FINAL REPORT

PARA-VETERINARY TRAINING FOR KATALA FOUNDATION INCORPORATED ON CLINICAL SAMPLE COLLECTION FOR DISEASE DIAGNOSIS AND IDENTIFICATION OF ECTOPARASITES OF PHILIPPINE COCKATOO

Katala Foundation INCORPORATED

Oriental BIRD CLUB

PROJECT SUMMARY

Philippine Cockatoo or Katala is a critically endangered bird endemic to the Philippines. The highest known cluster of their population is at Rasa Island, Barangay Panacan, Narra, Palawan. About 200-300 individuals are known to breed and roost there. They are being conserved by Katala Foundation Incorporated (KFI). With their initiative, the population of Philippine Cockatoos is increasing, but birds are still susceptible to diseases and parasites. KFI noted that chicks at the nesting areas suffer from ectoparasites that cause morbidity and mortality to the hatchlings.

Collection of these parasites was done to identify these organisms. This is to help KFI on managing parasitism on the nest areas and on the Philippine Cockatoos. Training on parasite collection and identification was also provided to field personnel so that this can be replicated to other conservation sites of KFI. Staff were also trained on clinical sample collection for disease diagnosis and basic emergency treatment and response. Data and information were compiled and recorded on a para-veterinary training manual that was turned over to KFI, as well as a microscope to aid in their laboratory works.

PROJECT OBJECTIVES

1. Collect and identify ectoparasites present in the nests and on the Philippine cockatoos at Rasa Island Wildlife Sanctuary

2. Share practical skills on clinical sample collection, processing, and identification

3. Create a para-veterinary training manual for KFI

PART I

PARA-VETERINARY TRAINING FOR KATALA FOUNDATION INCORPORATED ON CLINICAL SAMPLE COLLECTION FOR DISEASE DIAGNOSIS

INTRODUCTION

Katala Foundation Inc. (KFI) is the major organization that manages, protects, and conserves the Philippine Cockatoos. They are stationed in Palawan where majority of the remaining Katala are found in the Philippines. With the lack of a mainstay veterinarian that can immediately diagnose and treat their animal patients, their staff must be aware on basic management of rescued animals and on clinical sample collection and processing for disease diagnosis.

METHODS

Capacity building through skills sharing

Demonstration of field activities during field survey and hands- on experience on doing clinical sample collection were done during the activity. A two-way learning set-up was achieved by UPLB Research Team and KFI staff by collecting field specimen and sample processing demonstration at the laboratory.

Creation of a paraveterinary training manual

A para-veterinary training manual was written and compiled, summarizing laboratory activities, such as clinical sample collection and basic disease diagnosis and description. It also includes the materials needed and procedures on processing each sample.

RESULTS

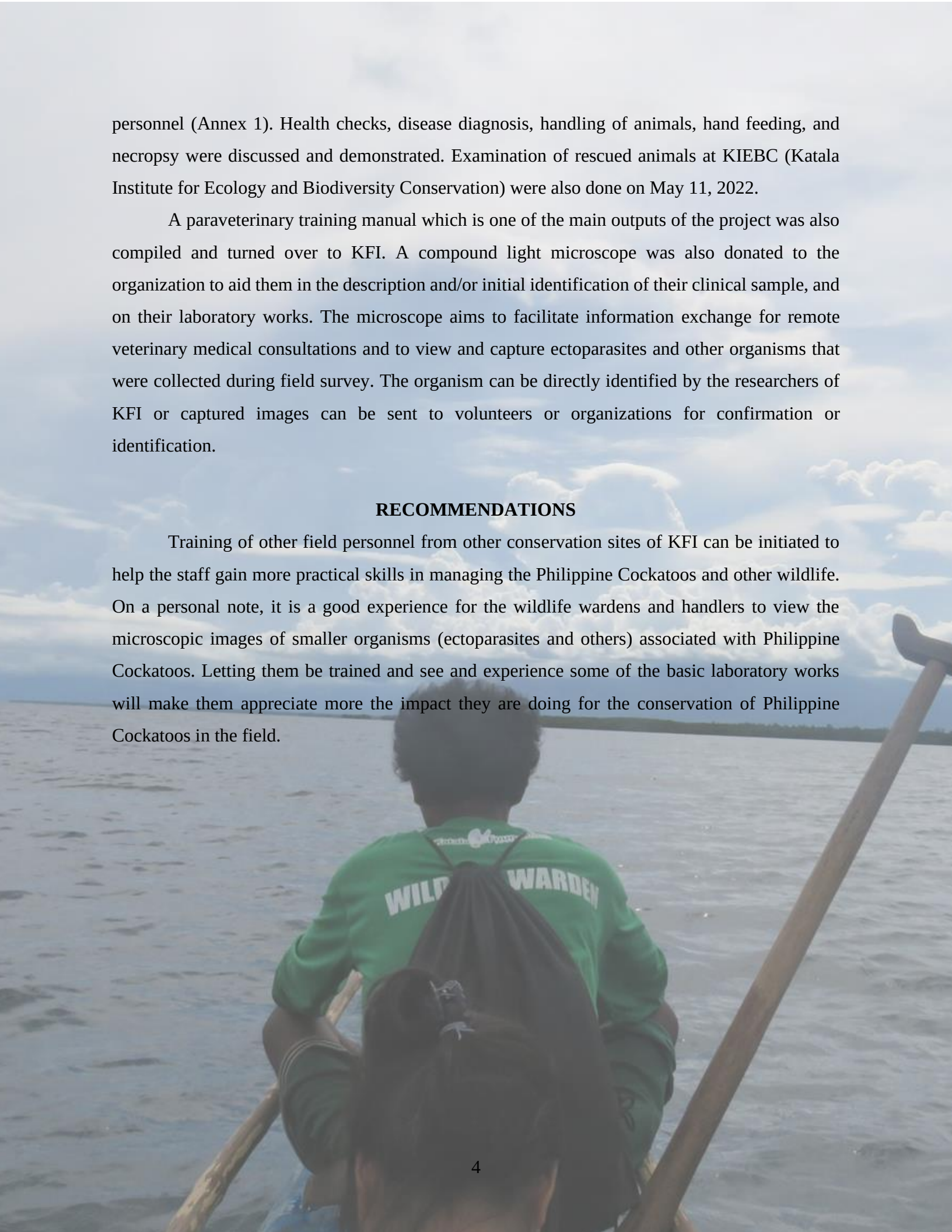
The paraveterinary training from May 12-13, 2022, is a two-day event attended by KFI staff and Department of Environment and Natural Resources - Protected Area Management Office

personnel (Annex 1). Health checks, disease diagnosis, handling of animals, hand feeding, and necropsy were discussed and demonstrated. Examination of rescued animals at KIEBC (Katala Institute for Ecology and Biodiversity Conservation) were also done on May 11, 2022.

