CANID, HYENA, & AARDWOLF

CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP)

CANID, HYENA, & AARDWOLF

CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP)

Final Draft Report

Edited by
Jack Grisham, Alan West, Onnie Byers and Ulysses Seal

Canid Specialist Group

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2 May 1994

Conservation Assessment and Management Plan (CAMP) for Canids, Hyaenas, and Aardwolves

Co-Sponsored by

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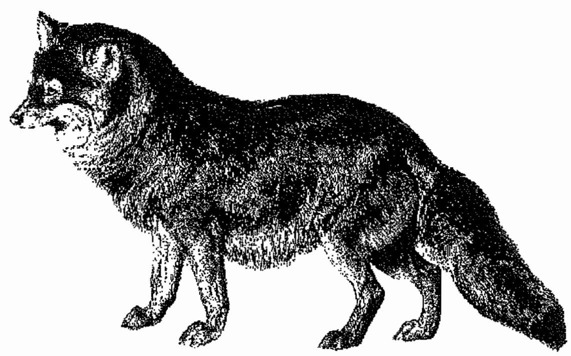

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Executive Summary

by Tom Foose

All taxa (species and subspecies) in the families Canidae, Hyaenidae and Protelidae are reviewed on a taxon-by-taxon basis to assign a category of threat and to recommend captive programs as well as other intensive management action.

Currently, there are:

- 34 species and 221 distinct taxa (subspecies) recognized in the family Canidae;
- Three species and three distinct taxa (subspecies) in the family Hyaenidae;
- One species and one distinct taxon (subspecies) in the family Protelidae.

Approximately 1,800 living canid specimens, 145 living hyaena, and 40 living aardwolf specimens are registered with the International Species Identification System (ISIS). The number of living mammals registered with ISIS (65,000) represents about 25 percent of the total mammalian specimens estimated/reported to be maintained in the world's 1100 zoos. Hence, the numbers of captive "spaces" in the world's zoos are conservatively estimated to be at least 3,600 for canids, 300 for hyaenas, and 100 for aardwolves, if all were devoted to conservation of these animals.

Thirty-three (33) of the 221 canid taxa (15 percent) and one of the three hyaena taxa (33 percent) are assigned to one of three categories of threat according to Mace-Lande criteria while 188 of the canid taxa (85 percent), two of the hyaena taxa (67 percent) and the aardwolf are considered "Safe" (i.e., not under threat at this time):*

	Canids	Hyaenas	Aardwolf
Critical	8 (3.5%)	0 (0%)	0 (0%)
Endangered	10 (4.5%)	0 (0%)	0 (0%)
Vulnerable	15 (7%)	1 (33%)	0 (0%)
Safe	188 (85%)	2 (66%)	1 (100%)

Twenty-nine (29) of the 221 canid taxa (14 percent), three of the hyaena taxa (100 percent), and the aardwolf (100%) are recommended for one of four levels of captive program:

	Canids	Hyaenas	Aardwolf
90/100 I	6 (3%)	0 (0%)	0 (0%)
90/100 II	0 (0%)	0 (0%)	0 (0%)
Nucleus I	17 (8%)	1 (33%)	0 (0%)
Nucleus II	6 (3%)	2 (67%)	1 (100%)

Fourteen (14) of the 221 canid taxa (6 percent) but none of the hyaenas nor the aardwolf are recommended for population and habitat viability analyses (PHVAs).

Twenty-one (21) of the 221 canid taxa (10 percent) and one of the hyaena taxa (33 percent) are recommended for more intensive *in situ* management.

