid haemochromatosis (Harcourt-Brown & Chitty, 2005). Because their natural diet is low in vitamin A, lorikeets may also be more susceptible to vitamin A toxicosis.

Levels as low as 1000 IU/kg may possibly be toxic (Park, 2006). Nectar mixes are prone to bacterial growth, so excellent hygiene is essential (Harcourt-Brown & Chitty, 2005). Lorikeets are susceptible to *Clostridium perfringens* and necrotising enteritis, and this may be due to microbial dysbiosis (i.e. an imbalance in the gut microbiome) (Minich et al., 2022). Necrotising enteritis is frequently deadly and has been reported as a problem in several zoo populations (Minich et al., 2022). Trypsin inhibitors in the nectar-feed could increase susceptibility to this disease (Cabana & Lee, 2019). Lories and lorikeets also feed on fruits, but fruit sold for human consumption has less protein and fibre and more easily digestible sugar than the fruits that would be consumed by lories in the wild. This also must be taken into account as too much fruit may contribute to a negative protein balance (McDonald, 2003). Wild figs contain calcium within recommended level for psittacines, but farmed figs contain less and are not a suitable calcium source for lories in captivity (McDonald, 2003).

Ramphastidae

Toucans and some other frugivorous birds (see *Trichoglossus* spp. above) are at risk of developing iron storage diseases (hemosiderosis/haemochromatosis) in captivity (Cork, 2000; Sheppard & Dierenfeld, 2002). Iron is stored as ferritin and hemosiderin throughout the body, but especially in the liver and spleen. The natural diet of Ramphastidae contains little iron. Thus, they may have evolved an effective uptake of iron from the intestine, whereas current commercial feed often is high in iron. Ingestion of ascorbic acid (vitamin C) and other acids in fruits enhances absorption of iron. It is recommended that diets should be formulated to contain less than 50-100 mg/kg iron on a dry matter basis and fruits rich in vitamin C should be given separately in time (Sheppard & Dierenfeld, 2002).

4.2.2 Physical environment

4.2.2.1 Housing

Lack of adequate housing will result in a welfare challenge for birds in captivity. There must be enough space for free flights and other highly motivated behaviours (Mancinelli & Bament, 2014). This is further specified under 4.2.5.1.

An outdoor aviary will allow for the fulfilment of many behavioural needs such as flying, playing, climbing, and foraging if it is large enough and designed with relevant physical and foraging enrichment (Harcourt-Brown & Chitty, 2005). The birds will need access to an indoor area where they are more protected from the weather so that they are not completely exposed to the elements. In order to express high-speed and vertical flying, the birds need to be let out of the aviary for completely unrestricted flight.

Housing in cages cannot fulfil the birds' welfare needs. Cages can be used for resting, sleeping, and transport, but they are not recommended as the birds' primary residence (Harcourt-Brown & Chitty, 2005). Psittacines and toucans housed in an aviary need a sheltered area during the night.

If birds are allowed to fly indoors, there are several hazards to their safety. Hot stoves, ingestion of toxic food (e.g. salt, avocado), tobacco smoke, fumes from non-stick cooking utensils or hot cooking oils, poisonous plants, and flying into glass, fans, and mirrors can result in lethal injury or intoxication (Harcourt-Brown & Chitty, 2005; Meehan & Mench, 2006). Training the bird to navigate indoors may reduce some of these dangers.

Exposure to a prolonged light photoperiod can induce reproductive behaviour which may in some cases lead to feather damaging behaviour (Seibert, 2006a). Also, sleep deprivation will have detrimental effects on health and welfare, and lead to chronic stress, which again is a risk factor for feather damaging behaviour.

4.2.2.2 Physical enrichment

Increased complexity in the enclosure including physical enrichments and bathing opportunities is essential in providing positive animal welfare for birds in captivity. It is well documented that physical enrichment has a positive effect on welfare in parrots and toucans, reducing self-mutilation and stereotypical behaviours, e.g. in *A. hyacinthinus* (Checon et al., 2020), *A. amazonica* (Meehan et al., 2004), *A. aestiva* (de Sousa et al., 2024), *Pyrrhura* spp. (van Hoek & King, 1997), *A. ararauna* (de Almeida et al., 2018; Miglioli & Vasconcellos, 2021), *P. erithacus* (Lumeij & Hommers, 2008), *N. hollandicus* (Assis et al., 2016), and *R. tucanus* (Alaniz et al., 2022). Furthermore, parrots kept in non-enriched cages show a higher degree of fear towards novelty (Meehan & Mench, 2006). Enrichment is also seen to increase reproductive behaviour in *A. ararauna* (Miglioli & Vasconcellos, 2021).

The amount of time spent interacting with enrichment objects does not directly predict the size of the behavioural changes observed, as even a little time with objects can cause substantial improvements, e.g. in several *Ara* species (Reimer et al., 2016). Perches should be regarded as a fundamental necessity for birds in captivity (van Hoek & King, 1997). However, natural tree branches and ropes made from natural fibres offer birds the opportunity for manipulation and can function as enrichment materials. Even very simple objects, such as bead rings and twigs, can stimulate *N. hollandicus* to play and the interactions positively affect their behaviour (Assis et al., 2016).

Supplying different types of enrichment is important for the welfare of the birds, as individual differences in the response towards environmental enrichments has been observed in *A. ararauna* (de Almeida et al., 2018). Furthermore, the types of enrichment are of significance. *A. amazonica* demonstrated different preferences for colour, hardness, size, and material of the enrichment devices (Kim et al., 2009; Webb et al., 2010). Different preferences for type of enrichment are also seen in macaws (Reimer et al., 2016) and *Pyrrhura perlata* (van Hoek & King, 1997).

Bathing is an important part of feather maintenance behaviour in birds, which is essential for insulation, waterproofing, and flight (Stevens et al., 2021). A study demonstrated that *A. amazonica* in captivity bathed at least once during the day when given the opportunity (Murphy et al., 2011).

4.2.2.3 Foraging enrichment

Foraging enrichments can imitate food search and acquisition that normally would be performed in the wild. Spending more time per day foraging reduces the risks of boredom. Environmental enrichment which predominantly targeted foraging reduced inactive time and self-mutilation behaviours in *R. tucanus* (Alaniz et al., 2022). The provision of different foods, particularly fruits and nuts, engages the animals to forage for a longer period of time. For instance, by encapsulating food into inedible structures, which have to be laboriously torn off, and by also making these items only accessible by solving a manipulation task (e.g. guiding a marble through a maze), *P. erithacus* reached foraging times comparable to over 4 hours in

wild conditions (Beekmans et al., 2023). Making the food simply harder to access also extends feeding time (van Zeeland et al., 2013). *N. hollandicus* is predominantly granivorous yet can spend substantial amounts of time chewing up and consuming collard green stalks, increasing its daily activity period (Carvalho et al., 2017). *A. amazonica* prefers significantly larger pellets than the regular, commercially available size and is willing to exert considerable effort to obtain them. This suggests that they innately prefer food items similar in size to their natural diet (e.g. palm nuts), which must be manipulated before consumption (Rozek & Millam, 2011). Also, parrots occasionally engage in 'contrafreeloading' (i.e. working to access food that could be freely obtained) (Smith et al., 2022), which further supports that they have an innate urge for extractive foraging and need for foraging enrichments.

Playful object manipulations during foraging appear to be intrinsically rewarding. For instance, both *C. alba* and *P. erithacus* frequently choose to peel shelled almonds even when deshelled ones are available (Carroll & Pepperberg, 2025; Smith et al., 2021).

4.2.2.4 Temperature and humidity

Inappropriate temperature and humidity can affect parrot and toucan welfare. The majority of parrot species, as well as toucans, are forest dwelling birds in subtropical and tropical climate zones (Juniper & Parr, 2010). In general, the birds included in this assessment are able to adjust to a range of temperatures (Jackson et al., 2015). However, it is important that they have access to different temperature zones to adjust their exposure to heat and cold according to need. A study in *N. hollandicus* demonstrated behavioural changes with increased temperature, as the birds increased their time spent on the perch, ingested more food, as well as gnawed more on the feeder (Carvalho et al., 2015). Fewer studies are published on humidity, but clinical literature recommends not exposing exotic birds to humidities below 40% as this will increase the risk of respiratory infections, reduce feather quality, and increase the risk of feather damaging behaviour (Harcourt-Brown & Chitty, 2005).

4.2.3 Health

Health is an integral part of animal welfare. It is integrated in the biological functioning approach and is one of the Five Freedoms (FAWC, 1993) and the Five Domains for animal welfare (Mellor, 2016; Mellor & Reid, 1994). Good health is generally necessary for fitness, i.e. for a wild bird to survive and to have reproductive success. Poor health influences affective states and can lead to change in behaviour. If the bird is injured, tissue damage can cause pain from broken bones, wounds, bruises, or torn tissues. Furthermore, an injury may cause loss of physical function for a transient period or permanently, depending on which body part is injured. Reduced or lost body function may affect other feelings and emotions. Impaired ability to fly may increase insecurity, distress, and fear of potential predators due to loss of control. The bird's suffering will depend on both the intensity and duration of the negative feelings and emotions. Birds kept together do not necessarily get along and aggression may occur. In addition to painful lesions, the victim of aggressive behaviour is also at risk of developing negative emotions such as fear, causing chronic stress.

In addition to the direct effects of pain and other negative feelings, traumatic physical injuries may be followed by indirect effects. For example, an injured foot may impair the ability to walk and climb the interior of the enclosure and thus reduce activity level. This may impact the

intake of feed and water. Hence, inactivity and loss of appetite are common signs of poor health.

Diseases have an impact on the animal's affective state. Diseases usually are accompanied by negative feelings such as pain, distress, malaise, nausea, uneasiness, thermal discomfort, weakness, and fatigue, depending on the type of disease (Aubert, 1999; Broom, 1998).

Poor hygiene generally increases the risk of disease. Many infectious diseases have a faecal-oral route of transmission. The number of pathogens in diarrhetic faeces is very high and may scatter across the bird's environment. This means that the interiors of the enclosure including water, feed, and toys can be polluted with faecal material.

Birds' feathers produce dust which may occlude nares and even reach the deeper respiratory system (David et al., 2015). Furthermore, dust particles frequently carry microorganisms that are directly pathogenic or release toxins, increasing the risk of disease.

4.2.3.1 Common health problems in specific species

According to Stanford (2010) common health issues in *Cacatua* spp., *N. hollandicus*, *Amazona* spp., macaws, *P. erithacus*, *Platycercus* spp., *Psittacula* spp., and lories/lorikeets are similar, and include nutritional diseases (obesity, lipomas, thyroid dysplasia, iodine deficiency, bacterial enteritis, hepatitis), bacterial infections (psittacosis), viral diseases (polyomavirus, psittacine beak and feather disease virus, proventricular dilatation disease), *M. ornithogaster*, testicular tumors, CNS disorders, and renal problems. Further common health problems for each species are specified below.

Cacatuidae

Cacatua spp. is prone to behavioural problems associated with sexual maturity (Stanford, 2010).

In *N. hollandicus,* reproductive diseases (e.g. egg over-production) are common (Stanford, 2010). Furthermore, atherosclerosis is relatively frequent in this species (Beaufrère et al., 2013). Ingestion of foreign bodies, primarily from toys, perches, and accessories, is a significant cause of gastrointestinal obstruction in adult *N. hollandicus* (Rosenwax & Cowan, 2015).

Psittacidae

While hypercholesterolemia is common in psittacines, *Amazona* spp. is particularly susceptible (Gustavsen et al., 2016). Furthermore, hepatic lipidosis is common (Stanford, 2010). Atherosclerosis is relatively frequently detected in these species (Beaufrère et al., 2013)

In *P. erithacus,* disorders of calcium metabolism and juvenile osteodystrophy are common (Stanford, 2010). Furthermore, atherosclerosis is relatively common in this species (Beaufrère et al., 2013)

Psittaculidae

Lories and lorikeets are susceptible to bacterial and mycotic infections from contaminated nectar, as well as iron storage disease (Stanford, 2010).

Ramphastidae

Toucans show higher morbidity and mortality rates compared to other bird families kept in captivity (Dislich, 2023).

Iron storage disease is a common health issue and is considered to be the most serious disease of toucans in captivity (Cork, 2000; Powers, 2014; Sheppard & Dierenfeld, 2002).

The most important causes of death in toucans in captivity are related to gastrointestinal diseases, such as the parasite *Capillaria* spp. and bacterial enteritis (Dislich, 2023). Bacterial enteritis and pneumonia will often evolve into septicaemia if not treated in time, and many toucans are found dead without signs of disease being noticed by caretakers (Dislich, 2023).

Diabetes mellitus (in *R. toco*) and atherosclerosis may also occur (Dislich, 2023; Hoppes, 2024). Furthermore, metabolic bone disease, yersiniosis, yeast and fungal infections, and avian tuberculosis are common health issues (Stanford, 2010).

Toucans are highly inquisitive birds which often will pick up and ingest objects such as rocks, pieces of wood, screws, strings, and coins. These foreign bodies may cause inflammation or even perforate the gastrointestinal tract, which may lead to death (Powers, 2014).

4.2.4 Husbandry practices

4.2.4.1 Caretaker's capacity and knowledge

It is of major importance for animal welfare to have a well-informed caretaker. If the caretaker does not possess the knowledge or ability to provide the bird with the appropriate husbandry practice, it is equally important that the caretaker seeks out resources to enable informed decisions for the health and welfare of the birds. A survey among parrot caretakers demonstrated that respondents who provided environmental enrichments or were familiar with flight training, were less likely to perform feather clipping on their birds (Aguiar et al., 2026). Early signs of disease may be vague and difficult to detect, which may delay treatment until the bird is severely sick and beyond effective treatment or dead. Basic knowledge about avian health in general and the individual birds' behaviour in particular can aid the caretaker in seeking veterinary help when needed. Another important aspect is the caretaker's capacity and knowledge to plan for the whole lifespan of the birds. Several exotic bird species have lifespans (Table 2) far exceeding other pets such as dogs and cats, and changes in the life situation or health of the caretaker may lead to the bird being at risk of neglect or given up for rehoming (Bradshaw & Engebretson, 2013).

4.2.4.2 Social interaction

If the caretaker keeps only one parrot, some argue that human-bird interactions may alleviate some of the welfare risks seen from social isolation. Birds do become emotionally attached to their caretakers, and studies have described how both macaws and cockatoos display positive affect towards known humans (Bertin et al., 2018; Bertin et al., 2020; Bertin et al., 2023). Problems arise whenever the human cannot stay at home with the bird all the time. Tygesen & Forkman (2023) reported an increased risk of feather damaging behaviour in parrots left alone for more than 6 hours daily. It is also questionable whether humans can completely fulfil the social needs of parrots and toucans.

4.2.4.3 Hand-rearing

Hand-rearing (i.e. removing the chicks completely from their parents in order to feed and handle them), is performed with the motivation to produce tamer birds (Aengus & Millam, 1999). However, this is a risk factor for the development of many behavioural problems (Wilson, 2022a, 2022b). In most parrots, both parents remain in close affiliation with their offspring for several months post-fletching, and the lack of conspecific interactions during this period are likely to have lifelong effects on cognition. In addition, removing chicks from their parents is most likely distressful for both parents and chicks. In mammals, physiological development is disrupted after maternal separation, and the stress axis is changed as a consequence (Fox, 2006).

A consequence of hand-rearing may be a deficient social cognition due to a lack of social learning from conspecifics during ontogeny. In *N. hollandicus*, it was shown that pairs composed of hand-reared birds had altered nest-related behaviour and significantly lower reproductive success than parent-reared ones (Myers et al., 1988). Furthermore, pairs without a parent-reared male had no offspring reaching fledging stage in this specific study. Hand-reared birds may sexually imprint on humans and choose their caretaker over a conspecific as mate, not least because caretakers inadvertently provide reproductive cues: feeding, petting, and providing a nest (Van Sant, 2006). This results in birds that prefer humans over conspecifics which leaves lasting negative effects on their ability to mate and reproduce naturally (Fox & Millam, 2006; Myers et al., 1988; Piseddu et al., 2024). This may also be at the root of some common behavioural problems in parrots in captivity, leading to frustration and attention-seeking. Birds may direct sexual behaviour, both courtship and aggression, towards their human caretakers. In addition, hand-reared chicks fed by the caretaker will not receive the parental microbiota transferred from parent to offspring during feeding (Harcourt-Brown, 2009). Therefore, letting the parents feed their chicks will give better digestive health and welfare.

In *A. amazonica*, hand-rearing altered social preferences (Fox, 2006). Hand-reared parrots showed a preference for staying close to a human handler rather than conspecifics in a choice test, whereas parent-reared parrots stayed closer to the parrots. Interestingly, parrots that had been handled but reared by the parents showed approximately equal preference for humans and parrots. Hand-reared *P. erithacus* developed stereotypies more often, were more aggressive, more selective towards humans, and begged for food more often (Schmid et al., 2006).

Parrots develop their idiosyncratic contact calls in early life and probably learn how to apply them in a wider social environment (Berg et al., 2011). The absence of acoustic tutors during critical periods could prevent this development and irreversibly negatively affect social cognition in adults. Hand-reared birds are more likely to learn human vocalisations and less likely to perform species-specific calls (Fox, 2006).

Hand-rearing was also found to influence the development of neophobia as hand-reared birds were initially markedly less neophobic than parent-reared birds (Fox, 2006). However, at 180 days of age, when neophobia begins to decline in parent-reared birds, hand-reared birds showed an abrupt increase in fear of a novel object. At 12 months of age, the response to a novel object was quite similar in the two rearing groups. Nevertheless, this altered developmental trajectory of response to novelty may be the underlying cause of phobic behaviour in juvenile parrots, in which a previously tame parrot suddenly shows strong fear

towards a wide range of stimuli around the age when it would normally leave its parents in the wild (Fox, 2006).

On the other hand, parent-reared birds exposed to neonatal handling showed reduced aggressiveness, reduced fear, and reduced feather damaging behaviours later in life (Collette et al., 2000; Fox & Millam, 2004), compared to only hand-reared birds (Costa et al., 2016; Ebisawa et al., 2021).

4.2.4.4 Feather clipping

The procedure of feather clipping is performed to make the bird easier to control, either to ensure less risk for escaping when providing outdoor access or when moving around in a house or flat (Harcourt-Brown & Chitty, 2005). It may also be carried out as a breeding management practice to reduce effects of male aggression and prevent mate trauma (Meehan & Mench, 2006). However, in the latter case, it will not reduce the aggression of the male towards the female but merely reduce his ability to physically attack (Harcourt-Brown & Chitty, 2005).

There are several ways to perform feather clipping (Wernick, 2016). Being effective for reducing the bird's ability to fly, the unilateral cut will also render the bird unbalanced and thus increase the risk of injuries from falling when jumping or climbing (Harcourt-Brown & Chitty, 2005). Furthermore, in addition to impaired flight, feather clipping is associated with broken blood feathers (Aguiar et al., 2026).

To what extent feather clipping is performed on exotic birds in Norway is unknown. In a questionnaire survey from Brazil, 65% (n=534) of the bird caretakers reported that their birds were already feather clipped upon arrival (Aguiar et al., 2026).

4.2.5 Behaviour

In this section, we describe behaviours that are signs of poor welfare, serve as welfare indicators, and welfare consequences of not having the opportunity to perform highly motivated behaviours. Behaviours caused by poor welfare are often referred to as problem behaviours and stereotypies (Piseddu et al., 2024, 2025).

Many behavioural indicators of poor welfare have been described in literature. Birds becoming apathetic, showing anhedonia, or not interacting with their favourite foods or toys are clear warning signs that something is wrong (Meehan & Mench, 2006). Feather damaging behaviour, incessant screaming, excessive aggression, fearfulness, and stereotypies are commonly described (Meehan & Mench, 2006; Piseddu et al., 2024). Stereotypies can be classified as oral, locomotor, or object-oriented and are extremely common when parrots are housed in cages without foraging opportunity or physical complexity and they may persist after the original cause has been attended to (Meehan & Mench, 2006; Piseddu et al., 2024). In a study of amazons housed in barren conditions, 96% developed stereotypies (Meehan & Mench, 2002). Stereotypies may take up the majority of the bird's waking time. However, in some cases the stereotypy is only performed when alone, making it harder to detect (Meehan & Mench, 2006; Piseddu et al., 2024). Regardless, stereotypies are associated with frustration and poor psychological welfare (Garner et al., 2003). In addition to being a sign that the environment is not meeting the needs of the bird, maladaptive behaviours can develop into stereotypies or make it difficult for the caretaker to handle or train the bird (Kaytee Avian

Foundation, 2010), contributing to a vicious circle in which the parrot is handled and stimulated even less.

4.2.5.1 Flying and locomotion

Common for all the exotic bird species included in this assessment is their natural flight and movement across relatively large distances (several kilometres) during the day.

The captive environment will restrict this movement and ability to fly, even if the bird is kept in a large and spacious cage or an aviary. Many species can reach speeds of 30-40 km/h, and they also fly vertically (Razmadze et al., 2018). An enclosure will have to be large to allow the maximum speed to be reached without the bird having to interrupt the flight immediately, and with a considerable roof-height to accommodate vertical movement. For a bird to fly at 30-40 km/h for 5 seconds (Broom, 2002), 42-55 meters are needed. Thus, it is highly unlikely that unrestricted, fast flight, and vertical flight, is provided to the majority of psittacines and toucans in captivity, unless they are allowed free, unrestricted flight outdoors.

There are few studies on the long-term consequences on welfare of restricted flying possibilities, but low physical activity is described as one of the factors contributing to obesity in companion birds and has also been suggested as a risk factor for feather damaging behaviour (Seibert, 2006a). In general, birds will work hard to obtain the possibility of performing natural behaviours, indicating high motivation (Mason & Bateson, 2002). A study in *E. roseicapilla* indicated high motivation for and positive affect after flying (Massen et al., 2022). The birds showed more appetitive behaviours after flying, and flying was associated with optimistic choice in a cognitive bias test. Flying is a highly motivated behaviour, and a bird without this opportunity will experience frustration, boredom, and chronic stress, which may manifest as stereotypies or feather damaging behaviour, in addition to impaired health from lack of physical activity (Harcourt-Brown & Chitty, 2005; Mason & Bateson, 2002; Mason & Burn, 2018). Loss of flight capacity has been associated with chronic pain, reduced cardiorespiratory fitness, and reduced life expectancy in psittacines (Aguiar et al., 2026). A study in great mynahs in captivity (*Acridotheres grandis*) demonstrated that muscle mass is reduced and deteriorates fast if not used in an appropriate manner (Peng et al., 2013).

4.2.5.2 Maintenance behaviour

When stressed, *N. hollandicus* preen in brief bursts rather than longer bouts and stays vigilant (Turpen et al., 2019). Birds with lower stress hormone levels (i.e. corticosterone) after handling tended to have longer preening bouts more focused on grooming their feathers than staying focused on their surroundings. This indicates that stress could disrupt preening and thereby the functioning of the feathers. However, birds may also preen more in response to chronic stress, as preening may be used as a displacement behaviour (Seibert, 2006a). This may develop into feather damaging behaviour, in particular if the stress is inescapable and chronic (Garner et al., 2006).

Reduced or no foraging possibilities have been suggested as one of the factors leading to feather damaging behaviour in companion birds (Seibert, 2006a; Turpen et al., 2019). In a recent review, lack of physical and foraging enrichment was associated with poor welfare, e.g. changes in maintenance, locomotor, exploratory, and social behaviours, increased stereotypies, and feather damaging behaviours (Piseddu et al., 2024). Feather damaging behaviour is a strong indicator of poor welfare in psittacines in captivity. Meehan & Mench

(2006) examined one group of young *A. amazonica* which were served their food in a dish every day and had no environmental enrichment. Meanwhile, another group had to work to get their food out of a feeder. The latter group did not develop feather damaging behaviour, whereas the majority of the first group did. In phase two of the experiment, the birds that had developed feather damaging behaviour were also given enrichment and had to work to get their food from their feeder. After four months, the feather damaging behaviour of all six birds was resolved (Meehan & Mench, 2006). Parrots that must work harder to get their food in the wild are more prone to develop feather damaging behaviours in captivity (Mellor et al., 2021). These results highlight the importance of foraging behaviour and enrichment to parrots.

Feathers are important for flight, thermoregulation, protection from the weather, camouflage, and communication, so when feathers are damaged, all these essential functions deteriorate, and the birds' demand for nutrients will increase (Meehan & Mench, 2006). Blood may be lost through damaged feather and damaged soft tissue, and there is risk of secondary infections. *P. erithacus*, *E. roseicapilla*, macaws, cockatoos, and *E. roratus* often show feather damaging behaviour (Doneley, 2003; Piseddu et al., 2025; Seibert, 2006a). However, determining which species has the highest likelihood of developing feather damaging behaviour is not straight forward, as other factors such as rearing, housing, and age will influence the expression of this behaviour (Andersson, 2025; Kinkaid et al., 2013; Piseddu et al., 2024).

4.2.5.3 Social behaviour

Inappropriate and/or inadequate social interactions and contact is deleterious for welfare and a risk-factor for the development of feather damaging behaviour. In a recent Delphi consultation survey (i.e. a survey where experts answer questions anonymously in multiple rounds), experts reached a 84-100% agreement that level of social contact, frequency of social separation events, free vs. imposed choice of partner, and social housing (alone vs. pair vs. group) all have a high impact on parrot welfare (Piseddu et al., 2025). Birds housed singly showed more stereotypies and less preening than birds housed in pairs (Williams et al., 2017). In the wild, parrots will often sleep, rest, preen, and forage in close proximity to each other, and they will also have physical contact during allopreening (Seibert, 2006b). In captivity without this possibility, the birds might experience a lack of safety, as they do not have the protection of the flock, and without a partner they cannot preen feathers which are out of reach. Birds kept in separate cages but with visual contact will still miss the possibility of being in close proximity and allopreening. Allopreening often occurs between reproductive partners, but also between siblings and in same-sex relationships and is interpreted as sign of a social bond (Seibert, 2006b). Singly kept amazons were more fearful of a novel object than birds raised in pairs, indicating that a social partner can mitigate fear (Meehan & Mench, 2006). The singly housed birds also spent twice as much time screaming than pair-housed individuals, even when the single parrots had visual and auditory contact with other birds. This highlights the difference between merely visual vs. visual and physical contact (Meehan & Mench, 2006). For some species, such as *P. erithacus*, being kept in pairs will not fulfil their social needs as they live in a lot more complex social constellations in the wild. Social isolation in *P. erithacus* has been related to shorter telomere lengths (a natural process of aging), which is evidence for chronic stress and relates to shorter lifespans (Aydinonat et al., 2014).

In VKMs assessment, housing in inappropriately composed groups carries highly comparable risks to the far more often studied social isolation. As the birds' social life gives them the

opportunity to exert their cognitive abilities, the effects of social deprivation are also described under 4.2.6.

4.2.5.4 Reproductive behaviour

Very few large parrots are kept in pairs or flocks in private homes due to costs and space restrictions. This means that the birds seldom are able to choose their preferred mate. In breeding facilities this may, however, be better accommodated by the caretakers, as systems facilitating successful breeding are often adopted.

Cavity-type nest boxes are important for reproductive success in captivity. *N. hollandicus* clearly preferred cavity-type nest boxes when tested in a choice experiment, and even those individuals who did not use this cavity-type nest box for their first clutch eventually changed preference and used the cavity-type box (Martin & Romagnano, 2006). Well-elevated and enclosed nests and roosts will mimic tree cavities, with wood being preferred over PVC or other materials.

Mate trauma is another welfare challenge in birds in captivity linked to reproductive behaviour. A group of cockatoo species, referred to as white cockatoos, are stated to be most likely to show this behaviour, but it has also been seen in macaws, amazons, conures, *Eclectus* spp., *P. krameri*, and toucans (Romagnano, 2006). Except in *Eclectus* spp., it is most often the male that attacks the female. It has been reported that females rescued from an attack will be very hungry and thin, indicating that the relationship between the birds deteriorate some time prior to the attack, and that the female is bullied away from the food (Romagnano, 2006). The reason for mate trauma is not known, but possible contributing factors are daylength (through effects on hormones), cage-size, non-optimal matching of birds, asynchronous reproductive activity, or thwarting of aggression.

4.2.5.5 Species-specific behaviour problems

Cacatuidae

92% of parrot expert participants disagreed with the statement that the *C. alba* should be kept as a companion animal in a recent Delphi survey, and 87% agreed with the statement that cockatoos in general (excluding *N. hollandicus*) should not be kept as pets (Piseddu et al., 2025). Furthermore, there was a high level of agreement (from 93-100%) that cockatoos (excluding *N. hollandicus*) are at high risk for developing feather damaging behaviour, aggressiveness, and hormonal behaviour. Two surveys estimated the prevalence of feather damaging behaviour to between 40 and 50% in *Cacatua* spp. (Jayson et al., 2014; Kinkaid et al., 2013). Furthermore, cockatoos were also reported to often develop a mate bond with their caretakers. Some cockatoo species are at high risk for performing mate trauma (Romagnano, 2006).