A paraveterinary training manual which is one of the main outputs of the project was also compiled and turned over to KFI. A compound light microscope was also donated to the organization to aid them in the description and/or initial identification of their clinical sample, and on their laboratory works. The microscope aims to facilitate information exchange for remote veterinary medical consultations and to view and capture ectoparasites and other organisms that were collected during field survey. The organism can be directly identified by the researchers of KFI or captured images can be sent to volunteers or organizations for confirmation or identification.

RECOMMENDATIONS

Training of other field personnel from other conservation sites of KFI can be initiated to help the staff gain more practical skills in managing the Philippine Cockatoos and other wildlife. On a personal note, it is a good experience for the wildlife wardens and handlers to view the microscopic images of smaller organisms (ectoparasites and others) associated with Philippine Cockatoos. Letting them be trained and see and experience some of the basic laboratory works will make them appreciate more the impact they are doing for the conservation of Philippine Cockatoos in the field.



PART II

ECTOPARASITES OF PHILIPPINE COCKATOO *Cacatua haematuropygia* (KATALA) AT RASA ISLAND WILDLIFE SANCTUARY, NARRA, PALAWAN

ABSTRACT

Philippine Cockatoo *Cacatua haematuropygia* (Katala) is a critically endangered bird endemic to the country. Aside from habitat loss and pet trade which caused the major decline of the species, Katala was also recorded suffering from lice and mite parasitism. Ectoparasites present on hatchings of Philippine Cockatoo and in the nests at Rasa Island Wildlife Sanctuary, a major in situ conservation site for the species, were collected and identified. The ectoparasites that were collected belong to Class Arachnida and Class Insecta. It comprises one species of louse and six species of mites. *Ornithonyssus bursa* (bird mite), *Franciscoloa thompsoni* (Mallophaga or chewing lice), *Psittophagus* feather mite, and an unidentified dust mite were found on the hatchlings while tortoise mite, tarsonemid mite, mesostigmatid mites, and the unidentified dust mite that was also found on the hatchling were collected in the nest substrates. Management and control of these ectoparasites include proper dosage and drug administration of parasiticide, application of the drug in the vent area to target *O. bursa* and using narrow-spectrum anti-parasitic drugs in controlling and killing the parasites, especially *O. bursa*, so that Philippine Cockatoo-specific species, *F. thompsoni* and *Psittophagus* feather mite, can still perform their possible commensalistic-mutualistic role on their host.

Key words: *ectoparasites, Philippine Cockatoo, Rasa Island Wildlife Sanctuary, Ornithonyssus bursa, Franciscoloa thompsoni. Psittophagus*

INTRODUCTION

Katala or Philippine Cockatoo *Cacatua haematuropygia* (Muller, 1776) is endemic to the Philippines. It is listed as Critically Endangered (BMB, 2020) and only about 640-1120 birds are estimated to occur in the wild. The highest known cluster of population of Katala is at Rasa Island Wildlife Sanctuary (RIWS), Barangay Panacan, Narra, Palawan. About 200-300 individuals are recorded in the area (Widmann *et al*., 2018).

Birds are susceptible to diseases and ectoparasites. In a study conducted by Rebong *et al*. (2001), they found that hatchlings at RIWS suffer from parasitism. They even noted that one of the chicks jumped out of the nest apparently due to severe mite infestation and presence of decomposing chicks. These decomposing chicks also possibly died because of external parasites.

Ectoparasites are parasites found outside the host's body, usually in the integument. It includes lice, flies, mites, ticks, fleas, and others. In general, these organisms can cause blood loss, skin inflammation, irritation, self-mutilation, and mortality (Wall and Shearer, 2001). In this study, ectoparasites of Philippine Cockatoos at Rasa Island Wildlife Sanctuary, a major in situ conservation site for the species, were collected and identified. There were records of parasitism in the nest areas, but identification of the parasite was not yet fully documented or studied.

Collection and identification of the specific external parasites present at RIWS is crucial in managing the hatchlings in the area. Though presence of external parasites in the wild population is natural and parasitism may not be a widespread problem, a chick heavily infested with parasites may not survive and this may contribute to the decline of their species. The control and management of parasitism in an animal starts with the proper identification of the organism/s causing it. The choice of therapeutics also depends on the species of parasites present on the animal.

MATERIALS AND METHODS

Approval from Institutional Animal Care and Use Committee of University of the Philippines Los Baños (UPLB) and Gratuitous Permit from Palawan Council for Sustainable Development were secured before the start of the study. Field surveys were conducted at Rasa Island Wildlife Sanctuary (RIWS), Narra, Palawan (Annex 2) through the assistance and collaboration of KFI. The nest trees that were scheduled to be monitored by KFI on April 27, April

29, and May 2 were checked for the presence of eggs or hatchlings of Philippine Cockatoos. Fourteen nests were visited and five out of these nests were collected for substrates. Three of these five nests have hatchlings that can be checked for ectoparasite. In total, five hatchlings were examined. Wardens, who are also expert tree climbers, were employed to get Philippine Cockatoo hatchlings from their nest and collect nest substrate. Ectoparasites were manually collected from each bird using a tweezer or a brush. Hatchlings infested with ectoparasites were sprayed with anti-parasiticide including their nest as part of the management protocol being implemented by KFI. Collected ectoparasites were then put in a vial with ethanol, labelled, and transported to UPLB. For the nest substrates, flotation technique and Berlese Funnel Method were used to extract arthropods from the nests.

Feather samples taken from the primary or secondary wing feather of the necropsied non-juvenile rescued individuals of Philippine Cockatoos by the Katala Institute for Ecology and Biodiversity Conservation were also collected to expedite sample collection of ectoparasites.

