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Running head - Post-mortem findings in bustards

Title - Post-mortem findings of bustards in the United Arab Emirates

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Abbreviations: NARC = National Avian Research Centre

UAE = United Arab Emirates

NBD = Nutritional bone disease

NDV= Newcastle disease virus

SI = Small intestine

LI = Large intestine

GIT =Gastro intestinal tract

SUMMARY. A review of 154 bustard post-mortem examinations performed by the Veterinary Science Department of the National Avian Research Centre, Abu Dhabi, United Arab Emirates between August 1992 and August 1994 was conducted. Historical post-mortem records of an additional 59 recently imported houbara bustard examined at the Al Ain Zoo for the period 1979-1991 are also summarised. Records for a total of 5 species of bustards were examined. The birds ranged in age from less than 24 hours post hatching to 8 years old. The majority of birds were older than one year. The most common causes of death in adult houbara bustard were euthanasia due to Newcastle disease, aspergillosis and stress following transportation in recently imported birds. The most common causes of death in adult captive houbara bustards were euthanasia for Newcastle disease, capture myopathy and handling related deaths and trauma. The most common causes of death in adult kori bustards were directly from or as a result of euthanasia for capture myopathy and handling

injuries. The most common causes of death in recently imported adult rufous-crested bustard were stress following transportation and in captive birds the most common causes were trichomoniasis and trauma. The main causes of death in juvenile houbara bustards were yolk sac infections and septicæmia. Juvenile rufous-crested bustards appeared to be highly susceptible to gizzard impactions and foreign body obstructions of the gastrointestinal tract. Nutritional bone disease is an important disease of all juvenile bustards, particularly kori and houbara bustards. Aspergillosis was also a common post mortem finding in captive and recently imported houbara bustards and also caused mortality in juvenile kori and houbara bustards. Helminth parasites were a common finding in recently imported houbara bustards and large parasite burdens occasionally caused intestinal obstruction and death. Fatty liver change was an important post mortem finding of captive adult houbara bustard which deserves further investigation.

Bustards are medium sized to very large terrestrial birds, chiefly inhabiting open plains and semi-desert regions of the world (Osborne et al, 1985). The bustard family is made up of 22 species in 8 Orders, some such as Heuglins' bustard (*Neohs heuglini heuglini*) are uncommon while others such as the rufous-crested bustard (*Euphodontis ruficrista ruficrista*) are still relatively common. Agricultural changes, overgrazing, hunting, trapping, habitat loss, droughts and wars threaten to make more species of bustards scarcer in the future and captive breeding programmes have been established for many bustard species (Osborne et al, 1985, Samour et al, 1989, Gaucher et al, 1989, Ramadan-Jaradi and Ramadan Jaradi, 1989 and Hornby, 1993). The National Avian Research Centre (NARC) in the United Arab Emirates (UAE) has a large captive breeding and restoration programme for the houbara bustard (*C.hlamydotis undulata macqueenii*). NARC also has successful breeding programmes for rufous-crested, kori (*Ardeotis kori kori*) and the white-bellied bustard (*Euphodontis senegalensis senegalensis*) and in the future may establish breeding programmes for black (*Eupodontis afra afra*) and Heuglins' bustards .

A thorough survey of the diseases of both wild and captive bustards is an essential prerequisite before captive bred birds are released into the wild to minimise the introduction of novel diseases into free-ranging populations (Munson, 1993). Unfortunately the published literature on general medical aspects in bustards and in particular the houbara bustard are scarce and to the knowledge of the authors there are no comprehensive published surveys of the causes of morbidity and mortality in bustards. This study was conducted to provide a broad overview of the causes of morbidity and mortality in the species of bustards maintained in captivity by NARC in the United Arab Emirates. The data from this post mortem survey will

also provide the necessary information on the important causes of mortality in captive bustards to target pharmacokinetic trials of selected therapeutic agents to determine appropriate dosage regimes in bustard species.

