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ISIS - A COLLECTING AND SHARING OF CAPTIVE ANIMAL STATISTICS

Modern day zoos are faced with the challenge of developing self-sustaining populations of captive exotic species and perhaps in selected instances of providing the only reservoir for species on the verge of extinction. To meet this problem it is necessary to develop policies for the management of gene pools over multiple generations and to collect data and share it. North American and European zoos are confronting this challenge head on through the International Species Inventory System (ISIS).

The collection of census and vital statistics data is presently being accomplished by ISIS of the American Association of Zoological Parks and Aquariums (AAZPA). ISIS can also provide pedigrees, studbooks and the data for analysis of breeding relationships within the captive population. Information for management purposes and data needed for life history analysis will also be provided.

ISIS had its beginning in Houston, Texas at the October 1973 meeting of the AAZPA when Dr. U.S. Seal and Dale G. Makey of Minnesota proposed the program to the board and membership. The program was adopted and initial financial support was approved. Since then grants and gifts totaling $72,735.00 have been received by ISIS. An additional $31,317.00 in operational funds has been provided to this date by 91 participating institutions as their $1 per mammal per year voluntary assessment voted by the AAZPA at its annual meeting in Philadelphia in October 1974. The assessment became mandatory beginning July 1, 1975.

ISIS is housed at the Minnesota Zoological Garden offices in West St.Paul, Minnesota and will move to the zoo site in Apple Valley, Minnesota later this month. Use of the IBM 370-158 computer, part of the state computer system, is also made possible through the relationship with the Minnesota Zoo. Personnel for ISIS includes Linda Murtfeldt, ISIS system manager and zoological records supervisor for MZG; Jan Olsen, ISIS Development Coordinator; and Kim Hastings, ISIS data processor.

Progress of ISIS as of July 1, 1976 has far exceeded the expectations of all who participated in the original formulation, presentation, and discussion of the program. The program currently has 177 zoos signed as participants. One hundred thirteen zoos are actively submitting data on their mammal/bird collections. Eighty zoos have completed their mammal inventories and are on a current basis. Data forms have been received on more than 23,000 mammals. Computer output inventories have been returned to all zoos who have completed submission of their data. The first Species Distribution Report of all data available to the system was completed in early May, 1975. Copies of the species distribution report in a microfiche form have been sent on a yearly basis to all participants who are submitting data. Hard copy of selected portions of the species distribution report have also been made available to participants.

Each participating zoo has been provided with a set of three manuals: the ISIS Mammalian Taxonomic Directory, the ISIS World Geographic and Zoological Institution Directory, and the ISIS Institution Procedures. The Mammalian Taxonomic Directory contains a listing of all living mammalian species, each taxon including the scientific name, a vernacular name, and the approximate distribution in the wild. The primary reference source for the organization of orders, families, and genera is Anderson and Jones (editors), Recent Mammals of the World, the Ronald Press Co., New York, 1967. The taxonomic literature from 1966 to date has been consulted for the revisions made. This literature plus regional and country check lists have been utilized for the assembly of the species listings.

The World Geographic and Zoological Institution Directory contains a hier-archical code system for the listing of all regions, subregions, countries, states and zoological institutions (zoos, aquariums, museums, dealers, special collections and researchers) throughout the world.

One data sheet is filled out for each animal within an institution. This form contains information on taxonomy, individual identification, sire and dam, place of birth or capture location, sex, age, transactions which occur and between whom, hybrid status, death and autopsy information, tag and tattoo numbers, studbook identification, marine mammal permit numbers, postentry quarantine numbers, endangered species permit numbers, price and color phase. Each institution keeps one copy of the form for its files and sends the original to ISIS. After review for completeness and accuracy by the system manager, the information is punched on keypunch cards and then sent to the computer for input.

A portion of the Avian Taxonomic Directory has been completed and distributed to active participants. The remainder of the Avian Taxonomic Directory will be complete in August 1976. Data forms containing information on 1,275 birds have been received from 29 zoos. Reptiles, amphibians and fish will follow in the near future.

Systems analysis has begun on three new subsystems: Pedigree/Studbook analysis, Demographic analysis and Physiological Norms. One thousand data forms were distributed to about twenty-five zoos for a test run of the Physiological Norms during the summer of 1975. This program of the American Association of Zoo Veterinarians (AAZV) will be carried out by zoo veterinarians. It will collect and collate baseline laboratory data and will be used for select specimens of special interest at each institution.

A fourth subsystem, Life History, is being developed by a group of zoo personnel headed by Paul Linger, Assistant Director of the Denver Zoo. It includes behavioral data, management procedures, growth statistics and animal husbandry information. It, too, is designed for use with a select group of animals.