The processing for examination of ectoparasites was adapted and modified from the methodologies used by Palma (1978) and Eduardo (2013). The ectoparasites were placed in 5% potassium hydroxide (KOH) solution overnight. For smaller specimens like mites, they were only soaked in KOH for 1-2 hours. Lactic acid was also used in some specimens where degradation of body parts due to processing were observed. The collected ectoparasites were then dehydrated with increasing concentrations of ethyl alcohol (40%, 70%, 96% or absolute ethanol). They were cleared in oil of cloves for 1-2 hours and were mounted on a slide using Canada balsam. For the louse species collected in the study, it was stained with Ziehl-Nielsen carbol fuchsin before dehydrating it with increasing concentrations of ethanol. Mounted specimens were properly labelled and were oven-dried until the balsam dries and hardens.

RESULTS AND DISCUSSION

The study determined the presence of ectoparasites on Philippine Cockatoos and in their nest areas. A total of 11 feather samples from necropsied non-juvenile Philippine Cockatoos were also examined for external parasites. Table 1 summarizes the ectoparasites collected on the Philippine Cockatoos and from the nest substrate. It also shows the number of individuals collected for each ectoparasite. *Ornithonyssus bursa* (Fig. 1), *Franciscoloa thompsoni* (Fig. 2) and an unidentified dust mite (Fig. 3) were collected on the hatchlings while a tarsonemid mite (Fig. 4),

tortoise mite (Fig. 5), mesostigmatid mites (Fig. 6) and the unidentified dust mite that was also found on the hatchling were collected from the nest substrates. A *Psittophagus* feather mite (Fig. 7) was collected at the necropsied non-juvenile Philippine Cockatoos.

Species collected on hatchlings of Philippine Cockatoo

Ornithonyssus bursa

O. bursa is a mesostigmatid mite from Class Arachnida and Family Macronyssidae. It is commonly called tropical fowl mite that infests poultry and wild birds (Taylor *et al*., 2016). Barn swallows *Hirundo rustica* (Wall and Shearer, 2001), European starling *Sturnus vulgaris* (Lareschi *et al*., 2017), house sparrows *Passer domesticus* (dos Santos *et al*., 2020), and monk parakeet *Myiopsitta monachus* (Briceño *et al*., 2021) were also reported to be infested with *O. bursa*.

Marcronyssid mites are blood sucking ectoparasites. They are about 750-1000 µm in size and may be gray-brown when unfed or black to red after a blood meal (Wall and Shearer, 2001). Their life cycle is rapid, about 5-12 days, and takes place entirely on their host. Its life stages include egg, larva, protonymph, tritonymph, and adult. Only the protonymph and adult stage are blood feeders (Taylor *et al*., 2016). Females lay eggs in masses at the base of feathers, especially in the vent area. *O. bursa* is a species of high veterinary interest. Severe infestation can cause irritation, anemia, lower egg production and death. The severity of the symptoms depends on the host resistance. They are also vectors of pathogens like fowl pox, Newcastle disease, and pasteurella (Wall and Shearer, 2001). Human dermatitis and allergic reactions were also reported from the bites of this macronyssid species (Waap *et al*., 2020).

Franciscoloa thompsoni

The louse species, *F. thompsoni* (Guimaraes, 1974), is from Class Insecta, Suborder Amblycera, and Family Menoponidae. It is a Mallophagan or chewing lice as determined by having a relatively blunt anterior head and the head broader than thorax. *F. thompsoni* was first described by Price and Beer in 1966 on Philippine Cockatoo specimens collected at Balabac Island and San Pedro, Culion, Calamianes Group of Islands in Palawan. Katala is the type host and the only known host for the louse. It was then rediscovered in 2009 by Eduardo and Lucas on rescued Philippine Cockatoos from Palawan and Mindanao.

Chewing lice feed on bits of skin and feathers as they can digest keratin. Their clinical importance is not significant unless there is severe pediculosis or lice infestation on birds. Its clinical signs include feather damage, restlessness, and injury due to scratching and feather plucking (Taylor *et al*., 2007).

In a published article by Rozsa and Vas (2014), they listed *F. thompsoni* along with the other lice only found on Philippine Cockatoos, *Neopsittaconirmus emersoni* (Guimaraes, 1974) and *Psittoecus hoogstrali* (Guimaraes, 1974), as critically co-endangered lice based on the IUCN status of the host species, Philippine Cockatoo. They also suggested considering preservation and re-introduction of the host- specific threatened lice as a way to conserve endangered animals ex-situ. Although lice are considered ectoparasites, special ecological relationships may result from interactions of host and host-specific parasites. This includes mutual grooming and social bonding between individual hosts (Deyrup, 2001).

Unidentified dust mite

The unidentified dust mite was observed on both the hatchling and in the nest. The dust mite is small, about 271.59 µm in length, and characterized by very long setae surrounding its body. Its tarsi are also noticeable. The closest group that resembles the species of interest is from Glycyphagidae. This is a family of dust mite from Class Arachnida Order Sarcoptiformes Suborder Oribatida. Dust mites are not known to cause major damage to animals. They are generalist species occurring on wild birds, rodents and in nest areas of various animals (Walter, 2016). In a study by Ardeshir (2010), dust mites from the Family Glycyphagidae *Lepidoglyphus destructor* (Schrank, 1781) were collected from nests of birds in Iran. Edible bird nests were also found with dust mites (Kew *et al*., 2015) including beehives (Klimov *et al*., 2016). Dust mites are considered harmless to their host animal. They can feed on organic materials in the nest area. In humans, some species can cause allergy and irritation (Ramos *et al*., 2007).

Species collected in the nests of Philippine Cockatoos

Mesostigmatid mite

Three individuals of mesostigmatid mite (one *Cosmolaelaps* sp. and two *Gaeolaelaps* sp.) were collected from the nest substrate. They were gray in color and about 500-724 µm in length. Holodorsal shield is almost covering the entire dorsum. The dorsal shield is undivided and without

mid-lateral incisions. Ventrally, the sternal shield is present and covers the intercoxal region. The peritreme runs through 1st coxa to between 3rd and 4th coxa. It ends with a round shaped stigma.

Tortoise mite

Tortoise mite is a mesostigmatid from Class Arachnida Superfamily Uropodoidea. They are also called uropodine mites. They are easily distinguishable by their armor or tortoise-like shields (Walter, 2016). In the specimens collected from nests of Philippine Cockatoos, the armor encases the mite dorsally. They are gray to dark red in color and are about 450-750 µm in length. There is marked sexual dimorphism in tortoise mites (Lachaud *et al*., 2016). In the collected specimens, the males have small circular to round genital shield while the females have large semi-oval genital shield that is flattened at the posterior side.