In another survey, 7% of *N. hollandicus* were reported to show feather damaging behaviour (Costa et al., 2016).

Psittacidae

Feather damaging behaviour is described in amazons. Two surveys estimated the prevalence to 10% and 15% for *A. aestiva* and *A. amazonica* (Kinkaid et al., 2013; Costa et al., 2016). They are prone to develop territorial aggression (Welle & Luescher, 2006).

Macaws are predisposed to develop feather damaging behaviour (Seibert, 2006a; Stanford, 2010). In two surveys, the prevalence in *A. ararauna* was 7% and 15% (Kinkaid et al., 2013; Costa et al., 2016).

P. erithacus very commonly performs feather damaging behaviour in captivity (Harcourt-Brown, 2009), with a prevalence of 18% and 22.5% in two surveys (Kinkaid et al., 2013; Costa et al., 2016). They have anecdotally been reported to develop fear biting and territorial aggression more often than many other species (Welle & Luescher, 2006).

Psittaculidae

Eclectus spp. is reported to be predisposed to develop feather damaging behaviour due to poor welfare (Seibert, 2006a), e.g. 40% in a survey (Kinkaid et al., 2013).

Ramphastidae

In the breeding season, toucans may become very aggressive towards other toucans and cause severe injuries (Dislich, 2023). They may also kill or mutilate their own nestlings (Mikich et al., 2001).

4.2.6 Cognition

The observable indications of the cognitive needs not being met are abnormal behaviours and consequences are feather damaging behaviour, self-mutilation, and other conditions discussed in 4.2.5. If physical and socio-cognitive needs are not met at all, these negative welfare consequences are almost guaranteed to occur. Even if some environmental enrichment is provided and the animals are not kept solitary, these consequences can arise. The enrichment may be insufficient in diversity. *A. amazonica* in isosexual pairs were more active and showed a more diverse behavioural repertoire than individually housed amazons (Meehan et al., 2003a). However, two birds kept together may not have matching personality types, which can lead to high intrapair aggression (Fox & Millam, 2014). In an experiment with attempts to pair amazons, not all pairs succeeded, but none of the birds chose to actively avoid another (Douglas et al., 2024). Interestingly, personality profiles could be used to increase the probability for pairings ending in successful cohabitation.

No data were found specifically for the long-term effects on cognition from suboptimal husbandry. However, there is evidence that abnormal behaviours have far reaching neurological effects, which may become irreversible. For example, *A. amazonica* showing stereotypical behaviours appear to have 'a general disinhibition of the behavioural control mechanisms of the dorsal basal ganglia' (Garner et al., 2003, p. 125). Parrots in captivity trained less than once a week tended to show more feather damaging behaviour and more stress-related behaviour (Tygesen & Forkman, 2023).

4.3 Risk characterisation

In this section, the magnitude of the welfare consequences of the welfare challenges described in 4.1 and 4.2 is assessed as is the likelihood of this welfare challenge having the estimated welfare effect *given that* the welfare challenge is present. This approach was chosen due to the nature of the welfare challenges and the available data as determining the likelihood of a welfare challenge occurring, such as being fed a seed-based diet or being kept in a small cage, could not be done based on the literature. The risks are quantified as Low, Medium, or High. The level of confidence for each risk characterisation (section 2.2.4 and table 3) is indicated by fonts (*low*, medium, or **high**) (Figure 2-10).

4.3.1 Nutrition

4.3.1.1 Seed-based diet

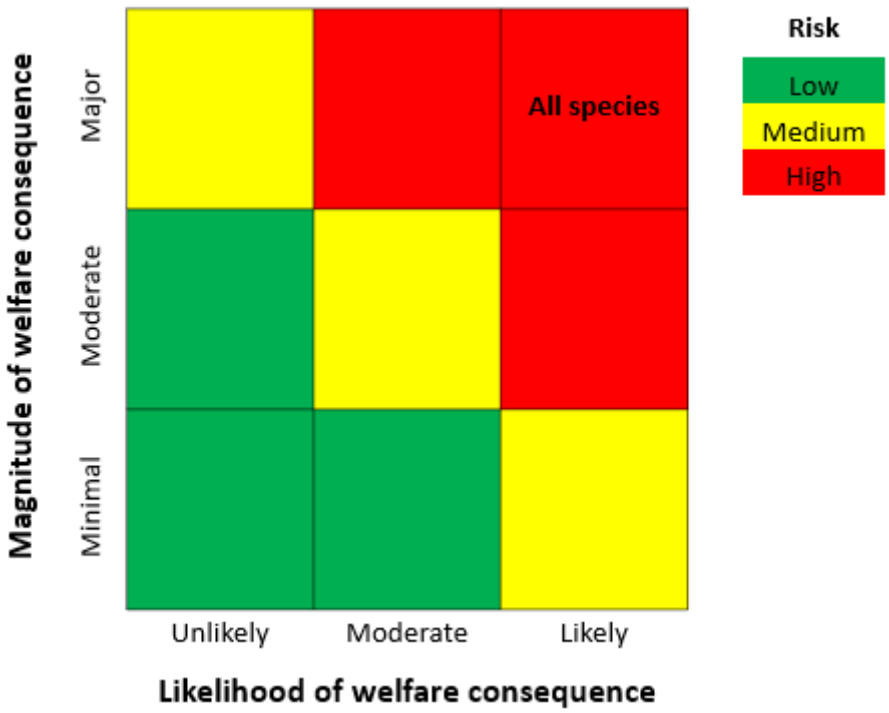

Figure 2. The risk characterisation based on the likelihood of welfare consequence if the birds are fed a seed-based diet and the magnitude of the welfare consequence.

There is a **high** risk of reduced welfare with **high confidence** for all species in this report if fed a seed-based diet. This is based on seed-based diets being deficient in several vitamins (A, D, E, K, several B-vitamins), minerals (iodine, calcium (inappropriate calcium/phosphorus-ratio), manganese, iron, sodium, zinc, selenium), and essential amino acids (e.g. lysine, methionine), leading to malnutrition, secondary hyperparathyroidism, and obesity.

4.3.2 Health

4.3.2.1 Non-infectious diseases and infections with microorganisms present in the environment

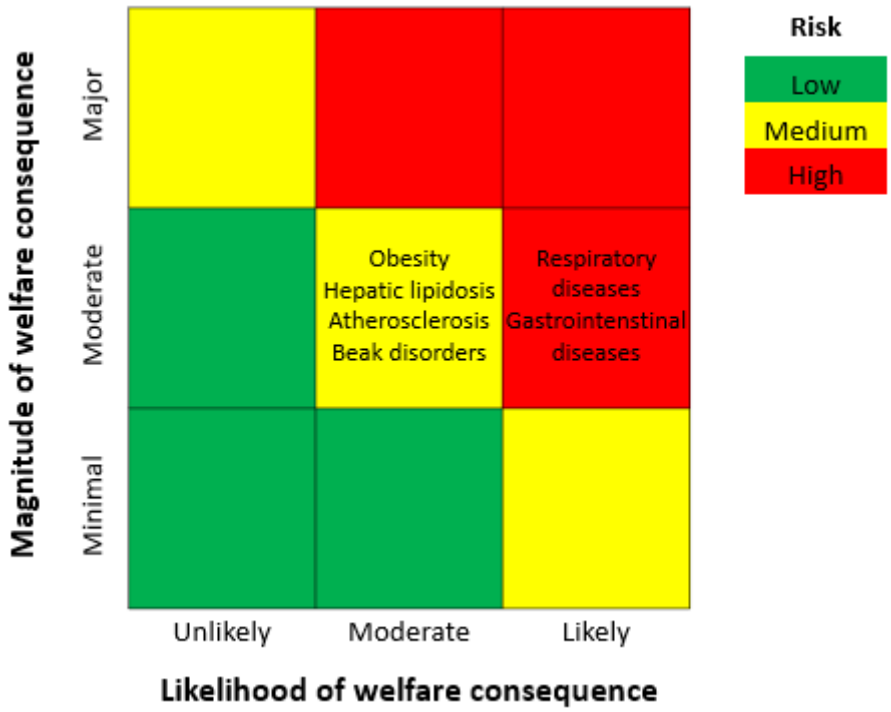

Figure 3. The risk characterisation based on the likelihood of welfare consequence of non-infectious diseases and infections with microorganisms present in the environment and the magnitude of the welfare consequence.

Birds that have been in the same household for a long time and originate from well controlled captive conditions have generally a low risk of being affected by contagious infectious diseases. This is based on the condition that no new birds have been introduced, and birds and caretakers do not visit other bird households. One exception is pathogens, such as salmonella, which can be introduced via contaminated feed. However, even birds kept under very stable conditions may be infected with opportunistic pathogenic microorganisms (i.e. microorganisms which are commonly present in most environments) and develop disease. Usually, this occurs when the bird is previously debilitated, has a weakened immune function due to age (very young or old), malnutrition, underlying disease, or lives in poor environmental conditions.

Participation at shows, exhibitions, or other gatherings where birds from different households meet will increase the risk of exposure to these diseases. Furthermore, susceptibility may be increased due to stress from transportation and being in a noisy and unfamiliar environment.

VKM assessed a **high** risk of negative welfare consequences with **medium confidence** of respiratory diseases in birds in captivity housed under stable conditions. This is based on birds being more sensitive to unhygienic conditions than mammals. Birds living indoors in Norway

may be subjected to unsuitable air quality with low humidity (especially in winter) and dust particles, which could exacerbate respiratory diseases.

Gastrointestinal disease as a result of opportunistic infections will result in a **high** risk of reduced welfare with **medium confidence**. Bacterial gastroenteritis can lead to a wide range of clinical signs varying in severity. A chronic low-grade infection will have a lower welfare consequence than a severe clostridial overgrowth with toxin production and collapse. The assessment is based on the intrinsic severity of some conditions and the potential for worsening of the milder manifestations.

Atherosclerosis, obesity, and fatty liver will result in a **medium** risk of reduced welfare with **medium confidence** for affected birds, especially in amazons, macaws, and *P. erithacus*. Diets high in calories and fat, hypercholesterolemia, and limited physical activity will increase this risk.

Beak disorders will result in a **high** risk of reduced welfare with **medium confidence** for the bird. The disorders include overgrowth, malocclusion, disease, and fractures. The confidence level estimate is based on that beak disorders could reduce their ability of food manipulation and feeding, social and sexual interaction, locomotion, thermoregulation, and respiratory distress.

4.3.3 Housing and husbandry-related factors

4.3.3.1 Housing in cages

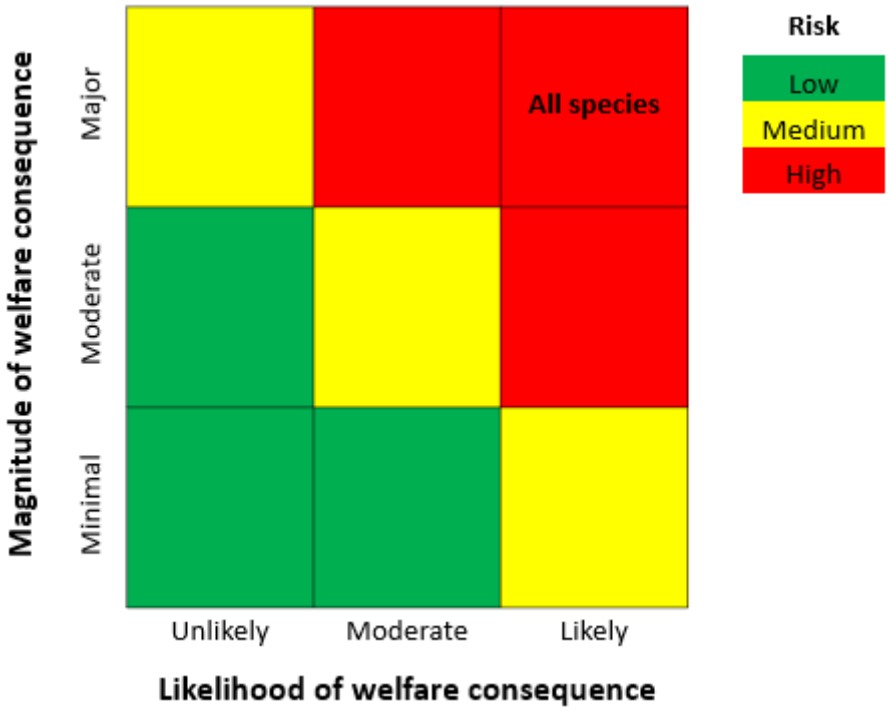

Figure 4. The risk characterisation based on the likelihood of welfare consequence of being housed in cages and the magnitude of the welfare consequence.

There is a **high** risk of reduced welfare with **high confidence** for all species kept in cages without the possibility of performing natural flying behaviour. This is based on flying being a highly motivated behaviour, and a bird without this opportunity is highly likely to experience frustration, boredom, and chronic stress, in addition to impaired health from lack of physical activity.

4.3.3.2 Lack of environmental enrichment

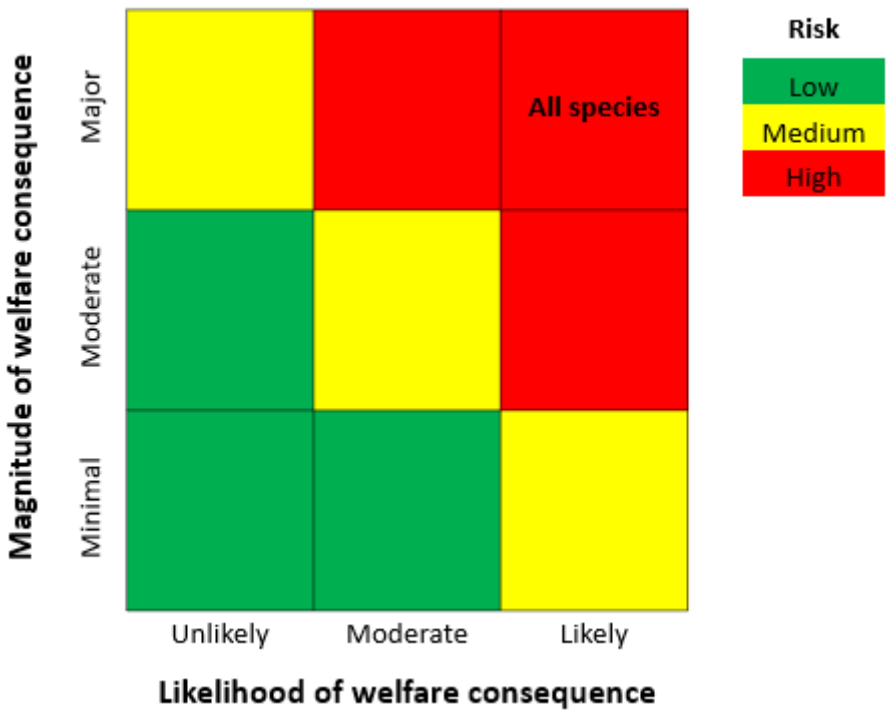

Figure 5. The risk characterisation based on the likelihood of welfare consequences of lack of environmental enrichment and the magnitude of the welfare consequence.

All species in this report require daily physical and foraging enrichment. It is necessary to provide a high variety and frequent refreshment of novel toys and other materials to interact with, including water for bathing or showering, as well as enrichment stimulating foraging behaviour. If the bird is not provided with environmental enrichment there is a **high** risk with **high confidence** of reduced welfare for all species. This is based on a barren environment increasing the risk of poor welfare shown as e.g. stereotypies, feather damaging behaviour, and on the beneficial effect of enrichment on welfare, health benefits of physical activity, and cognitive stimulation.

4.3.3.3 Hand-rearing

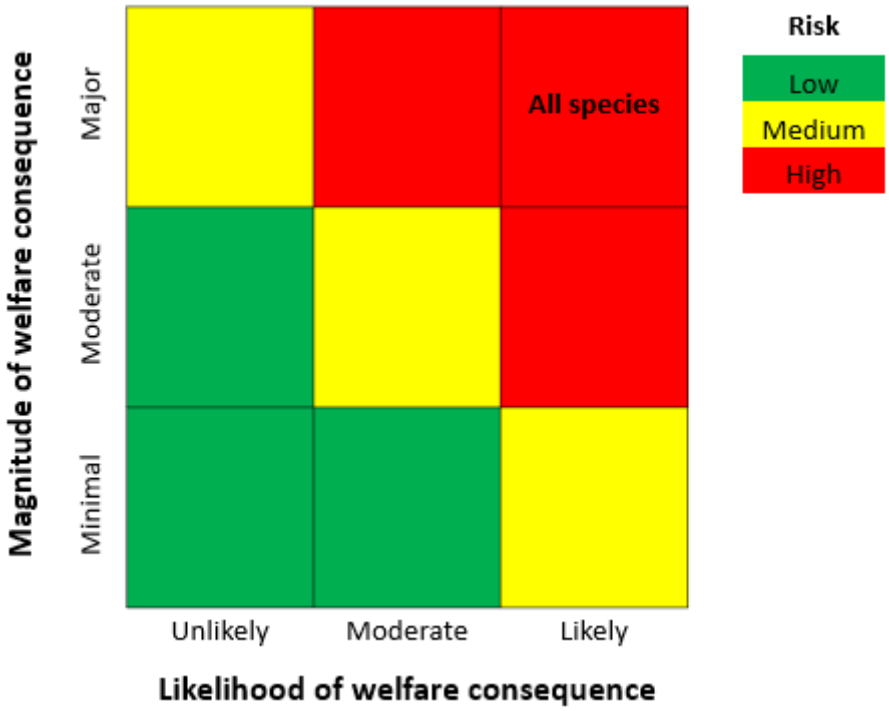

Figure 6. The risk characterisation based on the likelihood of welfare consequences if the birds are hand-reared and the magnitude of the welfare consequence.

There is a **high** risk of poor welfare in birds with **high confidence** subjected to hand-rearing. This is due to extensive information of a higher risk of developing stereotypic behaviour, effect on social cognition and sexual imprinting, increased aggression, and development of feather damaging behaviour.

4.3.3.4 Feather clipping

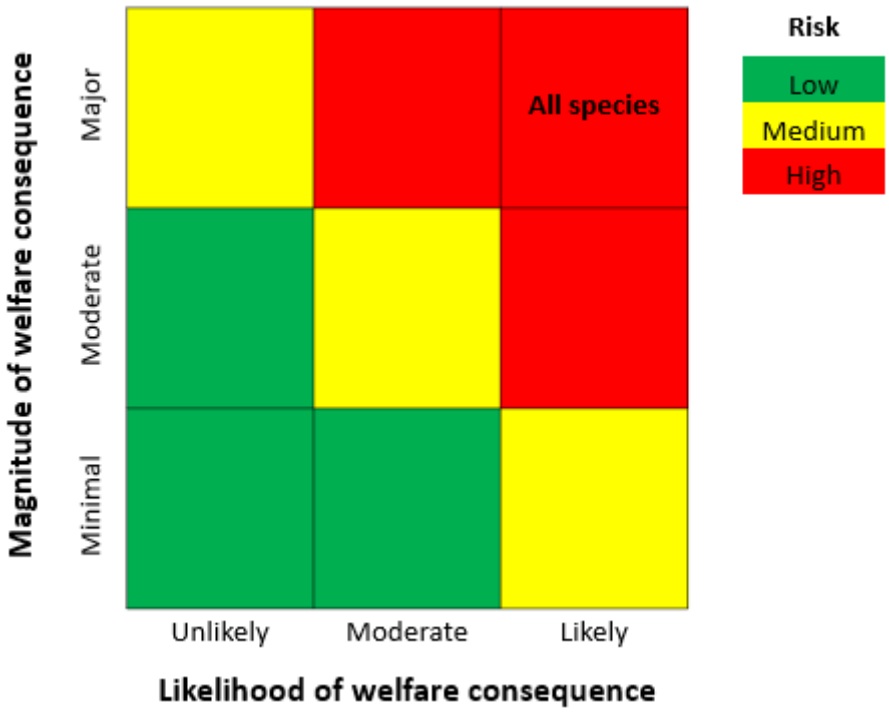

Figure 7. The risk characterisation based on the likelihood of welfare consequences if the birds are feather clipped and the magnitude of the welfare consequence.

The welfare risks of feather clipping are **high** with **high confidence** in all species included in this report. The assessment is based on well documented adverse effects of feather clipping, and inhibited flight and reduced locomotion have the potential to result in severe welfare issues.

4.3.3.5 Singly kept birds

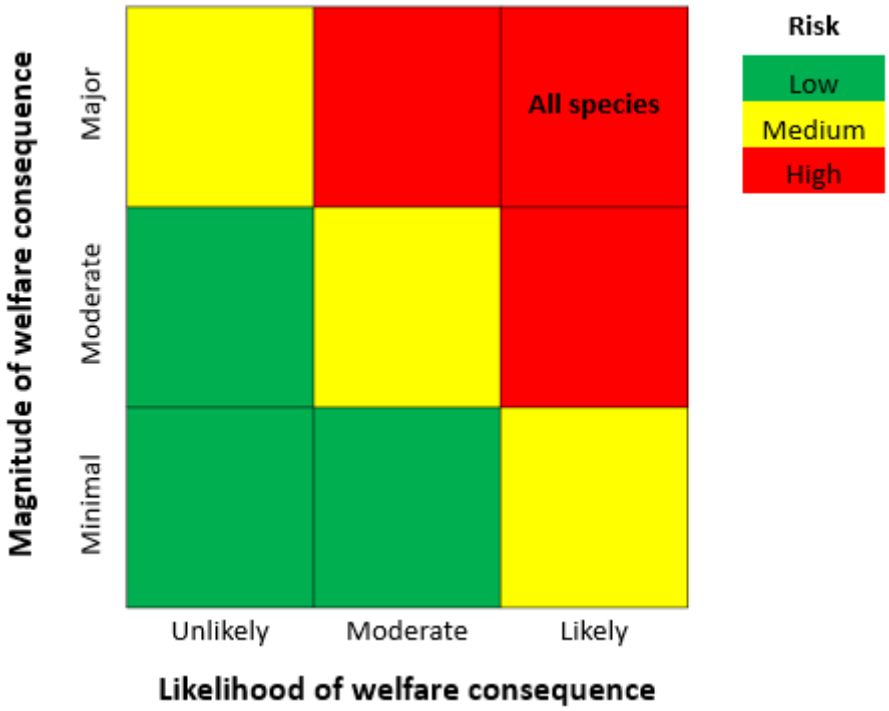

Figure 8. The risk characterisation based on the likelihood of welfare consequences for singly kept birds and the magnitude of the welfare consequence.

The risk of reduced welfare for singly kept birds is assessed to be **high** with **high confidence** for all species included in this report. In this report, singly kept birds include birds that are taken out of their enclosure and offered interaction with humans, as they are still isolated from physical contact with conspecifics over longer periods of time. While a human caretaker could partially fulfil some socio-cognitive needs, for most species this would require approximately six hours of proactive social interactions with the bird every day, and it would still not fulfil the need to carry out species-specific social behaviour. The mere presence of the caretaker would not be sufficient. Hence, keeping any of the species in this report permanently without conspecifics will, in the majority of cases, lead to severe mental impact, and subsequently to physical, welfare, and health risks. The high confidence is due to the many negative effects of social isolation that have been described. Studies have pointed out that birds may become very attached to their caretakers. There are caretakers that spend time with their bird 24/7, but more commonly, caretakers need to leave the house for longer periods. Social isolation does not need to last longer than a few hours per day to produce negative effects for the birds. Housing birds permanently with visual, but not physical contact with conspecifics will not fulfil their social needs.

It is, however, important to note that there might be situations where birds need to be separated temporarily due to diseases, treatment, or during breeding.

4.3.3.6 Birds kept in pairs

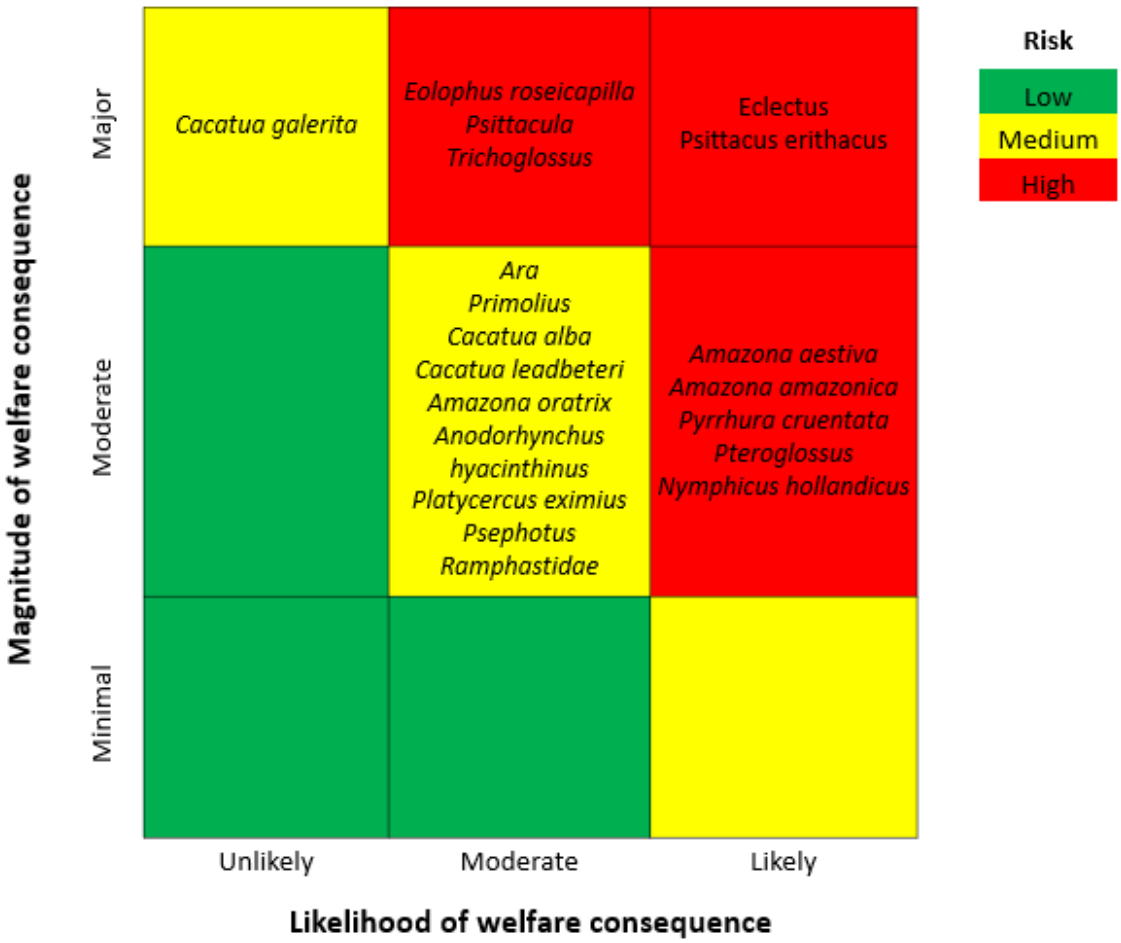

Figure 9. The risk characterisation based on the likelihood of welfare consequences for birds kept in pairs and the magnitude of the welfare consequence.

Keeping the majority of the species in this report in pairs is highly probable to significantly reduce the risks of not fulfilling socio-cognitive needs compared to keeping them in social isolation. However, as outlined below, all species will benefit from being housed in a larger group. In addition, there are complicating factors regarding how birds are paired. In other words, since the birds are not able to choose their partner, the pairs might not be fully compatible, which means that pair keeping arranged in a no-choice situation probably carry a higher welfare risk than if the birds had been able to choose their partner.

The risk of negative impact of birds kept in pairs is **high** with **medium confidence** for *Eclectus* spp. and *P. erithacus*. *Eclectus* spp. has a mostly polyandrous mating system, which is not compatible with classic pair keeping. *P. erithacus* forms many social bonds of differing quality and are unlikely to have their socio-cognitive needs met with only one strongly bonded individual.

E. roseicapilla, *Psittacula* spp., and *Trichoglossus* spp. have a **high** risk of reduced welfare with **low confidence** if kept in pairs. This assessment is based on some species living permanently in larger aggregations, with some breeding in proximity of other pairs of their flock (e.g.

E. roseicapilla). These species would also substantially profit from more than one social partner.

A. aestiva, *A. amazonica*, *P. cruentata*, *Pteroglossus* spp., and *N. hollandicus* have a **high** risk of poor welfare with **low confidence** if kept in pairs. This assessment is based on these species having less strong pair bonds with more extra-pair connections (e.g. *N. hollandicus*).

