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CLINICAL PATHOLOGY AND MORPHOMETRICS OF AFRICAN FISH EAGLES IN UGANDA

Simon Hollamby,[1,7] Josephine Afema-Azikuru,[2] James G. Sikarskie,[1] John B. Kaneene,[1] John N. Stuht,[1] Scott D. Fitzgerald,[1] William W. Bowerman,[3] Kenneth Cameron,[4] A. Rae Gandolf,[5] Gretchen N. Hui,[1] Christine Dranzoa,[6] and Wilson K. Rumbeiha[1]

[1] Veterinary Medical Center, Michigan State University, East Lansing, Michigan 48824, USA
[2] Uganda Wildlife Education Centre, PO Box 369, Entebbe, Uganda
[3] Department of Forestry and Natural Resources, Faculty of Environmental Toxicology, Clemson University, PO Box 709, Pendleton, South Carolina 29670, USA
[4] Cincinnati Zoo and Botanical Gardens, 3400 Vine St., Cincinnati, Ohio 45220, USA
[5] The Wilds, 14000 International Road, Cumberland, Ohio 43732, USA
[6] The Department of Wildlife and Animal Resource Management, The Faculty of Veterinary Science, Makerere University, Kampala, Uganda
[7] Corresponding author (email: simrah63@hotmail.com)

ABSTRACT: Packed cell volumes (PCVs) and plasma chemistry parameters were measured in 15 adult and 18 nestling African fish eagles (*Haliaeetus vocifer*) sampled from June 2002 through January 2003 in Uganda. Morphologic measurements were obtained from 15 adult eagles. All eagles were examined for blood parasites and sexed by examination of DNA from red blood cells. Ten adults and eight nestlings were sampled from Lake Mburo and five adults and 10 nestlings were sampled from Lake Victoria near Entebbe, Uganda. Analysis of variance was conducted to assess the association between site, age, sex, and plasma chemistry parameters and the association between sex and morphologic characteristics. Plasma chemistry values for nestling and adult African fish eagles were similar to those reported for other captive and free-ranging eagle species. Packed cell volumes for nestling African fish eagles were markedly lower than values reported for nestlings of other eagle species, although the mean estimated age of nestlings sampled also was lower. A significant association ($P \leq 0.05$) was found between PCV of nestling eagles and study site (lower at Lake Mburo) but no association was found between PCV and nestling body weight ($P \geq 0.05$). An unidentified *Plasmodium* sp. was present in erythrocytes of three nestlings from Lake Mburo. No other blood parasites were seen. There was significant variation ($P \leq 0.05$) in PCV, calcium, phosphorous, potassium, cholesterol concentrations, and creatine kinase activity between adults and nestlings; all were lower in adults. Aspartate transaminase activity was higher in adults. Like other *Haliaeetus* sp., body weight, bill depth, culmen length, footpad length, and hallux length as well as bill depth measurements were significantly ($P \leq 0.05$) greater for females than males. The objective of the study was to provide baseline biologic and physiologic information that may prove useful in the management and study of captive and wild populations of African fish eagles.

Key words: African fish eagle, blood parasites, *Haliaeetus vocifer,* morphometrics, packed cell volume, plasma chemistry, *Plasmodium,* Uganda.

INTRODUCTION

The African fish eagle (*Haliaeetus vocifer*) is a widespread, often locally abundant, highly territorial tertiary avian predator in lake-based food chains throughout sub-Saharan Africa (Brown, 1980). The African fish eagle diet is predominantly fish (Stewart et al., 1997). At both sites in this study, Nile tilapia (*Oreochromis niloticus*), a detritivorous fish species occupying the littoral zone, appeared to be the main prey item. Given the widespread distribution of the African fish eagle, it may be a valuable indicator species of environmental change in African lake-based ecosystems. However, many factors determine what constitutes an effective biomonitor species, including a comprehensive knowledge of the basic biology and physiology of the species. Temporal or spatial changes in baseline hematologic, plasma chemistry, and morphologic parameters within and between fish eagle populations may provide a nonspecific indication of changes within their environment. The specific causes of the changes may include exposure to contaminants, disease, variation in physiologic

