Appendix S1

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Parrot Survey: follow up 2020

This survey is aimed at pet parrot owners who have previously completed the longer version of our Parrot Survey. The purpose of this follow up survey is to collect up-to-date information on feather condition, diseases that affect feather condition, and your parrot's feather-related behaviour. This research is being undertaken by Professor Innes Cuthill (School of Biological Sciences, University of Bristol), Professor Mike Mendl (Bristol Veterinary School, University of Bristol), Professor Georgia Mason (Department of Animal Biosciences, University of Guelph), Dr Yvonne van Zeeland (Faculty of Veterinary Medicine, Utrecht University) and researcher Emma Mellor (Bristol Veterinary School, University of Bristol).

This survey has 13 questions and should take approximately 10 minutes to complete. Please note that your participation in this survey is completely voluntary. You may decline to answer any question(s) that you choose, and may withdraw your agreement to participate and your responses at any time during the study. While you will not be strictly anonymous, you will not be asked to provide your name or any other identifying information. Your submitted responses will be stored confidentially and securely on servers at Utrecht University and the University of Bristol. Your identity will not be published or otherwise released. Any images provided will be completely anonymised and securely stored on the same servers, so they

cannot be linked or traced back to a particular owner. Images will only be used for this particular study, and only used for scoring the feather condition of your parrot.

In order to participate, you must be at least 18 years old. If you are using a public computer to respond to the survey, you can help to ensure confidentiality by taking the following precautions to clear all private data from the computer:

1. Clear the browsing history 2. Clear the cache 3. Clear the cookies 4. Clear the authenticated session 5. LOG OFF

To send photographs, ask questions, or to request further information please email Emma Mellor: em15953@bristol.ac.uk

About you and your parrot:

Information collected in this section allows us to match up your responses to this current survey with your original Parrot Survey response

1. **What is your email address?**

2. **What is your parrot's name?**

3. **Which species is your parrot? Either common and/or scientific names are acceptable:**

4. **What sex is your parrot (please select one option)?**

☐Female

☐Male

☐Uncertain

About your parrot's current plumage and medical problems:

5. **Does your parrot currently have damaged plumage (i.e., damaged and/or missing feathers) (please select one)?**

☐Yes

☐No

6. **Which body parts are affected (i.e., feathers missing and/or damaged)? Check all that apply:**

☐Head

☐Throat/neck

☐Chest

☐Back

☐Wings: dorsal (top) surface

☐Wings: ventral (underneath) surface

☐Tail

☐Legs

7. **Which type(s) of feathers are damaged? Check all that apply:**

☐Down feathers

☐Covert feathers

☐Primary and/or secondary flight feathers (remiges, wings)

☐Tail feathers (rectrices)

☐Newly developing feathers (blood feathers)

☐Mature feathers

8. **Is there skin damage present (please select one)?**

☐Yes

☐No

9. **Does your parrot pluck, bite, or chew its own feathers (please select one)?**

☐Yes

☐No

☐No, the parrot is plucked by another bird

☐Unknown

10. **How severe is the feather damage caused by your parrot's behaviour (please select one)?**

☐Severe (bird [almost] completely devoid of feathers)

☐Moderate (patchy distribution, may leave down alone)

☐Mild (focal areas, most feathers intact)

☐No damage

11. **Has your parrot been diagnosed with any of the following medical problems? Check all that apply:**

☐None known

☐Lipomas/Xanthomas

☐Atherosclerosis

☐Liver lipodosis (fatty liver syndrome)

☐Diabetes mellitus

☐Pododermatitis (bumblefoot)

☐Arthritis/joint problems

☐Reproductive problems (e.g. reduced reproductive activity, egg binding)

☐Hypothyroidism

☐External parasites (e.g. ticks, mites)

☐Internal parasites (e.g. intestinal worms)

Other *please describe:* Click or tap here to enter text.

12. Do you think your parrot's feather condition has changed since you originally completed the Parrot Survey (please select one)?