Several European zoos have begun active participation in ISIS, and many others have shown keen interest in the system. Translations of directory introductions and instructions for participating zoos are being prepared in English, French, German, Japanese, Russian, and Spanish.

Personnel from all phases of zoo work are actively engaged in the ISIS system. Data forms are being filled out by everyone from directors to curators to record keepers to animal keepers to secretaries. Veterinarians and researchers are becoming actively involved. A real team effort is necessary if all vital information is to be obtained so that zoos throughout the world may develop systematic long-term management and propagation program of captive species.

ISIS AND THE MANAGEMENT OF CAPTIVE POPULATIONS. U.S. Seal, D.G. Makey, N.R. Flesness, T. Foose, D. Bridgwater and L. Murtfeldt, Minnesota Zoological Garden, West St. Paul, Minn. and Philadelphia Zoological Gardens, Philadelphia, Penn.

The ISIS program was designed to collect and analyze census, vital statistics and pedigree data on wild animals in captive collections. The information may be used for pedigree and demographic analyses of captive breeding populations in terms of historical and current events and for projection into the future. These analyses can provide captive animal managers the information and tools (1) to choose breeding strategies which minimize inbreeding; (2) choose animals to remove from the breeding population; (3) choose animals for reintroduction; (4) choose an age and sex distribution for a stable population at a specified carrying capacity; (5) predict effects of the breeding strategy used; (6) provide a quantitative assessment of the need for and consequences of introduction of new genetic material into a captive population; (7) predict composition of a growing population in the future and whether it can be stable or will fluctuate or will disappear; and (8) suggest the composition in terms of age, sex and numbers for establishing a new captive population. The models and computer programs for these analyses have been developed using the data from the studbooks for the Przewalski horse and Arabian oryx. Inbreeding and risk coefficients for each individual animal have been calculated and the demographic characteristics of the population projected for 20 years.

BASELINE LABORATORY DATA FOR THE GRANT'S GAZELLE

(GAZELLA GRANTI)

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The gazelles are members of the subfamily Antilopinae of the family Bovidae of the Artiodactyla. The genus Gazella contains about 11 species. There are approximately 500 specimens currently in American zoos. Seven species of the genus are well represented in American zoos including dama, dorcas, granti, leptoceros, spekei, subgutturosa, and thomsoni. There do not appear to be any published blood data on any of these species. We have accumulated samples over a 4-year period as a part of an ongoing program to establish norms. Our data on the Grant's gazelle are presented here.

MATERIALS AND METHODS

The laboratory methods utilized for these studies are summarized in the accompanying paper. Blood samples were collected from the jugular vein into EDTA for hematology and into serum tubes for the chemistries. The serum was separated after the blood had been allowed to clot and the serum and whole blood both shipped by airmail, special delivery to the laboratory. Data from 46 blood samples have been collected. Clinical observations were recorded on all of these animals at the time of handling and 16 samples were from animals either traumatized or sick. The remaining samples were from normal animals being handled for management reasons. The number of samples represented in each assay ranges between 25-35. The data are presented as means, standard deviation, and standard error, and the 95% range of expected values. It would be expected that 95% of the time values obtained would fall within the range given. Values falling outside this range might be considered abnormal depending upon the degree of deviation and the remaining pattern of values.

RESULTS AND DISCUSSION

The hematology data are presented in table 1. The mean hemoglobin level of 16 gm per 100 ml is somewhat lower than we observed for a small group of impala [4]. Also, the red cell volumes for the Grant's gazelle of 33 μ^3 are about double the size of those we observed for the impala. It may be noted that

hemoglobin levels falling below 12.5 gm/100 ml might be considered to begin

getting into the range of anemia. Four samples taken from animals with various

infections ranged between 9.9-11.9 gm%. Two animals with renal disease and

one with severe pneumonia had hemoglobin values ranging between 19.3-21.3 gm/

100 ml.

The serum chemistry data are tabulated in table 2. The serum electrolytes

are unremarkable. Comparison of serum calcium levels in animals less than one

year of age with those greater than one year of age indicated slightly but not

significantly higher values in the younger animals. The values for the younger

animals were $10.0 \pm .4$ (mean $\pm$ standard deviation) and $9.6 \pm .60$ mg/100 ml

(mean $\pm$ standard deviation) in the older animals. Serum phosphorus levels

were also higher in the younger animals with values of $7.0 \pm .82$ mg/100 ml and

5.4 ± 1.39 mg/100 ml for the older animals. Serum phosphorus levels of course

can vary with diet and tend to be rather variable in herbivores.

