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PATHOLOGY

Causes of bird losses recorded in a captive-bred wild bird flock between 2011 and 2015

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ABSTRACT: *This study discusses the causes of bird deaths recorded in a small aviary dedicated to the breeding of a few exotic, wild bird species. Findings from 28 birds were examined over a period of five years. About 40% of the deaths occurred in the first two weeks after hatching in the two most numerous species in the flock and such losses were mainly a result of starvation caused by inadequate nutritional management. Additionally, 28% of the cases affected recently introduced birds. Despite frequent treatment with anthelmintics; a total of 21% of the deaths in the flock could be attributed to parasitic diseases, most of them in recently acquired birds. Only three of the deaths could be associated with advanced age, all of the further cases were also attributable to management fails. Our results indicated that propagation of these and other species requires an improvement of the management of the newly hatched and newcomer birds to considerably enhance the flock's performance. Such information may be useful in conservation initiatives and may justify, at least in part, captivity of these animals.*
Key words: *wild bird management, causes of bird death, Leiothrix lutea, Callipepla californica, Tauraco livingstonii, Polyplectron sp. pheasants.*

Perdas registradas em um plantel de aves silvestres criadas em cativeiro, entre 2011 e 2015

RESUMO: *Este estudo discute as causas de morte de aves registradas em um pequeno criadouro de umas poucas espécies de aves silvestres exóticas. As mortes de 28 aves foram examinadas em um período de cinco anos. Cerca de 40% dos casos ocorreram na primeira semana de vida de filhotes das duas espécies mais numerosas no plantel e essas perdas foram consequentes à desnutrição por falhas no manejo nutricional. Outros 28% de casos ocorreram em aves, recentemente introduzidas, ou em fase de adaptação, no criadouro. Ainda que as aves do plantel sejam frequentemente dosificadas com anti-helmínticos, 21% das mortes no plantel foram secundárias a doenças parasitárias; a maioria afetou aves recentemente adquiridas. Exceto por três mortes que foram associadas com desordens atribuídas à idade avançada, todas as demais foram associadas com inadequações no manejo das aves. Esses resultados sugerem que, em sistemas dessa natureza, as aves recém-nascidas e as recém-introduzidas são categorias críticas que demandam concentração de esforços para o atendimento sistemático de suas necessidades. Tais dados podem ser aplicáveis em iniciativas de conservação de outras espécies e podem justificar, ainda que parcialmente, a manutenção desses animais, em cativeiro.*
Palavras-chave: *causas de morte de aves, Leiothrix lutea, Callipepla californica, Tauraco livingstonii, faisões Polyplectron sp.*

INTRODUCTION

Captive propagation and the subsequent reintroduction of threatened species may also be a tool for bird conservation (HEINRICH, 2009; COLLAR et al., 2012). Environmental and nutritional requirements of species kept in captivity are the major aspects to be addressed in such projects (KARSTEN, 2007). While important questions regarding management limitations in captive breeding programs have been raised (SNYDER et al., 1996; HEMMINGS et al., 2012), little specific and detailed information from bird breeding centers is available (CORK et al., 1999; CRUZ et al., 2011; PEREIRA et al., 2013), albeit this may be useful for planning such conservation initiatives. In this sense, analysis of the financial costs involved (FA et al., 2011; CRUZ et al., 2016) is essential for decision making or planning captive breeding efforts. This paper reports the bird losses recorded in a five-year period from a small southern Brazilian aviary, where a few captive-bred exotic wild bird species are kept.

MATERIALS AND METHODS

Information on management data and history from diseased bird was provided by the owner of the aviary, where data have been systematically

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recorded. All dead birds, even those in which an obvious cause of death could be recognized by the owner, were submitted for necropsy. Samples from several organs and tissues were collected, fixed in buffered formalin, and processed following standard procedures for histopathology. Hematoxylin and eosin were used for staining. Additional diagnostic tests, including microbiological and toxicological assays, were performed as needed.