☐Yes, it has improved

☐Yes, it has got worse

☐No, it has remained unchanged

☐Unsure

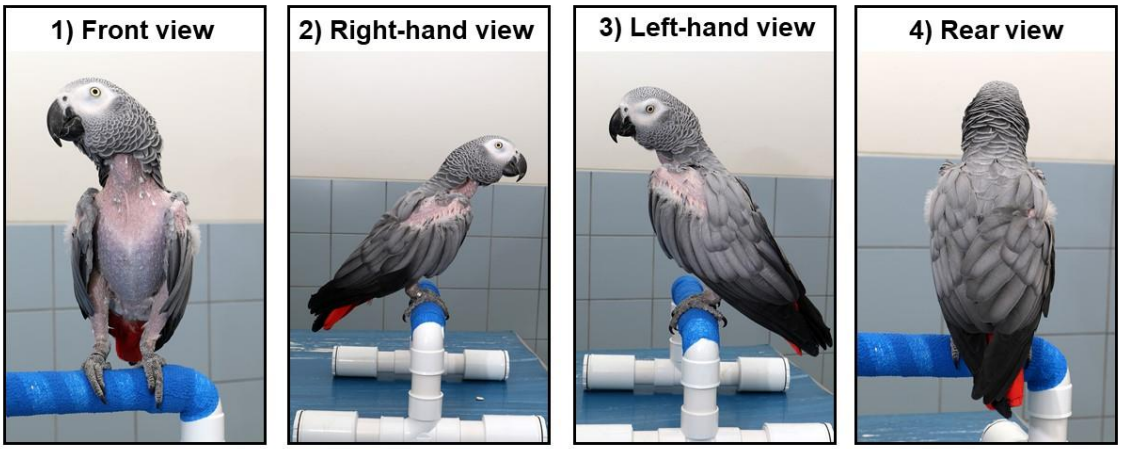
13. We would very much like to be able to assess your bird's feather condition. For this purpose, we would appreciate it if you would email us a standardised set of good quality photographs of your parrot, please?

☐Yes, and I will send them via email to: em15953@bristol.ac.uk

☐No, I would prefer not to provide photographs

Instructions: Please supply the following photographs of your parrot: 1) front view, 2) right-hand side view, 3) left-hand side view, and 4) rear view of your parrot as shown in the example (please note we have shown a bird with damaged plumage for illustrative purposes). Photographs may be taken using a smart phone or digital camera, with your bird comfortably perched and taking into account the following guidelines: a) feature only the bird of interest, and no others; b) preferably taken from either within the enclosure or when the parrot is (safely) out of the cage as the wire mesh or metal bars can obscure the view; c) photographs should be taken in a well-lit environment (ideally in natural light); and d) photographs should be taken from no more than 0.5 meters from your bird. Please add any additional photos you think may be of interest for us to assess your bird's feather condition.

Example photographs



Images kindly provided by Utrecht University's Divison of Zoological Medicine

Please email images to: em15953@bristol.ac.uk

Note: all images provided will be completely anonymised and securely stored on servers at Utrecht University and the University of Bristol, so that they cannot be linked or traced back to a particular owner. Images will only be used in this particular study, and only used for scoring the feather condition of your parrot.

Thank you for participating in our research!

Table S2 Details of the initial dataset gathered, and that used for main analyses after data processing. Columns towards the left give the species and the number of responses initially gathered for each with the current survey. The central columns describe the samples size for each species (also split by sex) featured in the final dataset of 78 parrots after data processing. On the right, 'Taxonomic group' shows how species were grouped for analyses assessing whether the proportion of agreement between each rater and the owners might be explained by species identity and/or sex, again giving the sample sizes for each group and split by sex. n = number of animals, F = female, M = males, U = uncertain.

		Details of final dataset of 78 parrots								
Species name	**n initial responses**	**n final dataset**	**F**	**M**	**U**	**Taxonomic group**	**n**	**F**	**M**	**U**
Blue-fronted amazon *Amazona aestiva*	2	0				Androglossini	7	5	2	
Blue-headed pionus *Pionus menstruus*	7	3	3							
Orange-winged amazon *Amazona amazonica*	2	0								
Red-crowned amazon *Amazona viridigenalis*	1	0								
Red-lored amazon *Amazona autumnalis*	1	0								
Scaly-headed parrot *Pionus maximiliani*	2	0								
Mealy amazon *Amazona farinosa*	1	1		1						
White-crowned pionus *Pionus senilis*	1	0								
Yellow-crowned amazon *Amazona ochrocephala*	1	1	1							
Yellow-naped amazon	3	2	1	1						

Species name	n initial responses	Details of final dataset of 78 parrots								
		n final dataset	F	M	U	Taxonomic group	n	F	M	U
Amazona auropalliata										
Barred parakeet	1	0				Arinae (others)	11	4	5	2
Bolborhynchus lineola										
Black-headed caique	1	0								
Pionites melanocephalus										
Blue-crowned conure	4	0								
Aratinga acuticaudata										
Golden conure	1	1	1							
Guaruba guarouba										
Green-cheeked conure	10	4	1	3						
Pyrrhura molinae										
Jenday conure	1	1	1							
Aratinga jandaya										
Monk parakeet	12	1			1					
Myiopsitta monachus										
Nanday conure	2	0								
Nandayus nenday										
Pacific parrotlet	3	1		1						
Forpus coelestis										
Parrotlet spp	3	0								
Species name unspecified										
Peach-fronted conure	1	0								
Aratinga aurea										
Pionites spp	1	0								
Possible P. leucogaster x melanocephalus										

