Management Protocols for Species Survival Plans and Animals in Captive Propagation Programs Intended for Ultimate Release into the Wild

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Introduction

Historically, infectious diseases have played an important role in captive wild animal management. The most obvious concerns have dealt with the possibility of epizootic or zoonotic diseases decimating a collection. Even an outbreak of non-lethal but debilitating disease might significantly affect the ability of a captive population to sustain itself. Most recently, however, the reintroduction of captive bred animals into managed wild situations for repopulation has presented the problem of the dissemination of disease acquired in captivity to a naïve wild population. Very little is known about the effect of most infectious agents on wild animal populations. Some feel that the risk is so great as to preclude the reintroduction of captive bred wild animals (Seal 1992). Certain diseases known to affect domestic animals will affect wildlife. The prevalence of many diseases for wild animals remains unknown as does the pathogenicity of specific infectious agents (Munson and Cook 1993). Phylogenetic proximity, as well as the agent's ability to mutate or cross-infect non-host species have meant that viral, bacterial, mycotic, and chlamydial agents that had not been known to cause disease in certain species are capable of pathogenicity. Some diseases affect wildlife first and later cross-over into domestic animals or humans. Diseases that occur in domestic animals may spread rapidly due to the intensive nature of most commercial production models. Confinement of wild animals for captive propagation or exhibition also propitiates a more rapid and potentially devastating spread of disease.

The ability to both detect an infectious agent and determine its pathogenicity is critical to a disease monitoring program (Munson and Cook 1993). In domestic animals, the economic implications to agriculture mean that considerable resources and research are dedicated to detecting, classifying, treating, and preventing disease. Unfortunately, the only means of detection of most infectious diseases are those developed specifically for domestic animals. The use of the same tests for the non-domestic species is not always valid, but may be the only means of probing captive wild animals for the presence of infectious agents.

Numerous factors affect disease transmission in captive populations. Animals in zoos are often in environments that differ from their native habitats. They may be housed in close proximity to species they would never contact in the wild. Management practices can significantly influence disease processes.

Species Survival Plans (SSP'S) in North America and comparable programs in other parts of the world have come into being to address the management issues related to maintaining populations of endangered species in captivity. Health issues are an important aspect of these programs, particularly for species intended for return to the wild. (It is the authors' opinion that the "wild" no longer exists. As the human population burgeons toward 6 billion people, wildlife that is not already managed may need to be managed to survive).

Species Survival Plan Programs

The Species Survival Plan is a cooperative population management and conservation program administered by the American Zoo and Aquarium Association (AZA).[1] Originally an effort to establish cooperative programs between facilities in North America, SSP'S now assume broader conservation goals (Table I). Species Survival Plans facilitate the maintainence of a genetically viable and demographically stable population of a species in captivity. Species Survival Plans support species preservation by raising funds for habitat and field conservation efforts. In addition, they educate the public and foster basic, veterinary, nutritional, and reproductive research.

It has been suggested that conservation programs maintain populations of sufficient size and genetic diversity to insure that there is a 95 % chance of survival for 100 years (Ballou 1993). The maintainence of metapopulations (subpopulations in geographically distinct areas), is a logical strategy to reduce the possibility of a single epidemic annihilating an entire population (Ballou 1993). In essence, SSP'S support both of these fundamental conservation strategies.

As of June 1995 there were 74 SSP'S for 121 species (59 mammals, 17 birds, 7 reptiles and amphibians, 34 fish and 4 invertebrates (Table II and Table III). Each SSP has a species coordinator and a management group responsible for developing a Master Plan. The Master Plan outlines long-range goals, management strategies and breeding recommendations for each animal in participating institutions. The studbook keeper determines the genealogy of each animal in the SSP population and continually updates a database of births, deaths, and animal locations. The Small Population Management Advisory Group provides technical assistance with genetic and demographic analyses to assist the SSP in determining appropriate pairings. In addition to the Masterplan, each SSP formulates a Five-Year Action Plan which identifies research, education, field conservation and related projects.