Serum glucose levels averaged 183 mg/100 ml which is considered to be high

for ruminants. However, it has been our experience that wild ruminants whether

restrained manually or through the use of drugs invariably exhibit levels well

over 100 mg/100 ml. Indeed, in this series of samples values less than 100 mg/

100 ml were always associated with sick animals or animals whose other data

indicated the presence of an illness. Urea nitrogen levels varied between

15-27 mg/100 ml in normal animals. Elevated levels were observed in four

animals with other signs of disease. Low levels were found in three animals

and these may be taken as possible indications of the animals having been off

feed for some time. This might be a useful indicator of competition for food

in a given group of animals and indicate the animal who is being deprived through

competition. Fibrinogen levels serve as a potentially useful indicator of trauma

or infection since fibrinogen is an acute phase reactant. Levels above 650 mg/ 100 ml were invariably associated with obvious infection, trauma, or other signs of disease. However, levels are not always invariably elevated in the face of trauma. Occasionally low levels are encountered which, however, to be certain of their validity would require reassay on a second specimen since small clots can result in loss of this protein. We are investigating the use of haptoglobin assays as a more general indicator of the acute phase reaction and one that is more readily applicable than fibrinogen assays.

The serum enzyme levels tended to be quite variable in these individuals, in part no doubt due to the effects of handling as we have observed with the white-tailed deer (3). However, elevations of SGOT above 120 I.U. were invariably associated either with sick animals or animals having a range of abnormal values.   , The interpretation of elevated CPK levels is made very difficult in terms of selenium or vitamin E deficiency since it is readily released with the stress associated with handling. Data are not available to help establish if animals with deficiency diseases release the enzyme more readily or in greater quantities. We observed levels of 2600 I.U. in an animal with pneumonia, 8400 I.U. in an animal down with severe injuries, and an animal with a jaw abscess and lung abscess had a level of 400 I.U. Two animals thought to be normal had CPK levels of 600 I.U. and 710 I.U. respectively. Both of these animals also had elevated LDH values of 464 I.U. and 590 I.U. respectively. This might be indicative of white muscle disease but would need further study. Alkaline phosphatase levels were quite variable in this species, ranging from 40 I.U. to over 600 I.U. It was not possible to rationalize this variability in terms of age, sex or season. Young animals do tend to have considerably higher levels than old animals, however. Overall,

the tests which would appear to be most useful for detecting or following the
course of disease in this species on the basis of this experience would include
hemoglobin, white blood cell count, glucose, BUN, fibrinogen, and SGOT. The
significance of changes in the other enzymes, including CPK, deserves further
study.

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Table 1. Baseline Hematology for the Grant's Gazelle (Gazella granti).

	$\overline{X}$	SD	SE	95% Range
Hemoglobin (g/dl)	16.0	1.66	.27	12.8 - 19.3
Hematocrit (%)	41	3.8	.62	33.4 - 48.6
Red Blood Cells ($10^6/mm^3$)	12.7	1.34	.23	10.0 - 15.4
MCV (μ^3)	32.6	2.7	.43	27.2 - 38.0
MCHC	37.9	2.2	.33	33.5 - 42.3
White Blood Cells ($10^3/mm^3$)	4.1	1.2	.19	1.7 - 6.5

Table 2. Baseline Chemistry for the Grant's Gazelle (Gazella granti).

	$\overline{X}$	SD	SE	95% Range
Sodium (meq/l)	151	3.4	.63	144 - 158
Potassium (meq/l)	4.4	.56	.11	3.3 - 5.5
Chloride (meq/l)	108	5.3	.95	97 - 119
Total CO_2 (meq/l)	23.0	2.7	.54	17.6 - 28.4
Calcium (mg/dl)	9.5	.71	.14	8.1 - 10.9
Phosphorus (mg/dl)	6.1	1.4	.27	3.3 - 8.5
Glucose (mg/dl)	183	40	7.5	103 - 263
BUN (mg/dl)	21	3.2	.55	15 - 27
Uric acid (mg/dl)	.48	.19	.04	.1 - .9
Serum protein (g/dl)	6.1	.52	.10	5.1 - 7.1
Cholesterol (mg/dl)	81	27	5.8	27 - 135
Fibrinogen (mg/dl)	409	122	26	165 - 653
Bilirubin (mg/dl)	.32	.13	.04	.1 - .6
SGOT (IU)	79	16	3.2	47 - 111
CPK (IU)	48	51	10	0 - 150
LDH (IU	184	72	14	40 - 330
Alk-P'tase (IU)	235	128	22	0 - 491