Species belonging to Uropodoidea are occurring in litters and other soil types. They are also recorded to occur in ant nests (Lachaud *et al*., 2016). Some are known as predatory to maggots and nematodes while some feed on fungi. Phoretic deutonymphs of the species may also be observed attached to insects, myriapods, and small lizards (Walter, 2016). As to the author's research, there were no records of bird parasitism noted for uropodoids.

Tarsonemid mite

This mite is from Order Trombidiformes, Infraorder Eleutherengona, Hyporder Heterostigmata, Family Tarsonemidae. It is small, oval, and completely hyaline. It is about 308 µm in length. Due to the small size of the mite, most of its parts are degraded during the processing.

Species collected on feathers of necropsied Philippine Cockatoos

Psittophagus sp.

The generic group *Psittophagus* is from Class Arachnida and Family Pterolichidae. They are feather mites found on psittacine birds. The genus is distinguishable from other feather mites by having two pairs of C-shaped or ball like heavily sclerotized structures in the females (Mironov *et al*., 2003). These structures, located at the lateral sejugal region and in the posterior part of the opisthosoma, are also very noticeable on female specimens collected on Philippine Cockatoos. For

the male specimens, they were observed to be lacking these two distinctive structures. They are also much smaller and lesser in number compared to females.

Feather mites, especially *Psittophagus* are host-specific. They show a high degree of monoxenity or restriction to only one host species or related hosts/conspecifics (oligoxeny). To date, based on author's research, there are only six species under the genus *Psittophagus* associated with Old World Parrots. These are *P. ornatus* (Mégnin and Trouessart, 1884), *P. obsoletus* (Mégnin and Trouessart, 1884), *P. galahi* (Mironov et al., 2003), *P. calyptorhynchi* (Mironov et al., 2003), *P. lacunosus* (Dabert et al., 2007), and *P. hollandicus* (Hernandes, 2017). All of these species are collected from birds belonging to Family Cacatuidae. This would be the first country record of the genus in the Philippines and probably the first recorded finding of the feather mite on Philippine Cockatoos.

Just like the louse species that can only be found on Philippine Cockatoos, host-specific feather mites are also shown to have beneficial effects on their hosts. An insightful DNA research on feather mite's diet has reported that their main food resources are fungi and bacteria. There was also no evidence of them feeding on blood, skin, and other bird resources. Doña *et al*. (2018) concluded that vane dwelling mites play a role in cleaning its host's feathers and a commensalistic or mutualistic relationship exists between monoxenous feather mites and its host.

RECOMMENDATIONS

Katala Foundation Incorporated is managing the parasitism by spraying broad-spectrum parasiticide on the birds and in the nest hole. For the drug to be effective, the usual dosage requires dipping the animal in the diluted solution and allowing it to dry by exposing the bird to sunlight. But this dosage cannot be easily followed in a wildlife setting. Spraying is more practical and efficient for the field staff and the birds. Thus, it is recommended to explore available parasitic drugs that are also formulated to be sprayed on the animal and/or to nest areas. It is also important to administer the formulation on the vent area of the bird since *O. bursa* lays its egg on this region.

The use of narrow-spectrum antiparasiticide, which only targets the species of *Ornithonyssus* can also be helpful in managing the Philippine Cockatoos. This can be useful as studies suggest that host-specific parasites, like *F. thompsoni* and *Psittophagus* species of feather mite, may have commensalistic-mutualistic role on the animal.

ACKNOWLEDGMENTS

The author expresses her gratitude to University of the Philippines Los Baños-College of Veterinary Medicine, Katala Foundation Incorporated and Katala Institute for Ecology and Biodiversity Conservation in Narra, Palawan. She is also extremely grateful to Oriental Bird Club for funding this study.

REFERENCES

Ardeshir F. 2010. A Preliminary Study on Mite Fauna of Bird Nests in Iran. *Podoces* 5(2): 112–115.

BMB. 2020. *Philippine Red List of threatened wild fauna. Part I. Vertebrates*. Philippines: Department of Environment and Natural Resources - Biodiversity Management Bureau. page 65.

Briceño C, Yevenes K, Laerrechea M, Rodriguez AS, Silva-de la Fuente MC, Fredes F, Hidalgo H, Alcayaga V, Ruiz PO, Munita C and Acuña DG. First record of *Ornithonyssus bursa* (Berlese, 1888) (Mesostigmata: Macronyssidae) parasitizing invasive monk parakeets in Santiago, Chile. Brazil Journal of Veterinary Parasitology 30(1): 1-10.

Dabert J, Badek A and Skoracki M. 2007. New feather mite species (Acari, Astigmata) from the Sulphur-crested Cockatoo *Cacatua galerita* and Yellow-crested Cockatoo *C. sulphurea* (Psittaciformes, Cacatuidae). *Acta Parasitologica* 52(3): 250-267.

Deyrup M. 2001. Endangered terrestrial invertebrates. https://www.sciencedirect.com Accessed 23 May 2022.

Doña J, Proctor H, Serrano D, Johnson KP, Oploo AO, Huguet-Tapia JC, Ascunce MS and Jovani R. 2018. *Molecular Ecology* 28: 203–218.

dos Santos LSS, Mascarenhas CS, dos Santos PRS and Farias A. 2020. Mites Macronyssidae parasites of *Passer domesticus* (Linnaeus, 1758) (Passeriformes: Passeridae) in the Southern of Brazil. *Revista Brasileira de Zoociências* 21(1): 1-12.

Eduardo SL. 2013. On three species of chewing lice (Mallophaga: Ischnocera) from the common emerald-dove and the spotted imperial-pigeon (Aves: Columbiformes) in the Philippines. *Philippine Journal of Veterinary Medicine* 50(1): 42–46.

Eduardo SL and Lucas SF. 2009. *Haemoproteus lanii* de Mello, 1937 (Apicomplexa: Haemoproteidae) from the Long-tailed Shrike and two species of chewing lice (Mallophaga) from the Philippine Cockatoo (Aves: Laniidae; Cacatuidae). *Philippine Journal of Veterinary Medicine* 46(2): 95–101.

Guimaraes L. 1974a. Ischnocera (Mallophaga) infesting parrots (Psittaciformes). *Papeis Avulsos de Zoologia, Sao Paulo* 28(9): 163–180.

Guimaraes L. 1974b. Ischnocera (Mallophaga) infesting parrots (Psittaciformes) I. *Arquivos de Zoologia, Sao Paulo* 25(5): 121–201.