While SSP'S focus on a single species, other AZA programs have broader scope. Taxon Advisory Groups (TAGS) focus on the relationships and comparisons between related species. They are responsible for developing a regional collection plan for a given taxon. In addition, TAGS establish priorities for management, research and conservation action.

Recommendations for priority species for new studbooks and SSP'S are often initiated by these groups. There are currently 41 TAGS. Fauna Interest Groups (FIGS) were established to coordinate AZA programs in specific geographical areas. There are currently 7 FIGS (Brazil, Mesoamerica, southeast Asia, West Indies, Zaire, Madagascar, and Cuban Amazon).

Scientific Advisory Groups (SAGS) are comprised of zoo professionals and outside experts who focus on specific topics. The SAGS serve as technical advisors to SSP'S and other AZA programs. Established SAGS include behavior and husbandry, reintroduction, veterinary science, contraception, nutrition, small population management, and genome banking.

The Veterinary Scientific Advisory Group has established guidelines for SSP veterinary advisors. (Peregrine Wolff, pers. comm.) Responsibilities of veterinary advisors are listed in Table IV. To date, 56 SSP'S and 26 TAGS have veterinary advisors.

Factors Affecting Disease Transmission in Captive Populations

Numerous factors influence the actual or potential transmission of disease in captive populations of animals. Institutional practices and policies for animal husbandry and management may encourage or minimize disease. A sound knowledge of disease epidemiology, prevention, and treatment is of paramount importance. Personnel at every level of animal contact must understand basic concepts of sanitation and disease transmission. Detailed record keeping is essential to control disease within individual facilities and to share information between institutions. Local, national and international animal health regulatory agencies also affect collections of captive wild animals. Animal movement is subject to regulations at various levels.

Impact of Institution Management Practices on Disease Transmission

Because wild animals often mask even advanced signs of disease, preventive medicine has become the hallmark of zoo veterinary practice. Preventive medicine includes procedures to screen for existing disease (physical examination, tuberculin testing, fecal examination) or to provide pre-exposure protection against disease (vaccination, heartworm prophylaxis).

Quarantine is one of the most important aspects of a preventive health care programs (Jacobson 1993). Other aspects of preventive health care include nutritional evaluation and routine health monitoring through physical examination. Basic sanitary practices must be in place to prevent direct or fomite transmission of infectious agents from one part of the facility to another. Personnel must receive training and understand the importance of enclosure cleanliness, hand-washing and the use of foot-baths. A health monitoring program for staff can prevent disease transmission to or from collection animals. (Cook 1993; Shellabarger 1993). Thorough pre-mortem and post-mortem investigation and documentation of disease occurrences is essential.

A number of documents have been developed by the North American zoo community to address disease issues and institutional standards. Guidelines for Zoo and Aquarium Veterinary Medical Programs and Veterinary Hospitals have been developed by the Veterinary Standards Committee of the American Association of Zoo Veterinarians (Joslin et al 1990). The Guidelines outline recommendations for veterinary coverage, hospital facilities, support personnel, preventive medicine, animal shipments, and diet and husbandry reviews. Detailed recommendations concerning basic medical care, quarantine, vaccination, parasite control, and husbandry procedures have been formulated by the infectious disease committee of the AAZV (Junge 1993). The AZA has developed recommended quarantine procedures for member institutions. Zoonotic diseases are addressed in the AAZV Guidelines, as well as in Zoonotic Diseases, a pamphlet published by the American Association of Zoo Keepers (Clark 1990).

Risk Assessment

The evaluation of benefits and risks (risk assessment) to decide management actions has recently become a popular conservation planning tool (Ballou 1993). Ecological variables (including disease) are identified and applied to mathematical models, which then predict the probability of extinction or genetic diversity loss. Effects of individual risk factors as well as the interaction between variables can be quantified.