During the experimental period, about 40 birds were kept in the aviaries; most of them in planted outside aviaries during the breeding season (September to January) and in aerial wire mesh floored enclosures during the rest of the year. The complete area of the aerial enclosures is covered by a roof, as well as both corners of the outside aviaries. Consumption of food items by most of the species kept in the aviaries has been reported in a previous study (CRUZ et al., 2016). Pekin robins (*Leiothrix lutea*) are fed commercial softbill ration, fruits (mostly apple and papaya), boiled egg meal, live insects (bought, bred, collected, and trapped), and invertebrates (collected). Livingstone's turacos (*Tauraco livingstonii*) are fed fruits, vegetables, boiled egg meal, and a few live mealworms (*Tenebrio molitor*). California quail (*Callipepla californica*) are fed with seed mixture, commercial quail ration, vegetables (mostly lettuce), boiled egg meal, and a few live mealworms and termites. In addition to the diet fed to quail, peacock pheasants (*Polyplectron emphanum* and *Polyplectron bicalcaratum*) also received a mix of chopped and crystallized fruits, broken maize seeds, giant mealworms (*Zophobas morio*), and collected *Scolopendra* sp., spiders, caterpillars, etc. In this aviary, reproduction has been kept to a minimum only for maintaining the flock, whose number remained stable throughout the experimental period. All the tasks in the aviary are performed by the aviary's owner.

RESULTS AND DISCUSSION

Bird losses recorded in the period are presented in table 1. Most losses affected newly hatched Pekin robin and California quail chicks, which also were the most numerous bird species in the flock. Most of these chicks showed a lack of feed in their digestive tracts and probably died due to starvation, associated with difficulties in the learning process of feed intake (artificially incubated quail chicks). In a previous study, the supply of insects in the breeding of Pekin robin nestlings has been associated with a relative lack of insects for the parents for feeding their nestlings (CRUZ et al., 2011). A total of 10% of the quail chicks hatched annually died within the first week after hatching, most of them were kept in a heated enclosure with a nanny quail (*Coturnix japonica* or *Coturnix chinensis*) (Figure 1), which may stimulate food uptake in chicks. Only one quail chick that was kept with its parents has died in a similar condition. While allowing the hen to incubate their eggs may diminish egg-laying rates, the viability of the chicks raised with the parents tends to be higher in comparison with that of the former method (CORDER, 2011). In the study period, a total of 11 Pekin Robins and 25 California quails were successfully raised.

The loss of four newly acquired California quails due to complications associated with severe

Table 1 - Bird losses recorded in a softbill breeding aviary in southern Brazil, 2011-2015.

Affected birds	N	Probable cause of death
1-we-o *Callipepla* chicks	09	Starvation
1-we-o *Leiothrix* chicks	03	Starvation
Callipepla californica[#]	04	Secondary to *Eucoleus contortus* parasitism
Callipepla californica[#]	01	Fatal acute toxoplasmosis
Leiothrix lutea	01	Gizzard obstruction, *Acuaria spiralis*
Leiothrix lutea	02	Multiple weakness, aged birds
Leiothrix lutea	01	Hypothermia, aged bird
Callipepla californica	02	Egg-binding
Tauraco Livingstonii[#]	01	Predation
Leiothrix lutea	01	Anaphylaxis, Hemiptera sting
Leiothrix lutea	01	Conspecific traumatism
Polyplectron bicalcaratum[#]	01	Intestinal obstruction
Polyplectron emphanum[#]	01	Aspiration pneumonia

[#]newly acquired.