The risk of negative impact of birds kept in pairs is **medium** with **low confidence** for *C. galerita*. This species forms strong pair bonds but also becomes fiercely territorial during the breeding season, and if pair partners are not fully compatible, this aggression can also be directed at the partner.

The risk of negative impact of birds kept in pairs is **medium** with **low confidence** for *Ara* spp., *Primolius* spp., *C. alba*, *C. leadbeateri*, *A. oratrix*, *A. hyacinthinus*, *P. eximius*, *Psephotus* spp., and *Ramphastidae* spp.

4.3.3.7 Birds kept in flocks

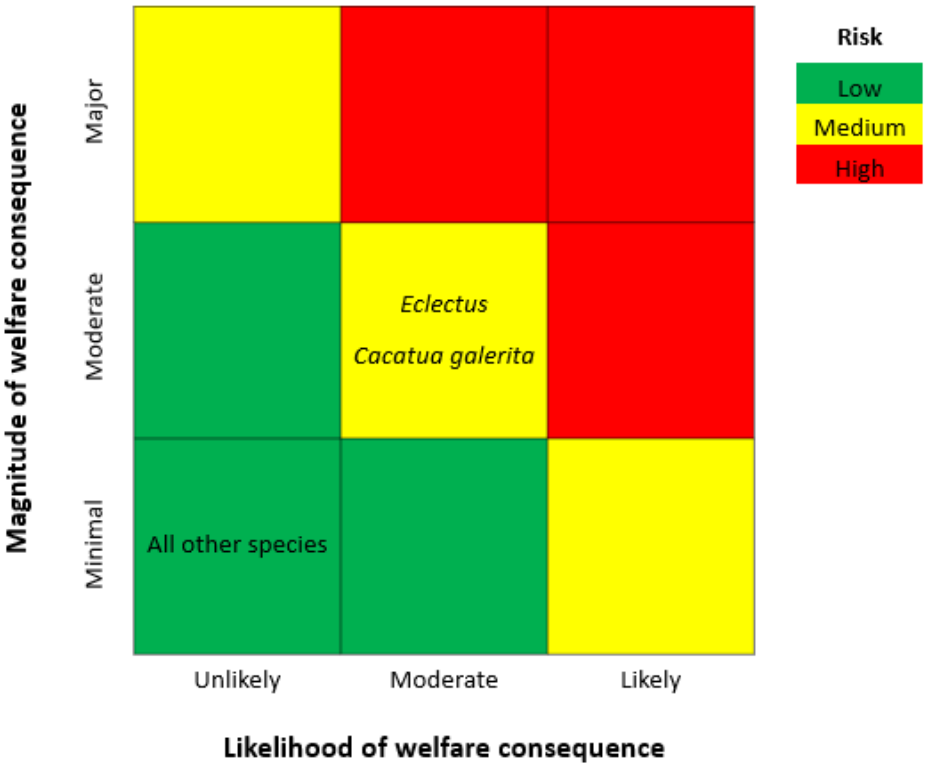

Figure 10. The risk characterisation based on the likelihood of welfare consequences for birds kept in flocks and the magnitude of the welfare consequence.

The risk of poor welfare for birds kept in flocks is **low** with **medium confidence** for most species included in our report. This is based on the literature on the social structures in the wild. A flock of all these bird species in captivity would ideally be composed of pairs and hence a captive group of at least two pairs could be considered a flock. Challenges of keeping larger number of these birds is outweighed by the socio-cognitive benefits. Even if pairs are not

optimally compatible, other birds could fill social needs not met by the pair partner (e.g. a higher motivation to play). Also, aggression can be diluted in a group which gives the individuals respite.

For *Eclectus* spp. and *C. galerita* there is a **medium** risk of reduced welfare with **low confidence** for when they are kept in flocks. This assessment is based on a temporary separation of pairs that might be necessary during the breeding season. This renders keeping species with heightened territoriality, such as the *C. galerita*, during breeding still challenging. *Eclectus* spp. might also not profit from a fixed sex ratio throughout the year due to their specialised breeding system.

5 Mitigation measures

Welfare needs (section 3) and risk assessment (section 4) were structured after the five freedoms: nutrition, physical environment, health, husbandry, behaviour, and cognition. For section 5, the structure is changed to reflect where the action points for mitigating welfare challenges are: nutrition, physical environment, health, and husbandry practices. When these factors are optimised, they allow for behavioural and cognitive needs to be met.

5.1 Nutrition

Providing drinking water in a way appropriate for the species' beak and preferences is vital for their welfare.

Parrot feed formulations were developed based on poultry requirements, and parrots are genetically far removed from *Gallus gallus*. While there is still a challenge regarding knowledge of the nutritional needs of different species of parrots and toucans kept in captivity (Di Santo et al., 2019), the quality of parrot formula has been reported to have been considerably improved (Burns, 2024; Hoppes, 2024) with lower calorie densities and better balance between micro-and macro-nutrients compared to seed-based diets (Burns, 2024; Hoppes, 2024). Formulated diets (pelleted or extruded food) have thus improved parrot and toucan nutrition considerably, leading to better health, longevity, and quality of life (Nijboer et al., 2025a). Updated recommendations (2025) are an 80% formulated diet with 10-15% fresh vegetables, and 5-10% fruit for large parrots (Hoppes, 2024). Smaller psittacines such as *N. hollandicus*, which have high amounts of seeds in their diet in the wild, may receive 40-50% formulated food, 30-40% seed mix, 10-15% vegetables, and 5-10% fruit. It is important that the seed-mix is of good quality and stored appropriately, as pet-grade quality nuts and seeds that are improperly stored may result in aflatoxicosis with hepatic fibrosis and cirrhosis (Hoppes, 2024).

Species-specific requirements and sensitivities exist, highlighting the importance of tailoring the diet to the species. *A. aestiva* that were switched from a sunflower-based to formulated diets showed an improvement in their biochemical profile of serum glucose and triglycerides (Di Santo et al., 2019). Some immune function markers also improved over the course of being fed the processed diets. *A. ararauna* that was moved from a maize, fruit, and seed-based diet to formulated feed with different levels of fibre showed a decrease in blood triglycerides, cholesterol, and glucose, even though they did not decrease their body weight (Veloso et al., 2014). Nutritional imbalances in amazons in captivity were corrected when they transitioned from a 25% seed/50% produce/25% pellet diet to diets with a lower percentage of seeds (Brightsmith, 2012). Birds fed a diet consisting of 75% pellets and 25% produce did not ingest more calories than recommended and were within the recommended ranges for almost all other nutrients. This was also the case for birds fed a low-seed diet with 18% seeds/22% produce/60% pellets, but they ingested more calories than the recommendation (Brightsmith, 2012) highlighting how seeds make calorie control difficult. Another study showed an improvement in the health of the birds as measured by serum biochemistry and radiography when amazons transitioned from a sunflower-seed based diet to a formulated diet (Di Santo et al., 2019). Cummings et al. (2022) suggested that 60-75% of the diet needs to be formulated to improve psittacine physical and psychological health, which corresponds to the recommendations cited above. In life stages where a higher calorie level is needed, some

seeds could be added (Brightsmith, 2012). However, care must be taken that the parrots cannot pick out the most calorie-dense food and leave the rest (Cummings et al., 2022; Ullrey et al., 1991). Switching to a formulated diet suitable for e.g. breeding or growing chicks might be a better solution (Harcourt-Brown & Chitty, 2005; Nijboer et al., 2025a). The recommendation to add fresh fruits and vegetables is important, as receiving only one foodstuff (such as formulated food), which is very different from the foods the birds would consume in the wild, does not fulfil the birds' need to express foraging behaviour and is less rewarding to ingest (Harcourt-Brown & Chitty, 2005). Furthermore, it is essential to let the birds work for access to the food, so that the whole daily calorie requirement for a day is not ingested in a matter of minutes (Meehan & Mench, 2006). Because foraging behaviour takes up several hours of the day in the wild and parrots have considerable cognitive abilities, incorporating cognitive and physical challenges in connection with feeding is a good way of increasing welfare (Meehan et al., 2003b). The pellet size has been shown to impact the time-budget of foraging, as a group of *A. amazonica* strongly preferred larger pellets, similar in size to fruits they would eat in the wild (Rozek et al., 2010). In this study, increasing pellet size increased the time spent foraging from 5 to 27%. An experiment in *N. hollandicus* showed a preference for seeds over extruded food, but extruded food was preferred over dry mash, indicating that particle size is important when making a balanced formulated diet attractive to *N. hollandicus* (Naves et al., 2017).

Supplements with vitamins and minerals might not be needed when formulated food is used, and supplements have been associated with vitamin toxicosis (Harcourt-Brown & Chitty, 2005; Park, 2006). If supplement is given, it is not recommended to be added to the water. Water intake might be variable, and some vitamins might be partly degraded through exposure to light and certain minerals (Kollias & Kollias, 1995).

Older parrots and toucans need a tailored diet to ensure good health and welfare for the entire lifespan. Below are mitigating measures tailored to the genus/species level for birds where such information is available.

5.1.1.1 Species-specific nutritional mitigation measures

Psittaculidae

Lories and lorikeets need diets with a high water content, a mixture of proteins, easily digestible carbohydrates, and a balanced vitamin and mineral supplement (Nijboer et al., 2025a). When fed a commercial nectar mixture, care must be taken that enough methionine and cysteine is included, as deficiencies in those amino acids have been reported (Cabana & Lee, 2019). The hygiene must be excellent.

Ramphastidae

Toucans have long beaks, and ensuring a large enough drinking pan is necessary to avoid dehydration (Nijboer et al., 2025b). The species are susceptible to accumulation of iron in the liver and avoiding foods with a high iron content like grapes, raisins, and certain pellet foods is important (Kusolsongkhrokul et al., 2022; Powers, 2014). Furthermore, keeping the amount of iron low in drinking water is important (Nijboer et al., 2025b). Because vitamin C increases absorption of iron from the intestine, it is recommended to avoid feeding fruits and vegetables with high vitamin C content and other acidic foods (e.g. oranges, tangerines, grapefruits,

pineapples, tomatoes) at the same time as foods high in iron (Kusolsongkhrokul et al., 2022; Powers, 2014).

5.2 Physical environment

The structure of the physical environment is the foundation for parrot and toucan welfare in captivity: It can allow for space to fly, encourage species-specific behaviours and cognitive stimulation through enrichment, and fulfil social needs when two or more birds are housed together. The mitigating measures related to physical environment are therefore sorted under housing (size and structure), enrichment, and social housing.

5.2.1 Housing

Exotic birds tend to have very long lifespans (table 2) while at the same time not being classified as domesticated species (Davis, 1998; Engebretson, 2006). They need a highly enriched aviary resembling natural conditions rather than a small, barren cage. Supplying the aviary with perches of different sizes, diameters, and materials is fundamental for the birds' welfare (van Hoek & King, 1997).

Providing a separate area for resting/sleeping and another area, such as a spacious outdoor aviary, for foraging/other daytime activities has been recommended (Bergman & Reinisch, 2006). However, housing in spacious aviary with access to sheltered resting areas can also fulfil welfare needs without having to transfer the birds to a smaller sleeping cage. If a cage is used for sleeping, suspending it at roof height (minimum 2 meters) will position the birds higher than the humans and may give some of the same feeling of safety as being in a tree (Harcourt-Brown, 2009). The sleeping area should provide enough space for all birds to perch, preen, and move away from each other if needed.

In addition to the space required in the cage, large aviaries that allow the birds to move and fly freely are needed to provide the birds with the opportunity to exercise and express flying behaviour. Daily exercise is beneficial and has been shown to improve cholesterol profile in *Amazona ventralis* (Gustavsen et al., 2016). Furthermore, *E. roseicapilla* is highly motivated to fly when given the choice (Massen et al., 2022). It has been argued that animals in captivity should be provided with space giving them the opportunity for normal locomotion for at least 5 seconds (Broom, 2002). For birds, normal locomotion includes flight at full speed, translating to 42-55 meter long aviaries. Adding to this space requirement is the knowledge that these birds inhabit tall trees and perform vertical flight and providing aviaries with proper roof height is essential for the birds' ability to perform vertical flight (Razmadze et al., 2018). It is challenging to provide living conditions that meet the birds' flying needs. Training the birds to return to the caretaker and building up their competence in navigating as a social group under increasingly complex conditions might make free, unrestricted flight possible. This would provide the freedom to perform complex flying behaviours for preferred distances and at preferred heights and speeds (Woodman et al., 2021). However, this will increase the risk of birds escaping, pathogen transmission from wildlife, and predation. A combination of a spacious aviary and regular opportunity to fly outside the aviary will have the highest probability of fulfilling the birds' behavioural needs.

During breeding, a calmer environment with fewer changes and less or more careful introduction of novelty may be beneficial to welfare. In *P. haematonotus*, exploration of a

novel object changed from courtship to breeding for females, with higher latencies to contact the novel object and lower duration of exploration during breeding (Mettke-Hofmann, 2000).

5.2.2 Enrichment

Concerning physical cognition, all species in this report are curious and display neophilia. Most of the parrots are extractive foragers and require materials to explore and play with in ways that enhance their knowledge and skills. Providing opportunities to solve challenges allows parrots to express agency and control over their environment (Rodríguez-López, 2016). Toucans are also very curious and, among other things, motivated by novel smells (Hernández & Barja, 2024).

Foraging enrichment and feeding in a way that stimulates the birds to spend time searching for, extracting, and consuming food is imperative. In particular, ways to make the food challenging to access will occupy the birds, fulfil their motivation to explore, develop physical and cognitive competences, and reduce the risks of abnormal behaviours. Puzzle boxes, mixing food into other materials, and occasionally providing novel food items will improve the welfare of all the species included in this report. To meet the birds' needs to forage, providing food in ways that engage the birds in searching and manipulating is important, ideally for at least four hours every day comparable to the time spent foraging by wild conspecifics (e.g. 4-8 hours daily in *P. erithacus*; van Zeeland et al., 2013). Across parrot species, the greater the proportion of foraging time spent by wild populations in handling food materials to extract food, the greater the need to stimulate this manipulative behaviour through foraging enrichment in captivity to reduce the risk of feather damaging behaviour (Mellor et al., 2021).

Providing the birds with toys and other stimulating materials with a variation of colour, hardness, size, and material will meet the birds' individual preferences for different enrichments (de Almeida et al., 2018; Webb et al., 2010). It is less essential to have a large diversity of toys continually available, but rather to frequently rotate and refresh enrichments and introduce novel ones to maintain bird engagement. It is vital that the caretaker adds fresh enrichment if the birds start to lose interest. Because objects are chewed and may be eaten, it is essential that the materials are non-toxic and will not injure birds if broken or ingested. Enrichment items must also be provided in sufficient quantity to avoid stimulating competition, associated aggression, and guarding of items. While these birds require substantial stimulation, their playful nature provides a straightforward method to mitigate the risks of not meeting their physio-cognitive needs.

Providing parrots in captivity with the chance to bathe and display their natural bathing behaviours also acts as a means of enrichment that enhances their welfare (Meehan et al., 2004).

5.2.3 Social housing

Social stimulation has been suggested as the most effective environmental enrichment for psittacines living under human care (Douglas et al., 2024). Allowing social species to have physical contact with companion birds of its own species is a mitigation measure that will alleviate many of the described risks and consequences of keeping exotic birds in social isolation. Concerning socio-cognitive needs, the keeping of all the birds without a conspecific companion will impair their welfare. In a questionnaire to parrot owners, parrots that were left

alone for more than 6 hours per day were more likely to display abnormal behaviours compared to those that were alone for less than 6 hours (Tygesen & Forkman, 2023). The birds all live in flocks of pairs in the wild, yet they are most strongly bonded with their pair partner. In VKMs opinion, human caretakers cannot fulfil the role of a companion for these birds. However, bonds with humans can account for a part of the social network, which would otherwise be provided by extra-pair group members. For instance, *A. ararauna* shows facial indications of positive affect when reuniting with their caregivers and call for them during separation (Bertin et al., 2023).

As outlined under 4.3.3.6, pair-housing is better than singly housing, which will be detrimental for all species in this report. But even pair keeping of *Eclectus* spp., *P. erithacus*, *E. roseicapilla*, *Psittacula* spp., *Trichoglossus* spp., *P. cruentata*, *Pteroglossus* spp., *N. hollandicus*, *A. aestiva,* and *A. amazonica* will still result in a high risk for reduced welfare, and all species will benefit from being kept in flocks (multiple pairs). There are recommendations to keep psittacines in male-female pairs at the minimum, but aggression can occur as artificially paired birds might not be fully compatible breeding-partners. Mate trauma is a severe welfare issue, usually for the female of the pair, with death as a common outcome unless action is taken (except in *Eclectus* spp. where the male may be the victim of aggression). Careful observation on the part of the caretaker is required, and rapid action is needed to separate the pair in time to avoid escalation of aggression. A nest-box with multiple holes to ease escape (Romagnano, 2006), bushes, or other obstacles in the aviary may slow an attacking male down and provide the caretaker more time to spot the problem and removing the male. However, even with careful observation and considerable experience, mate trauma might be very difficult to prevent (Romagnano, 2006). Keeping more than one pair together can dilute the aggression and drastically reduce these issues. Nevertheless, in either case, ample space between individuals and pairs and the provision of escape ways or hides is vital to reduce aggression, particularly during the breeding season (Harcourt-Brown, 2009).

In general, keeping at least two pairs has many benefits (for almost all species in this report with the probable exception of *Eclectus* spp. and toucans), such as providing multiple social contacts and diluting aggression. Ideally the pairs can be separated if required (e.g. during nesting season). In the case of cockatoos (particularly *C. galerita*), this might be a necessity as they are very social outside the breeding season but highly territorial when nesting (Billerman et al., 2020). *Eclectus* spp. fall outside this description due to their specialised social behaviour (Billerman et al., 2020). Mitigating most socio-cognitive issues in this genus can probably only be accomplished by caretakers who can keep *Eclectus* parrots in mixed sex groups with the option of fragmenting the birds into subgroups during breeding season.

5.3 Health

Good hygiene is important for the birds' health, and it is important to keep the enclosure's interior and water clean. Furthermore, water, food, and toys which are manipulated by the beak, need to be placed out of reach of droppings. Frequent change of water and cleaning of water containers are essential. Toucans have especially wet and smelly faeces, hence an adsorbing cage bottom material and frequent cleaning of the enclosure is vital. Reducing air dust and increase humidity will prevent exposing the bird to stressors over time.

An environment stimulating the birds to be physically active will strengthen the musculo-skeletal and cardiac system, as well as counteract obesity-related conditions. Keeping the

birds' environment free of toxic plants and toys made of toxic materials will reduce the risk of intoxications. Furthermore, removing items on which the birds can harm themselves, both inside and when out of the enclosure, will reduce the risk of physical injuries.

Protecting the birds against pathogens by avoiding unnecessary contact with birds from other households with unknown health status, as well as wildlife, is important to ensure good health. Furthermore, securing outdoor aviaries to prevent predators from entering and avoiding the birds escaping is vital. A precaution when acquiring a new bird is learning its health history and preferably get a veterinary health check. Health certificates, when birds are imported and moved between households or for exhibitions, will reduce the risk of introducing or spreading infectious diseases.

Many veterinarians have only general knowledge on diagnosing and treating health problems in exotic birds. Thus, it is important that primary veterinarians contact avian veterinarians for recommendations when necessary. Early diagnostics, including lab testing to identify responsible pathogen and possible microbial resistance, will help to initiate an effective treatment and thus improve the prognosis.

Further, environmental enrichment may be helpful during recovery. Alaniz et al. (2022) reported that a *R. tucanus* affected by a collision trauma which received treatment and care together with an enrichment protocol showed less self-mutilation behaviour and increased activity level.

5.4 Husbandry practices

5.4.1 Handling and interaction

In practice, the caretaker plays a vital role for the health and welfare of the bird. Good nutrition, suitable environment, enrichments meeting behavioural needs, training to facilitate handling, and avoiding chronic stress, will support the birds' immune status and general resilience towards diseases. Thus, it is important that caretakers acquire knowledge on the needs and best management of their birds and learn to recognise both the signs of thriving and early signs of poor health. Further, providing proper care and not waiting too long before bringing the sick bird to a veterinarian is essential. Science-based and quality-controlled species-specific information made easily available for caretakers can be an effective mitigating measure.

Taming and taming procedures need to be in line with the species-specific behavioural needs that produce a level of tameness providing the bird with the ability to cope with its captive environment. Training of the companion bird is essential in this process (Luescher & Wilson, 2006). The ability to train birds without punishment can both serve as environmental enrichment, cognitive stimulation, and as prevention or treatment of problem behaviours. This means species appropriate training, taming, and handling is imperative - even for birds bred and raised in captivity. Being brought to a veterinarian and closely examined by an unfamiliar person may be a stressful experience for the bird. The caretaker can use positive reinforcement training to prepare birds to tolerate such handling, reduce stress, and evoke voluntary participation (Daugette et al., 2012).

5.4.2 Hand-rearing

If parrots are hand-reared or otherwise primarily imprinted to humans, they may never develop the behavioural repertoire to interact with conspecifics. Hand-rearing may lead to aggressive behaviour towards other humans, increased stereotypical behaviour, reduced propensity to interact with enrichment items, and a higher likelihood to mimic human speech, which in turn renders conspecific connections harder to form (Schmid et al., 2006; Williams et al., 2017). Given that these birds can become very old, they might not stay with one caretaker all their life, and the increased selectiveness of hand-reared birds can prevent them from forming a bond with a new caretaker. VKM therefore considers parent rearing to be the best solution for the long-term health and welfare of the birds.

5.4.3 Feather clipping

The negative effects of feather clipping outweigh the positive effect of having better control of the bird. Positive handling and training methods will improve the caretaker-bird relationship and are good mitigation measures.

5.4.4 Transport and exhibitions

When birds are taken to exhibitions, it is important to take precautions regarding health to reduce the risk of pathogen transmission. Furthermore, proper training and preparation of the bird is essential to avoid negative stress.

6 Data gaps and uncertainties

VKM has identified several uncertainties and data gaps relevant for assessing the welfare of exotic birds. Factors influencing the welfare in captivity are in general understudied for most psittacines and all toucans.

For some species distributed over vast ranges and multiple countries in the wild (e.g. *P. krameri* and *A. severus*), detailed knowledge about parts of their range may exist while lacking for other areas.

Furthermore, some bird species are little studied in captivity. This is particularly the case for toucans, *Pyrrhura* spp., and *Platycercus* spp.

There is a lack of scientific studies on commercially available formulated feeds for most species in this report. Furthermore, there is a lack of long-term studies on how diet affects health and welfare.

There is a lack of data on the most common diseases and health challenges for exotic birds in captivity in Norway. There are no official veterinary records available which make it challenging to assess the disease pressure present at exhibitions and other gatherings involving these birds.

Only a few studies have focused on positive animal welfare in parrots and toucans. Knowledge is lacking for the space needed for each species in captivity to perform natural flying behaviour. While many studies have focused on reducing the occurrence of problem behaviours, few have attempted to increase behavioural indicators of positive welfare.

There is limited scientific evidence of physiological characteristics of the species included in this assessment, particularly their climatic tolerance and ability to adjust to different temperatures. Furthermore, few studies are available regarding optimal humidity in captivity.

The welfare effects of not being able to perform reproductive behaviour are not well documented.

Overall assessment of data quality was done for each species. To reflect the influence of uncertainty on the conclusions, confidence levels were provided as described in 2.2.4 and table 3.

7 Conclusions with answers to ToR

Chapter 7 is structured according to the ToR provided by the NFSA, which are repeated here with italics.

7.1 ToR 1 – Overview of welfare needs

Give an overview of available knowledge concerning welfare-related needs of exotic birds kept as companion and hobby animals in Norway.

To achieve adequate welfare for parrots and toucans in captivity, these large-brained, long-lived birds need to be offered lifelong opportunities to continually develop species-relevant knowledge and skills. They need to be able to make choices that can lead to rewards and allow them to cope with challenges such that, over time, positive experiences outweigh negative experiences. Their species-specific needs for nutrients, water, shelter, companions, flying, foraging, and cognitive stimulation need to be met, and their perceived quality of life needs to be good. Without the opportunity to fly, forage, and engage in affiliative behaviour, these birds are highly likely to experience negative welfare through frustration, boredom, and chronic stress, in addition to impaired health from lack of physical activity and social contact.

Free access to water of high quality is fundamental to good health and welfare. A diet tailored to the species in question is vital, fulfilling the birds' needs for energy, nutrients, vitamins, and minerals. Feeding mainly formulated diets with supplementary fruits and vegetables is the best way to ensure that the birds' need for macro- and micronutrients are met, but without adding more calories than they need. The diet needs to be adjusted according to life stage and physiological state of the bird. Furthermore, feeding practices allowing for the expression of foraging behaviours is important for the birds' welfare.

Parrots and toucans need to be kept in an environment with enough vertical and horizontal space to perform the highly motivated behaviour of flying, as all species included in this report typically fly several kilometres during the day in the wild. The birds need a variety of perches of different sizes and heights. Furthermore, birds in captivity need access to an abundance of enrichment objects and materials that support exploration, play, problem-solving, and contribute to physical dexterity and cognitive development. Parrots and toucans in captivity need access to fresh water for bathing or showering, as bathing is an important part of feather maintenance behaviour in these birds.

In nature, these birds fly from the roosting area to the feeding grounds in the morning and return to sleep in the evening. Separate areas for resting/sleeping and for foraging/flying/other daytime activities will mimic this. A dark night period, protected from light and noise, is needed to ensure undisturbed sleep and support eye function. An appropriate photoperiod and exposure to UV-light is important for parrots and toucans. Hence, they need exposure to full-spectrum daylight in captivity, which is important for the visual perception of their environment.

Gradual acclimation to change in temperatures and weather protection is necessary. Maintaining the humidity between 40-60% is beneficial for the birds.

Sufficient knowledge on the part of the caretaker is essential to ensure good health in the bird, avoid inducing fear, and prevent chronic stress. The birds can hide early signs of poor health,

so the caretaker's knowledge of normal bird behaviour and behavioural indicators of poor health are important. There is an interplay between the host, the environment, and microbes, e.g. a poor nutritional state or chronic stress hamper immune function. Hence, a good understanding of birds' behaviour is central in the evaluation of welfare needs. It is necessary to perform rearing, taming, and training in a way that makes healthy behavioural and cognitive development possible. Furthermore, providing proper care is essential, along with expedient contact with a veterinarian to minimise negative welfare and health consequences in case of disease, injury, or intoxication.

Regardless of duration, the performance of highly motivated behaviour like flying, foraging, and social interactions, is a welfare need and deprivation causes suffering. Birds also need substantial cognitive stimulation to thrive. Further, all species included in this report would substantially benefit from being kept in flocks. Parrots and toucans are highly social birds and require extensive social interactions for several hours daily. However, some species become highly territorial during the breeding season. If the pairs within a flock are not fully harmonic, it may be necessary to temporarily separate breeding pairs from other group members, and in some cases separating the individuals in a pair from each other.

7.2 ToR 2 – Risk assessment of welfare challenges

Assess the risk of reduced welfare for these birds when kept as companion and hobby animals.

7.2.1 Nutrition

The main hazards are lack of water and a diet that fails to meet the nutritional needs of the birds. Lack of water can quickly lead to dehydration and death. A diet that fails to meet the nutritional needs of the birds will have long-lasting negative impact on the birds' health and welfare. There is a high risk of reduced welfare with high confidence for all species in this report if fed mainly seed-based diets. Seed-based diets are associated with providing excessive amounts of calories while being deficient in several essential nutrients (vitamins, minerals, and several amino acids). Parrots are reported to feed selectively if they get the opportunity, picking out the most calorie-dense part of their food with malnutrition and obesity as consequences. Obesity and metabolic disorders are common in parrots in captivity, and these negative effects accumulate over time. Foraging activity is a highly motivated behaviour for birds and fulfilling their nutritional need fast, but with little or no stimulation of foraging behaviour or natural feeding behaviour, is another welfare hazard.

7.2.2 Physical environment

Daily supply of different types of enrichment is important for the welfare of birds. Enrichments can imitate their habit of foraging in tree canopies in the wild and provide cognitive stimulation and challenges. Enrichment stimulating foraging behaviour and novel toys and other materials to interact with have a beneficial effect on health, physical activity, and cognitive stimulation. If the bird is not provided with enrichments, there is a high risk with high confidence of reduced welfare. Behaviours such as stereotypies and feather damaging behaviour are indicators of poor welfare and often occur where enrichments are lacking.

7.2.3 Health

Several diseases are common in companion birds, with poor diet, deficient husbandry, and unhygienic conditions as frequent contributing factors. Participation at shows, exhibitions or other gatherings where birds from different households meet will furthermore increase the risk of exposure to pathogens.