BASELINE LABORATORY DATA FOR THE WHITE RHINOCEROS

(CERATOTHERIUM SIMUM SIMUM)

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INTRODUCTION

The family Rhinocerotidae of the order Perissodactyla contains five living species in four genera. Two of these species, the Sumatran and Javan rhinoceros, are nearly extinct if not extinct and are not represented in North American collections. Statistics from the ISIS inventory indicate that there are about 15 Indian rhinoceros (Rhinoceros unicornis), 75 black rhinoceros (Diceros bicornis) and 150 white rhinoceros (Ceratotherium simum) in zoo collections in North America. Monographs on the biology of two of these species have been published in recent years. The white rhinoceros is currently divided into two subspecies, the southern race C. s. simum and the northern race C. s. cottoni. Only three members of the northern race are in North American zoo collections. This subspecies is considered endangered. The southern subspecies, once on the endangered list, has been successfully re-established and large numbers of this race have been exported to zoos around the world. However, there does not appear to be any information available on blood constituents for any species of rhinoceros. We collected blood samples from 16 animals in a single collection over a 2-day period and present some of the results of studies on these samples here.

MATERIALS AND METHODS

The analytical methods employed in our laboratory have been described in other publications (5). Essentially, red and white blood cells are determined with a Coulter counter model B, hematocrit by a micro method microhematocrit, and hemoglobin by a cyanmethemoglobin method. Differentials are counted on 200 cells. Serum protein fractions are measured by cellulose acetate electrophoresis. Total protein is determined by an ultraviolet method. Enzymes, glucose, BUN and bilirubin are measured using the kits and machine of Abbott Laboratories - the ABA 100. Calcium, phosphorus, electrolytes, cholesterol and

triglycerides are determined with special methods and the specific instruments of Technicon Corporation. Cortisol and thyroxine are determined by the competetive protein binding and testosterone by radioimmunoassay. Blood samples were collected from the ear vein of drug immobilized animals. The hematology samples were drawn into EDTA and samples for the other assays were drawn as serum. The serum was separated within two to three hours of drawing the blood and stored frozen. Hematology was determined 24-48 hours after drawing the blood. The 16 animals from whom samples were obtained are located at Lion Country Safari, Kings Dominion, Doswell, Virginia. There are eight males and eight females. The ages are not known precisely but would appear to range between three and six years. None appear full grown. The blood samples were collected on November 12th and 13th. The animals were immobilized with 1.5 mg of M-99. The time required for the animals to become manageable was 28.3 ± 9.3 minutes (mean ± standard deviation). Most animals went into sternal recumbency with this dose. The drug was administered by dart gun. Blood samples were drawn, temperature taken, measurements made, and each animal was tattooed in an ear for future identification. Except for two animals, M-50/50 in a dose of 3 mg was administered as an antidote when the work was complete. The average time required for recovery and active moving of the animal was 10.6 ± 4.1 minutes (mean ± standard deviation. The antidote was administered I.V. in an ear vein. The rectal body temperature was 37.5 ± .45°C (mean ± standard deviation) or 99.6 ± .82°F (mean ± standard deviation). All of the laboratory data are presented as mean with standard deviations, and standard error and the 95% range of expected values in the tables. The 95% range is defined as the mean ± two standard deviations. Values falling outside of this range may tentatively be regarded as abnormal depending in part upon the magnitude of the deviation.

RESULTS AND DISCUSSION

The hematology data are presented in table 1. The results of every test were examined for possible significant sex differences. In those cases where significant differences were found, the data are presented separately in the respective tables. The females averaged more white blood cells than males, but there is a considerable overlap in the range. The bulk of this difference in white blood cells was contributed by the segmenters or neutrophils. These animals have a relatively high level of eosinophils and with some scatter of the data, possibly reflecting the presence of intestinal parasites in greater densities in some animals than in others. Two of the animals with the highest eosinophils also had the lowest hemoglobin levels, and so some physiological effects of the intestinal parasites may be present.

Serum chemistry data are presented in table 2. The actual range of blood glucose values was 35-137 mg%. It is possible that for reliable values in this species it will be necessary to draw blood into fluoride-containing tubes, as is essential for lions in our experience. This point will be reinvestigated in further studies. Serum calcium levels had a mean of 11.9 mg/100 ml and thus average higher than is found in many other mammals. However, the several collections of zebra data that were reported by us several years ago (Baseline Laboratory Data for Captive Native and Exotic Species; Seal, U.S., Makey, D.G. and SEAMAK Systems) indicate comparable levels of calcium in these species so that this may be a characteristic of the Perissodactyla. This remains to be established with further studies. It is also possible that the average levels will decline with increasing age of the animals, as happens with many mammalian species.