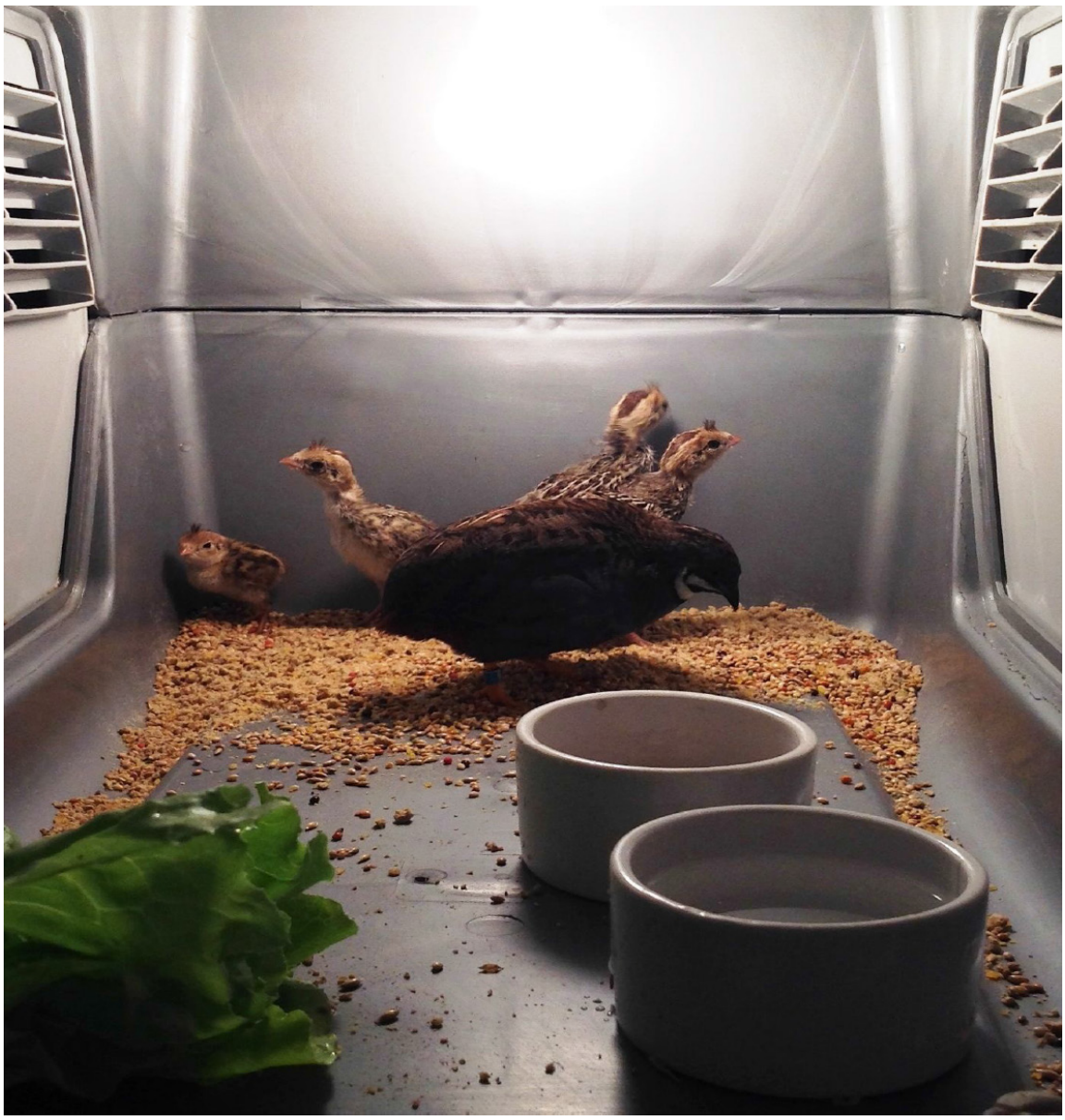

Figure 1 - A heated enclosure with 1- to 9-d-o California quail chicks. A nanny male *Coturnix chinensis* stimulates the chicks to take food items and provides shelter under his wings at night.