or nutritional status, or a combination of these factors. All can be precipitated by anthropogenic environmental alteration and although hematologic, plasma chemistry, and morphologic parameters alone cannot incriminate an etiology, they may lend valuable supporting evidence of the effects such changes have on wild populations. Numerous studies have collected clinical pathology parameters on wild populations to examine the effects of known environmental changes (Miller et al., 2001; Hanni et al., 2003) or to establish baseline values for future monitoring purposes (Christopher et al., 1999; Uhart et al., 2003). With rapid population growth, urbanization, and an expanding economy, Uganda needs effective methods to assess the quality of its environment. Development of suitable bioindicator species can be part of a multifaceted approach to effectively assess environmental changes and to monitor the impact of such changes on wildlife.

Collection of biological data on common raptor populations in their natural habitats is preferable to data collected on small numbers of captive specimens. The latter has become necessary for some raptor species, such as the Spanish imperial eagle (*Aquila adalberti*), because of declines in the wild population (Garcia-Montijano et al., 2002).

Much of the information on African fish eagle behavior, biology, and physiology is anecdotal, dated, site-specific, and nonstandardized. No known reports describe plasma chemistry or hematologic parameters in adult or nestling African fish eagles. Morphometric data on adult African fish eagles, to our knowledge, are not published in the scientific literature. The purpose of this paper is to present packed cell volumes (PCVs), plasma chemistry values, blood parasite analysis, and morphometric data on nestling and adult African fish eagles of known sex that may prove useful in the conservation and management of captive and wild populations. The sampling of African fish eagles for the parameters reported in this paper formed part of a larger study to assess the potential of this species as a biomonitor of the environment (Hollamby et al., 2004).

MATERIALS AND METHODS

African fish eagles were sampled at Lake Mburo, a 6-km-long freshwater lake in south western Uganda (0°9′S, 30°57′E) situated in a 256-km^2 national park and on Lake Victoria near Entebbe, from Nfo Island (0°00′N, 32°26′E) to Kisubi Bay (0°05′N, 32°35′E). Fish eagles were sampled at Lake Mburo in July, August, and December 2002 and at Lake Victoria in August 2002 and January 2003. Our general observations as well as physical examinations of the birds suggested that both populations of birds were physically and reproductively healthy (Hollamby et al., 2004). The populations sampled are nonmigratory. Thirty-three eagles were sampled, including 10 adults and eight nestlings from Lake Mburo and five adults and 10 nestlings from Lake Victoria. Forty-five percent of birds were sampled between 6:00 AM and noon and 55% were sampled between noon and 6:00 PM.

Adult fish eagles were captured on water using a fish "snare vest" technique. Tilapia were fitted with fishing line snares (loops) and packed with foam so the fish floated laterally. Eight to twelve 5- to 6-cm-diameter snares with a free end of line were made per fish. The free ends of line penetrated and were tied on the body of the fish and the excess line was cut. The line was attached to a handheld reel and the fish was placed in water. Once captured, the eagle was retrieved and secured by the legs. Fish eagles swim well so there was little risk of drowning. On shore, the eagles were placed in dorsal recumbency and the eyes were covered. Ten milliliters of blood was collected from the brachialis vein via a 21- or 23-gauge×1.9-cm butterfly catheter (Surflo Winged Infusion Set, Elkton, Maryland, USA) connected to a 10-ml syringe flushed with sodium heparin (100 IU/ml). The blood was immediately transferred to a 10-ml lithium heparin evacuated blood tube (Becton Dickinson, Franklin Lakes, New Jersey, USA). An additional 4 ml of blood was drawn and placed in a 5-ml tube with ethylenediaminetetraacetic acid (Becton Dickinson). Three blood smears were made with fresh blood by using the slide-on-slide technique (Campbell, 1988). Fresh whole blood also was used to determine blood glucose levels (Medisense 2® card glucometer utilizing Precision Plus Sensors®, Medisense Inc., Bedford, Massachusetts, USA). A drop of whole blood was placed on a commercially prepared paper sam-