Hernandes FA. 2017. Psittophagus hollandicus n. sp., a new feather mite species (Acariformes: Pterolichidae) from the cockatiel *Nymphicus hollandicus* (Kerr, 1792) (Psittaciformes: Cacatuidae) in Brazil. *Acarologia* 57(4): 893-900.

Kew PE, Wong SF, Ling SJ, Lim PKC and Mak JW. 2015. Isolation and identification of mites associated with raw and commercial farm edible bird nests. *Tropical Biomedicine* 32(4): 761–775.

Klimov PB, OConnor B, Ochoa R, Bauchan GR, Redford AJ and Scher J. 2016. Bee Mite ID: Bee-Associated Mite Genera of the World. USDA APHIS Identification Technology Program (ITP), Fort Collins, CO. http://idtools.org/id/mites/beemites/index.php Accessed 24 May 2022.

Krantz GW and Walter DE (eds.) 2009. *A Manual of Acarology*, Third ed. Lubbock: Texas University Press. page 807.

Lachaud J, Klompen H and Perez-Lachaud G. 2016. Macrodinychus mites as parasitoids of invasive ants: an overlooked parasitic association. *Scientific Reports* 6:29995.

Lareschi M, Cicuttin GL, De Salvo MN, Ibañez L and Montalti D. 2017. The tropical fowl mite *Ornithonyssus bursa* (Acari: Mesostigmata: Macronyssidae) parasitizing the European starling *Sturnus vulgaris* (Aves: Passeriformes: Sturnidae), an invasive bird in central Argentina. An approach to the bacterial fauna of this mite. *Revista Mexicana de Biodiversidad* 88: 454–458.

Mironov SV, Dabert J, Ehrnsberger R. 2003. A review of feather mites of the *Psittophagus* generic group (Astigmata: Pterolichidae) with descriptions of new taxa from parrots (Aves: Psittaciformes) of the Old World. *Acta Parasitologica* 48: 280-293.

Palma RL. 1978. Slide-mounting of lice: a detailed description of the Canada balsam technique. *The New Zealand Entomologist* 6(4): 432–436.

Ramos JDA, Castillo MPS, del Rosario M, Gapay MA, Go TP and Kamantigue EG. 2007. Allergenicity and cross-reactivity of 3 house dust mite species among Filipino allergic patients. *Philippine Journal of Science* 136 (2): 139-146.

Rebong G, Boussekey M, Widmann P, Lacerna I and Diaz S. 2001. Psittacine feather and beak disease testing and DNA sexing of wild Red-vented Cockatoo chicks at Rasa Island, Palawan. *Siliman Journal* 42(2): 150-151.

Rozsa L and Vas Z. 2014. Co-extinct and critically co-endangered species of parasitic lice, and conservation-induced extinction: should lice be reintroduced to their hosts? *Fauna & Flora International, Oryx* 49(1): 107–110.

Taylor MA, Coop RL and Wall RL. 2007. *Veterinary parasitology*. Third edition. United Kingdom: Blackwell Publishing Ltd. pp. 1247-1248.

Taylor MA, Coop RL and Wall RL. 2016. *Veterinary parasitology*. Fourth edition. United Kingdom: Blackwell Scientific Ltd. pp. 236-238.

Waap H, Aguin-Pombo A and Maia M. 2020. Case Report: Human dermatitis linked to *Ornithonyssus bursa* (Dermanyssoidea: Macronyssidae) infestation in Portugal. Frontiers in Veterinary Science 7: 567902.

Wall R and Shearer D. 2001. *Veterinary Ectoparasites: Biology, Pathology and Control*. UK: Blackwell Science Ltd. pp. 1-3, 50-53.

Walter DE. 2016. Invasive Mite Identification: Tools for Quarantine and Plant Protection, Lucid v. 3.6, last updated July 24, 2006, Colorado State University, Ft. Collins, CO and USDA/APHIS/PPQ Center for Plant Health Science and Technology, Raleigh, NC. http://idtools.org/id/mites/invasive_mite Accessed 24 May 2022.

Widmann I, Antonio R, Agullo AR, Guion-Satioquia A, Plazos M, Nuñez and Widmann P. 2018. *Philippine Cockatoo Conservation Programme Technical Progress Report*. September 2017 June 2018: 11-27

Widmann P, Lacerna DL and Diaz SH. 2008. Aspects of Biology and Conservation of the Philippine Cockatoo *Cacatua haematuropygia* on Rasa Island, Palawan, Philippines. In Widmann IL, Widmann P, Schoppe S, van den Beukel D and Espeso M. *Conservation Studies on Palawan Biodiversity: A compilation of researches conducted in cooperation with or initiated by Katala Foundation Inc.* Puerto Princesa: Katala Foundation Inc. pp. 100-108.

TABLE

Table 1. Mites (M) and louse (L) collected on Philippine Cockatoos and in their nests in Rasa Island Wildlife Sanctuary, Narra, Palawan.

	Ectoparasite	Number of individuals
Philippine Cockatoo	*Ornithonyssus bursa* (M)	4
	Unidentified dust mite (M)	1
	Franciscoloa thompsoni (L)	1
	Psittophagus sp. (M)	265
Nest	*Cosmolaelaps* sp. (M)	1
	Gaeolaelaps sp. (M)	2
	Dust mite (M)	1
	Tarsonemid mite (M)	1
	Trichouropoda sp. (M)	99

FIGURES

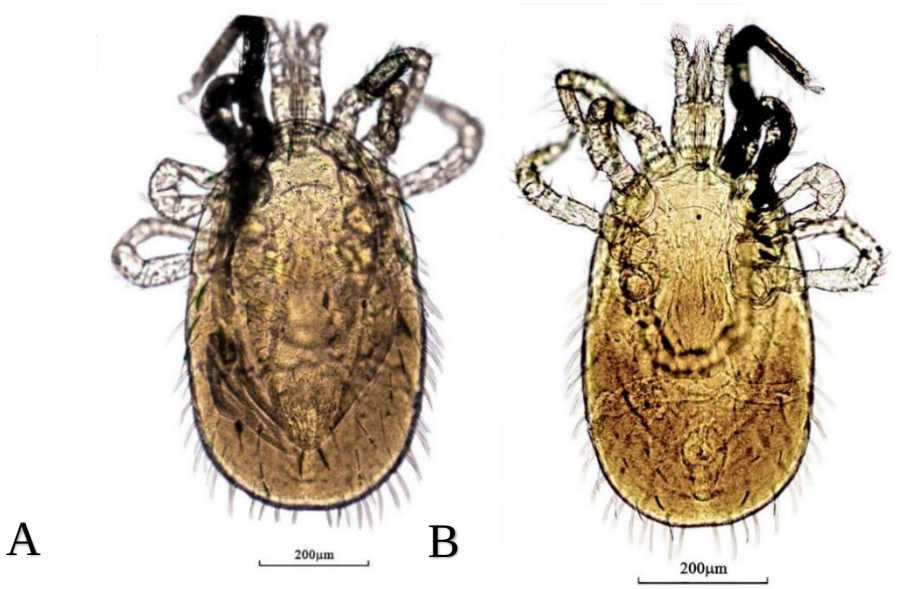


Figure 1. Dorsum (A) and venter (B) of *Ornithonyssus bursa*. 10x objective, 200µm.