Eucoleus contortus infection has been described previously (CRUZ et al., 2015), including the measures applied for controlling the parasitosis. A systemic and fatal case of toxoplasmosis affecting a recently introduced California quail has also been reported (CASAGRANDE et al., 2015). A three-year-old Pekin robin died after suffering from a gizzard inflammation and obstruction by *Acuaria spiralis* worms (Figure 2). At this age, this bird had been dosed three times with a fipronil/methoprene combination (2 and 1mg) and three times with pour on selamectin (2mg). The last dose was performed 40 days before its death. The bird died 48 hours after appearing ill. Arthropods woodlice *Porcellio* sp. and *Armadillidium* sp. have been shown to serve as intermediate hosts for *Acuaria spiralis* (= *Dispharynx spiralis*) (CRAM, 1931). The presence of the parasite in some bird species has sporadically been reported

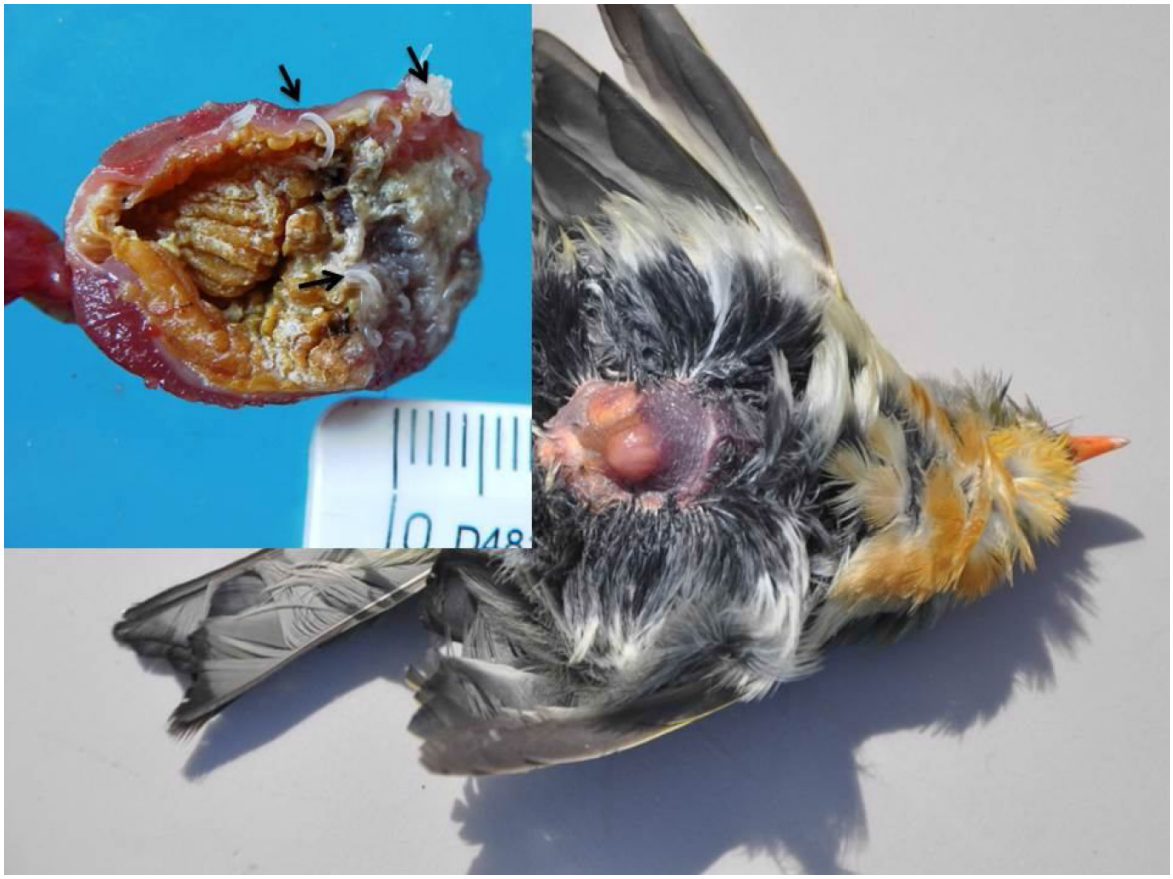

Figure 2 - A dead 3-y-o female Pekin robin (*Leiothrix lutea*) with a dilated gizzard evident through the abdominal wall. Inset: numerous nematodes (arrows) *Acuaria spiralis* agglomerated near the pylorus.