ple card for sex determination (Avian Biotech International, Tallahassee, Florida, USA). Five whole breast feathers were hand plucked for determination of total mercury concentrations. A physical examination including scoring body condition (based on pectoral muscle mass and feather condition), whether the crop was empty or full, and a visual description of any abnormalities was made. Length of the eighth primary feather and footpad were determined with a 60-cm ruler. Hallux and culmen length and bill depth were measured with a dial caliper (model SPI 2000, Forestry Suppliers, Jackson, Michigan, USA); measurement methods were the same as those described for bald eagles (*Haliaeetus leucocephalus*) (Bortolotti, 1984a, b). Birds were banded with 18- to 22-mm internal diameter metal rivet bands (Gey Band and Tag Company, Norristown, Pennsylvania, USA). Suspected female birds were banded on the left leg and suspected males were banded on the right leg. African fish eagles were classified as adult if they had attained full adult plumage color (i.e., were suspected to be at least 5 yr old). Last, birds were placed in a cotton sack and body weight was determined on a spring balance with gradations of 100 g (Homs model 20, Douglas Homs Corp., Belmont, California, USA). Eagles were released from land at the closest point possible to the capture location. Average time from capture to release was 34 min (range 20–45 min).

African fish eagle nestlings were retrieved for sampling from the nest using professional tree climbing methods (US Department of Agriculture Forest Service, 1996). The main method of tree ascent was by using tree climbers (Klein Tools, Chicago, Illinois, USA). Eagle nestlings were gently coaxed to the side of the nest using an "eagle hook" modified from a car aerial or ice gaff. Eagle nestlings were placed singly into a ventilated nylon bag and lowered to the ground for sampling. Sampling of nestlings was as described for adults with the exception that the volume of blood collected varied from 4 ml to 14 ml depending on body weight. Nestling eagle's ages were estimated based on a reported fledging period of 76 days (Sumba, 1988), as well as nest site observations. A weight deduction was made for crop content in smaller nestlings.

Samples were placed in a chilled cooler. Average time of sampling to separation of red blood cells from plasma and subsequent plasma storage in liquid nitrogen was 3.5 hr (range 2–9 hr). Packed cell volume and total plasma protein (TPP) were determined in the field. Two microhematocrit capillary tubes were centrifuged (Vulcon Mobilespin PS126-6, Vulcon Technologies, Grandview, Missouri, USA) for 5 min and an average PCV was recorded. Total plasma protein was determined by using a temperature compensated refractometer (Leica Inc. Optical Products Division, Buffalo, New York, USA). The remaining blood was centrifuged for 10 min. Plasma was evaluated for hemolysis, icterus, and lipemia and these changes were subjectively classified as slight, moderate, or severe. Plasma was pipetted into five 2-ml cryovials (Cryogenic Vial, Corning Incorporated, Corning, New York) and deposited into a MVE Doble-20 Vapor Shipper/Liquid Nitrogen Tank (MVE Bio-Medical Systems, Burnsville, Minnesota, USA).

Plasma samples were transported to the Diagnostic Center for Population and Animal Health (DCPAH) at Michigan State University Veterinary Medical Center (MSU; East Lansing, Michigan) then transferred to a −80 C freezer until analyzed. Analysis occurred 5 mo after sampling for 14 of the samples and after less than 1 mo for the remaining samples. Plasma chemistry analyses were performed at the clinical pathology and endocrinology laboratories of the DCPAH at MSU. Plasma chemistry analyses were performed on an Olympus AU640 chemistry analyzer (Olympus America Inc., Irving, Texas, USA). Electrolyte analyses were performed with a sodium potassium crown ether membrane, whereas the chloride analysis employed a molecular-oriented polyvinylchloride membrane. Calcium, phosphorous, TPP (determined by colorimetry), albumin, aspartate transaminase (AST), creatine kinase (CK), cholesterol, and uric acid determinations were performed with Olympus reagents.