Serum sodium and chloride levels are lower than has been observed for most other mammalian species including the zebras. Potassium and total bicarbonate

levels fall within the usual range. Four animals were found to have much lower sodium levels and these data are presented in a separate table. These data were not included in the calculation of the mean presented in table 2. Evaluation of the significance of this result will require measurements of urinary sodium and determination of the effects of sodium supplement upon sodium levels. It would also be of interest to measure renin, angiotensin and aldosterone in this species. Serum lipid levels were quite low also. The levels of triglycerides actually varied between 0-25 mg/100 ml. The levels of cholesterol averaged 10-30 mg% lower than has been reported for the zebras. Triglyceride levels have not been reported for the equids.

The values for serum protein fractions determined by electrophoresis are shown in table 3. The total serum protein value of 7.6 gm/100 ml is in the characteristic range for mammals. However, the fraction attributable to albumin (2.6 gm/100 ml) is lower than is usually seen in mammals with the result that all of these animals show what would be considered a reversed A/G ratio of about 0.5. This would appear to be normal for this species. The low serum albumin and the relatively low levels of serum electrolytes leads one to suspect different osmotic pressure adjustments in these animals than encountered in other mammals for whom data are available. It would be of interest to determine the blood pressure of this species and the effects of posture. Blood volume and body water measurements would also be of interest. Fibrinogen levels averaging 520 mg/100 ml were unremarkable but indicated that none of these animals had any severe trauma or infection.

Serum hormone levels are shown in table 4. Serum thyroxine levels were in the same range as seen with the zebras. However, serum cortisol levels were very low, averaging less than 1 µg/100 ml, in sharp contrast to the zebras -- all of whom average between 9-10 µg/100 ml. It is possible that cortisol is not

the predominant adrenal corticosteroid in the rhinoceros. They should be examined for the presence of corticosterone. Serum testosterone levels were low in both males and females but the differences between the groups were significant.

As mentioned above, four animals had much lower serum sodium levels than the remainder of the group. These electrolyte data and several other chemistry data are presented in table 5 for the individual animals. As can be seen, these four animals have significantly lower serum sodium, chloride, and total CO_2 levels than the remainder of the group. The explanation for this is not known but these animals will be re-examined to determine if this is a persistent finding. The results of the other assays fell well within the range of the remaining 12 animals.

SUMMARY

Hematology and serum chemistries have been measured on blood samples obtained from eight male and eight female white rhinoceros immobilized with M-99. Tentative baseline ranges for each of the tests have been calculated from these data. Serum sodium levels were observed to average 130 mEq/l, which is lower than usually observed in mammals. Some animals had even lower levels.

Since we have not located any other data on rhinoceros in the literature, it is not possible to make further comparisons of these data. Although comparisons can be drawn with the equids or tapirs, it would be of far greater interest to obtain similar data on the black and Indian rhinoceros. It is our intention to gather further data on this group of white rhinoceros during the next year and to explore some of the questions raised by the data already obtained.

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Table 1. Hematology of the White Rhinoceros (Ceratotherium s. simum)

	$\overline{X}$	SD	SE	95% Range
Red Blood Cells $(10^6/\text{mm}^3)$	6.99	.56	.14	5.87 - 8.11
Hemoglobin (g/dl)	16.3	1.6	.40	13.1 - 19.5
Hematocrit (%)	43.1	3.2	.81	36.7 - 49.5
MCV	61.4	3.1	.79	55.2 - 67.6
MCHC	37.6	2.5	.62	32.6 - 42.6
MCH	23.3	1.9	.48	19.5 - 27.1
White Blood Cells $(10^3/\text{mm}^3)$				
Males	9.7	1.8	.65	6.1 - 13.3
Females	12.2	1.7	.59	8.8 - 15.6
Lymphocytes $(10^3/\text{mm}^3)$	4.0	.65	.16	2.7 - 5.3
Neutrophils $(10^3/\text{mm}^3)$				
Males	4.7	1.34	.47	2.0 - 7.4
Females	6.7	1.18	.42	4.3 - 9.1
Bands (mm^3)	210	200	50	0 - 600
Monocytes (mm^3)	300	140	40	20 - 600
Eosinophils (mm^3)	780	390	100	?
Basophils (mm^3)	0	0	0	0 - 1

Table 2. Serum Chemistry of the White Rhinoceros (Ceratotherium s. simum).