(BOLETTE, 1998; BARTMANN & AMATO, 2009). Many live insects and arthropods have been offered to these Pekin robins. While the owner has never offered woodlice to birds, these arthropods are sporadically present in the grounds of the outside enclosures and it is possible that the bird had hunted and ingested an infected woodlouse. In addition, the possibility that other arthropods could serve as intermediate hosts cannot be excluded. All the remaining Pekin robins were captured, dosed with oral levamisol (2mg), and had two consecutive negative fecal samples in parasitological tests, before being released back in the outside aviary, which had its bedding material (gravel) exchanged and limed. Bedding exchange and liming were performed twice annually in the planted outdoor enclosures.

Two aged Pekin robins (12 and 18 y-o) died due to wasting associated with blindness secondary to cataracts (Figure 3A). A previous failure in an attempt to treat the disorder (CRUZ et al., 2011) has discouraged us to try again. Contrary to the evidence recorded in free-living Pekin robins (MALE et al., 1998), the captive birds have lived much longer (CRUZ et al., 2011); and therefore, may present age-related disorders such as cataracts and wasting (WILLIAMS, 1994). A nine-y-o Pekin robin was found dead one morning after a severe nightly storm. While Pekin robins usually choose good cover branches as night roosting places, this bird may have been scared by thunder and flown to unprotected areas, becoming wet and dying of hypothermia. While both corners of the enclosure had water proof covers, as recommended to minimize such losses (KARSTEN, 2007), this bird was completely wet. As an aggravating factor, the bird had a large ventral abdominal hernia (which had been developing since he was three years; since then, it has been increasing from the size of a pea to the size of an olive), possibly providing additional surface for heat loss, since it was prominent over the feather cover (Figure 3B).

Figure 3 - A 12-y-o Pekin robin (*Leiothrix lutea*) affected by cataracts (A) and a 9-y-o Pekin robin presenting a large and ventral abdominal hernia (B).

Fatal egg-binding affected two first-time-laying California quail females. Birds were 10 months old and still kept with young males in the same aerial enclosure. During non-breeding seasons, California quails are usually kept together for maintaining high stocking bird density in the enclosure. In this manner, there is no territory to defend and such territorial birds can be cared for more easily. Young hens, calcium and/or vitamin D deficiency, obesity, stress, and cold weather, among others factors, have been listed in the disorder's etiology (KARSTEN, 2007). Birds were in good body condition and have been regularly supplemented with crushed eggshell. However, probably young age, lack of sunlight, and stress associated with overcrowding had acted as determinant factors in such cases. One of them was found dead and the other was placed in a heated cage, where it died 1/2 hour later. Several authors recommend placing the affected bird in a heated environment as a therapeutic measure for this condition (VINCE, 1996; KARSTEN, 2007). Additional six hens (quails and pheasants) have been affected by this condition (mostly at the beginning of the breeding seasons) in the aviary within the study period and could be successfully treated through immediate intervention: injecting mineral oil into the cloaca (1ml $100g^{-1}$ bw) and gently pressing and pushing the egg out after restraining the bird with a towel.