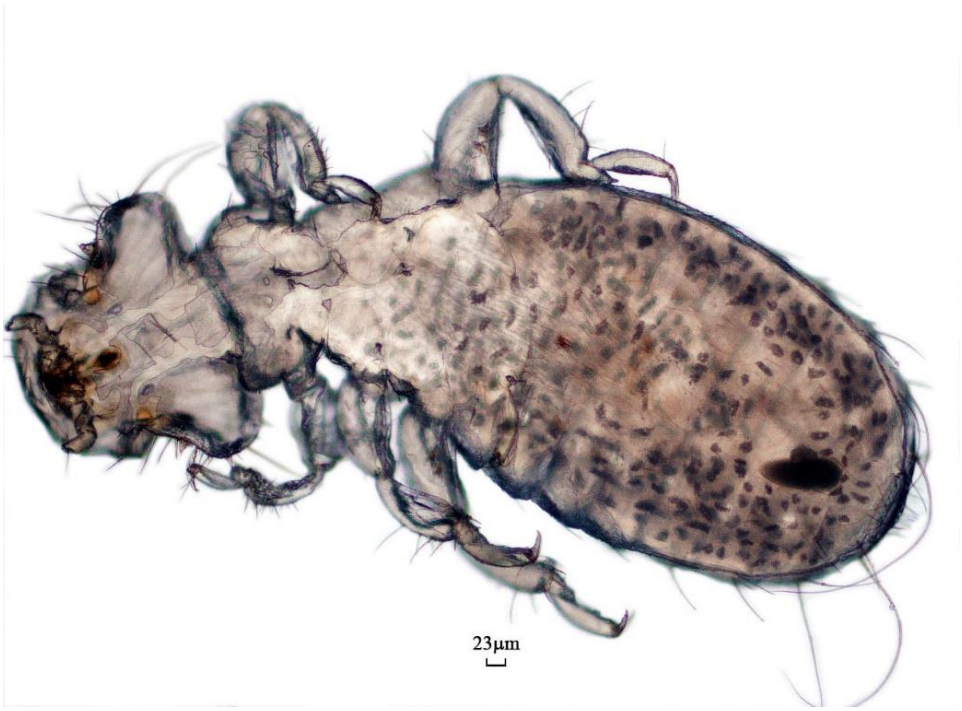


Figure 2. A female *Franciscoloa thompsoni* in dorsal view (10x objective, 23µm). Note the egg inside its abdomen.

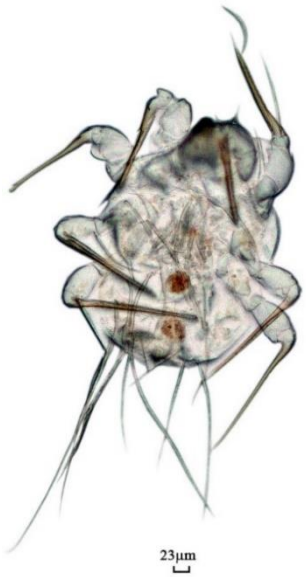


Figure 3. Unidentified dust mite that were collected on Hatchling 78-2 and in Nest 78 (10x objective, 23µm). Note the long setae and tarsi. (ventral view)

Figure 4. A Tarsonemid mite collected at Nest 72. 40x objective, 50µm. The specimen was damaged during processing.