A system has also been proposed to prioritize disease risks in captive populations intended for release. (Munson and Cook 1993) Patterned after the Mace/Lande system for categorizing species by degree of extinction, parameters such as pathogenicity and prevention availability determine the degree of threat. These criteria can then be used to categorize diseases as high risk, low risk, or no risk. Recommendations for investigation of high priority diseases are given (Munson and Cook 1993).

Role of Government Agencies Concerned with Health Issues

Legislation specific to wildlife is generally concerned with conservation of species. It affects possession, exhibition, and movement of certain animals (Mikota 1993). Animal health laws, for the most part, focus on diseases that are a threat to commercial agricultural industries or to humans (Cooper1993). In many cases animal health laws neither include nor exclude wild animals. Decisions concerning wild animals may be made on a case by case basis by the authorizing agent in charge. Coordination with government agencies is critical.

Domestic animal health programs and laws may present a confusing situation when wildlife become involved. Screening tests and control methods routinely used for domestics may not be valid in other species. As an example, tuberculosis continues to provide a diagnostic challenge in non-domestic hoofed animals and has impacted both captive propagation and reintroduction programs (Dunker and Bennet 1994; Flamand 1994; Cook 1993). Improved testing procedures are also needed for bluetongue, epizootic hemorrhagic diarrhea, and equine babesiasis (Heuschele 1990).

Record-Keeping Procedures Used to Monitor Diseases

Within an institutional framework, medical records are utilized to document diseases and treatments administered to individual animals. Many zoos evaluate morbidity and mortality annually as a tool for improved management and health care practices. For the most part, information sharing is done in the context of professional meetings, journal publications or informally between colleagues discussing difficult cases. As the movement of captive-held animals to other facilities or to the wild continues, access to current information on disease issues will be critical. Veterinary advisors to SSP's will need comprehensive medical information to be able to make decisions on health issues (Teare 1991). Such data exists for only a few species.

The benefits of a standardized computerized medical record keeping system cannot be overstated. "Medical records form a history of the past that we can use in the present to change the future" (Teare 1991). In addition to allowing analysis of an institutions' data, a standardized system also permits information sharing between facilities. Prospective medical information can be accessed and analyzed, providing veterinary advisors with timely information.

The most widely used system is the Medical Animal Record Keeping System (MedARKS, ISIS, 12101 Johnny Cake Road, Apple Valley, Minnesota, 55124, USA). Currently, there are 310 MedARKS users in 38 countries. Designed by zoo veterinarians, the MedARKS system has modules for clinical notes, treatment, anesthesia, parasitology, clinical pathology, and serum and tissue banking. Additional modules are forthcoming.

Disease monitoring is a component of several SSP'S and will be a part of all all SSP'S if the recommendations of the Veterinary Scientific Advisory Group are adopted. The Cheetah SSP is exemplary in utilizing an interdisciplinary team (a nutritionist, a geneticist, a clinical veterinarian, a pathologist, a reproductive physiologist, and a behaviorist (Miller 1993). Disease/pathology

surveys have been done for black rhino (E. Miller, pers. comm.), cheetahs (Munson 1993), maned wolves (Montali and Kelly 1989), red pandas (Montali et al 1984), and prosimians (Benirschke et al 1985). Detailed retrospective studies have been done for orangutans (Wells-Mikota) and elephants (Mikota).

The need for on-going surveillance of captive animals, especially those intended for reintroduction, is clear. The components of a disease monitoring program have been identified (TABLE V).

Several initiatives have emerged to address monitoring, investigation, and surveillance of disease in captive and free-ranging wildlife. An international system modeled after the American Committee on Arthropod-borne Viruses has been proposed. Epidemiology, laboratory diagnostics, and an information/data base are key components of the system. (Murphy et al 1993).

It has also been proposed that the International Office of Epizootics (OIE) collect information on wildlife diseases. The OIE coordinates the control of contagious domestic animal diseases through a global network of 126 member nations. Review of international wildlife movement regulations and standardization of diagnostic procedures and vaccination protocols are additional aspects of this initiative (Woodford 1993).