Species name	n initial responses	*Details of final dataset of 78 parrots*								
		n final dataset	F	M	U	Taxonomic group	n	F	M	U
Sun conure	10	2	1		1					
Aratinga solstitialis										
White-bellied caique	4	1		1						
Pionites leucogaster										
Blue-and-yellow macaw	9	2	1	1		Arini (macaws)	5	2	2	1
Ara ararauna										
Blue-winged macaw	1	0								
Primolius maracana										
Chestnut-fronted macaw	6	0								
Ara severus										
Great green macaw	1	0								
Ara ambiguous										
Hyacinth macaw	1	1		1						
Anodorhynchus hyacinthinus										
Red-and-green macaw	4	1	1							
Ara chloropterus										
Red-shouldered macaw	5	1			1					
Diopsittaca nobilis										
Scarlet macaw	1	0								
Ara macao										
Ducorp's cockatoo	1	0				Cacatuinae	19	8	9	2
Cacatua ducorpsii										
Galah	5	1	1							
Cacatua roseicapilla										
Goffin's cockatoo	8	7	3	3	1					

Species name	n initial responses	*Details of final dataset of 78 parrots*								
		n final dataset	F	M	U	Taxonomic group	n	F	M	U
Cacatua goffiniana										
Lesser sulphur-crested cockatoo	5	2	1	1						
Cacatua sulphurea										
Little corella	1	1			1					
Cacatua sanguinea										
Salmon-crested cockatoo	3	2		2						
Cacatua moluccensis										
Sulphur-crested cockatoo	2	0								
Cacatua galerita										
White cockatoo	13	6	3	3						
Cacatua alba										
Yellow-crested cockatoo	1	0								
Cacatua sulphurea										
Budgerigar	6	0				Melopsittacus*	0			
Melopsittacus undulatus										
Cockatiel	22	9	3	6		Nymphicinae*	9	3	6	
Nymphicus hollandicus										
Eastern rosella	1	0				Old World	6	2	4	
Platycercus eximius						Psittacidae				
Eclectus	9	3	1	2						
Eclectus roratus										
Princess parrot	1	1		1						
Polytelis alexandrae										
Rainbow lorikeet	2	1	1							
Trichoglossus haematodus										

Species name	n initial responses	*Details of final dataset of 78 parrots*								
		n final dataset	F	M	U	Taxonomic group	n	F	M	U
Rose-ringed parakeet *Psittacula krameri*	4	0								
Rosy-faced lovebird *Agapornis roseicollis*	4	1		1						
Brown-necked parrot *Poicephalus fuscicollis*	1	0				Poicephalus	5	2	3	
Meyer's parrot *Poicephalus meyeri*	4	1		1						
Red-bellied parrot *Poicephalus rufiventris*	1	0								
Red-fronted parrot *Poicephalus gulielmi*	1	0								
Senegal parrot *Poicephalus senegalus*	6	4	2	2						
Grey parrot *Psittacus erithacus*	42	16	6	8	2	Psittacus	16	6	8	2
Species name not specified or unclear	13	0				-				
TOTAL	**259**	**78**	**32**	**39**	**7**					

* Budgerigars and cockatiels were each placed into separate groups from their nearest relatives because they, unlike their sister species, are considered to be likely domesticated (Bergman & Reinisch 2006, Kalmar *et al* 2010, Polverino *et al* 2012).

Table S3 Frequency (with percentages) of scores given to images of pet parrots by two raters regarding the presence/absence of feather damage, and those given by the birds' owners. Note that for the intra- and between-rater inter-observer scores, the raters scored 'Not visible' if a body area and/or feather type was not visible on a given bird's set of images. For the rater to owner inter-observer scores, these cells were re-coded as 'NA' and any survey responses unanswered by owners were likewise scored as such, to allow correct comparisons across the sets of scores. FDB = feather-damaging behaviour.