Rats used to be the top predators in these aviaries (CRUZ et al., 2011); however, rigorous rat control has completely prevented such cases. Although controversial, we have reported that cats may help in controlling rodents in the aviary grounds (CASAGRANDE et al., 2015). A recently acquired 90-d-o Livingstone's turaco had its head and viscera eaten by a young opossum that entered

the cage through the slot (4x2cm) of the sliding door latch. A 6-y-o female Pekin robin was dead one morning after ingesting an assassin bug (*Ricolla* sp., Reduviidae) the previous afternoon. Usually, assorted insects (Figure 4) collected by sweeping a net on the top of plants are offered to these birds. Immediately after taking the bug, the bird presented torticollis, and dyspnea. Sting from this insect has been associated with severe pain and inflammation (WATKINS, 2012). Attempts to capture the bird failed, since it was not interested in additional insect in the trap and a net capture was not tried to avoid disturbing the birds in the evening. Laryngeal swelling and diffuse pulmonary edema were associated with inflammatory infiltrates, findings which are consistent with anaphylaxis. A 2-y-o female Pekin Robin died 1 hour after it was found at the bottom of the aviary presenting extreme distress, blood stained feathers, and severe head lesions. This had happened during day time and the most probable cause was aggression by its sister, probably due to a dispute following the attention from a male Pekin robin kept in the contiguous enclosure. Diffuse pallor was evident at necropsy.

A newly acquired 11-mo-o grey peacock pheasant (*Polyplectron bicalcaratum*) died after presenting apathy and complete lack of food ingestion over a period of 18 days. The bird showed apparent interest in food items, but only was observed drinking water and did not even take insects. Periods of improving and worsening were noticed after forced feeding. The bird was kept in a heated environment. At necropsy, an 1.5cm diameter rock was found within the ileum; in the previous segment, a dilated gut was evident (Figure 5). Microscopically, a focally extensive necrotic and hemorrhagic area affected the ileal mucosa and was associated with fibrin deposition, inflammatory infiltrates, and basophilic bacterial myriads. Sand boxes are usually placed in the Galliformes' enclosures for bathing (Figure 5, inset). Often, rocks are mixed with the sand, from where probably the bird ingested that one which caused its death. New arrivals may become stressed, confused and consume such strange bodies (VINCE, 1996). Sifting the sand to be used for newcomers has been established in the aviaries as a preventive measure.

Figure 4 - Assorted insects collected by sweep net. Note an assassin bug (*Ricolla* sp., Reduviidae) (arrow) among other insects, mostly grasshoppers and leafhoppers. Inset: detailed aspect of an assassin bug.