Similar recommendations were made by a working group formed during the International Conference on Implications of Infectious Disease for Captive Propagation and Reintroduction of Threatened Species (Oakland, California, USA, November 11-13, 1992).

Protocols for Regional Species Conservation Programs

At present there are virtually as many recommendations on captive species management as there are SSP programs. Indications by advisors range all the way from the extremely simple and intuitively correct need for pre-release quarantine, observation and physical exam, to protocols for specific tests and procedures involving individual members of certain species.

Fauna Interest Groups have historically had a range of interest species too broad to make specific recommendations. Their goal is to promote the environmental well being of entire regions.

Some TAG and all SSP protocols recommend procedures that are common in institutions dealing with animals. General practices include weighing over time, quarantine, and monitoring for pathogens. Advisors to TAGs identify disease risks and recommend testing procedures. In some cases, recommended protocols have been so broad that they cover entire Orders or Classes of animals involved in captive breeding situations (Zdziarsk et al 1993; Jacobson 1993).

Many conservation programs have similar components. This fact was recognized early on in the implementation of multiple single species conservation and reintroduction efforts. The need for universal methods of assessing, evaluating, monitoring, and preventing the transmission of disease to naive wildlife by reintroduced species was recognized. As mentioned before, an International Conference on Implications of Infectious Disease for Captive Propagation and Reintroduction of Threatened Species was held in Oakland, California, in November of 1992. Five working groups of recognized experts in the field of wildlife disease met and developed guidelines, recommendations and manuals designed to standardize data collection through established protocols to be used by Regional Species Conservation Programs (SSPs, TAGs, and FIGS). The working group dedicated to monitoring, investigation, and surveillance of disease in captive wildlife (Cook et al 1993) created a manual with four major components. The first part of this manual Is dedicated to the protocols for monitoring disease and disease surveillance of species in captive breeding and

reintroduction programs. The other three sections present guidelines for developing a central disease database, criteria for risk assessment in determining the threat of infectious diseases to reintroduction programs, and the interpretation and reporting of diagnostic tests, respectively. We will focus on the specific protocols recommended in the first section.

The Regional Species Conservation Program (RSCP) protocols are universal in application. They are presented as generic guidelines to be tailored for each species or taxa. Though most SSPs consider it the "gold standard", the protocols are detailed and extensive, so only a few programs have complied fully with submitting all the information.

The RSCPs emphasize the importance of designating a veterinary advisor for each conservation plan. The advisor's functions are clearly indicated in TABLE V.

Information on clinical and subclinical disease is best obtained by thorough tissue examination of dead individuals of the group of interest. The RSCP Necropsy Protocol Worksheet can be altered to fit the needs of each program. It covers not only all major Classes of animals involved in conservation projects, but also extends to neonates and fetuses. The RSCP Necropsy Protocol is presented in TABLE VI. A full tissue collection list is presented in TABLE VII.

Animals considered for reintroduction must be carefully scrutinized during captivity, and undergo a stringent, intensive prerelease quarantine period. The protocol detailed in TABLE VIII is designed to maximize data collection on each animal being considered for release. It should only be a starting point for the RSCP veterinary advisors. Specific tests should reflect as much as is known about disease processess in captivity and the wild. Pre-release screening does not preclude the possibility of disease introduction to naive wild populations. It only prevents that occurrence within the limitations of current knowledge.

Veterinary advisors to Regional Species Conservation Programs are responsible for implementing comprehensive animal health programs. Suggested components are presented in Table IX.

A veterinary advisor can follow an established protocol for reporting all collected information to the RSCP (TABLE XI). Once again, the form is generic and can be tailored for each species or taxa.

The Captive Disease Monitoring Workshop developed a list of infectious agents of concern to the zoological community (TABLE XII). Test availabilty or interpretation is unreliable for these agents. Interpretation of positive test results is difficult in some cases. The infectious agents are difficult to detect or eliminate from a captive population.