MATERIALS AND METHODS

One hundred and fifty four individuals from 5 different species were examined post-mortem including; 101 adult houbara bustard (41 recently imported and 60 captive), 5 juvenile houbara bustards, 12 adult rufous-crested bustard (5 recently imported and 7 captive), 16 juvenile rufouscrested bustard, 8 adult kori bustard, 10 juvenile kori bustard, 1 adult white-bellied bustard and 1 adult heuglins bustard. The cases were examined~afpost-mortem by the authors during a two year period from August 1992 to August 1994. All the bustards classified as 'captive' had been in captivity for a minimum of two months and some had been in captivity for more than 8 years. All bustards classified as 'recently imported' had been imported into the UAE at least 2 months prior to death. All juvenile bustards had been captive bred at NARC facilities in the UAE. Adult birds are classified as birds older than 1 year and juvenile birds as less than one year for this survey. Captive bustards were housed at Al Ain Zoo (Al Ain Municipality), Sweihan Research Facility (NARC), Abu Al Abyad Breeding facility (NARC), Al Ain Breeding facility (NARC) or at a private farm in Al Ain (NARC). The Veterinary Science Department of NARC was also requested to examine carcasses of recently imported birds from 2 private collections which made up the 'recently imported' category .

The techniques of post mortem examination were as described by Cooper (1989) a,~ ~ Nicholls (1994). The condition of the birds was recorded as emaciated, poor, fair, good~bese, based on the degree of pectoral muscle wasting. Birds with emaciated and poor pectoral muscle scores were included in the pectoral muscle wasting group. Routine laboratory diagnostic aids included bacteriology, fungal culture, histopathology, parasitology and some birds were radiographed. Virological and serological investigations were performed in selected cases.

In most cases other findings were made post-mortem which had not necessarily contributed to death but were of significance. These findings are listed as incidental findings. Where the cause of death was not ascertained 'no gross cause of death' was recorded.

Following guidelines established by Cooper (1989) a reference collection of frozen and formalin fixed normal and abnormal bustard tissue specimens was established from the material. Future histopathological, toxicological and virological studies of this material are

planned. All parasites collected at post mortem were preserved in 5% buffered formalin and were submitted to the International Institute of Parasitology for identification. This reference material has been used as the foundation for a number of publications describing the clinical-pathological findings of cestode infections, lead toxicosis, Newcastle disease and vascular parasite infections (Jones et al, in prep, Bailey et al, in press, Bailey et al, in prep, Nicholls et al, in prep).

A survey of 59 houbara bustard post mortem records of Al Ain Zoo was undertaken to provide historical data on the causes of death in this species. The records were for the period 1979-1991 and the post-mortems were performed by different veterinarians working at Al Ain Zoo during this period. These birds were all adult and most had been recently imported into the UAE but detailed clinical histories were not available. In the late 1970's and 1980's there was a large trade in houbara bustard from Pakistan to the Middle East to supply birds for the training of hunting falcons. It is probable that most of these birds fell into this category and this information is included to provide background historical data only.

Results

The results are summarised in tables 1-7;

Table 1. Causes of death in 101 adult (41 recently imported and 60 captive) and 5 juvenile houbara bustard examined from August 1992 to August 1994. Table 2. Breakdown of reasons for euthanasia described in table 1. Table 3. Incidental post-mortem findings in 101 adult (41 recently imported and 60 captive) and 5 juvenile houbara bustard examined from August 1992 to August 1994. Table 4. Causes of death in 12 adult (5 recently imported and 7 captive) and 16 juvenile rufous-crested bustard examined from August 1992 to August 1994. Table 5. Incidental post-mortem findings in 12 adult (5 recently imported and 7 captive) and 16 juvenile rufous-crested bustard examined from August 1992 to August 1994. Table 6. Causes of death in 8 captive adult and 10 juvenile kori bustard examined from August 1992 to August 1994. Table 7. Incidental post-mortem findings in 8 adult and 10 juvenile kori bustard examined from August 1992 to August 1994. Table 8. Causes of death in adult houbara bustard at Al Ain Zoo between 1979 - 1991.

Additionally one Heuglins' bustard which died of haemorrhage post-venepuncture and one white-bellied bustard which was euthanased for chronic central nervous system signs were examined. No incidental post-mortem findings were recorded for these two birds, the white-bellied bustard was serologically positive for Newcastle disease but virus isolation proved negative.