	$\overline{X}$	SD	SE	95% Range
Glucose (mg/dl)	84	28	7	28 - 140
Urea Nitrogen (mg/dl	13	2.0	.5	9 - 17
Calcium (mg/dl)	11.9	.7	.18	10.5 - 13.4
Phosphorus (mg/dl)	5.2	.52	.13	4.2 - 6.2
Sodium (meq/l)	130	4.8	1.39	120 - 140
Potassium (meq/l)	4.6	.56	.14	3.5 - 5.7
Chloride (meq/l)	92	3.2	.91	86 - 98
Total CO_2 (meq/l)	26.3	1.3	.38	23.7 - 28.9
Cholesterol (mg/dl)	89	21	5.3	47 - 131
Triglyceride (mg/dl)	6.8	7.9	2.0	0 - 25
Bilirubin (mg/dl)	.21	.10	.03	0 - 0.4
Alkaline Phosphatase (IU)	100	27	7	46 - 154
LDH (IU)	270	58	15	154 - 386
SGOT (IU)	47	8	2	31 - 63
SGPT (IU)	8.9	1.0	.26	6.9 - 10.9
CPK (IU)	93	33	9	27 - 159

Table 3. Plasma Proteins of the White Rhinoceros (Ceratotherium s. simum).

	$\overline{X}$	SD	SE	95% Range
Serum Protein (g/dl)	7.6	.74	.19	6.1 - 9.1
Albumin (g/dl)	2.6	.25	.06	2.1 - 3.1
Alpha-1 (g/dl)	.14	.04	.01	.06 - .22
Alpha-2 (g/dl)	.35	.09	.02	..17 - .53
Betas (g/dl)	1.93	.29	.07	1.35 - 2.51
Gamma globulin (g/dl)	2.47	.36	.09	1.75 - 3.19
Fibrinogen (mg/dl)	520	53	13	414 - 626

Table 4. Serum Hormones of the White Rhinoceros (Ceratotherium s. simum).

	$\overline{X}$	SD	SE	95% Range
Thyroxine (μg/dl)	2.8	.71	.18	1.4 - 4.2
Cortisol (μg/dl)	.8	.56	.14	0 - 2
Testosterone (ng/dl)				
Males	81	32	11	17 - 145
Females	41	18	6	5 - 77

Table 5. Deviant Blood Values of Four White Rhinoceros

(Ceratotherium s. simum) with Low Serum Sodium

Levels.

	73*	75*	82*	85*
Sodium	113	113	103	104
Chloride	81	82	72	74
Total CO_2	22.4	22.8	20.8	21.6
Hemoglobin	18.2	16.5	18.2	18.2
Serum Protein	7.0	8.3	6.6	6.1
Cholesterol	72	69	74	63

* Animal identification number.

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SUBSYSTEM STUDY AND EVALUATION REPORT

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INTRODUCTORY LETTER

TO: Donald Bridgwater, MZG
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FROM: Dale Makey, Consultant, Minnesota Zoological Garden

The review meeting of the information requirements and subsystems approach for the ISIS – Veterinary Record Subsystem will be held on Tuesday, December 30, 1975 in the ISD Conference Room C at 1:00 p.m. The purpose of this review is to approve, disapprove or request further revisions to this study and evaluation. If any details of this report are not clear, please contact me at 725-6767 x6581.

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PROJECT SCOPE

The development of an ISIS - Veterinary Record subsystem as a suppliment to the ISIS - Vital Statistics subsystem represents the second step in the development of a complete animal care system. The ISIS - Veterinary Record will be composed of information such as disease diagnosis, disease treatment procedures, detailed autopsy results, physiological norms, surgical procedures and other elective procedures. Due to funding limitations, the current development will be limited to the Physiological Norms segment. However, during the development of the Physiological Norms segment, attention will be given to the other segments of the subsystem so problems will be minimal during the development of those segments.

The Physiological Norms will be based on the SEAMAK system developed on a CDC 3300 computer by D. G. Makey and U. S. Seal at the Minneapolis V.A. Hospital. That system has provided useful physiological norms to the zoo veterinarians for the last several years. Those experiences have indicated which laboratory assays are useful for disease diagnosis and other parameters which are necessary for the maintenance of captive animal populations. The development of the Physiological Norms segment of the ISIS - Veterinary Record subsystem will be concerned with three report generations:

1. Physiological Records Survey - This survey will count and categorize the number of records in the file by animal type and disease state. The results of this report will allow the ISIS Systems Manager to evaluate the data base prior to a report request described in item 2 below.

2. Physiological Norms Summary - This report will be generated in response to a request which will identify the type of animal and the disease state of that animal. This report will contain means and standard errors of the laboratory test values summarized from all records from all participating zoos. The report will be used by veterinarians for disease diagnostic procedures.