It is critical to develop standards of practice that ultimately impact issues of animal health. Species or taxa-specific guidelines may safeguard against the inadvertent introduction of disease into wild populations. These initiatives clearly define what needs to be done. Further coordination and cooperation are needed to carry out the work.

TABLE I *

Species Survival Plan (SSP) Mission Statement

The mission of the American of Zoo and Aquarium Association's (AZA's) Species Survival Plan (SSP) Program is to help ensure the survival of selected wildlife species. The mission will be implemented using a combination of the following categories:

- Organize scientifically managed captive breeding programs for selected wildlife as a hedge against extinction.
- Cooperate with other institutions and agencies to ensure integrated conservation strategies.
- Increase public awareness of wildlife conservation issues.
- Conduct basic and applied research to contribute to our knowledge of various species.
- Train wildlife and zoo professionals.
- Develop and test various technologies relevant to field conservation.
- Reintroduce captive-bred wildlife into restored or secure habitat as appropriate and necessary.

* American Zoo and Aquarium Association, Bethesda, Maryland, USA.

Table II *
Species Survival Plans
Mammals

Addax	Elephant	Okapi
African wild dog	Gaur	Orangutan
Arabian oryx	Goeldi's monkey	Pygmy hippopotamus
Asian small-clawed otter	Gibbon	Pygmy loris
Babirusa	Giant Panda	Red panda
Barasingha	Golden lion tamarin	Red wolf
Black Lemur	Greater one-horned rhinoceros	Asian ring-tailed lemur
Black rhinoceros	Grevy's zebra	Rodriques' fruit bat
Black and white colobus	Hartmann's mountain zebra	Ruffed lemur
Black-footed ferret	Jaguar	Scimitar-horned oryx
Bonobo	Lions	Snow leopard
Chacoan peccary	Lion-tailed macaques	Sloth and Sun bears
Cheetah	Lowland Gorilla	Spectacled bear
Chimpanzee	Maned wolf	Sumatran rhinoceros
Clouded leopard	Mangabey	Tiger
Cotton-top tamarin	Mexican grey wolf	Tree kangaroo
Drill	Mongoose lemur	

* American Zoo and Aquarium Association, Bethesda, Maryland, USA.

TABLE III *

Species Survival Plans

Birds, Reptiles, Amphibians, Fishes, and Invertebrates

Birds	Reptiles and Amphibians	Fish
Bali mynah	Aruba island rattlesnake	Haplochromine cichlids(34 species)
Cinereous Vulture	Chinese alligator	
Condor	Cuban crocodile	**Invertebrates**
Congo peafowl	Dumeril's ground boa	Partula snail
crane	Puerto Rican crested Toad	
Greater hornbill	Radiated tortoise	
Guam rail	Mona/Virgin islands boa	
Humboldt penguin		
Micronesian kingfisher		
Palm cockatoo		
Pink pigeon		
St. Vincent parrot		
Thick-billed parrot		

* American Zoo and Aquarium Association, Bethesda, Maryland, USA.

TABLE IV *

Responsibilities of veterinary advisors to AZA Species Management Plans *

1.	Identify the major medical problems of the species/taxa
2.	Participate in the development and distribution of medical protocols through the species/taxa husbandry manual, studbook, etc.
3.	Identify specialists in the areas affecting the health and well-being of the species. Assist in coordinating data collection efforts between other AZA Science Advisors, scientific specialists, collection managers and veterinarians.
4.	Provide regular reports (at least annual) to the Species Management Group and the chair of the Veterinary Science Advisory Committee.
5.	Advise the SSP/TAG on animal welfare, guidelines for surplus animals and significant federal legislation as it pertains to captive breeding, movement and or reintroduction.
6.	Facilitate the development of centralized sera and tissue banks.
7.	Act as a reviewer for proposed research protocols and methods that pertain to the species/taxa. The SSP/TAG Management Group must be advised on the value and potential health and welfare issues posed by such proposals.
8.	Act as reviewer for the medical portion of any surveys that are being sent out through the SSP/TAG or that are received by the SSP/TAG.
9.	Cooperate closely with the other Scientific Advisors for the species.