Histological examinations of livers diagnosed as fatty change in the incidental findings showed vacuolation of hepatocytes typical of fatty liver.

Discussion

Euthanasia was responsible for 28% of deaths in captive adult houbara bustards, 19.5% of deaths in recently imported adult houbara bustards and 38.5% of deaths in captive adult kori bustards. 87.5% of euthanased recently imported houbara and 50% of the captive adult houbara bustard were euthanased for central nervous signs and serological evidence of Newcastle disease virus infection was confirmed in 10 birds where samples were taken (Bailey et al, in press). The clinical and pathological findings of houbara bustards infected with Newcastle disease is discussed in Bailey et al (in press).

Capture myopathy and handling related deaths were responsible for 21.5% of deaths in captive adult houbara bustards and 50% of deaths in adult captive kori bustards. 10% young kori bustards died following handling with no grossly discernible cause of death. Capture myopathy is a commonly occurring condition in domestic and wild animals following trapping, restraint, transportation and chemical immobilisation and subclinical nutritional deficiencies have also been implicated in the aetiology of this syndrome (Brannian 1981, Carpenter et al 1991 and Rae, 1992). Because of the susceptibility of long-legged birds such as bustards to capture myopathy and capture injuries, special care must be taken when trapping, handling, chemically immobilising and transporting these species. Safe techniques for handling bustards and minimise handling injuries and mortality are described in the Bustard Care Manual (NARC, 1994). A clinico-pathological description of capture myopathy in bustards will be written elsewhere.

Aspergillosis alone was responsible for the death of 27% of recently imported adult houbara and 25% young houbara and 10% young kori bustards. A combination of severe aspergillosis and trichomoniasis was responsible for the death of an additional 5% of recently imported adult houbara and 1.5% of captive adult houbara bustards. Additionally aspergillosis lesions not responsible for the cause of death were found in 57% of adult captive houbara and 22% of recently imported houbara. Both the kori and houbara bustard chicks that died of aspergillosis were reared together. Poor hatchery and brooder sanitation are reported to be important sources of infection in ostrich chicks (Perelman et al, 1992). Predisposing factors to aspergillosis include immunosuppression, malnutrition and unhygienic environmental conditions (Cooper, 1978, Redig, 1980, Campbell, 1986 and Jordan, 1990).

Immunosuppression appears to play a major role in the chronic forms of aspergillosis often

resulting from stress, malnutrition or pre-existing disease conditions (Cooper, 1978, Redig, 1980, Campbell, 1986 and Jordan, 1990). The high incidence of aspergillosis in houbara bustards is not surprising considering that they are frequently transported and housed in over-crowded, dusty, unhygienic conditions and then subjected to inappropriate and insufficient diets.

Fatty liver changes were found in 32% of captive adult houbara bustards and 5% of recently imported adult houbara bustards. Fatty liver changes are known to occur following hepatocyte damage, nutritional deficiencies, excess dietary fat, low protein diets, high carbohydrate diets, exposure to toxins and insufficient exercise (Wadsworth et al, 1984, Squires and Leeson, 1988, Murphy, 1992). The aetiology of fatty liver changes in poultry have been comprehensively reviewed by Squires and Leeson (1988). Houbara bustards appear to be susceptible to developing fatty liver changes and more research is needed on this subject. A diet suitable for captive bustards is currently being developed by NARC. The full description of the clinico-pathology of fatty liver disease in bustards will be written elsewhere.

Traumatic causes of death (intraspecific trauma, fractured neck, euthanasia due to fractures and dislocations and other trauma) were responsible for the death of 21% of captive adult houbara and 57% of rufous-crested bustards and 10% of young kori bustards. 60% of deaths of captive adult houbara bustards at the National Wildlife Research Centre of Saudi Arabia are caused by trauma (NWCD, 1993). Stressed birds, non-domesticated birds, birds that have not been pinioned or had their primary flight feathers cut appear to be particularly susceptible to trauma. Disturbed or frightened rufous-crested bustards will often fly vertically and are susceptible to breaking their necks.