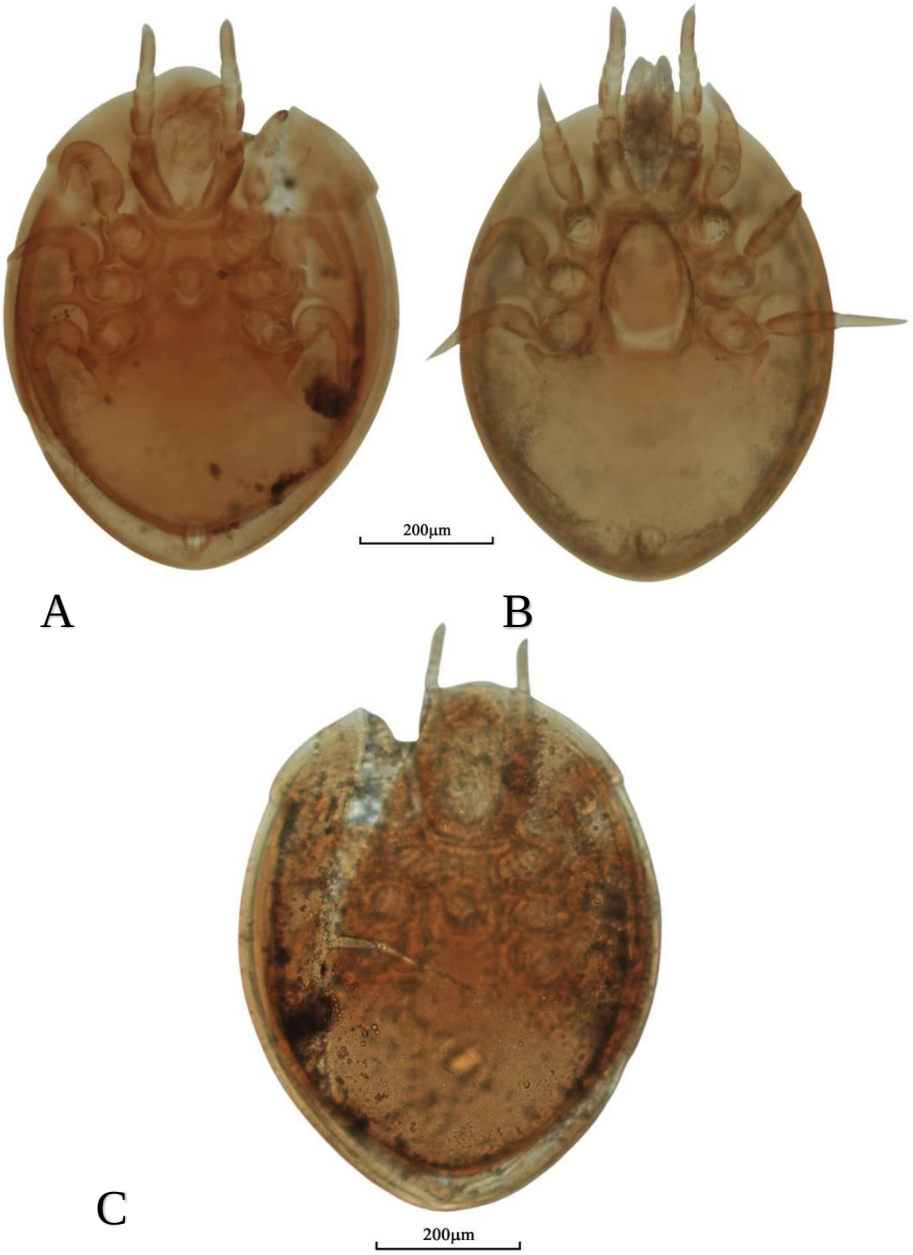


Figure 5. Tortoise mites from Superfamily Uropodoidea. Note the sexual dimorphism between male (A) circular genital shield, and female (B) large semi-oval genital shield. Dorsal view (C). All are in 10x objective, 200µm.

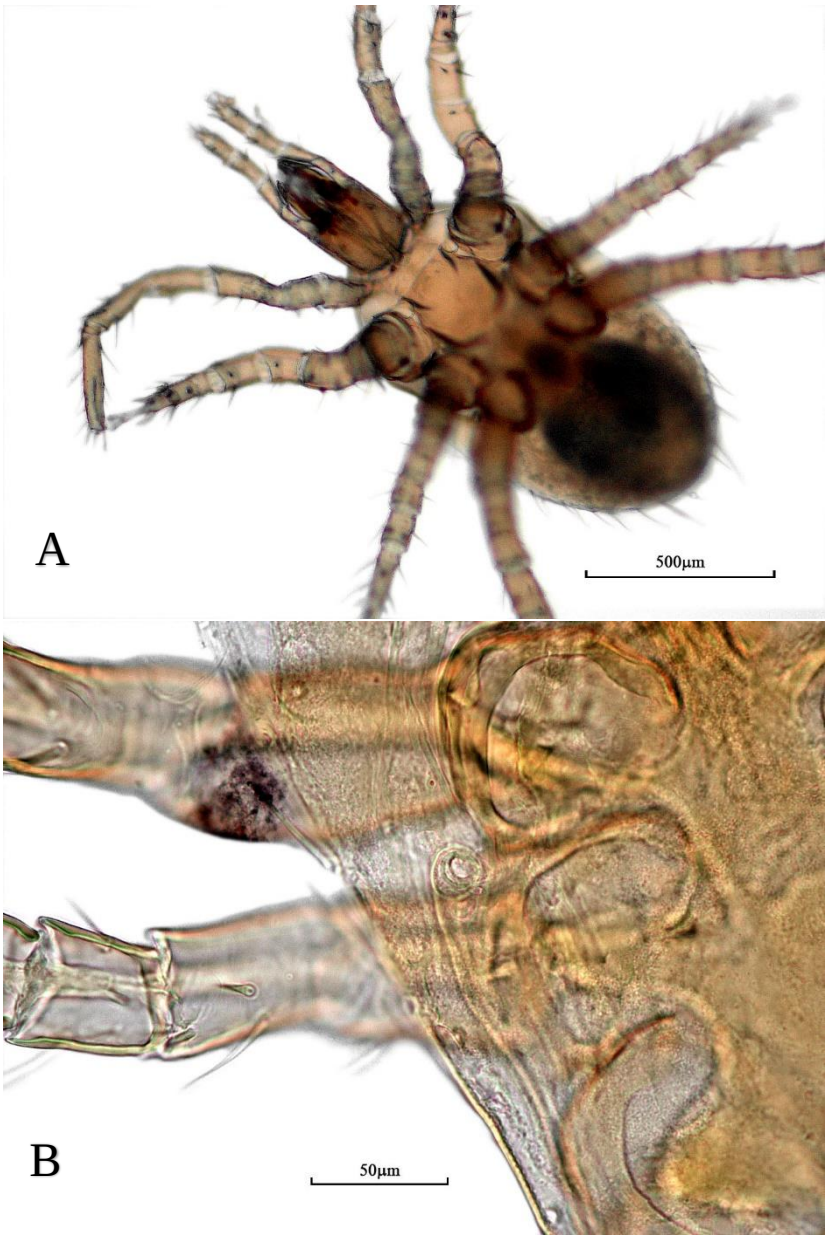


Figure 6. (A) Mesostigmatid mites in ventral view. 10x objective, 500µm. (B) Peritreme and stigma located between coxa III and IV. 40x objective, 50µm.