VKM assesses that there is a high risk of negative welfare consequences with medium confidence of respiratory diseases in birds in captivity. Birds living indoors in Norway may be subjected to unsuitable air quality with low humidity (especially in winter) and dust particles, which may occlude nares or affect the respiratory system.

Diets high in calories and fat, hypercholesterolemia, and limited physical activity predispose the birds to atherosclerosis, obesity, muscle loss, and fatty liver. There is a medium risk of reduced welfare with medium confidence for these diseases in all species.

Beak disorders will result in a high risk of reduced welfare with medium confidence for the birds as these disorders could reduce their ability of food manipulation and feeding, social and sexual interaction, locomotion, thermoregulation, and respiratory distress.

In addition, intoxications due to exposure to toxic compounds are health risks to parrots and toucans. Traumatic physical injuries, such as collisions or falls, induce pain and fear and may also lead to inactivity and loss of appetite.

7.2.4 Husbandry practices

VKM assesses that there is a high risk of poor welfare with high confidence in birds subjected to hand-rearing. Hand-rearing carries the risk that the birds do not develop the socio-cognitive skills required to naturally interact with conspecifics in adulthood, which in turn will lead to abnormal behaviours. Hand-reared birds have higher probabilities of developing stereotypic behaviour, feather damaging behaviour, and lower reproductive success. Finally, hand-rearing influences the development of neophobia, and the chicks will not receive parental microbiota transferred from parent to offspring during feeding.

The welfare risks of feather clipping are high with high confidence as the procedure leads to reduced locomotion, loss of the ability to fly, deterioration of balance, and therefore deprives the birds of highly motivated behaviours.

7.2.5 Behaviour

All species included in this report fly relatively long distances (several kilometres) during the day. The space in which they spend the majority of their waking time needs enough vertical and horizontal space for the birds to perform highly motivated behaviours such as free, unrestricted flight at different speeds. VKM assesses that there is a high risk of poor welfare with high confidence for all species housed in cages without the possibility of performing natural flying behaviour. A bird without the opportunity to fly will experience frustration, boredom, and chronic stress, in addition to impaired health from lack of physical activity, and reduced life expectancy. Even if the birds are kept in a large and spacious aviary, their possibility to fly will be hampered. Fast flight (42-55 meters to fly at top speed for five seconds) is difficult to achieve unless the birds are allowed free, unrestricted flight outdoors. Vertical flight also plays an important role in parrot locomotion, and not providing enough roof height

will hamper this type of movement. Being allowed to fly freely inside the house will not provide enough space for the full expression of flying behaviour, as indicated by the calculation of how far a parrot or toucan can fly in five seconds. Furthermore, birds may suffer traumatic physical injuries when flying freely inside the house.

Restricting the birds' natural behaviour leads to reduced welfare. Many behavioural indicators of poor welfare like apathy, anhedonia, feather damaging behaviour, incessant screaming, excessive aggression, fearfulness, and stereotypies are commonly described in birds in captivity.

7.2.6 Cognition

VKM assesses that there is a high risk for negative welfare with high confidence in birds housed without conspecifics. All species in this report are highly social and spend most of their life in pairs and social groups in the wild. Keeping any of these species in isolation (i.e. without a conspecific partner), will critically reduce their welfare and create severe risks to their health through self-mutilation. There is a high risk of negative impact with medium confidence for *Eclectus* spp. and *P. erithacus* kept in pairs. Furthermore, *E. roseicapilla*, *Psittacula* spp., *Trichoglossus* spp., *A. aestiva*, *A. amazonica*, *P. cruentata*, *Pteroglossus* spp., and *N. hollandicus* have a high risk of reduced welfare with low confidence if kept in pairs (see section 4.3.3.6). Hence, keeping the birds in appropriately composed flocks (multiple pairs) will benefit the birds' welfare. During breeding season, some of the species (especially cockatoos and toucans) may need to be separated in pairs.

Social stimulation has been suggested as the most effective environmental enrichment for psittacines living under human care. Hence, flocks are the optimal way of keeping most birds. However, for *Eclectus* parrots and *C. galerita* there is a medium risk of reduced welfare with low confidence when they are kept in flocks. These species are highly territorial during breeding season, and a temporary separation of pairs might be necessary during this time.

Parrots and toucans are adapted to spend several hours foraging every day. Many of their food items require substantial manipulations and time investment to obtain and/or process. Therefore, VKM assesses with high confidence that birds which are not physio-cognitively stimulated in captivity are at high risk of reduced welfare and showing abnormal behaviours. Daily provision of physical challenges (e.g. extracting food from inedible objects and/or solving puzzles to access the food or objects), is essential to meet their physio-cognitive needs.

7.2.7 Species-specific assessment

7.2.7.1 Cacatuidae

Cockatoos are social during most parts of the year, living in family groups and up to large flocks. In the breeding season, they tend to become highly territorial, and the pairs defend their nesting area aggressively. A temporary separation of the birds during breeding season might be necessary. Cockatoos are particularly inquisitive and require extensive physical enrichment, ideally including puzzles to solve. They are prone to developing feather damaging behaviours. *C. alba* and C. *galerita* may display mate trauma making them very challenging to keep, and it is difficult to ensure that their welfare needs are met in captivity. The suitability of these two species as companion and hobby animals is questionable.

E. roseicapilla is a strong flyer and lives in flocks of up to a thousand birds. This species is highly social year-round and breed in proximity to each other. They are monogamous and mate for life. Offspring tend to disperse to other flocks and keeping multiple generations together could cause stress. In captivity, *E. roseicapilla* frequently develop behavioural disorders. Housing in flocks is essential for their welfare in captivity, but even then, VKM concludes that it is difficult to ensure that all the welfare needs of *E. roseicapilla* are met in captivity and the suitability of this species as a companion and hobby animal is questionable.

N. hollandicus lives in large nomadic flocks in arid environments. They are specialised seedeaters and can easily eat too many seeds if available. This causes severe health issues, and they require a more varied diet. These birds are highly social and have comparatively weaker pair bonds than other parrots and engage in many interactions with other flock members. Group keeping is therefore necessary to meet many of their welfare needs.

7.2.7.2 Psittacidae

Amazona spp. tend to be highly social during their foraging and roosting activities. As forest dwelling species they fly distances between roosting and feeding areas in the wild. Hence, keeping these species in flocks with the opportunity of both horizontal and vertical flying is important for their welfare in captivity. Feather damaging behaviour is relatively common in this genus.

A. hyacinthinus is monogamous and mate for life. They are highly social birds, living in pairs, family, and flocks. Hence, to obtain acceptable welfare for these macaws in captivity, keeping in pairs or flocks is vital. These large parrots fly over substantial distances in the wild.

In the wild, all *Ara* spp. has a daily movement pattern of several km every day. Furthermore, *A. macao* and *A. chloropterus* stay high in the tree canopies and rarely come lower than 10 meters. Hence, very high vertical space in the aviaries is essential. Macaws are particularly susceptible to several diseases, e.g. atherosclerosis, mycotic disease, and vitamin D toxicosis. Hence, appropriate diet is vital in captivity. Macaws are prone to developing feather damaging behaviour.

P. maracana lives in pairs and flocks of up to 15 birds in the wild. Hence, keeping this species in pairs or flocks is essential for their welfare in captivity.

P. erithacus may fly 30 km in one day in the wild. *P. erithacus* is extremely social, displaying more prosocial behaviours to non-pair partners than other Psittacidae. They live in flocks of up to 1200 birds and have a fission-fusion society, meaning that they all roost together but forage in smaller groups which can be composed out of different individuals every day. *P. erithacus* are monogamous but maintain relationships of different strengths and quality with many conspecifics. They hence require so much social stimulation that keeping them in flocks of multiple pairs is necessary to meet their welfare needs. Environmental enrichment is also important as they easily show feather damaging behaviour when their needs are not met. This species tends to become hooked on seeds and is particularly susceptible to several diseases in captivity (e.g. atherosclerosis, mycotic disease, and malnutrition). Hence, an appropriate diet is vital.

There is a little knowledge of *P. molinae* and *P. cruentata*. Hence, based on lack of information about their specific needs in captivity, VKM cannot conclude if this species is suitable as companion and hobby animal.

7.2.7.3 Psittaculidae

E. roratus has a large home range and flies in flocks of up to 80 individuals in the wild. Furthermore, they have specialised social behaviours. Mitigating most socio-cognitive issues in this genus can probably only be accomplished by caretakers who can keep *Eclectus* spp. in mixed sex flocks with the option of fragmenting the birds into subgroups during breeding season. Keeping them in pair-based groups is therefore likely not to be advisable for this species. It is difficult to ensure that all the welfare needs of *E. roratus* are met in captivity and the suitability of this species as a companion and hobby animal is questionable.

Platycercus eximius usually lives in small flocks. However, based on lack of information about their specific needs in captivity, VKM cannot conclude if this species is suitable as companion and hobby animal. In the wild, *Psephotus* spp. is reported to live in flocks on an average of 10 individuals, but with considerable variation of up to 139 individuals. Housing in flocks is necessary to meet this genus' welfare needs.

Psittacula spp. has alternate seasonal home ranges. They may live in very large flocks with several hundred individuals with nocturnal roost for sleeping and communal roost for daytime activities. Housing in flocks is necessary to meet this genus' welfare needs.

Trichoglossus spp. lives permanently in larger flocks. Housing in flocks is necessary to meet this genus' welfare needs. Fruit sold for human consumption has less protein and fibre and more easily digestible sugar than the fruits that would be consumed by lories in the wild. Nectar mixes are very prone to bacterial growth, increasing the probability that the birds are exposed to bacterial and mycotic infections from contaminated nectar. The hygiene must be excellent. Furthermore, lorikeets are more susceptible to vitamin A toxicosis and iron storage disease than other species. VKM concludes that the correct feeding of lories and lorikeets in captivity is complicated.

7.2.7.4 Ramphastidae

Toucans have large home-ranges and may travel long distances. *R. tucanus* forage in pairs or small flocks of up to 20 individuals, while *R. toco* are less social and usually forage individually or in smaller flocks. On the other hand, *P. castanotis* gather in flocks for feeding. Furthermore, they frequently nest in groups, seldom only pairwise.

The welfare needs of Ramphastidae are assessed to be difficult to fulfil in captivity as this genus shows higher morbidity and mortality rates compared to other bird species. They are active and inquisitive birds who need enrichments that are changed frequently to meet the exploratory behaviour and challenge their cognitive ability. Furthermore, iron storage- and other dietary diseases are common health issues, making it difficult to meet their dietary needs in captivity. Furthermore, due to lack of knowledge, it is difficult to ensure that their welfare needs are met in captivity. Therefore, the suitability of these species as companion and hobby animals is questionable.

7.3 ToR 3 – Mitigation measures

Describe relevant mitigation measures for how the bird species should be kept to ensure good welfare. This includes a description of an optimal living environment, feeding, activation, supervision, and care, as well as other conditions that affect the welfare of these birds.

7.3.1 Nutrition

Providing drinking water in a way appropriate for the species' beak and preferences is vital for the birds' welfare. Feeding a formulated rather than a seed-based diet will improve the welfare of the birds, as a seed-based diet will almost certainly lead to obesity together with vitamin, mineral, and amino acid deficiencies. Formulated diets have improved parrot and toucan nutrition considerably, leading to better health, longevity, and quality of life compared to seed-based diets. Different species, life stages, and physiological states need different formulated diets. It is recommended that a formulated diet should be the main ingredient of the birds' diet, and that fresh vegetables and fruits are added. The smaller psittacines that eat considerable amounts of seeds in the wild can also receive seeds in captivity, but in combination with and not instead of, the formulated diet. The quality and storage of the seed mixture is very important.

Feeding in a way that stimulates foraging behaviour and problem solving is an important enrichment. For large parrots, seeds can, together with nuts, be used as treats for training.

7.3.2 Physical environment

Flying is an essential welfare need. The parrots and toucans fly vertically in addition to horizontally, so the height of the aviary must be sufficient for the species. Regarding the length, several tenths of meters are needed to accommodate the birds' natural flying behaviour. Housing in a spacious aviary will meet some of the birds' behavioural needs, but free, unrestricted flight is essential for them to fully utilise their entire range of speed and direction. This can only be achieved outside. A cage can be used for sleeping or transport. Staying in the aviary during the night, with access to a sheltered roosting area, will fulfil the need for resting for the birds. During breeding, provision of nest-boxes with appropriate substrate for the species is necessary to fulfil the birds' needs during reproductive behaviour.

Foraging enrichment and feeding using puzzle boxes, mixing food into other materials, and hiding it at different locations will stimulate foraging behaviour and the use of mental and motoric skills. Providing the bird with toys and other stimulating materials with a variation of colour, hardness, size, and material will meet the birds' individual preferences to different enrichments. It is essential to frequently change toys, or the birds will get bored with them. Providing water in form of bath or shower, tailored to the birds' water-preening behaviour in the wild, is another important enrichment.

Concerning socio-cognitive needs, the keeping of all these birds without a conspecific companion will severely impair their welfare. If a parrot is left alone for six hours daily or more, abnormal behaviours are likely to occur. The assessment of VKM is that human caretakers cannot adequately fulfil the role of a companion to these birds. For all species in this report, keeping in flocks is important for the birds' welfare.

7.3.3 Health

Good hygiene is important for the birds' health, and it is essential to keep the enclosure with interior clean. Furthermore, water, feed, and toys which are manipulated by the beak, need to be placed out of reach of droppings. Frequent change of water and cleaning of water containers are essential. Reducing air dust and increasing humidity, especially in winter, will reduce the risk of respiratory diseases. In order to reduce the risk of injuries and intoxications, care should be taken to remove dangers from their environment, and when free flying.

Protecting the birds against pathogens by avoiding unnecessary contact with birds from other households with unknown health status, as well as wildlife, is important to ensure good health. Furthermore, securing outdoor aviaries to prevent predators from entering is vital. Health checks before birds arrive at the household or exhibitions will reduce the risk of introducing or spreading pathogens. Expedient contact with a veterinarian in case of disease or injury is essential.

7.3.4 Husbandry practices

The caretaker plays a vital role for the health and welfare of the bird. Good nutrition, a suitable environment, enrichments meeting behavioural and cognitive needs, and avoiding chronic stress, will support the birds' immune status and general resilience towards diseases. Thus, it is important that caretakers acquire knowledge on the needs and best management of their birds and learn to recognise both the signs of thriving and early signs of poor health. Furthermore, the caretaker needs to acquire knowledge to plan for the whole lifespan of the birds, particularly since many of the species live longer than 40 years in captivity.

Exhibitions could enrich the birds by providing variation in routine and allowing them to meet conspecifics. However, susceptibility to microorganisms may be increased due to stress from transportation and new environments. Proper training and preparation of the bird will reduce negative stress.

Hand-rearing may lead to aggressive behaviour towards other humans, increased stereotypical behaviour or feather damaging behaviour, reduced propensity to interact with enrichment items, and reduced connections to conspecifics. Parent rearing will improve the short- and long-term health and welfare of the birds.

The negative effects of feather clipping outweigh the positive effect of having better control of the bird. Positive handling and training methods will improve the caretaker-bird relationship and are good mitigation measures.

References

Aengus, W. L., & Millam, J. R. (1999). Taming parent-reared orange-winged Amazon parrots by neonatal handling. *Zoo Biology*, *18*(3), 177-187. https://doi.org/10.1002/(SICI)1098-2361(1999)18:3<177::AID-ZOO2>3.0.CO;2-D

Aguiar, R. M., Azevedo, C. S., & Châline, N. (2026). Wing clipping does not make birds safer: Caregiver perceptions, practices, and associated risks in Brazil. *Applied Animal Behaviour Science*, *294*, 106870. https://doi.org/10.1016/j.applanim.2025.106870

Ahmed, I., İnal, F., & Riaz, R. (2022). Insects usage in pets food. *Veteriner Hekimler Derneği Dergisi*, *93*(1), 87-98. https://doi.org/10.33188/vetheder.909963

Alaniz, A. J., Astudillo-Hinojosa, K., Soto, A. F., Vergara, P. M., Carvajal, M. A., & Moreira-Arce, D. (2022). Rapid behavioral recovery based on environmental enrichment of a white-throated toucan (*Ramphastos tucanus*: Ramphastidae) affected by collision trauma. *Journal of Veterinary Behavior*, *57*, 1-5. https://doi.org/10.1016/j.jveb.2022.07.014

Alotiby, A. (2024). Immunology of stress: a review article. *Journal of Clinical Medicine*, *13*(21), 6394. https://doi.org/10.3390/jcm13216394

Andersson, E. (2025). *Sällskapsfåglar i Sverige*. Sveriges lantbruksuniversitet (SLU), Institutionen för tillämpad husdjursvetenskap och välfärd.

Animal Welfare Act. (2009). Lov om dyrevelferd. LOV 2009-06-19 nr 97. https://www.regjeringen.no/en/documents/animal-welfare-act/id571188/

Arnold, K. E., Owens, I. P. F., & Marshall, N. J. (2002). Fluorescent signaling in parrots. *Science*, *295*(5552), 92-92. https://doi.org/10.1126/science.295.5552.92

Ashley, F. H., Waterman-Pearson, A. E., & Whay, H. R. (2005). Behavioural assessment of pain in horses and donkeys: Application to clinical practice and future studies. *Equine Veterinary Journal*, *37*(6), 565-575. https://doi.org/10.2746/042516405775314826

Assis, V. D. L., Carvalho, T. S. G., Pereira, V. M., Freitas, R. T. F., Saad, C. E. P., Costa, A. C., & Silva, A. A. A. (2016). Environmental enrichment on the behavior and welfare of cockatiels (*Nymphicus hollandicus*). *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *68*(3), 562-570. https://doi.org/10.1590/1678-4162-8747

Aubert, A. (1999). Sickness and behaviour in animals: a motivational perspective. *Neuroscience & Biobehavioral Reviews*, *23*(7), 1029-1036. https://doi.org/10.1016/S0149-7634(99)00034-2

Auersperg, A. M., Borasinski, S., Laumer, I., & Kacelnik, A. (2016). Goffin's cockatoos make the same tool type from different materials. *Biology Letters*, *12*(11), 20160689. https://doi.org/10.1098/rsbl.2016.0689

Auersperg, A. M., van Horik, J. O., Bugnyar, T., Kacelnik, A., Emery, N. J., & von Bayern, A. M. (2015). Combinatory actions during object play in psittaciformes (*Diopsittaca nobilis, Pionites melanocephala, Cacatua goffini*) and corvids (*Corvus corax, C. monedula, C. moneduloides*). *Journal of Comparative Psychology*, *129*(1), 62-71. https://doi.org/10.1037/a0038314

Aydinonat, D., Penn, D. J., Smith, S., Moodley, Y., Hoelzl, F., Knauer, F., & Schwarzenberger, F. (2014). Social isolation shortens telomeres in African grey parrots (*Psittacus erithacus erithacus*). *PLoS One*, *9*(4), e93839. https://doi.org/10.1371/journal.pone.0093839

Baldrey, V., & Rogerson, M. (2024). Understanding the behavioural challenges of companion parrots. *In Practice*, *46*, 180-186. https://doi.org/10.1002/inpr.427

Balsby, T. J., & Bradbury, J. W. (2009). Vocal matching by orange-fronted conures (*Aratinga canicularis*). *Behavioural Processes*, *82*(2), 133-139. https://doi.org/10.1016/j.beproc.2009.05.005

Balsby, T. J. S., Momberg, J. V., & Dabelsteen, T. (2012). Vocal imitation in parrots allows addressing of specific individuals in a dynamic communication network. *PLoS One*, *7*(11), e49747. https://doi.org/10.1371/journal.pone.0049747

Beaufrère, H. (2009). A review of biomechanic and aerodynamic considerations of the avian thoracic limb. *Journal of Avian Medicine and Surgery*, *23*(3), 173-185. https://doi.org/10.1647/2007-023.1

Beaufrère, H., Ammersbach, M., Reavill, D. R., Garner, M. M., Heatley, J. J., Wakamatsu, N., Nevarez, J. G., & Tully, T. N. (2013). Prevalence of and risk factors associated with atherosclerosis in psittacine birds. *Journal of the American Veterinary Medical Association*, *242*(12), 1696-1704. https://doi.org/10.2460/javma.242.12.1696

Beaufrère, H., Cray, C., Ammersbach, M., & Tully Jr, T. N. (2014). Association of plasma lipid levels with atherosclerosis prevalence in psittaciformes. *Journal of Avian Medicine and Surgery*, *28*(3), 225-231. https://www.jstor.org/stable/24624173

Beekmans, M. H. C., Vinke, C. M., Maijer, A., de Haan, I., Schoemaker, N. J., Rodenburg, T. B., Kooistra, H. S., & van Zeeland, Y. R. A. (2023). Increasing foraging times with appetitive and consummatory foraging enrichment in grey parrots (*Psittacus erithacus*). *Applied Animal Behaviour Science August*, *265*(71). https://doi.org/10.1016/j.applanim.2023.105986

Benson, C. W., Benson, F. M., Stuart, S. N., & Fry, C. H. (1988). *Psittacus erithacus*. In C. H. Fry, S. Keith, & E. K. Urban (Eds.), *The Birds of Africa: Volume III* (pp. 1-3). Academic Press.

Berg, K. S., Beissinger, S. R., & Bradbury, J. W. (2013). Factors shaping the ontogeny of vocal signals in a wild parrot. *Journal of Experimental Biology*, *216*(2), 338-345. https://doi.org/10.1242/jeb.073502

Berg, K. S., Delgado, S., Okawa, R., Beissinger, S. R., & Bradbury, J. W. (2011). Contact calls are used for individual mate recognition in free-ranging green-rumped parrotlets, *Forpus passerinus*. *Animal Behaviour*, *81*(1), 241-248. https://doi.org/10.1016/j.anbehav.2010.10.012

Bergman, L., & Reinisch, U. S. (2006). Comfort behavior and sleep. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 59-62). Blackwell Publishing.

Bertin, A., Beraud, A., Lansade, L., Blache, M.-C., Diot, A., Mulot, B., & Arnould, C. (2018). Facial display and blushing: means of visual communication in blue-and-yellow macaws (*Ara Ararauna*)? *PLoS One*, *13*(8), e0201762. https://doi.org/10.1371/journal.pone.0201762

Bertin, A., Beraud, A., Lansade, L., Mulot, B., & Arnould, C. (2020). Bill covering and nape feather ruffling as indicators of calm states in the sulphur-crested cockatoo (*Cacatua galerita*). *Behavioural Processes*, *178*, 104188. https://doi.org/10.1016/j.beproc.2020.104188

Bertin, A., Mulot, B., Nowak, R., Blache, M.-C., Love, S., Arnold, M., Pinateau, A., Arnould, C., & Lansade, L. (2023). Captive blue-and-yellow macaws (*Ara ararauna*) show facial

indicators of positive affect when reunited with their caregiver. *Behavioural Processes*, *206*, 104833. https://doi.org/10.1016/j.beproc.2023.104833

Billerman, S. M., Keeney, B. K., Kirwan, G. M., Medrano, F., Sly, N. D., & Smith, M. G., (Eds.),. (2020). *Birds of the World*. Cornell Laboratory of Ornithology. Retrieved January 12, 2026 from https://doi.org/10.2173/bow

Birch, J. (2024). A walk along the edge. In J. Birch (Ed.), *The edge of sentience: Risk and precaution in humans, other animals, and AI*. Oxford University Press. https://doi.org/10.1093/9780191966729.001.0001

BirdLife Norge. (2025). *Norske navn på verdens fugler*.Retrieved January 12, 2026 from https://www.birdlife.no/fuglekunnskap/navn/

Bradshaw, G. A., & Engebretson, M. (2013). *Parrot breeding and keeping: The impact of capture and captivity*. Animals and Society Institute. https://www.animalsandsociety.org/wp-content/uploads/dlm_uploads/2020/11/ePP09-Parrots-As-Pets-2013-FINAL-CC4.0.pdf

Brambell, F. W. R. (1965). Report of the technical committee to enquire into the welfare of animals kept under intensive livestock husbandry systems. *London: Her Majesty's Stationery Office*, *2836*.

Brice, A. T., Dahl, K. H., & Grau, C. R. (1989). Pollen digestibility by hummingbirds and psittacines. *The Condor: Ornithological Applications*, *91*(3), 681-688. https://doi.org/10.2307/1368120

Brightsmith, D. J. (2012). Nutritional levels of diets fed to captive Amazon parrots: Does mixing seed, produce, and pellets provide a healthy diet? *Journal of Avian Medicine and Surgery*, *26*(3), 149-160, 112. https://doi.org/10.1647/2011-025R.1

Brightsmith, D. J., Boyd, J. D., Hobson, E. A., & Randel, C. J. (2021). Satellite telemetry reveals complex migratory movement patterns of two large macaw species in the western Amazon basin. *Avian Conservation and Ecology*, *16*(1), 14. https://doi.org/10.5751/ACE-01822-160114

Broom, D. M. (1986). Indicators of poor welfare. *British Veterinary Journal*, *142*(6), 524-526. https://doi.org/10.1016/0007-1935(86)90109-0

Broom, D. M. (1998). Welfare, stress, and the evolution of feelings. In P. J. B. Slater, A. P. Møller, & M. Manfred (Eds.), *Advances in the study of behavior* (Vol. 27, pp. 371-403). Academic Press. https://doi.org/10.1016/S0065-3454(08)60369-1

Broom, D. M. I., 37, 4-6. (2002). *Welfare in wildlife management and zoos.* Proceedings of the 4th international congress on the physiology and behaviour of wild and zoo animals. Advances in ethology, Berlin.