Globulin was calculated from the measured parameters. Birds were sexed by polymerase chain reaction amplification of homologous sections of chromo-helicase-DNA binding genes located on the avian sex chromosome (Griffiths et al., 1998). Reference controls were from known-sex samples from bald eagles and white-tailed sea eagles (*Haliaeetus albicella*).

A thin blood smear from each bird was made at the time of capture, air dried, and stored in an insect-proof box. The smear was later stained with Giemsa and examined for blood parasites by using the method described by Stuht et al. (1999) for bald eagles.

Analysis of variance (ANOVA) was conducted to assess the association between the risk factors of site, age (nestling or adult), sex, and plasma chemistry parameters. Analysis of variance was also used to assess the association between morphologic characteristics and sex of adult fish eagles (SAS PROC ANOVA for categorical risk factors and SAS PROC GLM for continuous risk factors, SAS 8.2, SAS Inc., Cary, North Carolina, USA). Univariate and

multivariate analyses were conducted. The level of significance was set at $P \leq 0.05$. Descriptive statistics were done by using Excel (Microsoft Excel, Microsoft Corporation, Redmond, Washington, USA). An outlying value was defined as being 1.5 times greater or less than the interquartile range. Descriptive statistics are emphasized because of the small sample size. This emulates the methods of other studies examining wild avian hematologic and plasma chemistry values where only small sample sizes could be obtained (Lumsden, 1998; Garcia-Montijano et al., 2002).

RESULTS

The results of the study are presented in Tables 1–4. The mean PCV for nestlings was 27%. No significant difference ($P \geq 0.05$) was found in PCV of nestling fish eagles of different body weights but a significant difference ($P \leq 0.05$) was found in PCVs of nestlings between the two study sites. Nestlings at Lake Mburo had PCVs (mean 24%) that were lower than those from Lake Victoria at Entebbe (mean 30%). Plasma chemistry values that were significantly ($P \leq 0.05$) different between adults and nestlings were AST, phosphorous, potassium, and CK, all of which were lower in adults, except AST. Significant differences ($P \leq 0.05$) were found in cholesterol, albumin, potassium, and phosphorous values in fish eagles between the study sites.

Total plasma protein values were consistently higher when measured with a temperature-compensated refractometer in the field than with a colorimetric method in the laboratory.

Mean values for nestlings were 9 g/l higher and adult values were 10 g/l higher for measurements taken with a refractometer. A strong positive correlation existed between values returned by each method ($r^2 = 0.77$).

Two plasma samples, one from a nestling from Lake Victoria and one from an adult from Lake Mburo, were slightly hemolyzed. Two plasma samples had slight lipemia (nestlings from Lake Mburo), two samples had moderate lipemia (nestlings from Lake Victoria), and one sample had severe lipemia (nestling from Lake Mburo). Three nestlings from Lake Victoria had empty crops and seven had full crops. Four nestlings from Lake Mburo had empty crops and four had full crops. Three adults from Lake Victoria had full crops and two had empty crops. Six adults from Lake Mburo had empty crops and four had full crops. Average calculated ages of nestlings were 31±14 days (range 15–44 days) from Lake Mburo and 23±9 days (range 9–38 days) from Lake Victoria. All birds were in good body condition as assessed by pectoral muscle mass and general physical examination. A weak positive correlation was found between blood glucose levels and a full crop ($r^2 = 0.012$).

Body weights, culmen length, footpad length, eighth primary feather length, and bill depth parameters were significantly ($P \leq 0.05$) greater in adult female than in adult male fish eagles. Female fish eagles were on average 20% heavier than male fish eagles. The ratios of male to female culmen length, footpad length, eighth primary feather length, and bill depth were 0.87, 0.89, 0.91, and 0.92, respectively.