3. Institution Veterinary Records - This report will provide physiological information about the specimens in each institution. In the cases where greater than 10 animals have been sampled within a zoo, the means and standard errors for this group will be determined. The report will be used by each veterinarian to provide a detailed physiological data history on each animal in the zoo.

The programs to be developed in the following phases will be written in either COBOL or FORTRAN depending on the application. FORTRAN programs will be required for the calculation of means and standard errors for the reports type 2 and 3 described above. However, COBOL programs will be required for data input editing, file manipulation and report generation.

INFORMATION REQUIREMENTS

General Requirements

The main function of the project defined in this report is the generation of physiological norms summaries for the use in disease diagnosis in the zoo animals. These summaries will be produced on a demand basis after periodic analysis of the physiological data base. This procedure is necessary since if too few test values are used to compute the means and standard errors, the results can be biased considerably. The two secondary requirements of the system are to provide the zoos with the accumulation of physiological data from their own animals and to provide expansion capabilities to eventually encompass the total ISIS – Veterinary Record subsystem.

A central requirement for the ISIS – Veterinary Record subsystem is a classification system for the various disease states and surgical procedures used by veterinarians. The coding system which will be used is the "Standard Nomenclature of Veterinary Diseases and Operations" produced by the U. S. Department of Health, Education and Welfare.

Special Requirements

A. Physiological Records Survey

This report will survey all physiological data records in the ISIS file. The report will list each animal type which has physiological records available and the number of normal or disease state records for each animal and type. This report will be used by the ISIS Systems Manager to determine which animals and associated disease state qualify for the generation of physiological norms. This report will then list the numbers of physiological records by institution, subclassifying the records by animal and disease state within each institution.

B. Physiological Norms Summary

1. Laboratory Tests - 50 laboratory tests will be used in the summary procedure.

2. Summary Methods

a. Means, standard errors and the number of test values used will be made available for each laboratory test.

b. If the number of values for each test is less than 10, the values used for the summary will be printed on the report.

c. When the number of values used in the summary exceeds 10, the printing of these values will be controlled by user request parameters.

d. Listings of these test values will be in a columnar fashion for easy human scanning procedures.

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3. Animal related parameters which control the summary groups. These will be user specified.

    a. Summarize overall animal records.

    b. Summarize over each sex independently.

    c. Summarize by immobilization type independently.

    d. Summarize by age categories defined by request parameters.

C. Institution Veterinary Record

This report will provide the zoo veterinarians with a physiological history of the animals in their care. In addition to the physiological data, other vital statistics data will be extracted from the data already accumulated by ISIS. The support data will include age, tag or tattoo numbers, house names and etc. which will properly identify the animal. Additionally, the report will contain summaries of the physiological test values for an animal type when the number of individuals sampled exceeds ten. These summaries will contain means, standard errors and the number of test values used for each laboratory test.

D. Expansion Capabilities

As indicated earlier, in this study the segment being discussed here only one of five categories which will eventually be implemented into the ISIS - Veterinary Record subsystem. The five categories are:

1. Physiological Data Collection,

2. Autopsy Results,

3. Disease Diagnosis and Treatment,

4. Surgical Procedures, and

5. Elective Procedures.

Thus, when all these categories are developed a complete medical records system for the animals will be available.

SUBSYSTEM APPROACH

General Approach

The general approach will be the direct integration of the ISIS - Veterinary Records subsystem into the ISIS system. This approach is necessary since the existing taxonomic list, institution list and inventory data file are required for editing of physiological data records and the generation of reports associated with the new subsystem.

Prior to the beginning of the programing for this subsystem, a Phase 8 will be performed on the ISIS - Vital Statistics subsystem. It is requested that the same ISD programer be assigned to both the Phase 8 and this new subsystem. This Phase 8 experience should radically improve the efficiency of the programer in the development of the Vet Edit/ Input subsystem (SS-20) describe below.

Specific Approach

A. Files

    1. Existing files

        - taxonomic list file (single entry)

        - institution list file (single entry)

        - inventory data file (variable entry)

    No modifications are necessary to the two single entry files, while the variable entry file must be capable of accepting the physiological records defined below (see records).

    2. New files

        - Topographic file

        - Etiological file

    These two files will be simple look-up tables of the disease nomenclature system referred to above in the Information Requirement section.

    This system uses a 4 digit code associated with a brief description. The tables will be used for editing and report generation procedures.

    These two files will each be approximately 2000 records in length.

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B. Records

    1. Physiological Norms Segment

        a. One record type each for the Topographic and Etiological look-up tables will probably be required.

        b. There will probably be three record types concerned with the physiological data.

    2. Other Segments

    Each of the other four segments will require one record type for each segment.