Brucks, D., & von Bayern, A. M. P. (2020). Parrots voluntarily help each other to obtain food rewards. *Current Biology*, *30*(2), 292-297.e5. https://doi.org/10.1016/j.cub.2019.11.030

Bundle, M. W., Hansen, K. S., & Dial, K. P. (2007). Does the metabolic rate–flight speed relationship vary among geometrically similar birds of different mass? *Journal of Experimental Biology*, *210*(6), 1075-1083. https://doi.org/10.1242/jeb.02727

Burns, K. M. (2024). Key nutritional factors and obesity prevention in companion psittacine birds. *Veterinary Clinics of North America. Exotic Animal Practice*, *27*(1), 13-29. https://doi.org/10.1016/j.cvex.2023.07.001

Burrows, W. (2026, January 23). Disease. In *Encyclopedia Britannica*. https://www.britannica.com/science/disease

Buttemer, W. A., Hayworth, A. M., Weathers, W. W., & Nagy, K. A. (1986). Time-budget estimates of avian energy expenditure: physiological and meteorological considerations. *Physiological Zoology*, *59*(2), 131-149. https://doi.org/10.1086/physzool.59.2.30156027

Cabana, F., & Lee, J. G. (2019). Feeding cluster preferences in four genera of lories and lorikeets (*Loriinae*) that should be considered in the diet of nectarivorous psittacine species in captivity. *Journal of Animal Physiology & Animal Nutrition*, *103*(1), 354-362. https://doi.org/10.1111/jpn.13012

Cambridge Dictionary. (n.d.-a). Anhedonia. In *Cambridge Dictionary*. Retrieved February 4, 2026 from. https://www.britannica.com/search?query=Anhedonia

Cambridge Dictionary. (n.d.-b). Preening. In *Cambridge Dictionary*. Retrieved February 4, 2026 from. https://dictionary.cambridge.org/dictionary/english/preen?q=preening

Cannon, C. E. (1983). Descriptions of foraging behaviour of eastern and pale-headed rosellas (*Platycercus eximius*). *Bird Behaviour*, *4*(2), 63-70. https://www.scopus.com/inward/record.uri?eid=2-s2.0-0021039477&partnerID=40&md5=8df9a6ad298849571c722c99cad2b738

Carciofi, A. C., Sanfilippo, L. F., de-Oliveira, L. D., do Amaral, P. P., & Prada, F. (2008). Protein requirements for blue-fronted Amazon (*Amazona aestiva*) growth. *Journal of Animal Physiology and Animal Nutrition*, *92*(3), 363-368. https://doi.org/10.1111/j.1439-0396.2007.00800.x

Carroll, A., & Pepperberg, I. M. (2025). Contrafreeloading in umbrella cockatoos (*Cacatua alba*): Further evaluation of the play hypothesis. *Journal of Comparative Psychology*, *139*(2), 84-97. https://doi.org/10.1037/com0000395

Carvalho, T., Saad, C., Alvarenga, R., Ferreira, W., Assis, V., Pereira, V., Scalon, J., Silva, J., & Zangeronimo, M. (2017). Use of collard green stalks as environmental enrichment for cockatiels (*Nymphicus hollandicus*) kept in captivity. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *69*(3), 718-724. https://doi.org/10.1590/1678-4162-8988

Carvalho, T. S. G., Zangeronimo, M. G., Saad, C. E. P., Alvarenga, R. R., Assis, V. D. L., Pereira, V. M., Scalon, J. D., & Silva, J. P. (2015). Behaviour of cockatiels (*Nymphicus hollandicus*) at two temperatures in captivity. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *67*, 1669-1674. https://doi.org/10.1590/1678-4162-7892

Chakraborty, M., Walløe, S., Nedergaard, S., Fridel, E. E., Dabelsteen, T., Pakkenberg, B., Bertelsen, M. F., Dorrestein, G. M., Brauth, S. E., Durand, S. E., & Jarvis, E. D. (2015). Core and shell song systems unique to the parrot brain. *PLoS One*, *10*(6), e0118496. https://doi.org/10.1371/journal.pone.0118496

Checon, C. T., Rosenfield, D. A., Jorge-Neto, P. N., & Pizzutto, C. S. (2020). Influence of environmental enrichment on the behavioral variables of caged hyacinth macaws (*Anodorhynchus hyacinthinus*). *Ornithology Research*, *28*(2), 125-132. https://doi.org/10.1007/s43388-020-00017-y

Chitty, J. (2023). Approach to managing obesity in parrots. *In Practice*, *45*(8), 461-474. https://doi.org/10.1002/inpr.360

Collette, J. C., Millam, J. R., Klasing, K. C., & Wakenell, P. S. (2000). Neonatal handling of Amazon parrots alters the stress response and immune function. *Applied Animal Behaviour Science*, *66*(4), 335-349. https://doi.org/10.1016/S0168-1591(99)00098-2

Cork, S. C. (2000). Iron storage diseases in birds. *Avian Pathology*, *29*(1), 7-12. https://doi.org/10.1080/03079450094216

Cornejo, J., & Clubb, S. (2005). Analysis of the maintenance diet offered to lories and lorikeets (Psittaciformes; Loriinae) at Loro Parque Fundacion, Tenerife. *International Zoo Yearbook*, *39*(1), 85-98. https://doi.org/10.1111/j.1748-1090.2005.tb00008.x

Cornejo, J., Dierenfeld, E. S., Renton, K., Bailey, C. A., Stahala, C., Cruz-Nieto, J., & Brightsmith, D. J. (2022). Nutrition of free-living neotropical psittacine nestlings and implications for hand-feeding formulas. *Journal of Animal Physiology & Animal Nutrition*, *106*(5), 1174-1188. https://doi.org/10.1111/jpn.13749

Cornelia, K., & Krautwald-Junghanns, M. E. (2022). Heart disease in pet birds - diagnostic options. *Veterinary Clinics of North America. Exotic Animal Practice*, *25*(2), 409-433. https://doi.org/10.1016/j.cvex.2022.01.004

Costa, P., Macchi, E., Tomassone, L., Ricceri, F., Bollo, E., Scaglione, F. E., Tarantola, M., De Marco, M., Prola, L., Bergero, D., & Schiavone, A. (2016). Feather picking in pet parrots: sensitive species, risk factor and ethological evidence. *Italian Journal of Animal Science*, *15*(3), 473-480. https://doi.org/10.1080/1828051X.2016.1195711

Cruickshank, A. J., Gautier, J.-P., & Chappuis, C. (1993). Vocal mimicry in wild African grey parrots *Psittacus erithacus*. *Ibis*, *135*(3), 293-299. https://doi.org/10.1111/j.1474-919X.1993.tb02846.x

Cummings, A. M., Hess, L. R., Spielvogel, C. F., & Kottwitz, J. J. (2022). An evaluation of three diet conversion methods in psittacine birds converting from seed-based diets to pelleted diets. *Journal of Avian Medicine & Surgery*, *36*(2), 145-152. https://doi.org/10.1647/21-00025

Curiel, A. R. (2006). *Conservation and sustainable use of parrots in Mexico*. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), NDF Workshop. https://cites.org/sites/default/files/ndf_material/WG6-CS6.pdf

Daugette, K. F., Hoppes, S., Tizard, I., & Brightsmith, D. (2012). Positive reinforcement training facilitates the voluntary participation of laboratory macaws with veterinary procedures. *Journal of Avian Medicine and Surgery*, *26*(4), 248-254. https://doi.org/10.1647/2011-056

David, B., Moe, R. O., Michel, V., Lund, V., & Mejdell, C. (2015). Air quality in alternative housing systems may have an impact on laying hen welfare. Part I—dust. *Animals*, *5*(3), 495-511. https://doi.org/10.3390/ani5030368

Davis, C. (1998). Appreciating avian intelligence: The importance of a proper domestic environment. *JAVMA*, *212*(8), 1220-1221.

de Almeida, A. C., Palme, R., & Moreira, N. (2018). How environmental enrichment affects behavioral and glucocorticoid responses in captive blue-and-yellow macaws (*Ara ararauna*). *Applied Animal Behaviour Science*, *201*, 125-135. https://doi.org/10.1016/j.applanim.2017.12.019

de Figueiredo, R. L., & Chappell, J. (2024). Behavioral observations of free-living scarlet macaws (*Ara macao*) in Costa Rica, to inform ex situ management. *Journal of Zoological and Botanical Gardens*, *5*(4), 668-690. https://doi.org/10.3390/jzbg5040044

de Paula, G. A., Laps, R., & Fischer, E. (2017). Hyacinth macaws (*Anodorhynchus hyacinthinus*, psittacidae) feeding on termites. *Ornitologia Neotropical*, *28*, 187-190. https://doi.org/10.58843/ornneo.v28i0.247

de Sousa, V. M. A. M. A., Almeida, B., Castro, M. C., & Sobral, G. (2024). Low-cost environmental enrichment reduces stereotypical behaviors in the blue-fronted parrot *Amazona aestiva* and the yellow-faced amazon *Alipiopsitta xanthops*. *Ornithology Research*, *32*(4), 322-328. https://doi.org/10.1007/s43388-024-00198-w

Di Santo, L. G., Braos, L. B., Kawanami, A. E., Oliveira, J. P., Cruz, N. R. N., Mendonça, F. S., Peixoto, M. C., & Carciofi, A. C. (2019). Feed processing effects on digestibility, palatability, excreta fermentation products and blood parameters in blue-fronted Amazon parrots (*Amazona aestiva*). *Journal of Animal Physiology and Animal Nutrition*, *103*(1), 339-353. https://doi.org/10.1111/jpn.13011

Dislich, M. (2023). Chapter 68 - Causes of death in toucans. In E. Miller, N. Lamberski, & P. Calle (Eds.), *Fowler' s Zoo and Wild Animal Medicine Current Therapy* (Vol. 10, pp. 461-466). W.B. Saunders. https://doi.org/10.1016/B978-0-323-82852-9.00068-X

Doneley, R. (2003). The galah. *Seminars in Avian and Exotic Pet Medicine*, *12*(4), 185-194. https://doi.org/10.1053/S1055-937X(03)00034-3

Donnelly, S., & Kidd, E. (2021). The longitudinal relationship between conversational turn-taking and vocabulary growth in early language development. *Child Development*, *92*(2), 609-625. https://doi.org/10.1111/cdev.13511

Dorrestein, G. M. (2009). Passerines and exotic softbills. In T. N. Tully, M. P. C. Lawton, & G. M. Dorrestein (Eds.), *Avian Medicine* (pp. 144-179). Butterworth-Heinemann. https://doi.org/10.1016/B978-0-7506-3598-1.50012-6

dos Santos, G. J., Aleixo, A. S. C., Hippólito, A. G., Ferro, B. S., Okamoto, P. T. C. G., Lourenço, M. L. G., Machado, V. M. V., Ramos, P. R. R., Rahal, S. C., Teixeira, C. R., & Melchert, A. (2022). Are echocardiographic parameters affected by body condition scores in blue-fronted Amazon parrots (*Amazona aestiva*, Linnaeus, 1758)? *Veterinary Research Communications*, *46*(3), 749-755. https://doi.org/10.1007/s11259-022-09894-8

Douglas, J. M., Paul-Murphy, J., Stelow, E., Guzman, D. S.-M., & Udaltsova, I. (2024). Personality characteristics predictive of social pairing outcome in orange-winged Amazon parrots (*Amazona amazonica*). *Journal of Applied Animal Welfare Science*, *27*(2), 386-407. https://doi.org/10.1080/10888705.2023.2268522

Dranzoa, C., Williams, C., & Pomeroy, D. (2011). Birds of isolated small forests in Uganda. *Scopus: Journal of East African Ornithology*, *31*, 1-10. https://nru.uncst.go.ug/server/api/core/bitstreams/dc4b26e3-f2b8-443e-afc2-7edfb3019943/content

Dyrehelseforskriften. (2022). Forskrift om dyrehelse. FOR-2022-04-06-631. https://lovdata.no/dokument/SF/forskrift/2022-04-06-631/*#&

Eastwood, J. R., Berg, M. L., Ribot, R. F. H., Stokes, H. S., Martens, J. M., Buchanan, K. L., Walder, K., & Bennett, A. T. D. (2018). Pair fidelity in long-lived parrots: Genetic and

behavioural evidence from the crimson rosella (*Platycercus elegans*). *Emu - Austral Ornithology*, *118*(4), 369-374. https://doi.org/10.1080/01584197.2018.1453304

Ebisawa, K., Nakayama, S., Pai, C., Kinoshita, R., & Koie, H. (2021). Prevalence and risk factors for feather-damaging behavior in psittacine birds: Analysis of a Japanese nationwide survey. *PLoS One*, *16*(7), e0254610. https://doi.org/10.1371/journal.pone.0254610

EFSA. (2012). Guidance on risk assessment for animal welfare. *EFSA Journal*, *10*(1), 2513. https://doi.org/10.2903/j.efsa.2012.2513

Emery, N. J., Seed, A. M., von Bayern, A. M., & Clayton, N. S. (2007). Cognitive adaptations of social bonding in birds. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *362*(1480), 489-505. https://doi.org/10.1098/rstb.2006.1991

Engebretson, M. (2006). The welfare and suitability of parrots as companion animals: a review. *Animal Welfare*, *15*(3), 263-276. https://doi.org/10.1017/s0962728600030475

Englund, M. D., & Cronin, K. A. (2023). Choice, control, and animal welfare: Definitions and essential inquiries to advance animal welfare science. *Frontiers in Veterinary Science*, *10*, 1250251. https://doi.org/10.3389/fvets.2023.1250251

Enkerlin-Hoeflich, E. C. (1995). *Comparative ecology and reproductive biology of three species of Amazona parrots in Northeastern Mexico.* [Doctoral dissertation, Texas A&M University].

Enkerlin-Hoeflich, E. C., Snyder, N. F. R., & Wiley, J. W. (2006). Behavior of wild *Amazona* and *Rhynchopsitta* parrots, with comparative insights from other psittacines. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 13-25). Blackwell publishing.

Fastré, C., Igwili, B., Van de Perre, F., & van der Hoek, Y. (2024). Visitation patterns of endangered grey parrots (*Psittacus erithacus*) in a forest clearing in the Democratic Republic of the Congo. *Ecology and Evolution*, *14*(8), e70039. https://doi.org/10.1002/ece3.70039

FAWC. (1993). *Report on priorities for animal welfare research and development*. Farm Animal Welfare Council. https://edepot.wur.nl/134980

Fecchio, R. S. (2021). Avian fractrued and maloccluded beaks. In P. P. Emily & E. R. Eisner (Eds.), *Zoo and Wild Animal Dentistry* (pp. 87-117). Wiley Blackwell.

FEDIAF. (2025). *Facts & figures*. FEDIAF (The European Pet Food Industry). Retrieved January 23, 2026 from https://europeanpetfood.org/wp-content/uploads/2025/06/FEDIAF-Facts-Figures-2025.pdf

Ferdinand, V., Pattenden, E., Brightsmith, D. J., & Hobson, E. A. (2023). Inferring the decision rules that drive co-foraging affiliations in wild mixed-species parrot groups. *Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences*, *378*(1878), 20220101. https://doi.org/10.1098/rstb.2022.0101

FHI. (2024). *Rød hønsemidd*. Folkehelseinstituttet. Skadedyrhåndboka. https://www.fhi.no/sk/skadedyrhandboka/edderkoppdyr/rod-honsemidd/

Flammer, K., Whitt-Smith, D., & Papich, M. (2001). Plasma concentrations of doxycycline in selected psittacine birds when administered in water for potential treatment of *Chlamydophila psittaci* infection. *Journal of Avian Medicine and Surgery*, *15*(4), 276-282. http://www.jstor.org/stable/30134184

Forshaw, J. M. (2010). *Parrots of the world*. Princeton University Press.

Forskrift om dyrevelferd ved fremvisning av dyr. (2017). FOR-2016-09-05-1035. https://lovdata.no/dokument/SF/forskrift/2016-09-05-1035

Fox, R. (2006). Hand-rearing: Behavioral impacts and implications for captive parrot welfare. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 83-91). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch10

Fox, R. A., & Millam, J. R. (2004). The effect of early environment on neophobia in orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *89*(1), 117-129. https://doi.org/10.1016/j.applanim.2004.05.002

Fox, R. A., & Millam, J. R. (2006). Novelty and individual differences influence neophobia in orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *104*(1), 107-115. https://doi.org/10.1016/j.applanim.2006.04.033

Fox, R. A., & Millam, J. R. (2014). Personality traits of pair members predict pair compatibility and reproductive success in a socially monogamous parrot breeding in captivity. *Zoo Biology*, *33*(3), 166-172. https://doi.org/10.1002/zoo.21121

Frankel , T. L., & Avram, D. (2001). Protein requirements of rainbow lorikeets, *Trichoglossus haematodus*. *Australian Journal of Zoology*, *49*(4), 435-443. https://doi.org/10.1071/ZO01005

Ganpule, P. (2011). Rose-ringed parakeet *Psittacula krameri* feeding on an old beehive. *Indian Birds*, *7*(2), 52. https://indianbirds.in/pdfs/IB7.2_Ganpule_Parakeet.pdf

Garner, J. P., Meehan, C. L., Famula, T. R., & Mench, J. A. (2006). Genetic, environmental, and neighbor effects on the severity of stereotypies and feather picking in orange-winged Amazon parrots (*Amazona amazonica*): An epidemiological study. *Applied Animal Behaviour Science*, *96*(1), 153-168. https://doi.org/10.1016/j.applanim.2005.09.009

Garner, J. P., Meehan, C. L., & Mench, J. A. (2003). Stereotypies in caged parrots, schizophrenia and autism: Evidence for a common mechanism. *Behavioural Brain Research*, *145*(1), 125-134. https://doi.org/10.1016/s0166-4328(03)00115-3

Garner, M. M., Clubb, S. L., Mitchell, M. A., & Brown, L. (2008). Feather-picking psittacines: histopathology and species trends. *Veterinary Pathology*, *45*(3), 401-408. https://doi.org/10.1354/vp.45-3-401

Gaskins, L. A., & Bergman, L. (2011). Surveys of avian practitioners and pet owners regarding common behavior problems in psittacine birds. *Journal of Avian Medicine and Surgery*, *25*(2), 111-118. https://doi.org/10.1647/2010-027.1

Gibson, D. J., Nemeth, N. M., Beaufrère, H., Varga, C., Eagalle, T., & Susta, L. (2019). Captive psittacine birds in Ontario, Canada: A 19-year retrospective study of the causes of morbidity and mortality. *Journal of Comparative Pathology*, *171*, 38-52. https://doi.org/10.1016/j.jcpa.2019.07.002

Gilardi, J. D., & Munn, C. A. (1998). Patterns of activity, flocking, and habitat use in parrots of the Peruvian Amazon. *Condor*, *100*(4), 641-653. https://doi.org/10.2307/1369745

Gustavsen, K. A., Stanhope, K. L., Lin, A. S., Graham, J. L., Havel, P. J., & Paul-Murphy, J. R. (2016). Effects of exercise on the plasma lipid profile in hispaniolan Amazon parrots (*Amazona ventralis*) with naturally occurring hypercholesterolemia. *Journal of Zoo and Wildlife Medicine*, *47*(3), 760-769, 710. https://doi.org/10.1638/2015-0192.1

Harcourt-Brown, N., & Chitty, J. (2005). *BSAVA Manual of Psittacine Birds* (2, Ed.). BSAVA.

Harcourt-Brown, N. H. (2009). Psittacine birds. In T. N. J. Tully, G. M. Dorrestein, A. K. Jones, & J. E. Cooper (Eds.), *Handbook of Avian Medicine* (pp. 138-168). Saunders Ltd.

Heinsohn, R., Appleby, D., Wilson, D., & Legge, S. (2024). Large, overlapping home ranges reveal male mating strategies in polygynandrous *Eclectus* parrots. *Emu - Austral Ornithology*, *124*(3), 261-267. https://doi.org/10.1080/01584197.2024.2368006

Heinsohn, R., Ebert, D., Legge, S., & Peakall, R. (2007). Genetic evidence for cooperative polyandry in reverse dichromatic *Eclectus* parrots. *Animal Behaviour*, *74*(4), 1047-1054. https://doi.org/10.1016/j.anbehav.2007.01.026

Hernández, M. C., & Barja, I. (2024). The role of neophobia in a pioneer olfactory enrichment for amazons, macaws, and toucans. *Revista de Biologia Tropical*, *72*(1), e54616. https://doi.org/10.15517/rev.biol.trop..v72i1.54616

Hoppes, S. M. (2024). *Pet birds*. Merck & Co. Veterinary Manual. Retrieved February 15, 2026 from https://www.msdvetmanual.com/exotic-and-laboratory-animals/pet-birds

Ikkatai, Y., Watanabe, S., & Izawa, E.-I. (2016). Reconciliation and third-party affiliation in pair-bond budgerigars (*Melopsittacus undulatus*). *Behaviour*, *153*(9/11), 1173-1193. https://doi.org/10.1163/1568539X-00003388

Jackson, H., Strubbe, D., Tollington, S., Prys-Jones, R., Matthysen, E., & Groombridge, J. J. (2015). Ancestral origins and invasion pathways in a globally invasive bird correlate with climate and influences from bird trade. *Molecular Ecology*, *24*(16), 4269-4285. https://doi.org/10.1111/mec.13307

Jayson, S. L., Williams, D. L., & Wood, J. L. N. (2014). Prevalence and risk factors of feather plucking in African grey parrots (*Psittacus erithacus erithacus* and *Psittacus erithacus timneh*) and cockatoos (*Cacatua* spp.). *Journal of Exotic Pet Medicine*, *23*(3), 250-257. https://doi.org/10.1053/j.jepm.2014.06.012

Jenkins, J. R. (2001). Feather picking and self-mutilation in psittacine birds. *Veterinary Clinics of North America. Exotic Animal Practice*, *4*(3), 651-667. https://doi.org/10.1016/s1094-9194(17)30029-4

Jensen, P., & Wright, D. (2022). Chapter 2 - Behavioral genetics and animal domestication. In T. Grandin (Ed.), *Genetics and the Behavior of Domestic Animals (Third Edition)* (pp. 49-93). Academic Press. https://doi.org/10.1016/B978-0-323-85752-9.00002-0

Juniper, T., & Parr, M. (2010). *Parrots. A guide to the parrots of the world*. A&C Black Publishers.

Kalmar, I. D., van Loon, M., Burkle, M., Reinschmidt, M., Waugh, D., Werquin, G., & Janssens, G. P. (2009). Effect of dilution degree of commercial nectar and provision of fruit on food, energy and nutrient intake in two rainbow lorikeet subspecies. *Zoo Biology*, *28*(2), 98-106. https://doi.org/10.1002/zoo.20240

Kalmar, I. D., Veys, A. C., Geeroms, B., Reinschmidt, M., Waugh, D., Werquin, G., & Janssens, G. P. J. (2010). Effects of segregation and impact of specific feeding behaviour and additional fruit on voluntary nutrient and energy intake in yellow-shouldered amazons (*Amazona barbadensis*) when fed a multi-component seed diet *ad libitum*. *Journal of Animal Physiology and Animal Nutrition*, *94*(6), e383-e392. https://doi.org/10.1111/j.1439-0396.2010.01026.x

Kays, R., Jansen, P. A., Knecht, E. M. H., Vohwinkel, R., & Wikelski, M. (2011). The effect of feeding time on dispersal of *Virola* seeds by toucans determined from GPS tracking

and accelerometers. *Acta Oecologica*, *37*(6), 625-631. https://doi.org/10.1016/j.actao.2011.06.007

Kaytee Avian Foundation. (2010). *Parrot relinquishment survey of 2010*. Kaytee Animal Foundation. https://www.birdcompanions.com/Kaytee%202010%20parrot%20relinq%20survey%20results.pdf

Keeling, L. J., Rushen, J., & Duncan, I. J. H. (2018). Understanding animal welfare. In M. C. Appleby, I. A. S. Olsson, & F. Galindo (Eds.), *Animal Welfare* (3 ed., pp. 16-35). CABI Digital Library. https://doi.org/10.1079/9781786390202.0016

Khan, H. A. (2002). Movement patterns of the rose-ringed parakeet (*Psittacula krameri*) in daylight hours in its communal roost. *International Journal of Agriculture & Biology*, *4*(4), 506-509. https://api.fspublishers.org/viewPaper/77076_..pdf

Kim, L. C., Garner, J. P., & Millam, J. R. (2009). Preferences of orange-winged Amazon parrots (*Amazona amazonica*) for cage enrichment devices. *Applied Animal Behaviour Science*, *120*(3), 216-223. https://doi.org/10.1016/j.applanim.2009.06.006

Kinkaid, H. Y. M., Mills, D. S., Nichols, S. G., Meagher, R. K., & Mason, G. J. (2013). Feather-damaging behaviour in companion parrots: An initial analysis of potential demographic risk factors. *Avian Biology Research*, *6*(4), 289-296. https://doi.org/10.3184/175815513x13803574144572

Klump, B. C., Martin, J. M., Wild, S., Hörsch, J. K., Major, R. E., & Aplin, L. M. (2021). Innovation and geographic spread of a complex foraging culture in an urban parrot. *Science*, *373*(6553), 456-460. https://doi.org/10.1126/science.abe7808

Kollias, G. V., & Kollias, H. W. (1995). Feeding passerine and psittacine birds. In M. S. Hand, Tatcher, C. D., Remillard, R. L., Roudebush, P., Novotny, B. J. (Ed.), *Small Animal Clinical Nutrition* (Vol. 90, pp. 1255-1269). Mark Morris Institute.

Korver, D. R. (2012). Implications of changing immune function through nutrition in poultry. *Animal Feed Science and Technology*, *173*(1), 54-64. https://doi.org/10.1016/j.anifeedsci.2011.12.019

Koutsos, E., & Speer, B. (2024). Abridged clinical nutrition topics for companion avian species. In A. J. Fascetti, S. J. Delaney, J. A. Larsen, & C. Villaverde (Eds.), *Applied Veterinary Clinical Nutrition* (2 ed., pp. 574-589). John Wiley & Sons, Inc. https://doi.org/10.1002/9781119375241.ch22

Koutsos, E. A., Matson, K. D., & Klasing, K. C. (2001a). Nutrition of birds in the order Psittaciformes: a review. *Journal of Avian Medicine and Surgery*, *15*(4), 257-275. https://doi.org/10.1647/1082-6742(2001)015[0257:NOBITO]2.0.CO;2

Koutsos, E. A., Smith, J., Woods, L. W., & Klasing, K. C. (2001b). Adult cockatiels (*Nymphicus hollandicus*) metabolically adapt to high protein diets. *Journal of Nutrition*, *131*(7), 2014-2020. https://doi.org/10.1093/jn/131.7.2014

Koutsos, E. A., Tell, L. A., Woods, L. W., & Klasing, K. C. (2003). Adult cockatiels (*Nymphicus hollandicus*) at maintenance are more sensitive to diets containing excess vitamin A than to vitamin A-deficient diets. *Journal of Nutrition*, *133*(6), 1898-1902. https://doi.org/10.1093/jn/133.6.1898

Kuhl, P. K. (2007). Is speech learning 'gated' by the social brain? *Developmental Science*, *10*(1), 110-120. https://doi.org/10.1111/j.1467-7687.2007.00572.x

Kusolsongkhrokul, R., Petcharat, P., Hin-On, W., Pumipuntu, F. S., Purisotayo, T., & Pumipuntu, N. (2022). Iron storage disease (ISD) in a captive toco toucan (*Ramphastos toco*): a case report. *Thai Journal of Veterinary Medicine*, *52*(4), 807-812. https://he01.tci-thaijo.org/index.php/tjvm/article/view/261518

Kwok, A. J., Mentzer, A., & Knight, J. C. (2021). Host genetics and infectious disease: new tools, insights and translational opportunities. *Nature Reviews Genetics*, *22*(3), 137-153. https://doi.org/10.1038/s41576-020-00297-6

Lambert, Megan L., Jacobs, I., Osvath, M., & von Bayern, Auguste M. P. (2019). Birds of a feather? Parrot and corvid cognition compared. *Behaviour*, *156*(5-8), 505-594. https://doi.org/10.1163/1568539X-00003527

Laumer, I. B., Bugnyar, T., Reber, S. A., & Auersperg, A. M. I. (2017). Can hook-bending be let off the hook? Bending/unbending of pliant tools by cockatoos. *Proceedings Biological sciences*, *284*(1862), 20171026. https://doi.org/10.1098/rspb.2017.1026

Lefebvre, L. (2013). Brains, innovations, tools and cultural transmission in birds, non-human primates, and fossil hominins. *Frontiers in Human Neuroscience*, *7*, 245. https://doi.org/10.3389/fnhum.2013.00245

Louisville zoo. (n.d.). *Toucan, Toco*.Retrieved March 14, 2026 from https://louisvillezoo.org/animalsandplants/toucan-toco/#:~:text=The%20bill%20also%20helps%20the,25%20%E2%80%93%2030%20years%20in%20captivity

Lowry, H., & Lill, A. (2007). Ecological factors facilitating city-dwelling in red-rumped parrots. *Wildlife Research*, *34*(8), 624-631. https://doi.org/10.1071/WR07025

Luescher, A. U., & Wilson, L. (2006). Housing and management considerations for problem prevention. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 291-299). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch26

Lumeij, J. T., & Hommers, C. J. (2008). Foraging 'enrichment' as treatment for pterotillomania. *Applied Animal Behaviour Science*, *111*(1), 85-94. https://doi.org/10.1016/j.applanim.2007.05.015

MacMillen, R. E., & Baudinette, R. V. (1993). Water economy of granivorous birds: Australian parrots. *Functional Ecology*, *7*(6), 704-712. https://doi.org/10.2307/2390192

Maj, A. K., Gorecki, P., Szalus-Jordanow, O., & Janczak, D. (2025). Occurrence of *Aspergillus* spp. in parrot feeds on the Polish market: The potential health threat of aspergillosis and mycotoxicosis for exotic pet birds, a pilot study. *Veterinary Sciences*, *12*(6), 597. https://doi.org/10.3390/vetsci12060597

Mancinelli, E., & Bament, W. (2014). Clinical particulars of pet parrots. *Veterinary Times*, *44*(25).