* Veterinary Science Advisory Group, American Association of Zoos and Aquariums, Peregrine Wolff DVM, pers. comm.

Table V *

Essential components of a successful disease monitoring program for captive animals

1.	Collection of consistent biomaterials and data
	a. Necropsy protocols for correct tissue sampling for pathology, virology, and bacteriology
	b. Protocols for sampling of feces, blood, and pelage for parasites
	c. Physical examination protocols
2.	Participation of all zoological parks
3.	Consistent evaluation of biomaterials
	a. Identification of experienced comparative pathologists
	b. Identification of appropriate ancillary laboratories
	c. Protocols for bacterial and viral culture
	d. Protocols for parasitological examination
4.	Centralization of results
	a. Develop computer-based programs for data input, analysis and retrieval
	b. Integrate programs with existing zoo animal inventory and medical programs
	c. Periodic review of data bases by veterinary advisors
5.	Communication of results to zoo and wildlife communities

* Munson L. & Cook R. (1993). - Monitoring, investigation, and surveillance of diseases in captive wildlife. Journal of Zoo and Wildlife Medicine, 24 (3): 282.

TABLE VI *

Regional Species Conservation Program

Necropsy Protocol Worksheet

Common name: _____ Genus/Species:_____

Isis #: _____ Studbook #: _____ Transponder/Other ID:_____

Date of Birth: _____ Age: _____ Weight (kg): _____ Sex: _____

Date of Death: _____ Date of Necropsy: _____

Gross Exam By: _____ Histopathology by: _____

Institution/Owner/Address:_____

History (Include clinical signs, treatments, antemortem test results, diet, circumstances of death and quarantine status): (Attach copy of medical record): _____

GROSS EXAMINATION WORKSHEET

General Condition (Nutritional condition, physical condition, body score, skin): _____

Musculoskeletal System (Bone, joints, muscles):_____

Body Cavities (Fat stores, abnormal fluids): _____

Hemolymphatic (Spleen, lymph nodes, thymus, bursa of Fabricus):

Respiratory System (Nasal cavity, larynx, trachea, lungs, regional lymph nodes, air sacs):_____

Cardiovascular System (Heart, pericardium, great vessels):_____

Digestive System (Mouth, teeth, esophagus, stomach, intestines, liver, pancreas, mesenteric lymph nodes):

_____

Urinary System (Kidneys, ureters, urinary bladder, urethra):

Reproductive System (Testis/ovary, uterus, oviduct, vagina, cloaca, penis, prepuce, acc. glands, mammary glands, placenta):

_____

Endocrine System (Adrenals, thyroid, parathyroids, pituitary):___ _____

Nervous and Sensory Systems (Brain, spinal cord, peripheral nerves, eyes, ears):

_____

GROSS DIAGNOSIS (List each lesion separately. Include organ, lesion type, distribution, severity, etc.):

LABORATORY DIAGNOSIS (List samples submitted [bacteriology, viral, parasitology, hematology, etc.] and attach results:

* Adapted from Cook et al 1993.

TABLE VII *

Regional Species Conservation Program Necropsy Protocol

Tissue Collection List

TAKE DUPLICATE SETS OF TISSUES FOR THE REGIONAL SPECIES CONSERVATION PROGRAM PATHOLOGIST. Preserve the listed tissues in 10 % buffered formalin at a ratio of 1 part tissue to 10 parts formalin. Tissues should be no thicker than 1 cm. INCLUDE SECTIONS OF ALL LESIONS AND samples from all tissues listed. For EMBRYOS OR NEONATES, also include the information in the NEONATAL PROTOCOL.