An unidentified *Plasmodium* sp. was seen in two female nestlings and one male nestling from Lake Mburo (United States National Parasite Collection reference number 094408). No other blood parasite was seen. Parasitemia in one of the females was relatively high (60 parasites per 1,000 red blood cells). Parasitemia was lower in the other two infected birds (two parasites per 1,000 red blood cells).

DISCUSSION

Packed cell volumes for nestlings in this study were markedly lower than values reported in nestlings of other eagle species (Redig, 1993; Bowerman et al., 2000; Hoefle et al., 2000). The mean PCV of African fish eagle nestlings in this study was 27%. Values reported for free-flying bald eagle nestlings were 34% (Redig, 1993) and 32% (Bowerman et al., 2000). Values reported for free-flying Spanish imperial eagles were 32% (Hoefle et al., 2000). Despite

TABLE 1. Packed cell volumes and selected plasma chemistry values for adult African fish eagles (*Hilaeetus vocifer*) from Lake Mburo and Lake Victoria near Entebbe, Uganda (n=15).

Parameter	Mean	Median	SD[a]	Q1[b]	Q3[c]	Minimum	Maximum
Packed cell volume (l/l)	45	45	2	44	46	43	53
Total plasma protein R (g/l)[d]	48	47	4.7	45	52	38	54
Total plasma protein C (g/l)[e]	38	38	4	35	41	30	42
Glucose (mMol/l)[f]	12.4	11.9	2.01	10.7	12.8	10.3	16.3
Aspartate transaminase (U/l)	194	152	117	139	199	121	590
Calcium (mMol/l)	2.4	2.4	0.13	2.34	2.50	2.12	2.57
Creatine phosphokinase (U/l)	217	215	53	184	252	127	320
Phosphorous (mMol/l)	0.74	0.68	0.30	0.48	0.92	0.42	1.45
Uric acid (mMol/l)	0.998	1.011	0.408	0.690	1.190	0.291	1.731
Albumin (g/l)	12	12	1.3	12	13	11	15
Globulin (g/l)	25	26	3.3	23	28	19	30
Sodium (mMol/l)	153	155	5.56	153	155	143	161
Potassium (mMol/l)	1.3	1.2	0.33	1.1	1.5	1.0	1.8
Chloride (mMol/l)	115	116	5.21	112	117	105	124
Cholesterol (mMol/l)	4.69	4.56	0.644	4.22	5.05	3.86	6.16

[a] SD = standard deviation.
[b] Q1 = 25th percentile of the sample.
[c] Q3 = 75th percentile of the sample.
[d] Measured by refractometry.
[e] Measured by colorimetry.
[f] Determined on whole blood.

TABLE 2. Packed cell volumes and selected plasma chemistry values for nestling African fish eagles (*Haliaeetus vocifer*) from Lake Mburo and Lake Victoria near Entebbe, Uganda (n=18).

	Mean	Median	SD[a]	Q1[b]	Q3[c]	Minimum	Maximum
Weight (kg)	1.45	1.33	0.63	0.91	1.94	0.50	2.60
Age (days)	27	22	12	18	37	9	52
Packed cell volume (%)	27	28	3	26	30	20	33
Total plasma protein R (g/l)[d]	45	45	4	44	48	36	52
Total plasma protein C (g/l)[e]	36	37	4	32	39	27	42
lucose (mMol/l)[f]	13.8	14.3	1.8	12.6	14.9	10.4	17.7
Aspartate transaminase (U/l)	123	120	34	95	143	75	185
Calcium (mMol/l)	2.62	2.65	0.1	2.60	2.70	2.40	2.80
Creatine phosphokinase (U/l)	906	754	515	517	1201	178	1880
Phosphorous (mMol/l)	1.97	1.68	0.84	1.55	2.13	0.77	3.91
Uric acid (mMol/l)	0.898	0.922	0.345	0.660	1.041	0.422	1.650
Albumin (g/l)	13.8	13.5	2.1	12.3	16.0	10.0	17.0
Globulin (g/l)	22.0	21.0	3.6	20.3	24.5	16.0	28.0
Sodium (mMol/l)	148	148	2	147	149	145	154
Potassium (mMol/l)	2.45	2.30	0.65	2.10	2.90	1.30	3.80
Chloride (mMol/l)	110	111	5	107	113	101	118
Cholesterol (mMol/l)	5.49	5.36	1.11	4.76	6.24	3.29	7.41