Martel-Arquette, A., Mans, C., & Sladky, K. (2016). Management of severe frostbite in a grey-headed parrot (*Poicephalus fuscicollis suahelicus*). *Journal of Avian Medicine and Surgery*, *30*(1), 39-45. https://doi.org/10.1647/2015-100

Martens, J., Hoppe, D., & Woog, F. (2013). Diet and feeding behaviour of naturalised Amazon parrots in a European city. *Ardea*, *101*(1), 71-76. https://doi.org/10.5253/078.101.0111

Martin, S. G., & Romagnano, A. (2006). Nest box preferences. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 79-82). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch9

Mason, G. J. (1991). Stereotypies: a critical review. *Animal Behaviour*, 41(6), 1015-1037. https://doi.org/10.1016/S0003-3472(05)80640-2

Mason, G., & Bateson, M. (2002). Motivation and the organization of behaviour. In P. Jensen (Ed.), *The ethology of domestic animals* (3 ed., pp. 38-61). CABI Digital Library. https://doi.org/10.1079/9781786391650.0038

Mason, G. J., & Burn, C. C. (2018). Frustration and boredom in impoverished environments. In M. C. Appleby, A. S. Olsson, & F. Galindo (Eds.), *Animal Welfare* (pp. 114-138). CABI Digital Library. https://doi.org/10.1079/9781786390202.0114

Massen, J., Malone, K., de Vries, R., Beekmans, M., Zeeland, Y. v., & Oei, C. (2022). Do birds enjoy flying? An analysis of affect after flight in galah (*Eolophus roseicapilla*). *Research Square*. https://doi.org/10.21203/rs.3.rs-2386013/v1

Matinata, B. S., & Perrella, D. F. (2020). First record of geophagy by a Ramphastidae species (Piciformes). *Ornithology Research*, *28*(3), 174-177. https://doi.org/10.1007/s43388-020-00027-w

Matuzak, G. D., Bezy, M. B., & Brightsmith, D. J. (2008). Foraging ecology of parrots in a modified landscape: seasonal trends and introduced species. *The Wilson Journal of Ornithology*, *120*(2), 353-365. https://doi.org/10.1676/07-038.1

Maurice, M. E. (2023). Aggregation influence of African grey parrots (*Psittacus erithacus*) on environmental exploitation in Limbe botanic garden, Southwest region, Cameroon. *Journal of Ecosystem & Ecography*, *13*(454), 2. https://doi.org/10.4172/2157-7625.1000454

McDonald, D. (2003). Feeding ecology and nutrition of Australian lorikeets. *Seminars in Avian and Exotic Pet Medicine*, *12*(4), 195-204. https://doi.org/10.1053/s1055-937x(03)00035-5

Meehan, C., & Mench, J. (2006). Captive parrot welfare. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 301-318). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch27

Meehan, C. L., Garner, J. P., & Mench, J. A. (2003a). Isosexual pair housing improves the welfare of young Amazon parrots. *Applied Animal Behaviour Science*, *81*(1), 73-88. https://doi.org/10.1016/S0168-1591(02)00238-1

Meehan, C. L., Garner, J. P., & Mench, J. A. (2004). Environmental enrichment and development of cage stereotypy in orange-winged Amazon parrots (*Amazona amazonica*). *Developmental Psychobiology*, *44*(4), 209-218. https://doi.org/10.1002/dev.20007

Meehan, C. L., & Mench, J. A. (2002). Environmental enrichment affects the fear and exploratory responses to novelty of young Amazon parrots. *Applied Animal Behaviour Science*, *79*(1), 75-88. https://doi.org/10.1016/S0168-1591(02)00118-1

Meehan, C. L., Millam, J. R., & Mench, J. A. (2003b). Foraging opportunity and increased physical complexity both prevent and reduce psychogenic feather picking by young Amazon parrots. *Applied Animal Behaviour Science*, *80*(1), 71-85. https://doi.org/10.1016/S0168-1591(02)00192-2

Mellor, D. J. (2016). Updating animal welfare thinking: moving beyond the "Five Freedoms" towards "A life worth living". *Animals*, *6*(3), 21. https://www.mdpi.com/2076-2615/6/3/21

Mellor, D. J., & Reid, C. S. W. (1994). Concepts of animal well-being and predicting the impact of procedures on experimental animals. In *Improving the well-being of animals in the research environment* (pp. 3-18). Australian and New Zealand Council for the Care of Animals in Research and Teaching. https://www.wellbeingintlstudiesrepository.org/cgi/viewcontent.cgi?article=1006&context=exprawel

Mellor, E. L., McDonald Kinkaid, H. K., Mendl, M. T., Cuthill, I. C., van Zeeland, Y. R. A., & Mason, G. J. (2021). Nature calls: intelligence and natural foraging style predict poor welfare in captive parrots. *Proceedings of the Royal Society B: Biological Sciences*, *288*(1960), 20211952. https://doi.org/10.1098/rspb.2021.1952

Mettke-Hofmann, C. (2000). Changes in exploration from courtship to the breeding state in red-rumped parrots (*Psephotus haematonotus*). *Behavioural Processes*, *49*(3), 139-148. https://doi.org/10.1016/s0376-6357(00)00084-x

Mettke-Hofmann, C., Winkler, H., & Leisler, B. (2002). The significance of ecological factors for exploration and neophobia in parrots. *Ethology*, *108*(3), 249-272. https://doi.org/10.1046/j.1439-0310.2002.00773.x

Miglioli, A., & Vasconcellos, A. S. (2021). Can behavioural management improve behaviour and reproduction in captive blue-and-yellow macaws (*Ara ararauna*)? *Applied Animal Behaviour Science*, *241*, 105386. https://doi.org/10.1016/j.applanim.2021.105386

Mikich, S. B., Jennings, J., & Cubas, Z. S. (2001). Order Piciformes (toucans, woodpeckers). In M. E. Fowler (Ed.), *Biology, medicine, and surgery of South American wild animals* (pp. 180-199). Iowa State University Press.

Minich, D., Madden, C., Navarro, M. A., Glowacki, L., French-Kim, K., Chan, W., Evans, M. V., Soares, K., Mrofchak, R., Madan, R., Ballash, G. A., Laperle, K., Paul, S., Vodovotz, Y., Uzal, F. A., Martinez, M., Hausmann, J., Junge, R. E., & Hale, V. L. (2022). Gut microbiota and age shape susceptibility to clostridial enteritis in lorikeets under human care. *Animal Microbiome*, *4*, 7. https://doi.org/10.1186/s42523-021-00148-7

Morales, F., Montserrat-de la Paz, S., Leon, M. J., & Rivero-Pino, F. (2023). Effects of malnutrition on the immune system and infection and the role of nutritional strategies regarding improvements in children's health status: a literature review. *Nutrients*, *16*(1), 1. https://doi.org/10.3390/nu16010001

Moura, L. N., Silva, M. L., Garotti, M. M., Rodrigues, A. L., Santos, A. C., & Ribeiro, I. F. (2014). Gestural communication in a new world parrot. *Behavioural Processes*, *105*, 46-48. https://doi.org/10.1016/j.beproc.2014.03.003

Mullen, P., & Pohland, G. (2008). Studies on UV reflection in feathers of some 1000 bird species: Are UV peaks in feathers correlated with violet-sensitive and ultraviolet-sensitive cones? *Ibis*, *150*(1), 59-68. https://doi.org/10.1111/j.1474-919X.2007.00736.x

Murphy, S. M., Braun, J. V., & Millam, J. R. (2011). Bathing behavior of captive orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *132*(3), 200-210. https://doi.org/10.1016/j.applanim.2011.04.010

Myers, M. C., & Vaughan, C. (2004). Movement and behavior of scarlet macaws (*Ara macao*) during the post-fledging dependence period: Implications for in situ versus ex situ management. *Biological Conservation*, *118*(3), 411-420. https://doi.org/10.1016/j.biocon.2003.09.018

Myers, S. A., Millam, J. R., Roudybush, T. E., & Grau, C. R. (1988). Reproductive success of hand-reared vs parent-reared cockatiels (*Nymphicus hollandicus*). *Auk*, *105*(3), 536-542. https://doi.org/10.1093/auk/105.3.536

National Research Council. (1994). *Nutrient requirements of poultry*. National Academy Press. https://www.agropustaka.id/wp-content/uploads/2020/04/agropustaka.id_buku_Nutrient-Requirements-of-Poultry_Ninth-Revised-Edition-1994-NRC.pdf

Naves, D. A. S., Carvalho, T. S. G., Zangeronimo, M. G., Saad, C. E. P., & Scalon, J. D. (2017). Food preferences of cockatiel chicks (*Nymphicus hollandicus*) in captivity. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *69*(3), 683-686. https://doi.org/10.1590/1678-4162-9430

Newberry, R. C. (1995). Environmental enrichment: Increasing the biological relevance of captive environments. *Applied Animal Behaviour Science*, 44(2-4), 229-243. https://doi.org/10.1016/0168-1591(95)00616-Z

Nightengale, M., Stout, R. W., & Tully, T. N., Jr. (2022). Plasma vitamin D (25-hydroxyvitamin D) levels in hispaniolan Amazon parrots (*Amazona ventralis*) housed indoors over time. *Avian Diseases*, *66*(2), 148-154. https://doi.org/10.1637/aviandiseases-D-21-00117

Nijboer, J., Fens, A., & Brandão, J. (2025a). *Nutrition in Psittacines*. Merck & Co. Veterinary Manual. Retrieved March 5, 2026 from https://www.merckvetmanual.com/management-and-nutrition/nutrition-exotic-and-zoo-animals/nutrition-in-psittacines?query=nutrition%20in%20psittacines

Nijboer, J., Fens, A., & Brandão, J. (2025b). *Nutrition in toucans and hornbills*. Merck & Co. Veterinary Manual. Retrieved March 9, 2026 from https://www.merckvetmanual.com/management-and-nutrition/nutrition-exotic-and-zoo-animals/nutrition-in-toucans-and-hornbills?query=nutrition%20in%20toucans%20and%20hornbills

Norges Forskningsråd. (2005). *Forskningsbehov innen dyrevelferd i Norge*. https://www.regjeringen.no/globalassets/upload/kilde/lmd/rap/2005/0002/ddd/pdfv/262079-rapp_sammendrag_av_forskningsbehov_innen_dyrevelferd_i_norge.pdf

O'Hara, M., & Auersperg, A. M. (2017). Object play in parrots and corvids. *Current Opinion in Behavioral Sciences*, *16*, 119-125. https://doi.org/10.1016/j.cobeha.2017.05.008

O'Hara, M., Mioduszewska, B., Mundry, R., Yohanna, Haryoko, T., Rachmatika, R., Prawiradilaga, D. M., Huber, L., & Auersperg, A. M. I. (2021). Wild Goffin's cockatoos flexibly manufacture and use tool sets. *Current Biology*, *31*(20), 4512-4520.e4516. https://doi.org/10.1016/j.cub.2021.08.009

Oliveira, T. M. A., & Tubelis, D. P. (2023). Seasonal variation in the predation on avian resources by the toco toucan (*Ramphastos toco*) in Brazil, based on community science data. *Ornitologia Colombiana*, *24*, 37-45. https://doi.org/10.59517/oc.e571

Olkowicz, S., Kocourek, M., Lučan, R. K., Porteš, M., Fitch, W. T., Herculano-Houzel, S., & Němec, P. (2016). Birds have primate-like numbers of neurons in the forebrain.

Proceedings of the National Academy of Sciences, *113*(26), 7255-7260. https://doi.org/10.1073/pnas.1517131113

Orosz, S. E. (2014). Clinical avian nutrition. *Veterinary Clinics of North America. Exotic Animal Practice*, *17*(3), 397-413. https://doi.org/10.1016/j.cvex.2014.05.003

Ostrow, E. N., Catanach, T. A., Bates, J. M., Aleixo, A., & Weckstein, J. D. (2023). Phylogenomic analysis confirms the relationships among toucans, toucan-barbets, and New World barbets but reveals paraphyly of *Selenidera* toucanets and evidence for mitonuclear discordance. *Ornithology*, *140*(3), 1-13. https://doi.org/10.1093/ornithology/ukad022

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. *Systematic Reviews*, *5*(1), 210. https://doi.org/10.1186/s13643-016-0384-4

Park, F. (2006). Vitamin A toxicosis in a lorikeet flock. *Veterinary Clinics of North America. Exotic Animal Practice*, *9*(3), 495-502. https://doi.org/10.1016/j.cvex.2006.05.025

Patel, A. D., Iversen, J. R., Bregman, M. R., & Schulz, I. (2009). Experimental evidence for synchronization to a musical beat in a nonhuman animal. *Current Biology*, *19*(10), 827-830. https://doi.org/10.1016/j.cub.2009.03.038

Peng, S. J.-L., Chang, F.-C., Ting, J. S.-T., & Fei, A. C.-Y. (2013). Welfare assessment of flight-restrained captive birds: Effects of inhibition of locomotion. *The Thai Journal of Veterinary Medicine*, *43*(2), 235-241. https://doi.org/10.56808/2985-1130.2471

Penndorf, J., Farine, D., Martin, J., & Aplin, L. (2024). Long-term stability of dominance hierarchies in a wild parrot with fission-fusion dynamics. *bioRxiv*, 594429. https://doi.org/10.1101/2024.05.15.594429

Pepperberg, I. M. (2006). Cognitive and communicative abilities of grey parrots. *Applied Animal Behaviour Science*, *100*(1-2), 77-86. https://doi.org/10.1016/j.applanim.2006.04.005

Pepperberg, I. M. (2010). Vocal learning in grey parrots: A brief review of perception, production, and cross-species comparisons. *Brain and Language*, *115*(1), 81-91. https://doi.org/10.1016/j.bandl.2009.11.002

Pepperberg, I. M., & Carey, S. (2012). Grey parrot number acquisition: The inference of cardinal value from ordinal position on the numeral list. *Cognition*, *125*(2), 219-232. https://doi.org/10.1016/j.cognition.2012.07.003

Pepperberg, I. M., & Funk, M. S. (1990). Object permanence in four species of psittacine birds: An African grey parrot (*Psittacus erithacus*), an Illiger mini macaw (*Ara maracana*), a parakeet (*Melopsittacus undulatus*), and a cockatiel (*Nymphicus hollandicus*). *Animal Learning & Behavior*, *18*(1), 97-108. https://doi.org/10.3758/BF03205244

Pepperberg, I. M., & Kozak, F. A. (1986). Object permanence in the African grey parrot (*Psittacus erithacus*). *Animal Learning & Behavior*, *14*(3), 322-330. https://doi.org/10.3758/BF03200074

Péron, F., & Grosset, C. (2014). The diet of adult psittacids: veterinarian and ethological approaches. *Journal of Animal Physiology and Animal Nutrition*, *98*(3), 403-416. https://doi.org/10.1111/jpn.12103

Perpinan, D. (2015). Problems of excess nutrients in psittacine diets. *Companion Animal*, *20*(9), 532-537. https://doi.org/10.12968/coan.2015.20.9.532

Perrella, D. F., & Guida, F. J. V. (2019). Additional information on reproductive behavior of the red-breasted toucan, *Ramphastos dicolorus* (Aves: Piciformes: Ramphastidae). *Biota Neotropica*, *19*(1). https://doi.org/10.1590/1676-0611-BN-2018-0576

Phillips, C. J. C., Farrugia, C., Lin, C.-h., Mancera, K., & Doneley, B. (2018). The effect providing space in excess of standards on the behaviour of budgerigars in aviaries. *Applied Animal Behaviour Science*, *199*, 89-93. https://doi.org/10.1016/j.applanim.2017.10.015

Pichorim, M., Câmara, T. P. F., de Oliveira-Júnior, T. M., de Oliveira, D. V., Nascimento, É. P. G. d., & Mobley, J. A. (2014). A population of blue-winged macaw *Primolius maracana* in Northeastern Brazil: Recommendations for a local conservation action plan. *Tropical Conservation Science*, *7*(3), 488-507. https://doi.org/10.1177/194008291400700309

Pilny, A. A., Quesenberry, K. E., Bartick-Sedrish, T. E., Latimer, K. S., & Berghaus, R. D. (2012). Evaluation of *Chlamydophila psittaci* infection and other risk factors for atherosclerosis in pet psittacine birds. *Journal of the American Veterinary Medical Association*, *240*(12), 1474-1480. https://doi.org/10.2460/javma.240.12.1474

Piseddu, A., van Zeeland, Y. R. A., & Rault, J.-L. (2024). What we (don't) know about parrot welfare: Finding welfare indicators through a systematic literature review. *Animal Welfare*, *33*, e57. https://doi.org/10.1017/awf.2024.61

Piseddu, A., van Zeeland, Y. R. A., & Rault, J.-L. (2025). Evaluation of welfare indicators for companion parrots: a Delphi consultation survey. *Applied Animal Behaviour Science February*, *283*(84), 106526. https://doi.org/10.1016/j.applanim.2025.106526

Powers, L. V. (2014). Ramphastids: toucans and toucanets. *CABI Digital Library*. https://www.cabidigitallibrary.org/doi/pdf/10.5555/20143185471

Ragusa-Netto, J. (2006). Abundance and frugivory of the toco toucan (*Ramphastos toco*) in a gallery forest in Brazil's Southern Pantanal. *Brazilian Journal of Biology*, *66*(1a), 133-142. https://doi.org/10.1590/S1519-69842006000100017

Ragusa-Netto, J. (2007). Feeding ecology of the green-cheeked parakeet (*Pyrrhura molinae*) in dry forests in western Brazil. *Brazilian Journal of Biology*, *67*(2), 243-249. https://doi.org/10.1590/s1519-69842007000200009

Ragusa-Netto, J. (2024). Feeding ecology of the red-and-green macaw (*Ara chloropterus*; Gray 1859) in a habitat mosaic from Cerrado. *Brazilian Journal of Biology*, *84*, e280711. https://doi.org/10.1590/1519-6984.280711

Ragusa-Netto, J. (2025). Blue-and-yellow macaw (*Ara ararauna*; Linnaeus, 1758) and its novel and major food, *Terminalia catappa L.* seeds, in an urban area in central Brazil. *Brazilian Journal of Biology*, *85*, e288000. https://doi.org/10.1590/1519-6984.288000

Rault, J.-L., Bateson, M., Boissy, A., Forkman, B., Grinde, B., Gygax, L., Harfeld, J. L., Hintze, S., Keeling, L. J., & Kostal, L. (2025). A consensus on the definition of positive animal welfare. *Biology Letters*, *21*(1), 20240382. https://doi.org/10.1098/rsbl.2024.0382

Razmadze, D., Panyutina, A. A., & Zelenkov, N. V. (2018). Anatomy of the forelimb musculature and ligaments of *Psittacus erithacus* (Aves: Psittaciformes). *Journal of Anatomy*, *233*(4), 496-530. https://doi.org/10.1111/joa.12861

Reimer, J., Maia, C. M., & Santos, E. F. (2016). Environmental enrichments for a group of captive macaws: Low interaction does not mean low behavioral changes. *Journal of Applied Animal Welfare Science*, *19*(4), 385-395. https://doi.org/10.1080/10888705.2016.1175944

Renton, K., Salinas-Melgoza, A., de Labra-Hernández, M. Á., & de la Parra-Martínez, S. M. (2015). Resource requirements of parrots: Nest site selectivity and dietary plasticity of psittaciformes. *Journal of Ornithology*, *156* (Suppl 1), 73-90. https://doi.org/10.1007/s10336-015-1255-9

Rodríguez-López, R. (2016). Environmental enrichment for parrot species: Are we squawking up the wrong tree? *Applied Animal Behaviour Science*, 180, 1-10. https://doi.org/10.1016/j.applanim.2016.04.016

Romagnano, A. (2006). Mate trauma. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 247-253). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch22

Rosenwax, A., & Cowan, M. (2015). Fibrous ingluvial foreign bodies in 33 cockatiels (*Nymphicus hollandicus*). *Australian Veterinary Journal*, *93*(10), 381-384. https://doi.org/10.1111/avj.12367

Ross, M. R., Gillespie, K. L., Hopper, L. M., Bloomsmith, M. A., & Maple, T. L. (2013). Differential preference for ultraviolet light among captive birds from three ecological habitats. *Applied Animal Behaviour Science*, *147*(3), 278-285. https://doi.org/10.1016/j.applanim.2013.05.006

Rowland, L. O., Sloan, D. R., Fry, J. L., & Harms, R. H. (1973). Calcium requirement for bone maintenance of aged non-laying hens. *Poultry Science*, *52*(4), 1415-1418. https://doi.org/10.3382/ps.0521415

Rozek, J. C., Danner, L. M., Stucky, P. A., & Millam, J. R. (2010). Over-sized pellets naturalize foraging time of captive orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *125*(1), 80-87. https://doi.org/10.1016/j.applanim.2010.03.001

Rozek, J. C., & Millam, J. R. (2011). Preference and motivation for different diet forms and their effect on motivation for a foraging enrichment in captive orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *129*(2), 153-161. https://doi.org/10.1016/j.applanim.2010.11.009

Saldanha, A., Machado, R. G., Fernandes, B. D., de Oliveira, J. C., Carvalho, G. A., Moreno, T. B., & da Rocha, C. (2023). Voluntary intake of captive psittacines fed mixed diets of seeds and extruded feed. *Archives of Veterinary Science*, *28*(3). https://doi.org/10.5380/avs.v28i3.90983

Scherer-Neto, P., Robaldo Guedes, N. M., & Barbosa Toledo, M. C. (2019). Long-term monitoring of a hyacinth macaw *Anodorhynchus hyacinthinus* (Psittacidae) roost in the Pantanal, Brazil. *Endangered Species Research*, *39*, 25-34. https://doi.org/10.3354/esr00954

Schiffner, I., & Srinivasan, M. V. (2016). Budgerigar flight in a varying environment: flight at distinct speeds? *Biology Letters*, *12*(6), 20160221. https://doi.org/10.1098/rsbl.2016.0221

Schmid, R., Doherr, M. G., & Steiger, A. (2006). The influence of the breeding method on the behaviour of adult African grey parrots (*Psittacus erithacus*). *Applied Animal Behaviour Science*, *98*(3), 293-307. https://doi.org/10.1016/j.applanim.2005.09.002

Schneider, L., Serbena, A. L., & Guedes, N. M. R. (2006). Behavioral categories of hyacinth macaws (*Anodorhynchus hyacinthinus*) during the reproductive period, at south Pantanal, Brazil. *Revista de Etologia*, *8*(2), 71-80.

https://www.etologiabrasil.org.br/media/upload/publicacoes_revista/vol_8_2_071.pdf

Scholthof, K. B. (2007). The disease triangle: pathogens, the environment and society. *Nature Reviews. Microbiology*, *5*(2), 152-156. https://doi.org/10.1038/nrmicro1596

Seibert, L. M. (2006a). Feather-picking disorder in pet birds. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 255-265). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch23

Seibert, L. M. (2006b). Social behavior of psittacine birds. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 43-48). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch5

Seibert, L. M., & Crowell-Davis, S. L. (2001). Gender effects on aggression, dominance rank, and affiliative behaviors in a flock of captive adult cockatiels (*Nymphicus hollandicus*). *Applied Animal Behaviour Science*, *71*(2), 155-170. https://doi.org/10.1016/S0168-1591(00)00172-6

Sheppard, C., & Dierenfeld, E. (2002). Iron storage disease in birds: Speculation on aetiology and implications for captive husbandry. *Journal of Avian Medicine and Surgery*, *16*(3), 192-197. https://doi.org/10.1647/1082-6742(2002)016[0192:ISDIBS]2.0.CO;2

Shonkoff, J. P., & Bales, S. N. (2011). Science does not speak for itself: Translating child development research for the public and its policymakers. *Child Development*, *82*(1), 17-32. https://doi.org/10.1111/j.1467-8624.2010.01538.x

Silva, P. A., Melo, C., & Brito, L. (2015). Calyx-water consumption by blue-and-yellow macaws in *Spathodea campanulata* (Bignoniaceae) floral buds. *Ornitología Neotropical*, *26*(2), 201-206. https://doi.org/10.58843/ornneo.v26i2.27

Skutch, A. F. (1958). Roosting and nesting of araçari toucans. *The Condor: Ornithological Applications*, *60*(4), 201-219. https://doi.org/10.2307/1365190

Smith, B. T., Thom, G., & Joseph, L. (2024). Revised evolutionary and taxonomic synthesis for parrots (order: Psittaciformes) guided by phylogenomic analysis. *Bulletin of the American Museum of Natural History*, *2024*(468), 1-89. https://doi.org/10.1206/0003-0090.468.1.1

Smith, G. E., Bastos, A. P. M., Chodorow, M., Taylor, A. H., & Pepperberg, I. M. (2022). Contrafreeloading in kea (*Nestor notabilis*) in comparison to grey parrots (*Psittacus erithacus*). *Scientific Reports*, *12*(1), 17415. https://doi.org/10.1038/s41598-022-21370-6

Smith, G. E., Greene, D., Hartsfield, L. A., & Pepperberg, I. M. (2021). Initial evidence for eliciting contrafreeloading in grey parrots (*Psittacus erithacus*) via the opportunity for playful foraging. *Journal of Comparative Psychology*, *135*(4), 516-533. https://doi.org/10.1037/com0000295

Sossinka, R. (1982). Domestication in birds. In *Avian Biology* (Vol. VI, pp. 373-403). Academic Press, Inc.

Špinka, M., & Wemelsfelder, F. o. (2018). Environmental challenge and animal agency. In M. C. Appleby, I. A. S. Olsson, & F. Galindo (Eds.), *Animal Welfare* (3 ed., pp. 39-55). CABI Digital Library. https://doi.org/10.1079/9781845936594.002

Spoon, T., Millam, J., & Owings, D. (2004). Variation in the stability of cockatiel (*Nymphicus hollandicus*) pair relationships: The roles of males, females, and mate compatibility. *Behaviour*, *141*(10), 1211-1234. https://doi.org/10.1163/1568539042729711

Spoon, T. R. (2006). Parrot reproductive behavior, or who associates, who mates, and who cares. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 63-77). Blackwell Publishing.

Spoon, T. R., Millam, J. R., & Owings, D. H. (2006). The importance of mate behavioural compatibility in parenting and reproductive success by cockatiels, *Nymphicus hollandicus*. *Animal Behaviour*, *71*(2), 315-326. https://doi.org/10.1016/j.anbehav.2005.03.034

Spoon, T. R., Millam, J. R., & Owings, D. H. (2007). Behavioural compatibility, extrapair copulation and mate switching in a socially monogamous parrot. *Animal Behaviour*, *73*(5), 815-824. https://doi.org/10.1016/j.anbehav.2006.10.010

Stanford, L., & Lill, A. (2008). Out on the town: Winter feeding ecology of lorikeets in urban parkland. *Corella*, *32*(3), 49-57. https://absa.asn.au/wp-content/uploads/2021/04/Cor-Vol-32-Pg49-57-Lorikeets.pdf

Stanford, M. (2010). Cage and aviary birds. In A. Meredith & C. Johnson-Delaney (Eds.), *BSAVA manual of exotic pets*. BSAVA.