C. Reports

The media of the reports will remain the same as that currently being used by ISIS:

    1. Microfiche only, or

    2. microfiche and hard copy.

The option is user specified.

D. Subsystem Designation and Description

SS-20 Vet Edit/Input

    1. Disease Nomenclature Code

    No editing of these records can be performed by computer. The records will be produced by the ISIS staff in the form necessary to build the file.

    2. Physiological Norms

    To maintain compatability with the variable entry file (the inventory data file) the records will be formatted in the same length and will use the same first six data elements:

        a. card codes (DD-6149 & 6150)

        b. taxonomic code (DD6101)

        c. institution code (DD6110)

        d. specimen ID (DD6116)

        e. transaction date (DD6167-6169)

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The editing of these elements will be identical to that coded for the ISIS - Vital Statistics subsystem. The only criteria for the initiation of a new physiological data record in the variable entry file will be the existence of that animal in the file (defined by taxonomic code, institution code and specimen code identity). This procedure will be used since these data could be collected.

Due to variability in the selection by the veterinarian of laboratory tests to be completed on a blood sample, a single physiological record will be split into three input record types. The first input record will establish the physiological record in the variable entry file as described above. The second and third input records may or may not be present for input into this physiological record. However, their entry into the record requires the existence of the first record of the three possible types.

The one editing procedure which will be new to the system will be the verification of the topographic and etiological codes using the look-up tables described above.

SS-21 - Physiological Records Survey

The survey report will require counting of the physiological records available for use in predicting the physiological norms. This survey will involve extracting the physiological records, counting them by animal form and sub-categorizing and counting them by disease state (using the topographic and etiological code system described above). This data will form the first segment of the report. The physiological records will then be sorted by institution. The records will then be counted (as described above) within each institution and this information printed for each institution.

SS-22 - Physiological Norms Summary

This report will be generated using all the physiological records in the variable entry file. On the basis of the request by the ISIS - Systems Manager certain animal forms will be selected for summarization. As indicated in the Information Requirements, input data will be used as further selection criteria to subclassify these data before the summaries are performed. The means and standard errors can be calculated using routines found in the System/360 Scientific Subroutine Package. Thus, routines will be required to transform the data formats found in the physiological data records into a form acceptable by this routine and the transformation of the means and standard errors into a format suited to the Physiological Norms Summary report.

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SS-23 - Institution Veterinary Record

This report will involve the extraction of the physiological records from the variable entry file by institution. The records will be sorted by taxonomic code and animal ID within taxonomic code to order the records by animal form and individual animal within the form. The records will be transformed into columns of test values ordered by data so that the veterinarian can scan the data rapidly to perceive trends in the physiological data. Only in the cases where ten or more animals in a zoo have physiological data records will norms for the laboratory tests be determined. These calculations will be identical to those described in SS-22 above.

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PROJECT EVALUATION

Rational for Development

The need for this subsystem in the treatment of captive animals is quite real. The current procedures in establishing normal value for laboratory tests is by the reporting of values in various professional publications. This suffers from incomplete surveys of the entire zoo animal population and in many cases limited blood sample sizes from which to determine these norms. Other problems suffered by the SEAMAK system were incomplete animal identification and incomplete disease diagnosis. The former problem will be solved since the animal's vital statistics will already reside in the ISIS files. The latter problem will be solved by the adoption and strict adherence to the standard disease nomenclature system. Thus, the development of this subsystem segment will provide the veterinarians with accurate physiological norms which can be used for disease diagnosis. An additional benefit after the data base has been collected for some time will be the ability to evaluate each physiological test for each disease state to define which parameters are diagnostic for the disease states.

Project Staffing

ISIS Analyst - D. Makey

    Responsibilities:

    1. Development of Phases 1,2,3,4I and 9.

    2. Development of associated Data Management definitions.

    3. Co-development of Phase 4II.

    4. Consultation during Phases 5-7.

ISD Analyst - to be determined

    Responsibilities:

    1. Review of Phases 1, 2 and 3.

    2. Co-development of Phase 4II.

    3. Minor consultation during Phases 5-7.

ISD Programer- to be determined

    Responsibilities:

    1. Develop programs associated with SS-20 through SS-23.

    2. FORTRAN AND COBOL knowledge is required.

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Project Estimate

As indicated previously, this estimate is based on the premise that the programer developing Phases 5-7 will be familiar with the existing ISIS system because of a Phase 8 to be performed just prior to the beginning of this subsystem.

Effectiveness ratings used in development of the schedule were:

Project Management	75%
Data Management	75%
System Analyst	75%
Programer Analyst	50%