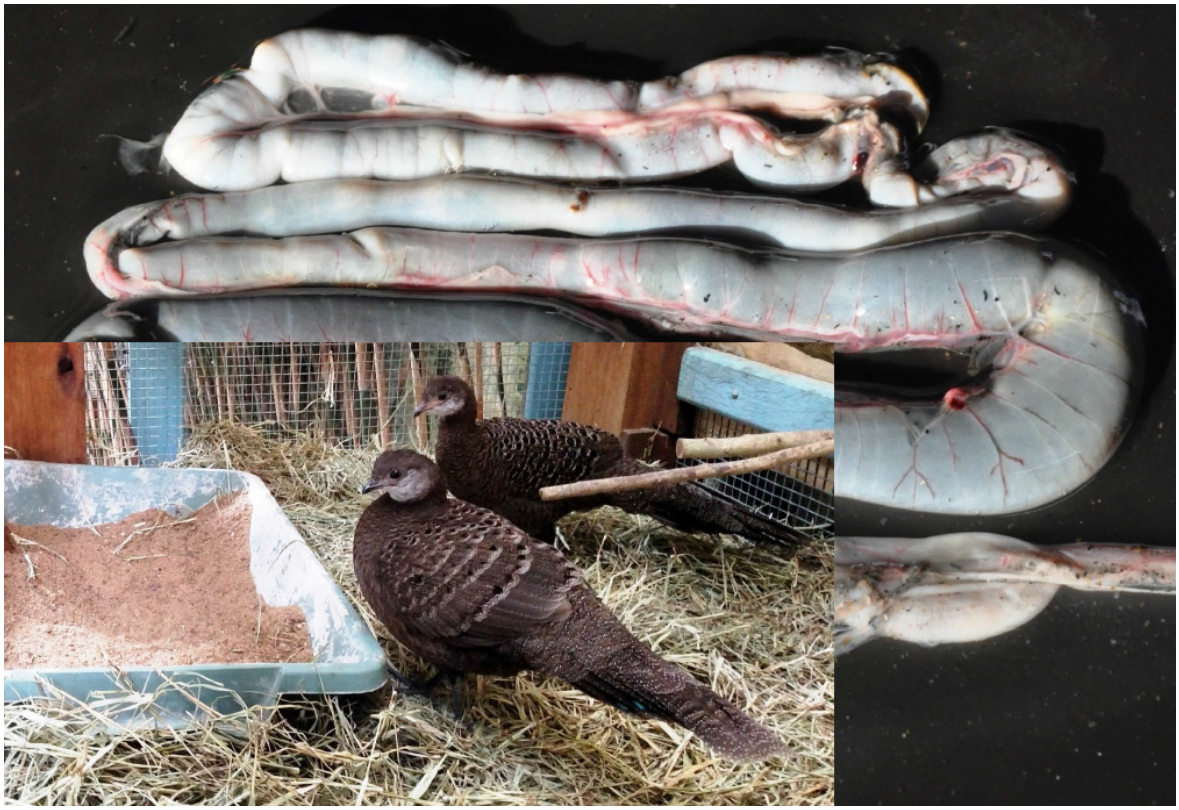

Figure 5 - Aspect of the intestines from a grey peacock pheasant (*Polyplectron bicalcaratum*) presenting a dilated segment anterior to an intestinal obstruction by a rock. Inset: sand box in a temporary enclosure in which a newcomer couple of grey peacock pheasants (*Polyplectron bicalcaratum*) were being adapted.

An 8-y-o male Palawan peacock (*Polyplectron emphanum*) died after showing anorexia and severe weakness that lasted for three weeks, a period in which it was force-fed every two days. The bird had been kept in these aviaries for four months and the owner reported that it never appeared to be completely healthy. While showing an excessive appetite and promptly taking numerous and assorted insects and invertebrates, the bird often remained lethargic for long periods. Its mate had laid and incubated four eggs in that breeding season, but not even one egg was fertile. Moderate multifocal infiltrate and diffuse congestion were observed in numerous organs; in the lungs, there were extent multifocal areas with severe infiltrates with heterophils and macrophages, associated with coccoid and bacillary bacterial myriads, cellular debris, and blackened granular material filling the parabronchial lumen. Death was probably secondary to septicemia due to aspiration pneumonia caused by reflux linked to force-feeding (TULLY & HARRISON, 1994).

CONCLUSION

While all the management is performed by the aviary's owner, who had tentatively adopted adequate management practices, the results presented here indicated that in such programs, newly hatched and newcomer birds should be managed at higher levels of care. In this sense, housing the California quail in a wire mesh-floored aviary outside the breeding season and allowing the quail couples to incubate their eggs and raising their chicks in properly installed enclosures (sand floored, sunny, and planted aviaries) have improved the health of the quail colony (CRUZ et al., 2015). In addition, plenty and diverse live food items are essential for achieving high Pekin robins' nestling survival rates (CRUZ et al., 2011 and 2016). The aforementioned practices could have prevented most losses described here. Many of the further losses were associated with unique situations, based on which the owner has improved the preventive practices applied in the aviary. Although the information presented here

is based on a specific case, it included data on species with diverse behaviors and habits; therefore, it may be extrapolated for other, but similar species.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

This study is included in the project 26308 - Management of wild bird flocks, which has been approved by the Universidade Federal do Rio Grande do Sul (UFRGS) Ethics Committee in 2015.

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