Forty-seven (47) of the 221 canid taxa (21 percent), three of the hyaena taxa (100 percent), and the aardwolf (100 percent) are recommended for research:

	Canids	Hyaenas	Aardwolf
Taxonomic research	36 (16%)	1 (33%)	1 (100%)
Surveys	41 (19%)	3 (100%)	1 (100%)
Husbandry research	4 (2%)	1 (33%)	0 (0%)

* **This information needs to be qualified considering the scarcity of information on some taxa (subspecies). Excluding species/subspecies which are unknown, 12 of the canid species (36%) and 26 of the subspecies (46%) are in one of the three categories of threat according to the Mace-Lande criteria.**

Status	Species	Subspecies
Critical	2 (6%)	7 (13%)
Endangered	4 (12%)	10 (17%)
Vulnerable	6 (18%)	9 (16%)
Unknown	2 (6%)	2 (4%)
Safe	19 (58%)	28 (50%)
Total Numbers	33	56

Preamble

by Jack Grisham
General Curator
Oklahoma City Zoological Park

Reduction and fragmentation of wildlife populations and habitats is occurring at a rapid and accelerating rate. The prospects for an increasing number of taxa are limited due to isolated populations that are in danger of extinction.

In addition to the deterministic threats of habitat degradation and unsustainable exploitation, stochastic problems also can imperil the survival of small populations. Stochastic events are random and therefore difficult to predict. However, careful genetic and demographic management of small populations can moderate many of these stochastic problems. The problems of small populations apply to species in both the wild and in captivity. Much of the methodology being developed by the captive community for managing small populations may be useful for management of small populations in the wild.

Stochastic problems can be environmental, demographic, or genetic in nature. Environmentally, small populations can be devastated by catastrophes or decimated by less drastic fluctuations in environmental conditions that can impair survival and fertility of individuals. Catastrophes (e.g., droughts, floods, epidemics) are increasingly recognized as severe threats to small populations. Demographically, even in the absence of deleterious fluctuations in the environment, small populations may develop intrinsic demographic problems (e.g., biased sex ratios, unstable age distributions, or random failures in survival and fertility) that can fatally disrupt propagation and persistence. Genetically, small populations also can rapidly lose heritable diversity that is necessary for fitness under existing environmental conditions and adaptation to changed environments in the future. The smaller the population and the more limited it is in distribution (i.e., the more fragmented it is), the greater these stochastic risks will be.

Conservation strategies and action plans for threatened taxa must be based on viable populations, those that are sufficiently large and well distributed to survive stochastic risks as well as deterministic threats. Viable conservation strategies and action plans also frequently will require management in addition to protection for small populations. Viable population strategies may often require that the taxa be managed as metapopulations (i.e., systems of disjunct subpopulations that are interactively managed with regulated interchanges among them and interventions within them to enhance survival of the taxon).

Development of viable metapopulation strategies can be greatly facilitated by population and habitat viability assessments (PHVAs) (Seal et al., 1990). The PHVA process is in an early and experimental stage. Experience thus far has indicated that workshops are effective in applying the PHVA process to development of conservation assessment and management plans (CAMPs) for taxa whose populations have declined to levels where they are considered under threat of extinction (Clark et al., 1990). PHVA/CAMP workshops use computer models to simulate the deterministic and stochastic processes that imperil small populations and to explore what effects various management options produce. Thus PHVA/CAMP workshops are powerful tools in developing viable conservation strategies and action plans.

PHVA/CAMP workshops assemble field biologists, captive professionals, and wildlife managers who have experience with, as well as the management responsibility and authority for, the taxon. PHVA workshops are almost always conducted in the country, and optimally the locality, of origin of the taxon under consideration. Population and conservation biologists with expertise in use of the computer models also participate to assist the taxon managers in performing the analyses. It is ultimately these managers who actually formulate and then implement the conservation assessment and management plans and action plans.

Viable metapopulations often will need to include captive components (Foose et al., 1987). In general, captive populations and programs can serve three roles in such holistic conservation strategies:

1) Living ambassadors that can educate the public at all levels and can generate funds for *in situ* conservation.

2) Scientific resources that can provide information and technologies beneficial to protection and management of populations in the wild.

3) Genetic and demographic reservoirs that can be used to reinforce survival of taxa in the wild either by revitalizing populations that are languishing in natural habitats or by reestablishing populations that have become extinct.