Intra-observer	**Yes**	**No**	**Not visible**
Rater 1: first scores	92 (26.1%)	236 (67%)	24 (6.8%)
Rater 1: second scores	83 (23.6%)	242 (68.8%)	27 (7.7%)
Rater 2: first scores	97 (27.6%)	222 (63.1%)	33 (9.4%)
Rater 2: second scores	101 (28.7%)	219 (62.2%)	32 (9.1%)
Inter-observer (between raters)			
Rater 1	429 (24.4%)	1205 (68.5%)	126 (7.2%)
Rater 2	447 (25.4%)	1186 (67.4%)	127 (7.2%)
Inter-observer scores (between raters and owners: all 78 parrots)			**NA**
Rater 1	374 (30%)	800 (64.1%)	74 (5.9%)
Rater 2	349 (28%)	818 (65.5%)	81 (6.5%)
Owners	229 (18.3%)	895 (71.7%)	124 (9.9%)
Inter-observer scores (between raters and owners: subset of 31 parrots with owner-reported FDB)			
Rater 1	243 (49%)	222 (44.8%)	31 (6.25%)
Rater 2	236 (47.6%)	225 (45.4%)	35 (7.1%)
Owners	193 (38.9%)	239 (48.2%)	64 (12.9%)
Scores for subset of 47 parrots without owner-reported FDB			
Rater 1	131 (17.4%)	578 (76.9%)	43 (5.7%)
Rater 2	113 (15%)	593 (78.9%)	46 (6.1%)
Owners	36 (4.8%)	657 (87.4%)	59 (7.8%)

Table S4 Frequency (with percentages) of scores given to images of pet parrots by two raters regarding the severity of feather damage present (ranked none – severe, 0 – 3), and those given by the birds' owners. FDB = feather-damaging behaviour.

Intra-observer	**0**	**1**	**2**	**3**
Rater 1: first scores	10 (45.5%)	9 (40.9%)	2 (9.1%)	1 (4.5%)
Rater 1: second scores	11 (50%)	8 (36.4%)	2 (9.1%)	1 (4.5%)
Rater 2: first scores	8 (36.4%)	8 (36.4%)	5 (22.7%)	1 (4.5%)
Rater 2: second scores	8 (36.4%)	9 (40.9%)	4 (18.2%)	1 (4.5%)
Inter-observer (between raters)				
Rater 1	56 (51%)	33 (30%)	13 (11.8%)	8 (7.3%)
Rater 2	52 (47.3%)	38 (34.5%)	13 (11.8%)	7 (6.4%)
Inter-observer scores (between raters and owners: all 78 parrots)				
Rater 1	31 (39.7%)	31 (39.7%)	10 (12.8%)	6 (7.7%)
Rater 2	33 (42.3%)	28 (35.9%)	12 (15.4%)	5 (6.4%)
Owners	40 (51.3%)	20 (25.6%)	14 (17.9%)	4 (5.1%)
Inter-observer scores (between raters and owners: subset of 31 parrots with owner-reported FDB)				
Rater 1	5 (16.1%)	11 (35.5%)	9 (29%)	6 (19.4%)
Rater 2	5 (16.1%)	10 (32.3%)	11 (35.5%)	5 (16.1%)
Owners	0 (0%)	15 (48.4%)	13 (41.7%)	3 (9.7%)

Table S5 Intra-observer reliability scores calculated for two raters. After scoring all 110 images once, a random 20% of sets (n = 22) were chosen to be re-scored for intra-observer reliability scoring, given as percentage agreement and Cohen's kappa (κ, agreement between two scores after accounting for agreement purely by chance: Cohen 1960, McHugh 2012). κ scores are interpreted as follows: < 0.21 = slight; 0.21 – 0.40 = fair; 0.41 – 0.60 = moderate; 0.61 – 0.80 = substantial; 0.81 – 0.99 = almost perfect; 1 = perfect. *P* < 0.05 indicates that two sets of scores agree more than would be expected by chance. n = 22 in all cases.

	Rater 1		**Rater 2**	
	Agreement	**Cohen's kappa**	**Agreement**	**Cohen's kappa**
Any feather damage?	95.5%	κ = 0.91, Z = 4.28, *P* < 0.001	100%	κ = 1, Z = 4.69, *P* < 0.001
Specific body parts				
Head	100%	κ = 1, Z = 4.69, *P* < 0.001	100%	κ = 1, Z = 5.86, *P* < 0.001
Throat/neck	100%	κ = 1, Z = 4.69, *P* < 0.001	100%	κ = 1, Z = 5.38, *P* < 0.001
Chest	95.5%	κ = 0.89, Z = 4.20, *P* < 0.001	100%	κ = 1, Z = 5.28, *P* < 0.001
Back	86.4%	κ = 0.60, Z = 3.33, *P* < 0.01	95.5%	κ = 0.91, Z = 5.15, *P* < 0.001
Wings (dorsal surface)	90.9%	κ = 0.81, Z = 3.88, *P* < 0.01	90.9%	κ = 0.82, Z = 4.14, *P* < 0.001
Wings (ventral surface)	90.9%	κ = 0.79, Z = 4.91, *P* < 0.001	100%	κ = 1, Z = 6.09, *P* < 0.001
Tail	90.9%	κ = 0.83, Z = 5.26, *P* < 0.001	100%	κ = 1, Z = 6.22, *P* < 0.001
Legs	77.3%	κ = 0.55, Z = 2.95, *P* < 0.01	95.5%	κ = 0.90, Z = 4.89, *P* < 0.001
Feather-types				