Trichomoniasis was responsible for the death of 28.% of captive rufous-crested bustards and 3% of deaths in captive houbara bustard. The introduction of a preventative medical programme in 1992 that includes antiprotozoal therapy has reduced the incidence of this disease in bustards managed by NARC.

Death following transportation was responsible for the death of 80% of newly imported rufous-crested bustards. Vascular parasites were found in 60% of recently imported rufous-crested bustards and may have been associated with the high mortality of individuals in this group. Clinical and pathological findings of heartworm infestations in rufous-crested bustards are described by Nicholls et al (in press). The mortality of houbara bustards dying after transportation into the UAE is high (Bailey, 1992) and 20% of the mortality of 59 recently imported houbara bustards received at Al Ain Zoo for the period 1979-1991 was associated with the stress of recent transportation. The mortality within individual imported bustard flocks

may be higher, 47% of one flock of 19 houbara bustards imported in 1991 died soon after arrival in the UAE (Bailey, 1992) and 50% of one flock of 10 of rufous-crested bustard in 1993 (Nicholls et al, in press). The transportation conditions of bustards are described by Bailey et al (in press). The admission of the UAE as a member of CITES and the banning of the trade in bustard species by the UAE in 1994 are important factors that may reduce the numbers of bustards dying through trade and transportation.

Intestinal parasites were found in 32% of recently imported houbara bustards and 16% of captive houbara bustards. One recently imported houbara bustard died following obstruction of the small intestine with a massive burden of cestodes and from the historical data of Al Ain Zoo birds, 5% of houbara deaths were considered to be caused by this condition. The cestode parasites of bustards in the UAE, their clinico-pathology and treatment is reviewed by Jones et al (in press).

Yolk sac infection was an important cause of death in young bustards responsible for 75% of young houbara bustard, 25% of rufous-crested bustard and 10% of kori bustard deaths respectively. Infection and improper incubation parameters are the main causes of retained yolk sacs in ratite chicks (Wade, 1992) The incidence of yolk sac infection is lower in the kori bustards because they are incubated naturally and the chicks are removed at pip to be hand-reared. *Staphylococcus aureus* contamination of an incubator and high incubation humidity were responsible for the high incidence of yolk sac infection and septicacaemias in newly hatched houbara bustards in the 1994 breeding season.

Gizzard impactions and foreign body obstruction of the upper digestive tract were responsible for 31% deaths of juvenile rufous-crested bustards. This species of bustard appears to be more susceptible to this condition than the other species. It is important to ensure that the substrate is not contaminated by foreign bodies that could lead to dietary indiscretion by the chicks.

Nutritional bone disease (NBD) is a common problem of growing bustard chicks. 20% of young kori bustards were euthanased because of severe NBD and an additional chick died following surgery to correct NBD. Metatarsal deformities were found in 40% of kori, 12.5% of rufous-crested and 50% of houbara bustard chicks. Nutritional and idiopathic metabolic bone diseases manifest most commonly as bent, bowed, twisted and rotated lower leg bones, usually of the metatarsus (Anderson, 1983). Numerous factors have been suggested as causing these deformities in ratites, including nutritional deficiencies and imbalances, excessively rapid growth rates, high protein concentrated diets and inadequate exercise

(Gandini et al, 1986 and Reece and Butler, 1984). Other incidental post-mortem findings of NBD from bustard chicks included fractures of the femoral head, curled toes, angel wing, sacrum deformity, softened long bones, joint swellings, rib nodules and radius nodules. Management changes to correct the calcium and vitamin D ratios have reduced the incidence of NBD in the bustards managed by NARC.

Because of the increasing popularity of maintaining flocks of bustards in captivity in the Middle East and the paucity of biomedical data available to veterinarians managing the health of these populations, further research regarding the diseases affecting these birds is warranted. Many of the houbara bustard breeding projects aim to restore captive bred progeny into the wild. Until the diseases of both captive and wild bustards are described and better understood there are potential risks of the introduction of alien diseases from captive bred birds into free-ranging populations.

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