Stelow, E. (2021). Avian behavior consultation for exotic pet practitioners. *Veterinary Clinics of North America. Exotic Animal Practice*, *24*(1), 103-117. https://doi.org/10.1016/j.cvex.2020.09.006

Stevens, A., Doneley, R., Cogny, A., & Phillips, C. J. C. (2021). The effects of environmental enrichment on the behaviour of cockatiels (*Nymphicus hollandicus*) in aviaries. *Applied Animal Behaviour Science*, *235*, 105154. https://doi.org/10.1016/j.applanim.2020.105154

Storting. (2024-2025). *Meld. St. 8 (2024–2025). Dyrevelferd.* https://www.regjeringen.no/no/dokumenter/meld.-st.-8-20242025/id3080297/

Strubbe, D. (2009). *Psittacula krameri* (rose-ringed parakeet). *CABI Compendium*. https://doi.org/10.1079/cabicompendium.45158

Strubbe, D., & Matthysen, E. (2011). A radiotelemetry study of habitat use by the exotic ring-necked parakeet *Psittacula krameri* in Belgium. *Ibis*, *153*(1), 180-184. https://doi.org/10.1111/j.1474-919X.2010.01074.x

Symes, C. T., & Marsden, S. J. (2007). Patterns of supra-canopy flight by pigeons and parrots at a hill-forest site in Papua New Guinea. *Emu - Austral Ornithology*, *107*(2), 115-125. https://doi.org/10.1071/MU06041

Tamungang, S. A., & Cheke, R. A. (2012). *Population status and management plan of the African grey parrot in Cameroon*. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). https://cites.org/sites/default/files/eng/com/sc/62/inf/E62i-14.pdf

Tattersall, G. J., Andrade, D. V., & Abe, A. S. (2009). Heat exchange from the toucan bill reveals a controllable vascular thermal radiator. *Science*, *325*(5939), 468-470. https://doi.org/10.1126/science.1175553

Tattersall, G. J., Arnaout, B., & Symonds, M. R. E. (2017). The evolution of the avian bill as a thermoregulatory organ. *Biological Reviews*, *92*(3), 1630-1656. https://doi.org/10.1111/brv.12299

Thabethe, V., Thompson, L. J., Hart, L. A., Brown, M., & Downs, C. T. (2013). Seasonal effects on the thermoregulation of invasive rose-ringed parakeets (*Psittacula krameri*). *Journal of Thermal Biology*, *38*(8), 553-559. https://doi.org/10.1016/j.jtherbio.2013.09.006

Tomás, X., & Senar, J. C. (2021). Leaf bathing in ring-necked parakeets *Psittacula krameri*. *Arxius de Miscel·lània Zoològica*, *19*, 131-133. https://doi.org/10.32800/amz.2021.19.0131

Turpen, K. K., Welle, K. R., Trail, J. L., Patel, S. D., & Allender, M. C. (2019). Establishing stress behaviors in response to manual restraint in cockatiels (*Nymphicus hollandicus*). *Journal of Avian Medicine and Surgery*, *33*(1), 38-45. https://doi.org/10.1647/2017-315

Tygesen, A., & Forkman, B. (2023). The parrot-owner relationship and problem behaviors in parrots. *Anthrozoos*, *36*(6), 985-997. https://doi.org/10.1080/08927936.2023.2238434

Ullrey, D. E., Allen, M. E., & Baer, D. J. (1991). Formulated diets versus seed mixtures for psittacines. *The Journal of Nutrition*, *121*(11), S193-S205. https://doi.org/10.1093/jn/121.suppl_11.S193

van Hoek, C. S., & King, C. E. (1997). Causation and influence of environmental enrichment on feather picking of the crimson-bellied conure (*Pyrrhura perlata perlata*). *Zoo Biology*, *16*(2), 161-172. https://doi.org/10.1002/(SICI)1098-2361(1997)16:2%3c161::AID-ZOO6%3e3.0.CO;2-8

Van Houtan, K. S., Rojas-Moscoso, J. I., van Houtan, H. N., & Gonzalez, O. (2025). Species cumulative impacts to mixed assemblages of Neotropical parrots. *Behavioral Ecology*, *36*(4). https://doi.org/10.1093/beheco/araf066

Van Sant, F. (2006). Problem sexual behaviors of companion parrots. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 233-245). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch21

van Zeeland, Y. R. A., Schoemaker, N. J., Ravesteijn, M. M., Mol, M., & Lumeij, J. T. (2013). Efficacy of foraging enrichments to increase foraging time in grey parrots (*Psittacus erithacus erithacus*). *Applied Animal Behaviour Science*, *149*(1), 87-102. https://doi.org/10.1016/j.applanim.2013.09.005

van Zeeland, Y. R. A., Spruit, B. M., Rodenburg, T. B., Riedstra, B., van Hierden, Y. M., Buitenhuis, B., Korte, S. M., & Lumeij, J. T. (2009). Feather damaging behaviour in parrots: A review with consideration of comparative aspects. *Applied Animal Behaviour Science*, *121*(2), 75-95. https://doi.org/10.1016/j.applanim.2009.09.006

Veloso, R. R., Sakomura, N. K., Kawauchi, I. M., Malheiros, E. B., & Carciofi, A. C. (2014). Effects of food processing and fibre content on the digestibility, energy intake and biochemical parameters of blue-and-gold macaws (*Ara ararauna* L. – Aves, Psittacidae). *Journal of Animal Physiology and Animal Nutrition*, *98*(2), 251-261. https://doi.org/10.1111/jpn.12075

Vendramin-Gallo, M., Pessutti, C., Pezzato, A. C., & Vicentini-Paulino, M. L. M. (2001). Effect of age on seed digestion in parrots (*Amazona aestiva*). *Physiological and Biochemical Zoology*, *74*(3), 398-403. https://doi.org/10.1086/320418

VKM. (2020). *Status and trade assessment of parrots listed in CITES Appendix I*. https://vkm.no/download/18.20e6b7d01766fe1e498fa68/1608274311949/Status%20and%20trade%20assessment%20of%20parrots%20listed%20in%20CITES%20Appendix%20I.pdf

VKM. (2023). *Kriterier for forfatterskap og faglig ansvar i VKMs uttalelser*. https://vkm.no/download/18.31466e2518a903f269871472/1695193122273/Forfatterskapskriterier%20i%20VKM_august%202023.pdf

VKM. (2024). *Rutine for godkjenning av risikovurderinger*. https://vkm.no/download/18.b0c9d0418d19b83a41abae/1705568203133/Rutine%20for%20godkjenning%20av%20VKMs%20vitenskapelige%20vurderinger_2024.pdf

Wanker, R., Apcin, J., Jennerjahn, B., & Waibel, B. (1998). Discrimination of different social companions in spectacled parrotlets (*Forpus conspicillatus*): Evidence for individual vocal recognition. *Behavioral Ecology and Sociobiology*, *43*(3), 197-202. https://doi.org/10.1007/s002650050481

Webb, N. V., Famula, T. R., & Millam, J. R. (2010). The effect of rope color, size and fray on environmental enrichment device interaction in male and female orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science*, *124*(3), 149-156. https://doi.org/10.1016/j.applanim.2010.02.013

Welle, K. R., & Luescher, A. U. (2006). Aggressive behavior in pet birds. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 211-217). Blackwell Publishing. https://doi.org/10.1002/9780470344651.ch18

Wernick, M. B. (2016). Wing clipping, pinioning, and feather-follicle extirpation. In J. Samour (Ed.), *Avian medicine* (3 ed., pp. 232-233). Elsevier.

West, J. A., Tully, T. N., Nevarez, J. G., & Stout, R. W. (2019). Effects of fluorescent lighting versus sunlight exposure on calcium, magnesium, vitamin D, and feather destructive behavior in Hispaniolan Amazon parrots (*Amazona ventralis*). *Journal of Avian Medicine and Surgery*, *33*(3), 235-244. https://doi.org/10.1647/2018-378

Westfahl, C., Wolf, P., & Kamphues, J. (2008). Estimation of protein requirement for maintenance in adult parrots (*Amazona* spp.) by determining inevitable N losses in excreta. *Journal of Animal Physiology and Animal Nutrition*, *92*(3), 384-389. https://doi.org/10.1111/j.1439-0396.2008.00814.x

White, D. (n.d.). *Humidity*.Avian Enrichment.Retrieved March 9, 2026 from https://avianenrichment.com/index.php/learn/physical-needs/environment/humidity?highlight=WyJodW1pZGl0eSJd

Williams, I., Hoppitt, W., & Grant, R. (2017). The effect of auditory enrichment, rearing method and social environment on the behavior of zoo-housed psittacines (Aves: Psittaciformes); implications for welfare. *Applied Animal Behaviour Science*, *186*, 85-92. https://doi.org/10.1016/j.applanim.2016.10.013

Wilson, C. (2022a). Parrot behaviour. In R. Casey, S. Heath, & H. Zulch (Eds.), *Companion animal behaviour problems: Prevention and management of behaviour problems in veterinary practice* (pp. 51-62). CABI Digital Library. https://doi.org/10.1079/9781800621312.0005

Wilson, C. (2022b). What every parrot owner should know. In R. Casey, S. Heath, & H. Zulch (Eds.), *Companion animal behaviour problems: Prevention and management of*

behaviour problems in veterinary practice (pp. 136-153). CABI Digital Library. https://doi.org/10.1079/9781800621312.0011

Wilson, G. H. (2006). Behavior of captive psittacids in the breeding aviary. In A. U. Luescher (Ed.), *Manual of Parrot Behavior* (pp. 281-290). Blackwell Publishing.

WOAH. (2016). Animal welfare. In *Terrestrial Animal Health Code*. World Organisation for Animal Health. https://www.woah.org/fileadmin/Home/eng/Health_standards/tahc/2016/en_chapitre_aw_introduction.htm

WOAH. (2020). *WHO guidelines on physical activity and sedentary behaviour*. World Health Organization. https://www.who.int/publications/i/item/9789240015128

Woodman, C., Biro, C., & Brightsmith, D. J. (2021). Parrot free-flight as a conservation tool. *Diversity*, *13*(6), 254. https://doi.org/10.3390/d13060254

Woon, J. A., Powlesland, R. G., & Edkins, C. (2002). Observations of the eastern rosella (*Platycercus eximius*) in the Wellington region. *Notornis*, *49*(2), 91-94. https://www.birdsnz.org.nz/wp-content/uploads/2021/12/Notornis_49_2_91.pdf

Appendix I

The scientific, English, and Norwegian names of the species included in the assessment.

Scientific name	English common name	Norwegian common name
Amazona aestiva	Turquoise-fronted amazon	Blåpanneamazon
Amazona amazonica	Orange-winged amazon	Oransjevingeamazon
Amazona oratrix	Yellow-headed amazon	Gulhodeamazon
Anodorhynchus hyacinthinus	Hyacinth macaw	Hyasintara
Ara ararauna	Blue-and-yellow macaw	Blågulara
Ara chloropterus	Red-and-green macaw	Grønnvingeara
Ara macao	Scarlet macaw	Rødara
Ara militaris	Military macaw	Soldatara
Ara severus	Chestnut-fronted macaw	Brunpanneara
Cacatua alba	White cockatoo	Hvittoppkakadu
Cacatua galerita	Sulphur-crested cockatoo	Gultoppkakadu
Cacatua leadbeateri	Pink cockatoo	Fagerkakadu
Eclectus roratus	Moluccan eclectus	Edelpapegøye
Eolophus roseicapilla	Galah	Rosenkakadu
Nymphicus hollandicus	Cockatiel	Nymfekakadu
Platycercus eximius	Eastern rosella	Praktrosella
Primolius maracana	Blue-winged macaw	Rødbukara
Psephotus haematonotus	Red-rumped parrot	Sangparakitt
Psittacula krameri	Rose-ringed parakeet	Halsbåndparakitt
Psittacus erithacus	Grey parrot	Gråjako
Pteroglossus castanotis	Chestnut-eared aracari	Brunkinntukan
Pyrrhura cruentata	Ochre-marked parakeet	Blåstrupeparakitt
Pyrrhura molinae	Green-cheeked parakeet	Grønnkinnparakitt
Ramphastos toco	Toco toucan	Tocotukan
Ramphastos tucanus	White-throated toucan	Vinnebbtukan
Trichoglossus haematodus	Coconut lorikeet	Kokoslori
Trichoglossus ornatus	Ornate lorikeet	Praktlori

Source: BirdLife Norge (2025)

Appendix II

Documentation of literature search provided by the library for the healthcare administration at the Norwegian institute of Public Health.

Litteratursøk fra Bibliotek for helseforvaltningen

Dokumentasjon av søkestrategi

Dyrevelferd eksotiske fugler

Kontaktperson:	Kristin Opdal Seljetun
Søk:	Marita Heintz
Fagfelle:	Bente Foss
Kommentar:	Bygger på søk gjort til: https://doi.org/10.1017/awf.2024.61 Tre søk: 1) alle treff fra årene 2022-2025, 2) treff med flyving og bevegelse - 2021, 3) ekstra fugler - 2021
Dublettsjekk i EndNote:	Før dublettkontroll: 2417 Etter dublettkontroll: 1313

Database: **Ovid MEDLINE(R) ALL 1946 to December 04, 2025**
Dato: 05.12.2025
Antall treff: 383

1	psittaciformes/ or cockatoos/ or parrots/ or amazona/ or parakeets/ or melopsittacus/ or psittacula/	3324
2	(Parrot? or Psittacines* or Psittacids* or Psittacidae? or Psittacinae? or Cacatuidae? or Cockatoo? or Macaw? or Parakeet? or Budgerigar? or Melopsittacus* or Cockatiel? or "Nymphicus hollandicus*" or Cacatua? or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) adj2 amazon) or Psittacula? or Psittaccula? or Conure? or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine? or Psittaciform* or (Ara adj (ararauna or chloropterus or macao or militaris or severus))).tw,kf.	5103
3	(Eolophus* or Galah? or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan? or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) adj lorikeet)).tw,kf.	650
4	Acoustic Stimulation/ or Social Isolation/ or Ostracism/ or Social Alienation/ or Social Deprivation/ or Psychosocial Deprivation/ or sensory deprivation/ or social interaction/ or Object Attachment/ or "Play and Playthings"/ or Water Deprivation/ or Food Deprivation/ or Diet/ or Diet, Fat-Restricted/ or Diet, Healthy/ or Diet, High-Fat/ or Diet, High-Protein/ or Diet, Plant-Based/ or Diet, Protein-Restricted/ or Diet, Reducing/ or Energy intake/ or Portion size/ or Access to Healthy Foods/ or Food Quality/ or Nutritive Value/ or Animal Feed/ or "Animal Nutritional Physiological Phenomena"/ or Animal Nutrition Sciences/ or Nutrition Assessment/	474322
5	(Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) adj (food? or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein? or calori* or dietary) adj1 (content or value or quality or quantity or assessment? or access or availability or intake or composition or recommendation? or requirement? or restriction or density)) or "portion size" or Play or playing or Toy? or Plaything? or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) adj3 stimulus) or (social adj (bond? or relation or relationship or isolation or alienation)) or ((emotional or object) adj (bond? or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment? or "Hand rearing" or "parent rearing" or coparenting or "co parenting").tw,kf.	6790587
6	Flight, Animal/ or Locomotion/ or Movement/	120031
7	(Fly or flying or flight? or restriction? or movement or locomotion).tw,kf.	748103
8	Bird Diseases/ or Diagnosis, Differential/ or exp Psittaciformes/gd, in, me, ph or Atherosclerosis/ or exp Bone Diseases, Metabolic/	633216
9	(disease? or desease? or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*").tw,kf.	5796925

10	Cognition/ or Attention/ or Awareness/ or Cognitive Dissonance/ or Cognitive Flexibility/ or Cognitive Reflection/ or Cognitive Reserve/ or Comprehension/ or Consciousness/ or Intuition/ or Metacognition/ or Neurobehavioral Manifestations/	279785
11	(Cognition? or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) adj (thought or thinking or process))).tw,kf.	2864953
12	Emotions/ or Affect/ or Irritable Mood/ or Anger/ or Rage/ or Anxiety/ or Apathy/ or Bereavement/ or Grief/ or Prolonged Grief Disorder/ or Boredom/ or Courage/ or Depression/ or Disgust/ or Emotional Exhaustion/ or mental fatigue/ or Emotional Regulation/ or Euphoria/ or Fear/ or Panic/ or Frustration/ or Happiness/ or Hostility/ or Jealousy/ or Loneliness/ or Pleasure/ or Psychological Distress/ or Sadness/ or Adaptation, Psychological/ or Emotional Adjustment/ or Stress, Physiological/ or Aggression/ or Bullying/ or Microaggression/	661633
13	(((Emotional or Psychological or Positive or negative) adj (Adjustment* or Adaptation* or state or Regulation*)) or Aggression? or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion? or feeling? or affect? or mood? or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear? or fearfulness or fright or Panic? or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) adj (Fatigue or Exhaustion))).tw,kf.	3720973
14	Stereotyped Behavior/ or Impulsive Behavior/ or Compulsive Behavior/ or Behavior, Addictive/ or Compulsive Exercise/ or Food Addiction/ or Agonistic Behavior/ or Behavior, Animal/ or Animal Communication/ or Vocalization, Animal/ or Animal Distribution/ or Appetitive Behavior/ or Grooming/ or Predatory Behavior/ or Consummatory Behavior/ or Nesting Behavior/ or Eliminative Behavior, Animal/ or Feeding Behavior/ or Cannibalism/ or Coprophagia/ or Herbivory/ or Freezing Reaction, Cataleptic/ or Homing Behavior/ or Immobility Response, Tonic/ or Kinesis/ or Taxis Response/ or Chemotaxis/ or Escape Reaction/ or Phototaxis/ or "Tool Use Behavior"/	334377
15	(Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder? or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) adj1 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) adj1 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction? or phagomania or Grooming or Preening or biting or screaming or (excessive adj (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) adj1 (Immobility or Immobilization or Immobilisation)) or (Death adj1 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) adj Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) adj (Distribution or dispersal))).tw,kf.	360060
16	Self-Injurious Behavior/ or Self Mutilation/	14636
17	((Feather adj1 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati*).tw,kf.	2713
18	Overweight/ or Obesity/ or Obesity Hypoventilation Syndrome/ or Obesity, Abdominal/ or Obesity, Metabolically Benign/ or Nutrition Disorders/ or Deficiency Diseases/ or Starvation/ or Malnutrition/ or exp Avitaminosis/ or Magnesium Deficiency/ or Potassium Deficiency/ or Protein Deficiency/ or Protein-Energy Malnutrition/ or Fetal Nutrition Disorders/	412362

19	("body condition" or obesity or obese or adiposit* or Overweight or (nutrition* adj (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* adj syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) adj deficienc*)).tw,kf.	615174
20	"Wounds and Injuries"/ or Accidental Injuries/ or Spinal Injuries/ or Decompression Sickness/ or Birth Injuries/ or Foreign Bodies/ or Eye Foreign Bodies/ or Foreign-Body Reaction/ or Granuloma, Foreign-Body/ or Foot Injuries/ or Microtrauma, Physical/ or Multiple Trauma/ or Trauma, Nervous System/ or Wounds, Penetrating/ or Eye Injuries, Penetrating/ or Feathers/in	177773
21	(injur* or ((Decompression or compression or caisson) adj (Sickness or illness)) or Bends or (Foreign adj (Bodies or Body or object? or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma? or wound? or Polytrauma? or multitrauma? or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma? or neurotrosis or neuroinjur* or ((eye or ocular) adj perforation)).tw,kf.	1653648
22	Fractures, Bone/ or Fractures, Closed/ or Fractures, Comminuted/ or Fractures, Compression/ or Fractures, Multiple/ or Fractures, Open/ or Fractures, Spontaneous/ or Fractures, Stress/ or exp Skull Fractures/ or Spinal Fractures/	134951
23	(Fracture? or "broken bone?" or Microfracture?).tw,kf.	359018
24	Heat Stress Disorders/ or Heat Exhaustion/ or Heat Stroke/ or Sunstroke/ or Hyperthermia/	7938
25	((Heat adj2 (Illness* or cramp? or fatigue or syncope? or Exhaustion or stroke? or Collapse or Prostration?)) or Heatstroke? or Sunstroke? or "sun stroke?" or Hyperpyrexia? or Hyperthermia?).tw,kf.	37804
26	Oviposition/ or Reproduction/ or Fertility/ or Compulsive Sexual Behavior Disorder/ or Sexual Behavior, Animal/ or Copulation/ or Mating Preference, Animal/ or Pair Bond/	144888
27	((egg adj1 laying) or reproduction or Reproductive or fertility or Oviposition? or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation? or Mating or (mate adj (choice or preference? or selection?)) or "pair bond*" or (Sexual adj (Selection* or activity or receptivity or response))).tw,kf.	528556
28	Hormones/ or Corticosterone/ or Adrenal Cortex Hormones/ or Glucocorticoids/ or exp Hydroxycorticosteroids/ or exp Gonadal Steroid Hormones/ or exp Hypothalamic Hormones/ or exp Parathyroid Hormone/	679541
29	(hormon or hormone or hormons or hormones or "endocrine agent?" or corticosterone? or Corticoid? or Corticosteroid? or ((cortical or cortico or glycocortico or Hydroxycortico or sex) adj steroid?) or Glucocorticoid? or glucocortoid? or glycocorticosteroid? or Hydroxycorticosteroid? or hydroxycorticoid? or hydroxycorticosterone? or oxycorticosteroid? or parathorm* or Parathyrin? or parathormon*).tw,kf.	828981
30	Longevity/ or Aging/ or Healthy Aging/ or Cognitive Aging/ or Life Expectancy/	307764
31	(Lifespan? or "Life span?" or "life expecta*" or longevity or aging or Senescence or "Length of Life").tw,kf.	481987
32	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31	14358836
33	(1 or 2 or 3) and (4 or 5 or 6 or 7) and 32	835
34	33 and (2022* or 2023* or 2024* or 2025*).ed,ep,yr,dp,dt.	150
35	(1 or 2 or 3) and (6 or 7) and 32	215
36	35 not (2022* or 2023* or 2024* or 2025*).ed,ep,yr,dp,dt.	180
37	3 and (4 or 5 or 6 or 7) and 32	95
38	37 not (2022* or 2023* or 2024* or 2025*).ed,ep,yr,dp,dt.	85
39	34 or 36 or 38	385
40	39 not (medrxiv the preprint server for health sciences or biorxiv the preprint server for biology or research square or arxiv or chemrxiv or ssrn).jn.	385
41	limit 40 to (danish or german or english or multilingual or norwegian or swedish)	383

Database: **Embase <1974 to 2025 December 03>**
Dato: 05.12.2025
Antall treff: 217

1	psittacine/ or cockatoo/ or cockatiel/ or macaw/ or parrot/ or "ara (bird)"/ or parakeet/ or melopsittacus/ or budgerigar/ or psittacula/	3943
2	(Parrot? or Psittacines* or Psittacids* or Psittacidae? or Psittacinae? or Cacatuidae? or Cockatoo? or Macaw? or Parakeet? or Budgerigar? or Melopsittacus* or Cockatiel? or "Nymphicus hollandicus*" or Cacatua? or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) adj2 amazon) or Psittacula? or Psittaccula? or Conure? or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine? or Psittaciform* or (Ara adj (ararauna or chloropterus or macao or militaris or severus))).tw,kf.	5394
3	Anodorhynchus/	12
4	(Eolophus* or Galah? or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan? or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) adj lorikeet)).tw,kf.	735
5	sensory stimulation/ or auditory stimulation/ or visual stimulation/ or tactile stimulation/ or social isolation/ or ostracism/ or social alienation/ or emotional deprivation/ or sensory deprivation/ or solitary confinement/ or social interaction/ or social bonding/ or emotional attachment/ or object relation/ or play/ or foraging behavior/ or foraging/ or optimal foraging/ or water deprivation/ or food deprivation/ or diet/ or low fat diet/ or healthy diet/ or lipid diet/ or protein diet/ or plant-based diet/ or low calorie diet/ or portion size/ or exp dietary intake/ or exp nutritional parameters/ or animal food/ or nutritional assessment/ or nutritional requirement/ or rearing/	1784325
6	(Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) adj (food? or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein? or calori* or dietary) adj1 (content or value or quality or quantity or assesment? or access or availability or intake or composition or recommendation? or requirement? or restriction or density)) or "portion size" or Play or playing or Toy? or Plaything? or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) adj3 stimulus) or (social adj (bond? or relation or relationship or isolation or alienation)) or ((emotional or object) adj (bond? or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment? or "Hand rearing" or "parent rearing" or coparenting or "co parenting").tw,kf.	8417274
7	locomotion/ or "movement (physiology)"/ or flying/	146713
8	(Fly or flying or flight? or restriction? or movement or locomotion).tw,kf.	921390
9	bird disease/ or differential diagnosis/ or atherosclerosis/ or exp metabolic bone disease/	838157
10	(disease? or desease? or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*").tw,kf.	8077959
11	attention/ or cognition/ or awareness/ or cognitive flexibility/ or cognitive reflection/ or cognitive reserve/ or comprehension/ or alertness/ or consciousness/ or intuition/ or exp metacognition/	807667
12	(Cognition? or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) adj (thought or thinking or process))).tw,kf.	3630499
13	emotion/ or affect/ or annoyance/ or anger/ or rage/ or anxiety/ or nervousness/ or apathy/ or bereavement/ or grief/ or mourning/ or prolonged grief/ or sorrow/ or boredom/ or courage/ or depression/ or hopelessness/ or disgust/ or emotional exhaustion/ or mental fatigue/ or emotion regulation/ or euphoria/ or fear/ or panic/	1501546

	or frustration/ or Happiness/ or Hostility/ or Jealousy/ or Loneliness/ or Pleasure/ or distress syndrome/ or Sadness/ or Unhappiness/ or psychological adjustment/ or physiological stress/ or aggression/ or aggressiveness/ or bullying/ or microaggression/	
14	(((Emotional or Psychological or Positive or negative) adj (Adjustment* or Adaptation* or state or Regulation*)) or Aggression? or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion? or feeling? or affect? or mood? or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear? or fearfulness or fright or Panic? or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) adj (Fatigue or Exhaustion))).tw,kf.	4899291
15	stereotypy/ or impulsiveness/ or compulsion/ or addiction/ or behavioral addiction/ or exercise addiction/ or food addiction/ or agonistic behavior/ or animal behavior/ or abnormal animal behavior/ or feather pecking/ or animal communication/ or vocalization/ or birdsong/ or animal dispersal/ or appetitive behavior/ or food-seeking behavior/ or grooming/ or predation/ or consummatory behavior/ or nesting/ or feeding behavior/ or cannibalism/ or coprophagy/ or herbivory/ or catalepsy/ or homing behavior/ or tonic immobility/ or chemotaxis/ or taxis response/ or escape behavior/ or phototaxis/ or "tool use"/ or exp "autoamputation (animal)"/ or "brooding (eggs)"/ or food hoarding/	434844
16	(Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder? or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) adj1 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) adj1 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction? or phagomania or Grooming or Preening or biting or screaming or (excessive adj (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) adj1 (Immobility or Immobilization or Immobilisation)) or (Death adj1 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) adj Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) adj (Distribution or dispersal))).tw,kf.	453138
17	automutilation/	30762
18	((Feather adj1 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati*).tw,kf.	3296
19	obesity/ or abdominal obesity/ or metabolically benign obesity/ or obesity hypoventilation syndrome/ or nutritional disorder/ or nutritional deficiency/ or starvation/ or malnutrition/ or exp vitamin deficiency/ or exp mineral deficiency/ or exp protein deficiency/ or fetal malnutrition/	1096357
20	("body condition" or obesity or obese or adiposit* or Overweight or (nutrition* adj (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* adj syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) adj deficienc*)).tw,kf.	903512
21	injury/ or accidental injury/ or spine injury/ or decompression sickness/ or birth injury/ or foreign body/ or intraocular foreign body/ or foreign body reaction/ or foreign body granuloma/ or foot injury/ or microtrauma/ or multiple trauma/ or nervous system injury/ or penetrating trauma/ or penetrating eye injury/	490769

22	(injur* or ((Decompression or compression or caisson) adj (Sickness or illness)) or Bends or (Foreign adj (Bodies or Body or object? or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma? or wound? or Polytrauma? or multitrauma? or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma? or neurotrosis or neuroinjur* or ((eye or ocular) adj perforation)).tw,kf.	2162766
23	fracture/ or comminuted fracture/ or compression fracture/ or multiple fracture/ or open fracture/ or pathologic fracture/ or stress fracture/ or exp skull fracture/ or exp spine fracture/	210528
24	(Fracture? or "broken bone?" or Microfracture?).tw,kf.	430833
25	heat injury/ or heat exhaustion/ or exp heat stroke/ or heat cramp/ or heat syncope/ or hyperthermia/ or hyperpyrexia/	39805
26	((Heat adj2 (Illness* or cramp? or fatigue or syncope? or Exhaustion or stroke? or Collapse or Prostration?)) or Heatstroke? or Sunstroke? or "sun stroke?" or Hyperpyrexia? or Hyperthermia?).tw,kf.	46759
27	egg laying/ or reproduction/ or fertility/ or sexual addiction/ or sexual behavior/ or Copulation/ or mating/ or extra-pair mating/ or mate choice/ or pair bonding/	323422
28	((egg adj1 laying) or reproduction or Reproductive or fertility or Oviposition? or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation? or Mating or (mate adj (choice or preference? or selection?)) or "pair bond*" or (Sexual adj (Selection* or activity or receptivity or response))).tw,kf.	616697
29	hormone/ or corticosterone/ or corticosteroid/ or glucocorticoid/ or hydroxycorticosteroid/ or exp sex hormone/ or exp hypothalamus hormone/ or parathyroid hormone/	1353922
30	(hormon or hormone or hormons or hormones or "endocrine agent?" or corticosterone? or Corticoid? or Corticosteroid? or ((cortical or cortico or glycocortico or Hydroxycortico or sex) adj steroid?) or Glucocorticoid? or glucocortoid? or glycocorticosteroid? or Hydroxycorticosteroid? or hydroxycorticoid? or hydroxycorticosterone? or oxycorticosteroid? or parathorm* or Parathyrin? or parathormon*).tw,kf.	1084964
31	longevity/ or aging/ or life expectancy/ or cognitive aging/ or healthy aging/	470562
32	(Lifespan? or "Life span?" or "life expecta*" or longevity or aging or Senescence or "Length of Life").tw,kf.	618264
33	9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	18794803
34	(1 or 2 or 3 or 4) and (5 or 6 or 7 or 8) and 33	907
35	34 and (2022* or 2023* or 2024* or 2025*).yr,dd,dp,dc.	227
36	(1 or 2 or 3 or 4) and (7 or 8) and 33	210
37	36 not (2022* or 2023* or 2024* or 2025*).yr,dd,dp,dc.	161
38	(3 or 4) and (5 or 6 or 7 or 8) and 33	108
39	38 not (2022* or 2023* or 2024* or 2025*).yr,dd,dp,dc.	83
40	35 or 37 or 39	450
41	limit 40 to (danish or german or english or norwegian or polyglot or swedish)	441
42	limit 41 to embase	217

Database: **Web of Science Core Collection: Science Citation Index Expanded (SCI-EXPANDED) --1987-present, Social Sciences Citation Index (SSCI) --1987-present, Arts & Humanities Citation Index (A&HCI) --1987-present, Emerging Sources Citation Index (ESCI) --2015-present**
Dato: 05.12.2025
Kommentar: Søkt med Exact search
Antall treff: 432