The third of these roles may often be a benefit for the longest term as return to the wild may not be a prospect for the immediate future. However, it is proposed that captive and wild populations should and can be intensively and interactively managed with interchanges of animals occurring as needed and as feasible. Captive populations are support, but should not be a substitute, for wild populations. There may be many problems with such interchanges including epidemiologic risks, logistical difficulties, financial limitations, etc. But with effort, based on limited but growing experience, these can be resolved. The bottom line is that strategies and priorities should try to maximize options and captive propagation can contribute significantly to this goal. The IUCN Policy Statement on Captive Breeding (IUCN 1987) recommends in general that captive propagation programs be a component of conservation strategies for taxa whose wild population is below 1,000 individuals.

As natural habitats decline, large and growing numbers of taxa will require assistance from captive programs. However, resources (space, funds, staff) are limited. Strategic priorities must be developed for program development and resource allocation. Developing these priorities is the purpose of Global and Regional Captive Action Plans. Applying these priorities, Regional and Global Captive Propagation Programs can be developed to assist conservation of threatened taxa.

Canid, Hyena and Aardwolf Conservation Assessment and Management Process

The Canid, Hyena and Aardwolf Conservation Assessment and Management Plan was held at Fossil Rim Wildlife Center from May 14 to May 17, 1992. This document is the first effort to define a plan that will be dynamic and evolving as new data become available.

The CAMP process entails consideration of wild and captive data in a very intensive and interactive workshop involving representatives of both the captive and field communities. During the course of the workshop, assessments of risks and formulation of recom-mendations for action are developed. These recommendations are then reviewed by a larger group of captive and field experts.

During the workshop, canid, hyena and aardwolf taxa were evaluated on a taxon-by-taxon basis in terms of their status and prospects in the wild to assign priorities for intensive management. For simplification purposes, all major species were assigned to one of four geographical task groups, North America, Central/South America, Africa and Asia.

The workshop participants applied the proposals by Mace and Lande (1991) for the redefinition of the IUCN Red Data Categories. The Mace-Lande scheme attempts to assess threats in terms of a likelihood of extinction within a specified period of time (Table 1). The system defines three categories for threatened taxa:

Critical 50 percent probability of extinction within 5 years or two generations, whichever is longer.

Endangered 20 percent probability of extinction within 20 years or ten generations, whichever is longer.

Vulnerable 10 percent probability of extinction within 100 years.

To assist in making recommendations, participants in the workshop were encouraged to be as quantitative as possible for two reasons: (1) conservation assessment and management plans ultimately must establish numerical objectives for population sizes and distribution if they are to be viable; (2) numbers provide for more objectivity, less ambiguity, more comparability, better communication and hence cooperation (Stevenson & Foose, in prep). During the workshop, there were many attempts to estimate if the total population of each taxon was greater or less than the numerical thresholds for the three Mace-Lande categories of threat. In many cases, population estimates were out-of-date or simply not available; in all cases, conservative numerical estimates were used. Where population numbers are estimated, these estimates represent first-attempt, order-of-magnitude guesstimates that are hypotheses for falsification and stimuli for better information that can be provided during the review process. As such, the workshop participants emphasize that these guesstimates should not be used as an authoritative estimate for any other purpose than intended by this process.

Table 1. Mace-Lande Categories and Criteria of Threat

Population Trait	Critical	Endangered	Vulnerable
Probability of extinction	50% within 5 years or two generations, whichever is longer	20% within 20 years or 10 generations, whichever is longer	10% within 100 years
	OR	OR	OR
	Any two of the following criteria:	Any two of the following criteria or any one CRITICAL criterion:	Any two of the following criteria or any one ENDANGERED criterion:
Effective population N_e	N_e <50	N_e <500	N_e <2,000
Total population N	N <250	N <2,500	N <10,000
Subpopulations	$\leq$ 2 with N_e > 25, N > 125 with immigration < 1/generation	$\leq$5 with N_e >100, N > 500 or $\leq$ 2 with N_e > 250, N > 1,250 with immigration < 1/generation	> 1%/year for last 10 years
Population Decline	> 20%/year for last 2 years or > 50% in last generation	> 5%/year for last 5 years or > 10%/generation for last 2 years	> 1%/year for last 10 years
Catastrophe: rate and effect	> 50% decline per 5-10 years or 2-4 generations; subpops highly correlated	> 20% decline/5-10 years, 2-4 gen. > 50% decline 10-20 years, 5-10 gen. w/subpops. highly correlated	> 10% decline/5-10 years > 20% decline/10-20 years or > 50% decline/50 yrs w/subpops. correlated
OR			
Habitat Change	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects
OR			
Commercial exploitation or Interaction/introduction taxa	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects

In assessing threat according to the Mace-Lande criteria, workshop participants used information on the status and interaction of other population and habitat characteristics in addition to the guesstimates of total number. Information about population fragmentation, trends, range, and environmental stochasticity were also considered. Numerical information about a species was not sufficient for assignment to one of the four Mace-Lande categories. For example, based on numbers alone, a taxon might be assigned to the Vulnerable category. Knowledge that the taxon is under severe threat in its natural habitat, that the population is declining, or that the population is severely fragmented might lead to assignment in the Endangered category. When a taxon bordered between two categories, it was always assigned to the category of greater threat.

Captive populations should be treated as integral parts of metapopulations that are managed by conservation strategies and action plans. The approximate scheme applied for formation of the Canid, Hyena and Aardwolf Conservation Assessment and Management Plan recommendations is as follows:

Captive Recommendation	Level of Captive Program
90/100 I	Population sufficient to preserve a minimum of 90 percent of the average heterozygosity of the wild gene pool for 100 years developed within 1-5 years.
90/100 II	Population sufficient to preserve a minimum of 90 percent of the average heterozygosity of the wild gene pool for 100 years developed within 5-10 years.
Nuc I	A captive nucleus (50-100 individuals) to always represent a minimum of 98 percent of the wild gene pool. This type of program will require periodic, but in most cases modest, immigration/importation of individuals from the wild population to maintain this high level of genetic diversity.
Nuc II	A captive nucleus (25-100 individuals) should be maintained in captivity. These taxa may not be of conservation concern, but may already be present in captivity or otherwise of interest. Their status may be poorly known or poorly monitored, so in some cases they are included pending review of population estimates or further survey work. For species already present in captivity, the captive nucleus should be managed as well as possible.
Eliminate	A captive nucleus should not be maintained in captivity. These taxa are not of conservation concern and are plentiful in the wild. The present captive population should be managed to extinction. (For some North American and Palearctic species, decisions to eliminate from captive collections are less conservative. These populations are closely monitored and in the event of a decline can be rapidly brought into captivity.)
No Rec	Establishment of a captive program is not recommended.

In cases where the recommendation for a captive program is Nucleus I or Nucleus II, it is proposed that genetic exchange take place between captive populations and wild populations as needed. This system would normally require the addition of one or two wild-caught individuals per generation to the captive nucleus. If the wild population declined into a greater state of threat (i.e., Endangered or Critical category), this subsidization would cease and the nucleus could be expanded into a full program that ultimately could be used to reinforce the wild population.

Some recommendations to retain small nuclei of canid, hyena and aardwolf species in captivity are based on a worst-case scenario (e.g., rapid, massive depletion in the wild). For all captive programs, it is recommended that species should be held in more than one institution with cooperative regional management plans, especially for those assigned Critical or Endangered status.

Canid CAMP Recommendations

by Joshua Ginsberg
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The table on the following pages summarizes the recommendations for 36 species of canids, 4 species of hyaenids, and their subspecies. It should be noted that the Action Plan only classifies 34 species (*Vulpes velox*, swift and kit, is considered as one species not two, and *Dusicyon fulvipes* is not given specific status). When the canid species in this table are compared to the recommendations in the Canid Action Plan, the following results can be seen:

- Three species/subspecies showed an increase in their threat status within classified groups (*Chrysocyon*, *Cuon*, and Dingo)
- Two species decreased in their threat status within classified groups (*Lycaon*, and *V. bengalensis*)
- Eighteen species showed no change within classified groups
- Five species went from a classification of Unknown to Safe. The Status Unknown Category was not used in the CAMP process. As a result five species, and four sub-species classified as "Safe". This does not indicate that these species are Safe but that, because their status is uncertain, they could not be put in a category of threat.