Down feathers	90.9%	$\kappa = 0.74$, $Z = 3.48$, $P < 0.01$	95.5%	$\kappa = 0.86$, $Z = 4.09$, $P < 0.001$
Covert feathers	95.5%	$\kappa = 0.91$, $Z = 4.28$, $P < 0.001$	95.5%	$\kappa = 0.91$, $Z = 4.28$, $P < 0.001$
Primary/secondary flight feathers	90.9%	$\kappa = 0.71$, $Z = 4.67$, $P < 0.001$	86.4%	$\kappa = 0.75$, $Z = 4.76$, $P < 0.001$
Tail feathers	90.9%	$\kappa = 0.83$, $Z = 5.26$, $P < 0.001$	100%	$\kappa = 1$, $Z = 6.22$, $P < 0.001$
Blood feathers	100%	–*	100%	$\kappa = 1$, $Z = 4.69$, $P < 0.001$
Mature feathers	95.5%	$\kappa = 0.91$, $Z = 4.28$, $P < 0.001$	100%	$\kappa = 1$, $Z = 4.69$, $P < 0.001$
Other				
Skin damage	100%	–*	100%	$\kappa = 1$, $Z = 4.69$, $P < 0.001$
Severity (0-3)	95.5%	$\kappa = 0.95$, $Z = 6.07$, $P < 0.001$	95.5%	$\kappa = 0.95$, $Z = 6.24$, $P < 0.001$
Mean agreement	**93.3%**		**97%**	

*Agreement was 100% but because all birds across both sets of scores were scored as having no damage, there was not any variance to enable calculation of κ

Table S6 Inter-observer reliability scores calculated between two raters of the 110 sets of images provided by parrot owners, given as percentage agreement and Cohen's kappa (κ, agreement between two scores after accounting for agreement purely by chance: Cohen 1960, McHugh 2012). κ scores are interpreted as follows: < 0.21 = slight; 0.21 – 0.40 = fair; 0.41 – 0.60 = moderate; 0.61 – 0.80 = substantial; 0.81 – 0.99 = almost perfect; 1 = perfect. *P* < 0.05 indicates that the raters' scores agree more than would be expected by chance. n = 110 in all cases.

	Agreement	**Cohen's kappa**
Any feather damage?	75.5%	$\kappa = 0.51$, $Z = 5.39$, $P < 0.001$
Specific body parts		
Head	94.5%	$\kappa = 0.60$, $Z = 6.99$, $P < 0.001$
Throat/neck	89.1%	$\kappa = 0.78$, $Z = 7.95$, $P < 0.001$
Chest	90.9%	$\kappa = 0.79$, $Z = 8.78$, $P < 0.001$
Back	83.6%	$\kappa = 0.60$, $Z = 6.62$, $P < 0.001$
Wings (dorsal surface)	77.3%	$\kappa = 0.54$, $Z = 5.76$, $P < 0.001$
Wings (ventral surface)	81.8%	$\kappa = 0.48$, $Z = 7.37$, $P < 0.001$
Tail	80.9%	$\kappa = 0.59$, $Z = 8.19$, $P < 0.001$
Legs	82.7%	$\kappa = 0.58$, $Z = 6.88$, $P < 0.001$
Feather-types		
Down feathers	92.7%	$\kappa = 0.79$, $Z = 8.27$, $P < 0.001$
Covert feathers	80%	$\kappa = 0.60$, $Z = 6.37$, $P < 0.001$
Primary/secondary flight feathers	85.5%	$\kappa = 0.63$, $Z = 8.05$, $P < 0.001$
Tail feathers	82.7%	$\kappa = 0.63$, $Z = 8.86$, $P < 0.001$
Blood feathers	91.8%	$\kappa = 0.08$, $Z = 1.36$, $P = 0.18$
Mature feathers	75.5%	$\kappa = 0.51$, $Z = 5.39$, $P < 0.001$
Other		
Skin damage	97.3%	$\kappa = 0.65$, $Z = 6.89$, $P < 0.001$
Severity (0-3)	67.3%	$\kappa = 0.65$, $Z = 9.36$, $P < 0.001$
Mean agreement	**84.1%**	