TISSUES TO SAMPLE: MAMMALS

Heart	Liver/gallbladder	Adrenal
Lungs	Stomach	Kidneys
Trachea/oesophagus	Pancreas	Urinary bladder
Thymus	Small intestine	Uterus/ovary
Thyroid/parathyroids	Large intestine	Testis/epid/prostate
Lymph nodes	Skeletal muscle	Brain/nervous tissue
Spleen	Bone/bone marrow	Skin
Eyes	Tongue	

TISSUES TO SAMPLE: BIRDS

Heart	Liver	Adrenal
Lungs	Crop	Kidneys
Trachea	Proventriculus	Bursa of Fabricius
Air sacs	Ventriculus	Skin with feathers
Thymus	Small intestine	Testis/ovary
Spleen	Large intestine	Oviduct
Pancreas	Skeletal muscle	Thyroid/parathyroid
Eyes	Bone/bone marrow	Brain/nervous tissue

TISSUES TO SAMPLE: REPTILES AND AMPHIBIANS

Heart	Liver	Adrenal
Lungs	Stomach	Kidneys
Trachea	Pancreas	Urinary bladder
Thymus	Small intestine	Testis/ovary
Skin	Large intestine	Oviduct
Spleen	Skeletal muscle	Brain/nervous tissue
Eyes	Bone/bone marrow	Thyroid/parathyroid

ESSENTIAL FROZEN TISSUE: Store 10 g (if possible) of liver, brain, kidney in an appropriate container and antemortem serum and plasma at - 70 C.

NEONATAL OR FOETAL NECROPSY PROTOCOL

Follow the adult protocol. Also include the following:

1. Fix the umbilical stump and surrounding tissues.

2. Examine for malformations (cleft palate, deformed limbs).

3. Assess hydration (tissue moistness) and evidence of nursing/eating (food or milk in stomach).

4. Determine if breathing occurred (do the lungs float in formalin ?).

5. Placenta

For avian and reptilian embryos: Open the coelomic cavity and fix the entire embryo. Include egg shell and membranes if available.

* adapted from Cook et al 1993.

TABLE VIII *

Minimum Quarantine Protocol for Preintroduction

Date: _____

Animal Identification: Accession #:_____ _____ Transponder # _____

Band #:_____ Genetic ID: _____ Other ID: _____

_____

Current Drug Exposure: (including contraceptives):

_____

Facility Standards

Length of quarantine: _____

Sanitation and hygiene requirements: _____

Required Testing/Biomaterials Collection for Species

Serology (date, test, results):_____

Fecal (method, results): _____

Culture (sites, results): _____

Biomaterials: _____

_____

Baseline Physiological Data

Temp (C): __ Weight (kg):__ Pulse/HR (BMP):___ Resp (RPM): __

_____

TABLE VIII (Continued) *

Minimum Quarantine Protocol for Preintroduction

Physical Examination

Ears/eyes/nose/throat: _____

Heart/lungs: _____

Abdomen:_____

Musculoskeletal:_____

Urogenital:_____

Dermatologic:_____

Other

Clinical Laboratory Tests Performed

CBC:_____ Biochemistry:_____ Urinalysis: _____ Fecal O&P:_____

_____

Vaccine: MLV/Killed Name brand:___
Date rec'd:____ Serial #:____

_____

Additional Required Tests (might include):

Radiographs TB testing Immune status Other

Prerelease Standards - The following tests must be negative or within acceptable limits for this species to be released (FOR EXAMPLE):

Negative TB test: _____ WBC no greater than: _____

3 negative fecal checks: _____ _____ _____

Negative fecal culture: _____ Negative blood parasites: _____

* adapted from Cook et al 1993.