1	TS=(Parrot$ or Psittacines* or Psittacids* or Psittacidae$ or Psittacinae$ or Cacatuidae$ or Cockatoo$ or Macaw$ or Parakeet$ or Budgerigar$ or Melopsittacus* or Cockatiel$ or "Nymphicus hollandicus*" or Cacatua$ or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) NEAR/1 amazon) or Psittacula$ or Psittaccula$ or Conure$ or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine$ or Psittaciform* or (Ara NEAR/0 (ararauna or chloropterus or macao or militaris or severus)))	10747
2	TS=(Eolophus* or Galah$ or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan$ or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) NEAR/0 lorikeet))	1876
3	TS=(Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) NEAR/0 (food$ or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein$ or calori* or dietary) NEAR/0 (content or value or quality or quantity or assessment$ or access or availability or intake or composition or recommendation$ or requirement$ or restriction or density)) or "portion size" or Play or playing or Toy$ or Plaything$ or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) NEAR/2 stimulus) or (social NEAR/0 (bond$ or relation or relationship or isolation or alienation)) or ((emotional or object) NEAR/0 (bond$ or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment$ or "Hand rearing" or "parent rearing" or coparenting or "co parenting")	10812196
4	TS=(Fly or flying or flight$ or restriction$ or movement or locomotion)	1656329
5	TS=(disease$ or desease$ or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*")	6330850
6	TS=(Cognition$ or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) NEAR/0 (thought or thinking or process)))	5510439
7	TS=(((Emotional or Psychological or Positive or negative) NEAR/0 (adjustment* or Adaptation* or state or Regulation*)) or Aggression$ or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion$ or feeling$ or affect$ or mood$ or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear$ or fearfulness or fright or Panic$ or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) NEAR/0 (Fatigue or Exhaustion)))	6688067
8	TS=(Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder$ or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) NEAR/0 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) NEAR/0 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction$ or phagomania or Grooming or Preening or biting or screaming or (excessive NEAR/0 (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) NEAR/0 (Immobility or Immobilization or Immobilisation)) or (Death NEAR/0 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) NEAR/0 Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) NEAR/0 (Distribution or dispersal)))	675556

9	TS=((Feather NEAR/0 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati*)	3449
10	TS=("body condition" or obesity or obese or adiposit* or Overweight or (nutrition* NEAR/0 (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* NEAR/0 syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) NEAR/0 deficienc*))	793004
11	TS=(injur* or ((Decompression or compression or caisson) NEAR/0 (Sickness or illness)) or Bends or (Foreign NEAR/0 (Bodies or Body or object$ or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma$ or wound$ or Polytrauma$ or multitrauma$ or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma$ or neurotrosis or neuroinjur* or ((eye or ocular) NEAR/0 perforation))	1849059
12	TS=(Fracture$ or "broken bone$" or Microfracture$)	693755
13	TS=((Heat NEAR/1 (Illness* or cramp$ or fatigue or syncope$ or Exhaustion or stroke$ or Collapse or Prostration$)) or Heatstroke$ or Sunstroke$ or "sun stroke$" or Hyperpyrexia$ or Hyperthermia$)	50677
14	TS=((egg NEAR/0 laying) or reproduction or Reproductive or fertility or Oviposition$ or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation$ or Mating or (mate NEAR/0 (choice or preference$ or selection$)) or "pair bond*" or (Sexual NEAR/0 (Selection* or activity or receptivity or response)))	858464
15	TS=(hormon or hormone or hormons or hormones or "endocrine agent$" or corticosterone$ or Corticoid$ or Corticosteroid$ or ((cortical or cortico or glycocortico or Hydroxycortico or sex) NEAR/0 steroid$) or Glucocorticoid$ or glucocortoid$ or glycocorticosteroid$ or Hydroxycorticosteroid$ or hydroxycorticoid$ or hydroxycorticosterone$ or oxycorticosteroid$ or parathorm* or Parathyrin$ or parathormon*)	888163
16	TS=(Lifespan$ or "Life span$" or "life expecta*" or longevity or aging or Senescence or "Length of Life")	741698
17	(#16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5) AND (#4 OR #3) AND (#2 OR #1)	1509
18	#17 Timespan (index date): 2022-01-01 to 2025-12-31	338
19	(#16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5) AND #4 AND (#2 OR #1)	396
20	#19 Timespan (index date): 1900-01-01 to 2021-12-31	308
21	(#16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5) AND (#4 OR #3) AND #2	246
22	#21 Timespan (index date): 1900-01-01 to 2021-12-31	193
23	#22 OR #20 OR #18	450
24	(#23 AND LA=(Norwegian OR Danish OR Swedish OR Multiple Languages OR English)) NOT DT= Meeting Abstract	432

Database: **Scopus**
Dato: 05.12.2025
Antall treff: 801 med dubletter (344 (treff 2022-2025), 295 (flying og bevegelse -2021), 162 (ekstra fugler -2021))

Søk 1 - treff 2022-2025:
(TITLE-ABS((Parrot or Parrots or Psittacines* or Psittacids* or Psittacidae* or Psittacinae* or Cacatuidae* or Cockatoo* or Macaw or Macaws or Parakeet or Parakeets or Budgerigar* or Melopsittacus* or Cockatiel or Cockatiels or "Nymphicus hollandicus*" or Cacatua or Cacatuas or Psittacus* or Amazona or ((Turquoise* or

Orange* or Yellow*) W/1 amazon) or Psittacula* or Psittaccula* or Conure or Conures or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine* or Psittaciform* or (Ara PRE/0 (ararauna or chloropterus or macao or militaris or severus)) or Eolophus* or Galah or Galahs or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan or toucans or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) PRE/0 lorikeet)) AND (Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) PRE/0 (food or foods or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein or proteins or calori* or dietary) W/0 (content or value or quality or quantity or assessment or assessments or access or availability or intake or composition or recommendation* or requirement* or restriction or density)) or "portion size" or Play or playing or Toy or Toys or Plaything* or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) W/2 stimulus) or (social PRE/0 (bond or bonds or relation or relationship or isolation or alienation)) or ((emotional or object) PRE/0 (bond or bonds or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment* or "Hand rearing" or "parent rearing" or coparenting or "co parenting" or Fly or flying or flight or flights or restriction* or movement or locomotion) AND (disease* or desease* or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*" or Cognition* or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) PRE/0 (thought or thinking or process)) or ((Emotional or Psychological or Positive or negative) PRE/0 (adjustment* or Adaptation* or state or Regulation*)) or Aggression* or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion* or feeling* or affect or affects or mood or moods or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear or Fears or fearfulness or fright or Panic or Panics or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) PRE/0 (Fatigue or Exhaustion)) or Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder* or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) W/0 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) W/0 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction* or phagomania or Grooming or Preening or biting or screaming or (excessive PRE/0 (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) W/0 (Immobility or Immobilization or Immobilisation)) or (Death W/0 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) PRE/0 Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) PRE/0 (Distribution or dispersal)) or (Feather W/0 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati* or "body condition" or obesity or obese or adiposit* or Overweight or (nutrition* PRE/0 (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* PRE/0 syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) PRE/0 deficienc*) or injur* or ((Decompression or compression or caisson) PRE/0 (Sickness or illness)) or Bends or (Foreign PRE/0 (Bodies or Body or object or objects or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma or traumas or wound or wounds or Polytrauma* or multitrauma* or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma* or neurotrosis or neuroinjur* or ((eye or ocular) PRE/0 perforation) or Fracture or Fractures or Fractured or "broken bone*" or Microfracture* or (Heat W/1 (Illness* or cramp or cramps or fatigue or syncope or syncopes or Exhaustion or stroke or strokes or Collapse or Prostration*)) or Heatstroke* or Sunstroke* or "sun stroke*" or Hyperpyrexia* or Hyperthermia* or (egg W/0 laying) or reproduction or Reproductive or fertility or Oviposition* or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation* or Mating or (mate PRE/0 (choice or preference* or selection*)) or "pair bond*" or (Sexual PRE/0 (Selection* or activity or receptivity or response)) or hormon or hormone or hormons or hormones or "endocrine agent*" or corticosterone* or Corticoid* or Corticosteroid* or ((cortical or

cortico or glycocortico or Hydroxycortico or sex) PRE/0 steroid*) or Glucocorticoid* or glucocortoid* or glycocorticosteroid* or Hydroxycorticosteroid* or hydroxycorticoid* or hydroxycorticosterone* or oxycorticosteroid* or parathorm* or Parathyrin* or parathormon* or Lifespan* or "Life span*" or "life expecta*" or longevity or aging or Senescence or "Length of Life")) OR AUTHKEY((Parrot or Parrots or Psittacines* or Psittacids* or Psittacidae* or Psittacinae* or Cacatuidae* or Cockatoo* or Macaw or Macaws or Parakeet or Parakeets or Budgerigar* or Melopsittacus* or Cockatiel or Cockatiels or "Nymphicus hollandicus*" or Cacatua or Cacatuas or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) W/1 amazon) or Psittacula* or Psittaccula* or Conure or Conures or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine* or Psittaciform* or (Ara PRE/0 (ararauna or chloropterus or macao or militaris or severus)) or Eolophus* or Galah or Galahs or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan or toucans or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) PRE/0 lorikeet)) AND (Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) PRE/0 (food or foods or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein or proteins or calori* or dietary) W/0 (content or value or quality or quantity or assessment or assessments or access or availability or intake or composition or recommendation* or requirement* or restriction or density)) or "portion size" or Play or playing or Toy or Toys or Plaything* or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) W/2 stimulus) or (social PRE/0 (bond or bonds or relation or relationship or 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or affects or mood or moods or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear or Fears or fearfulness or fright or Panic or Panics or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) PRE/0 (Fatigue or Exhaustion)) or Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder* or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) W/0 (behaviour* or 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perforation) or Fracture or Fractures or

Fractured or "broken bone*" or Microfracture* or (Heat W/1 (Illness* or cramp or cramps or fatigue or syncope or syncopes or Exhaustion or stroke or strokes or Collapse or Prostration*)) or Heatstroke* or Sunstroke* or "sun stroke*" or Hyperpyrexia* or Hyperthermia* or (egg W/0 laying) or reproduction or Reproductive or fertility or Oviposition* or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation* or Mating or (mate PRE/0 (choice or preference* or selection*)) or "pair bond*" or (Sexual PRE/0 (Selection* or activity or receptivity or response)) or hormon or hormone or hormons or hormones or "endocrine agent*" or corticosterone* or Corticoid* or Corticosteroid* or ((cortical or cortico or glycocortico or Hydroxycortico or sex) PRE/0 steroid*) or Glucocorticoid* or glucocortoid* or glycocorticosteroid* or Hydroxycorticosteroid* or hydroxycorticoid* or hydroxycorticosterone* or oxycorticosteroid* or parathorm* or Parathyrin* or parathormon* or Lifespan* or "Life span*" or "life expecta*" or longevity or aging or Senescence or "Length of Life")) AND ORIG-LOAD-DATE AFT 20220101 AND LANGUAGE(English or norwegian or swedish or danish or german)) AND NOT (DOCTYPE(cr))

Søk 2 - flying og bevegelse -2021:

(TITLE-ABS((Parrot or Parrots or Psittacines* or Psittacids* or Psittacidae* or Psittacinae* or Cacatuidae* or Cockatoo* or Macaw or Macaws or Parakeet or Parakeets or Budgerigar* or Melopsittacus* or Cockatiel or Cockatiels or "Nymphicus hollandicus*" or Cacatua or Cacatuas or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) W/1 amazon) or Psittacula* or Psittaccula* or Conure or Conures or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine* or Psittaciform* or (Ara PRE/0 (ararauna or chloropterus or macao or militaris or severus)) or Eolophus* or Galah or Galahs or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan or toucans or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) PRE/0 lorikeet)) AND (Fly or flying or flight or flights or restriction* or movement or locomotion) AND (disease* or desease* or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*" or Cognition* or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) PRE/0 (thought or thinking or process)) or ((Emotional or Psychological or Positive or negative) PRE/0 (adjustment* or Adaptation* or state or Regulation*)) or Aggression* or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion* or feeling* or affect or affects or mood or moods or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear or Fears or fearfulness or fright or Panic or Panics or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) PRE/0 (Fatigue or Exhaustion)) or Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder* or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) W/0 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) W/0 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction* or phagomania or Grooming or Preening or biting or screaming or (excessive PRE/0 (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) W/0 (Immobility or Immobilization or Immobilisation)) or (Death W/0 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) PRE/0 Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) PRE/0 (Distribution or dispersal)) or (Feather W/0 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati* or "body condition" or obesity or obese or adiposit* or Overweight or (nutrition* PRE/0 (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* PRE/0 syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) PRE/0 deficienc*) or injur* or ((Decompression or compression or caisson) PRE/0 (Sickness or illness)) or Bends or (Foreign PRE/0 (Bodies or Body or object or objects or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma or traumas or wound or wounds or Polytrauma* or multitrauma* or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or

neurotrauma* or neurotrosis or neuroinjur* or ((eye or ocular) PRE/0 perforation) or Fracture or Fractures or Fractured or "broken bone*" or Microfracture* or (Heat W/1 (Illness* or cramp or cramps or fatigue or syncope or syncopes or Exhaustion or stroke or strokes or Collapse or Prostration*)) or Heatstroke* or Sunstroke* or "sun stroke*" or Hyperpyrexia* or Hyperthermia* or (egg W/0 laying) or reproduction or Reproductive or fertility or Oviposition* or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation* or Mating or (mate PRE/0 (choice or preference* or selection*)) or "pair bond*" or (Sexual PRE/0 (Selection* or activity or receptivity or response)) or hormon or hormone or hormons or hormones or "endocrine agent*" or corticosterone* or Corticoid* or Corticosteroid* or ((cortical or cortico or glycocortico or Hydroxycortico or sex) PRE/0 steroid*) or Glucocorticoid* or glucocortoid* or glycocorticosteroid* or Hydroxycorticosteroid* or hydroxycorticoid* or hydroxycorticosterone* or oxycorticosteroid* or parathorm* or Parathyrin* or parathormon* or Lifespan* or "Life span*" or "life expecta*" or longevity or aging or Senescence or "Length of Life")) OR AUTHKEY((Parrot or Parrots or Psittacines* or Psittacids* or Psittacidae* or Psittacinae* or Cacatuidae* or Cockatoo* or Macaw or Macaws or Parakeet or Parakeets or Budgerigar* or Melopsittacus* or Cockatiel or Cockatiels or "Nymphicus hollandicus*" or Cacatua or Cacatuas or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) W/1 amazon) or Psittacula* or Psittaccula* or Conure or Conures or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine* or Psittaciform* or (Ara PRE/0 (ararauna or chloropterus or macao or militaris or severus)) or Eolophus* or Galah or Galahs or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan or toucans or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or 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Disgust or Contempt or Revulsion or Euphoria* or Fear or Fears or fearfulness or fright or Panic or Panics or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) PRE/0 (Fatigue or Exhaustion)) or Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder* or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) W/0 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) W/0 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction* or phagomania or Grooming or Preening or biting or screaming or 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adiposit* or Overweight or (nutrition* PRE/0 (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* PRE/0 syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) PRE/0 deficienc*) or injur* or ((Decompression or compression or caisson) PRE/0 (Sickness or illness)) or Bends or (Foreign PRE/0 (Bodies or Body or object or objects or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma or traumas or wound or wounds or Polytrauma* or multitrauma* or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma* or neurotrosis or neuroinjur* or ((eye or ocular) PRE/0 perforation) or Fracture or Fractures or Fractured or "broken bone*" or Microfracture* or (Heat W/1 (Illness* or cramp or cramps or fatigue or syncope or syncopes or Exhaustion or

stroke or strokes or Collapse or Prostration*)) or Heatstroke* or Sunstroke* or "sun stroke*" or Hyperpyrexia* or Hyperthermia* or (egg W/0 laying) or reproduction or Reproductive or fertility or Oviposition* or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation* or Mating or (mate PRE/0 (choice or preference* or selection*)) or "pair bond*" or (Sexual PRE/0 (Selection* or activity or receptivity or response)) or hormon or hormone or hormons or hormones or "endocrine agent*" or corticosterone* or Corticoid* or Corticosteroid* or ((cortical or cortico or glycocortico or Hydroxycortico or sex) PRE/0 steroid*) or Glucocorticoid* or glucocortoid* or glycocorticosteroid* or Hydroxycorticosteroid* or hydroxycorticoid* or hydroxycorticosterone* or oxycorticosteroid* or parathorm* or Parathyrin* or parathormon* or Lifespan* or "Life span*" or "life expecta*" or longevity or aging or Senescence or "Length of Life")) AND LANGUAGE(English or norwegian or swedish or danish or german)) AND NOT (DOCTYPE(cr) or ORIG-LOAD-DATE AFT 20220101)

Søk 3 - ekstra fugler -2021:

(TITLE-ABS((Eolophus* or Galah or Galahs or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan or toucans or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) PRE/0 lorikeet)) AND (Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) PRE/0 (food or foods or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein or proteins or calori* or dietary) W/0 (content or value or quality or quantity or assessment or assessments or access or availability or intake or composition or recommendation* or requirement* or restriction or density)) or "portion size" or Play or playing or Toy or Toys or Plaything* or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) W/2 stimulus) or (social PRE/0 (bond or bonds or relation or relationship or isolation or alienation)) or ((emotional or object) PRE/0 (bond or bonds or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment* or "Hand rearing" or "parent rearing" or coparenting or "co parenting" or Fly or flying or flight or flights or restriction* or movement or locomotion) AND (disease* or desease* or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*" or Cognition* or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) PRE/0 (thought or thinking or process)) or ((Emotional or Psychological or Positive or negative) PRE/0 (adjustment* or Adaptation* or state or Regulation*)) or Aggression* or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion* or feeling* or affect or affects or mood or moods or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear or Fears or fearfulness or fright or Panic or Panics or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) PRE/0 (Fatigue or Exhaustion)) or Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder* or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) W/0 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) W/0 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction* or phagomania or Grooming or Preening or biting or screaming or (excessive PRE/0 (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) W/0 (Immobility or Immobilization or Immobilisation)) or (Death W/0 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) PRE/0 Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) PRE/0 (Distribution or dispersal)) or (Feather W/0 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati* or "body condition" or obesity or obese or adiposit* or Overweight or (nutrition* PRE/0 (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* PRE/0 syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) PRE/0 deficienc*) or injur* or ((Decompression or compression or caisson) PRE/0 (Sickness or illness)) or Bends or (Foreign PRE/0 (Bodies or Body or object or

objects or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma or traumas or wound or wounds or Polytrauma* or multitrauma* or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma* or neurotrosis or neuroinjur* or ((eye or ocular) PRE/0 perforation) or Fracture or Fractures or Fractured or "broken bone*" or Microfracture* or (Heat W/1 (Illness* or cramp or cramps or fatigue or syncope or syncopes or Exhaustion or stroke or strokes or Collapse or Prostration*)) or Heatstroke* or Sunstroke* or "sun stroke*" or Hyperpyrexia* or Hyperthermia* or (egg W/0 laying) or reproduction or Reproductive or fertility or Oviposition* or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation* or Mating or (mate PRE/0 (choice or preference* or selection*)) or "pair bond*" or (Sexual PRE/0 (Selection* or activity or receptivity or response)) or hormon or hormone or hormons or hormones or 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Database: **CAB Abstracts <1973 to 2025 Week 48>**
Dato: 05.12.2025
Antall treff: 584

1	exp psittaciformes/ or exp ramphastidae/	8083
2	(Parrot? or Psittacines* or Psittacids* or Psittacidae? or Psittacinae? or Cacatuidae? or Cockatoo? or Macaw? or Parakeet? or Budgerigar? or Melopsittacus* or Cockatiel? or "Nymphicus hollandicus*" or Cacatua? or Psittacus* or Amazona or ((Turquoise* or Orange* or Yellow*) adj2 amazon) or Psittacula? or Psittaccula? or Conure? or Ecletus* or Eclectus* or Poichephalus* or Poicephalus* or psittacine? or Psittaciform* or (Ara adj (ararauna or chloropterus or macao or militaris or severus))).tw.	9828
3	exp eolophus/ or exp anodorhynchus/ or exp nymphicus/ or exp ramphastidae/ or exp platycercus/ or exp psephotus/ or exp pteroglossus/ or exp pyrrhura/ or exp trichoglossus/	1080
4	(Eolophus* or Galah? or Anordorhynchus* or Anodorhynchus* or Primolius* or Nymphicus* or Ramphastos* or Ramphastidae* or toucan? or Platycercus* or Rosella or Rosellas or Psephotus* or Pteroglossus* or aracari* or Pyrrhura* or Trichoglossus* or ((Coconut or Ornate) adj lorikeet)).tw.	1523
5	social isolation/ or social interaction/ or attachment behaviour/ or play/ or toys/ or water deprivation/ or food deprivation/ or diet/ or exp diets/ or exp energy intake/ or portion size/ or food quality/ or exp nutritive value/ or animal feeding/ or animal nutrition/ or nutritional assessment/ or foraging/ or nutrient requirements/ or small animal rearing/	781412
6	(Enrichment or Deprivation or Diet or Nutrition or ((bird or animal or healthy) adj (food? or feed)) or ((food or nutrient or Nutritive or nutritional or Energy or fat or fatty or protein? or calori* or dietary) adj1 (content or value or quality or quantity or assessment? or access or availability or intake or composition or recommendation? or requirement? or restriction or density)) or "portion size" or Play or playing or Toy? or Plaything? or Puzzle or Foraging or activity or stimulation or ((audio or auditory or acoustic or sound or tactile or social or sensory or visual or cognitive or emotional or lack or provid*) adj3 stimulus) or (social adj (bond? or relation or relationship or isolation or alienation)) or ((emotional or object) adj (bond? or relation or relationship)) or ostracism or "solitary confinement" or Bonding or attachment or interaction or interactment? or "Hand rearing" or "parent rearing" or coparenting or "co parenting").tw.	3808050
7	locomotion/ or flight/ or movement/	37360
8	(Fly or flying or flight? or restriction? or movement or locomotion).tw.	427058
9	bird diseases/ or differential diagnosis/ or atherosclerosis/ or pododermatitis/	32526

10	(disease? or desease? or pododermatitis or atherosclerosis or atheroscleroses or "differential diagnos*").tw.	3675796
11	cognition/ or attention/ or awareness/ or consciousness/	41553
12	(Cognition? or Cognitive or Attention or attentiveness or Awareness or Comprehension or Understanding or Consciousness or alertness or Intuition or Metacognition or "Neurobehavio* Manifestation*" or ((reflection or reflective) adj (thought or thinking or process))).tw.	936435
13	emotions/ or anxiety/ or enjoyment/ or fearfulness/ or fright/ or loneliness/ or depression/ or mental stress/ or aggression/ or bullying/	90537
14	(((Emotional or Psychological or Positive or negative) adj (Adjustment* or Adaptation* or state or Regulation*)) or Aggression? or aggressive* or anger or rage or rages or Anxiet* or Angst or Nervousness or nervosity or Anxiousness or emotion? or feeling? or affect? or mood? or Stress or stressed or distress or distressed or Apathy or Bereavement or Grief or mourning or sorrow or Boredom or Courage or Bravery or Depression or Depressive or Disgust or Contempt or Revulsion or Euphoria* or Fear? or fearfulness or fright or Panic? or Frustration* or annoyance or Happiness or Hostility or Jealousy or Loneliness or Pleasure or Enjoyment or Sadness or Unhappiness or hopelessness or despair or Bullying or Microaggressio* or ((Emotional or mental) adj (Fatigue or Exhaustion))).tw.	1513454
15	abnormal behaviour/ or animal behaviour/ or grooming/ or compulsive eating/ or addiction/ or agonistic behaviour/ or communication between animals/ or vocalization/ or feather pecking/ or predation/ or nesting/ or feeding behaviour/ or cannibalism/ or coprophagy/ or herbivory/ or kinesis/ or chemotaxis/ or escape responses/ or phototaxis/	226681
16	(Stereotyp* or ((abnormal or repetitive or repetition or destructive or natural or Agonistic or impulsive or compulsive* or addictive or problem or disorder? or unusual or strange or appetitive or Predatory or Consummatory or Nesting or Eliminative or feeding or eating or Homing or "Tool Use" or escape or seeking or foodseeking or searching or foodsearching or foraging or chemotactic or phototactic or sexual or sex) adj1 (behaviour* or behavior*)) or ((repetition or repetitive or eating or exercis*) adj1 compulsive*) or impulsiveness or impulsivit* or compulsion or addiction? or phagomania or Grooming or Preening or biting or screaming or (excessive adj (vocalization or vocalization or singing or birdsong or song or sound)) or Predation or nesting or "nest building" or Cannibalism* or Coprophag* or "eating faeces" or "eating feces" or Cecotrophy or Herbivor* or phytophagy or ((Tonic or reflex) adj1 (Immobility or Immobilization or Immobilisation)) or (Death adj1 Feigning*) or thanatosis or Kinesis or Kineses or "Taxis Response*" or Tropotaxis or "Heat Avoidance" or "Thermal Avoidance" or Thermotaxis or Galvanotaxis or Chemotaxis or Haptotaxis or ((Escape or "Cataleptic Freezing" or cataleptoid or Flight) adj Reaction*) or cataleps* or Phototaxis or Photokinesis or Photokineses or autoamputation or autotomy or "egg brooding" or hoarding or ((animal or bird) adj (Distribution or dispersal))).tw.	298120
17	((Feather adj1 (picking or plucking or pecking or damaging or destructi*)) or "self damag*" or selfdamag* or "self mutilati*" or selfmutilati* or "auto mutilati*" or automutilati*).tw.	1770
18	overweight/ or obesity/ or nutritional disorders/ or malnutrition/ or undernutrition/ or nutrient deficiencies/ or fat deficiencies/ or mineral deficiencies/ or protein deficiencies/ or vitamin deficiencies/ or starvation/ or body condition/	313180
19	("body condition" or obesity or obese or adiposit* or Overweight or (nutrition* adj (deficienc* or disorder*)) or Malnutrition or Malnourishment* or Undernutrition or undernourishment or Starvation or Avitaminosis or Avitaminoses or Marasmus or (Pickwick* adj syndrom*) or ((Vitamin or Magnesium or Potassium or mineral or protein or energy) adj deficienc*)).tw.	379001
20	injuries/ or trauma/ or foreign bodies/ or wounds/	97467
21	(injur* or ((Decompression or compression or caisson) adj (Sickness or illness)) or Bends or (Foreign adj (Bodies or Body or object? or material or matter or particle)) or "corpora aliena" or "corpus alienum" or Microtrauma or trauma? or wound? or Polytrauma? or multitrauma? or multiinjur* or polyinjur* or Axonotmesis or Axonotmeses or Neurotmesis or Neurotmeses or neurotrauma? or neurotrosis or neuroinjur* or ((eye or ocular) adj perforation)).tw.	288344
22	fractures/ or bone fractures/	17564

23	(Fracture? or "broken bone?" or Microfracture?).tw.	39764
24	heat stress/ or heat exhaustion/ or heat shock/ or hyperthermia/	53230
25	((Heat adj2 (Illness* or cramp? or fatigue or syncope? or Exhaustion or stroke? or Collapse or Prostration?)) or Heatstroke? or Sunstroke? or "sun stroke?" or Hyperpyrexia? or Hyperthermia?).tw.	5568
26	oviposition/ or reproduction/ or fertility/ or egg production/ or sexual behaviour/ or mating behaviour/ or copulation/ or mating preferences/ or mating/	267135
27	((egg adj1 laying) or reproduction or Reproductive or fertility or Oviposition? or Fecundability or Fecundity or Subfecundity or Hypersexuality or Copulation? or Mating or (mate adj (choice or preference? or selection?)) or "pair bond*" or (Sexual adj (Selection* or activity or receptivity or response))).tw.	751247
28	hormones/ or adrenal cortex hormones/ or hypothalamic inhibiting hormones/ or hypothalamic releasing hormones/ or parathyrin/ or sex hormones/ or corticosterone/ or glucocorticoids/	76090
29	(hormon or hormone or hormons or hormones or "endocrine agent?" or corticosterone? or Corticoid? or Corticosteroid? or ((cortical or cortico or glycocortico or Hydroxycortico or sex) adj steroid?) or Glucocorticoid? or glucocortoid? or glycocorticosteroid? or Hydroxycorticosteroid? or hydroxycorticoid? or hydroxycorticosterone? or oxycorticosteroid? or parathorm* or Parathyrin? or parathormon*).tw.	472019
30	longevity/ or aging/ or lifespan/ or life expectancy/	70807
31	(Lifespan? or "Life span?" or "life expecta*" or longevity or aging or Senescence or "Length of Life").tw.	170994
32	9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31	6650370
33	(1 or 2 or 3 or 4) and (5 or 6 or 7 or 8) and 32	1399
34	limit 33 to yr="2022 -Current"	222
35	(1 or 2 or 3 or 4) and (7 or 8) and 32	331
36	limit 35 to yr="1905 - 2021"	278
37	(3 or 4) and (5 or 6 or 7 or 8) and 32	212
38	limit 37 to yr="1905 - 2021"	176
39	34 or 36 or 38	643
40	limit 39 to (danish or english or german or norwegian or "not specified" or swedish)	589
41	40 not (conference proceedings or conference slides or preprint).pt.	584