[a] SD = standard deviation.
[b] Q1 = 25th percentile of the sample.
[c] Q3 = 75th percentile of the sample.
[d] Measured by refractometry.
[e] Measured by colorimetry.
[f] Determined on whole blood.

TABLE 3. Analysis of variance of plasma chemistry values in adult (n=15) and nestling (n=18) African fish eagles (*Haliaeetus vocifer*) from Lake Mburo and Lake Victoria near Entebbe, Uganda.

	Site		Age		Sex		Overall	
Plasma chemistry parameter	*F*	*P*	*F*	*P*	*F*	*P*	*F*	*P*
Albumin	17.17	<0.01	10.55	<0.01	0.66	0.42	9.46	<0.01
Aspartate transaminase	0.82	0.37	5.84	0.02	0.12	0.73	2.26	0.10
Calcium	9.03	<0.01	35.60	<0.01	0.0	0.97	14.88	<0.01
Creatine kinase	0.74	0.40	27.45	<0.01	2.45	0.13	10.21	<0.01
Chloride	0.38	0.54	7.22	0.01	0.32	0.58	2.64	0.07
Cholesterol	9.84	<0.01	7.82	<0.01	0.05	0.83	5.90	<0.01
Globulin	3.44	0.07	7.42	0.01	0.74	0.40	3.87	0.02
Glucose[a]	0.73	0.40	4.62	0.04	0.20	-0.66	1.85	0.16
Packed cell volume	0.25	0.62	275.30	<0.01	1.59	0.22	92.38	<0.1
Phosphorous	10.40	<0.01	39.30	<0.01	0.79	-0.38	16.83	<0.1
Potassium	6.51	0.02	50.21	<0.01	0.0	0.95	18.91	<0.1
Sodium	0.32	0.57	7.61	<0.01	0.55	0.46	2.83	0.06
Total plasma protein C[b]	0.01	0.93	1.54	0.22	0.62	0.44	0.72	0.55
Total plasma protein R[c]	2.36	0.14	2.99	0.09	0.03	0.86	1.79	0.17
Uric acid	3.71	0.06	0.65	0.43	3.73	0.06	2.70	0.06

[a] Determined on whole blood.
[b] Determined by colorimetry.
[c] Determined by refractometry.

TABLE 4. Univariable analysis of variance and descriptive statistics of morphologic data by sex for adult African fish eagles from Lake Mburo and Lake Victoria near Entebbe, Uganda (n=15).

Variable	Sex	n	Mean	SD[a]	Median	Q1[b]	Q3[c]	F	P
Body weight (kg)	Female	6	3.0	0.45	2.9	2.7	3.4	18.34	<0.01
	Male	9	2.4	0.12	2.3	2.3	2.4		
Eighth primary feather length (mm)	Female	6	418	8	420	412	424	26.91	<0.01
	Male	9	381	16	387	380	389		
Footpad length (mm)	Female	6	123	5	124	120	125	28.30	<0.01
	Male	9	109	5	110	106	112		
Bill depth (mm)	Female	6	27.39	1.79	27.21	26.39	28.29	8.30	0.01
	Male	9	25.24	1.13	24.76	24.64	24.88		
Culmen length (mm)	Female	6	45.71	5.14	44.31	43.35	44.96	11.07	<0.01
	Male	9	39.97	0.94	39.54	39.50	40.85		
Hallux length (mm)	Female	6	39.90	1.89	39.76	38.50	40.96	18.54	<0.01
	Male	9	35.64	1.87	36.17	35.15	36.40		

[a] SD = standard deviation.
[b] Q1 = 25th percentile of the sample.
[c] Q3 = 75th percentile of the sample.