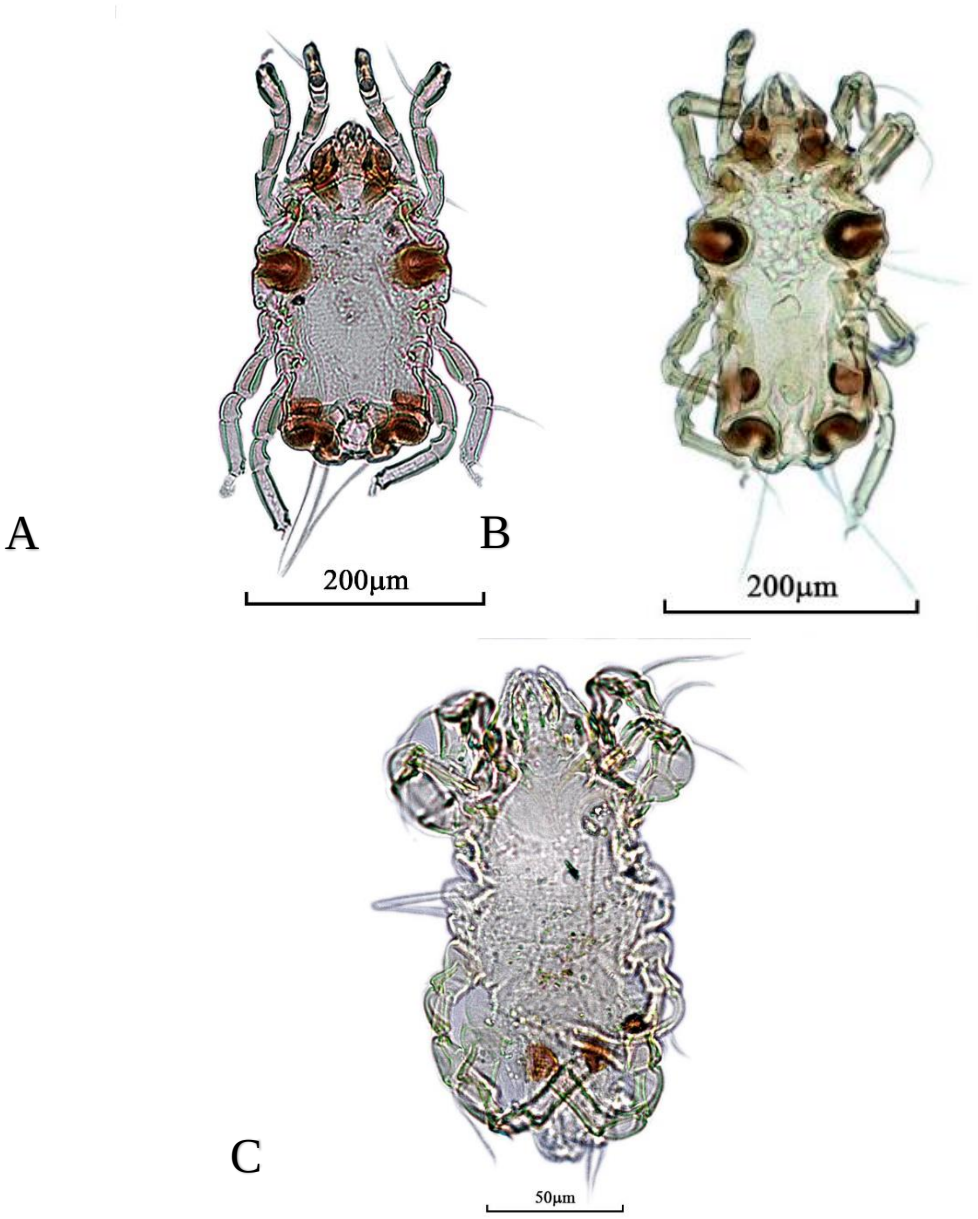
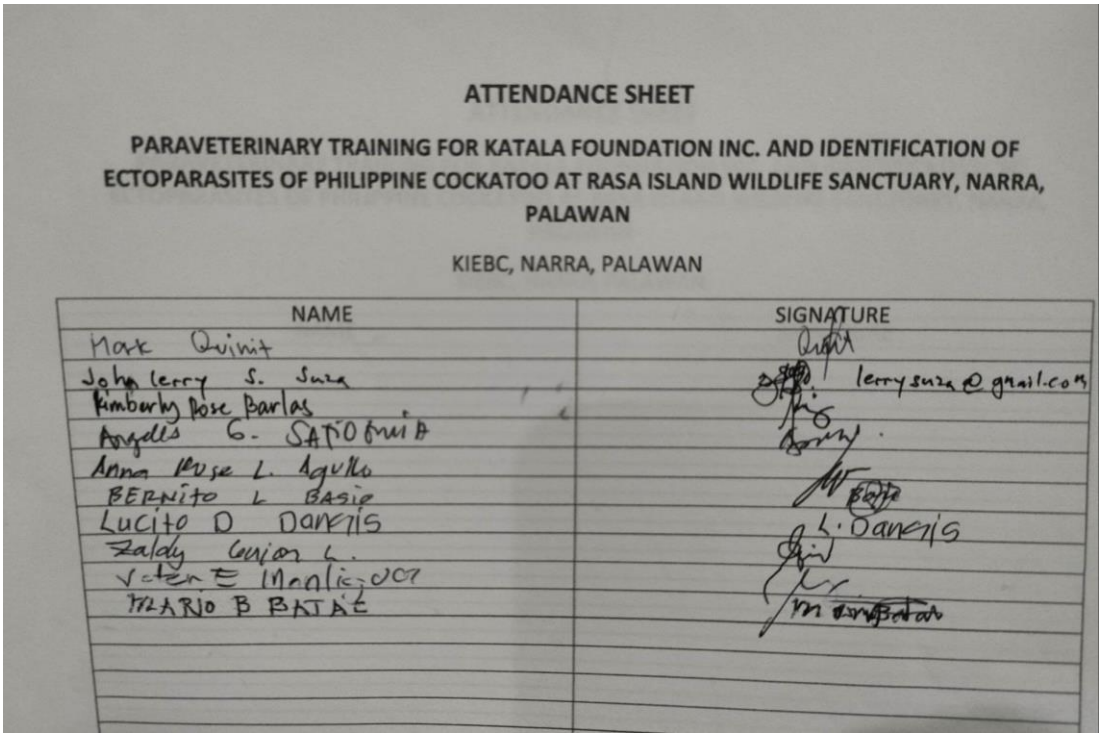


Figure 7. Female in dorsal (A) and ventral (B) views (10x objective, 200µm) and male (C) (40x objective, 50µm) *Psittophagus* sp.. Note the size difference and the absence of the two pairs of ball-like sclerotized structures in male.

ANNEXES

Annex 1. Attendance sheet during the paravertinary training at KIEBC, Narra, Palawan



ATTENDANCE SHEET

PARAVETERINARY TRAINING FOR KATALA FOUNDATION INC. AND IDENTIFICATION OF ECTOPARASITES OF PHILIPPINE COCKATOO AT RASA ISLAND WILDLIFE SANCTUARY, NARRA, PALAWAN

KIEBC, NARRA, PALAWAN

NAME	SIGNATURE
Mark Quinit	
John lerry S. Suza	lerrysuza@gmail.com
Kimberly Rose Barlas	
Angelis G. SATIOquia	
Anna Rose L. Aguilo	
BERNITO L BASIO	
Lucito D Daneis	L. Daneis
Zaldy Guion L.	
Victor E Manlicuor	
MARIO B BATAE	

Annex 2. Map showing the Rasa Island Wildlife Sanctuary