TABLE IX *

Health Programs for Regional Species Conservation Program Veterinary Advisors

- Quarantine
- Vaccination
- Disease Surveillance

  Parasitology
  Serology
  Hematology
  Biochemistry
  TB testing
  Culture
  Biomaterial Banking

- Physical Examination
- Personnel Health Screening
- Pest Control
- Husbandry and Facilities Review
- Medical Record Keeping
- Regulatory Compliance

* Adapted from Cook et al 1993

TABLE X *

Animal Movement Protocol for Regional Species Conservation Program Veterinary Advisors

- Air Transport - Meets IATA Specifications
- Land Transport - Meets Regional/National Requirements
- Animal Welfare Considerations Met
- Minimizes Exposure to Infectious Diseases
- Minimizes Stress
- Prohibits Contact with Other Animals with Different Test Status
- Veterinary Inspection

  __ Preshipment __ Receiving
- Veterinarian or Caretaker Accompaniment Required
- Acknowledge Receipt - Including Animal Permanent Identification
- Regional Veterinarians and Animal Managers Be Notified of Pass Through with Preagreement for Emergency Assistance
- Full Pathology Exam Prearranged for any Mortalities during Shipment

* Adapted from Cook et al 1993.

TABLE XI *

Regional Veterinary Advisor's Reporting Protocol

1. **Necropsy Summary**

   a. Total number of deaths (sex and age demographics
   b. Cause of deaths
   c. Significant lesions and prevalence based on year and total
   d. Test results

2. **Significant Morbidity**

   a. Total numbers
   b. Age and sex predilections
   c. Presenting signs
   d. Therapetics

3. **Significant Test Results**

   a. Means and ranges (if significant number of normal individuals)

4. **Other Significant Activities**

   a. Genetics
   b. Nutrition
   c. Reproduction
   d. Other research

* Adapted from Cook et al 1993

TABLE XII *

Infectious Disease Agents With Equivocal Testing Procedures for Non-Domestic Species

- Mycobacteriosis (including Johne's and tuberculosis
- Salmonellosis
- Shigellosis
- Chlamydiosis
- Retroviruses (including feline immunodeficiency virus, feline leukemia virus, simian immunodeficiency virus, and hepadnaviruses)
- Herpesviruses (including malignant catarrhal fever, inclusion body disease of cranes, and herpes B)

* Adapted from Cook et al 1993

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An example of recommendations made for monitoring of disease so broad that they cover a whole animal Class are those observed for reptiles (JACOBSON). Specific indications exist in dealing with known pathogens. It has been recommended that all tortoises be monitored for two known diseases, mycoplasmosis and herpesvirus. Both diseases have had catastrophic effects on large tortoise collections. Mycoplasmosis may have been introduced to wild tortoises of California, Utah, Nevada, and Arizona desert regions by released pet tortoises. Several outbreaks severely affected extant desert tortoise populations. The same disease has caused an epizootic among Florida gopher tortoises, which were threatened before its appearance. Herpesvirus has been the cause of epizootics in tortoises stressed by shipping. In one case, 1,200 of 2,200 Argentine tortoises (*Geochelone chilensis*) died in a three month period after importation with red-footed tortoises, which remained clinically healthy. Latent carriers, which are usually imported animals, may be responsible for the outbreaks.

Amebiasis, caused by *Entamoeba invadens*, has been known to cause epizootics in squamates and chelonians alike. Control is attempted by isolation of affected animals and strict disinfection. Cysts of the parasite are very resistant to desiccation, and may remain in an environment for a long time. Finally, crytposporidiosis, a chronic and frequently lethal gastritis caused by Cryptosporidium sp., is one of the most insidious diseases of reptiles. It is known to affect snakes, lizards and tortoises. There is no means of testing for its presence, which is usually not known until its final stages. Animals may present signs and remain ill for up to one year before dying. At present, there is no effective treatment for affected reptiles. The intermixing of species which occurs in the pet trade and in private zoological collections have contributed to the epizootics observed in captive reptiles. Retroviruses of pythons may have originated in boas, and paramyxovirus, so lethal to viperids, may have originated from non-viperids. Infectious disease associated to captive situations are critical factors to be considered when breeding animals meant for reintroduction (Jacobson 1993).

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