African fish eagles having a similar fledging period as these two eagle species, birds of a similar age to those sampled in the above studies still had lower PCVs. However, the lower mean PCV may be partly explained by the average age of nestlings sampled in this study being 27 days, which was lower than the age at sampling in the abovementioned studies. All nestlings were well nourished by visual assessment and no nestlings were considered in poor body condition. Despite some variation due to factors such as nutrition or possible parasitism, PCV would be expected to increase with age, as reported in studies on captive white storks (*Ciconia ciconia*) (Montesinos et al., 1997) and psittacine birds (Clubb et al., 1991).

The aging methods for nestlings used in this study are at best an estimate and are based on the only study that recorded nestling growth in African fish eagles from hatching to fledging (Sumba, 1988). This study was performed on few birds and under difficult field conditions. Also, with a small sample size, results may not be statistically valid. Reduced PCVs have been recorded from captive great egret (*Ardea albus*) nestlings orally dosed with methylmercury (Spalding et al., 2000). Total mercury concentrations in breast feathers of all birds in this study (Hollamby et al., 2004) were well below the feather concentrations associated with reduced PCVs in captive great egrets. However, it may be that rapid increases in PCV may only occur once nestlings have an increased oxygen demand at the time of fledging (Hawkey et al., 1984).

We were not able to determine the duration of the *Plasmodium* infections; however, the lowest PCV observed was in the bird with the highest parasitemia. Identification of the parasite is not complete, although it may belong to the subgenus *Giovannolaia* (Peirce and Bennett, 1996). Only one other report of a blood parasite in the African fish eagle, identified as *Leucocytozoon audieri,* was found (Laveran and Nattan-Larrier, 1911). The birds infected with *Plasmodium* also were in the poorest body condition of the nestlings examined and had old healing digital abrasions. They were infested with moderate numbers of unidentified species of lice and hippoboscid flies as well.

Variation in AST levels due to sex has been recorded in some avian species (Gee et al., 1981). The variation in potassium values between adults and nestlings and the absolute values were similar to those reported for bald eagles (Redig, 1993; Bowerman et al., 2000). Red blood cell lysis may result in elevated extracellular po-

tassium levels (Fudge, 1994). Increased levels of CK were most likely indicative of muscle damage or injection site trauma during sampling, although overt struggling was usually minimal (Fudge, 1997). Differences in various plasma chemistry parameters between study sites may reflect different numbers of adults and nestlings comprising the population sampled at each site because there was significant variation, based on age (nestling versus adult) for all these parameters.

The strong correlation between TPP measurements made by refractometry and the colorimetric method used in this study suggest that refractometric measurements of TPP provide single readings that are consistent (when compared to the colorimetric readings) but not precise. This may indicate that refractometry should be used only as an approximation of TPP. Furthermore, because we were only able to make one reading, we could not assess the reproducibility of the refractometric readings. Lumeij and Maclean (1996) demonstrated poor reproducibility of results when using refractometry to determine avian plasma protein levels.

Few morphometric data exist on African fish eagles. Average body weights in this study are similar to those cited by Sumba (1988) for captive fish eagles at Entebbe of 2.25 kg for males ($n=3$) and 2.83 kg ($n=2$) for females. Body weight ranges presented by Brown (1980), 3.00–3.60 kg ($n=3$) for females and 1.99–2.50 kg ($n=4$) for males, fall within ranges found in this study. Unlike the other studies, we determined sex by chromosomal DNA analysis, thus ensuring a high degree of accuracy when compared to sex determination based on body weight or visual characteristics. Examination of the morphometric data supports the conclusion that, like other *Haliaeetus* species, females have a larger body mass than males.

We hope the information presented in this paper can serve as a foundation for biological and physiologic databases for the African fish eagle. Such databases may prove valuable for conservation of fish eagles.

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