Subspecies were not considered in the above summary as they were not classified in the action plan as such. Endangered and Critical were considered equal classifications as the latter was not in current use when the Action Plan was written and indicates a subdivision only recognized indirectly in the Plan. The only species for which this appears to make a large difference are:

- *Canis lupus* -- one subspecies (*baileyi*) classified "Highly Endangered" and one population of another subspecies (*lupus lupus* in Italy) classified as "Highly Threatened" are classified as Critical.

- *Urocyon littoralis* -- when individual island groups are considered as subspecies, the persistence of the species as a whole remains vulnerable, but individual groups face greater threats of extinction.

- *Lycaon pictus* -- better data suggest that some sub-populations in southern Africa may be less threatened than those in other parts of the range of this species.

Genus	Species	Subspecies	Common Name	CAMP	CAP	Change	Action
Alopex	***lagopus***		Arctic fox	safe	safe	0	eliminate
Canis	***adustus***		side-striped jackal	safe	safe	0	eliminate
Canis	***aureus***		golden or asiatic jackal	safe	safe	0	eliminate
Canis	*aureus*	*lupaster*		safe	safe		none
Canis	*aureus*	*lanka*		safe	safe		eliminate
Canis	*familiaris*	*dingo*	dingo	vul	safe	+	Nuc I
Canis	***latrans***		coyote	safe	safe	0	eliminate
Canis	*lupus*		Grey wolf	vul	vul	0	eliminate
Canis	*lupus*	*arabs*		endangered	vul		Nuc I
Canis	*lupus*	*baileyi*		critical	vul		90/100I
Canis	*lupus*	*campestris*		safe	vul		eliminate
Canis	*lupus*	*chanco*		safe	vul		eliminate
Canis	*lupus*	*lupus*		safe	vul		eliminate
Canis	*lupus*	*lupus* (Fin, E. Eur)		safe	vul		eliminate
Canis	*lupus*	*lupus* (Italy)		crit	vul		Nuc I
Canis	*lupus*	*lupus* (Swed/Nor)		endangered	vul		None
Canis	*lupus*	*pallipes*		vul	vul		Nuc II
Canis	*lupus*	*signatus*		endangered	vul		Nuc I
Canis	***mesomelas***		black-backed jackal	safe	safe	0	eliminate
Canis	***rufus***		Red wolf	critical	endangered	0	SSP
Canis	*rufus*	*gregoriyi*		critical	endangered		SSP
Canis	***simensis***		Simien jackal	critical	endangered	0	None
Cerodocyon	***thous***		crab-eating zorro	safe	safe	0	eliminate
Chrysocyon	***brachyurus***		maned wolf	endangered	vul	+	90/100I
Crocuta	***crocuta***		spotted hyaena	safe			Nuc II
Cuon	***alpinus***		dhole/red dog	endangered	vul	+	Nuc I
Cuon	*alpinus*	*sumatrensis*		critical	vul	0	Nuc I
Dusicyon	***cuplaeus***		culpeo	safe	safe	0	eliminate
Dusicyon	***fulvipes***			vul?	vul	0	Nuc I
Dusicyon	***gymnocercus***		Azara's zorro	safe	safe	0	eliminate
Dusicyon	***griseus***		grey zorro	vul	vul	0	Nuc II
Dusicyon	***microtis***		small-eared dog	endangered	unknown	0	Nuc I
Dusicyon	***sechurae***		Sechuran zorro	vul	unknown	0	Nuc I
Dusicyon	***vetulus***		Hoary zorro	vul	unknown	0	Nuc I
Lycaon	***pictus***		African wild (hunting) dog	vulnerable	vul	-	not listed
Lycaon	*pictus*	West		critical	endangered		90/100I
Lycaon	*pictus*	East		endangered	endangered		90/100I
Lycaon	*pictus*	South		vul	endangered		Nuc I
Nyctereutes	***procyonoides***		Raccoon dog	safe	safe	0	eliminate
Otocyon	***megalotis***		Bat-eared fox	safe	safe	0	Nuc II
Speothos	***venaticus***		bush dog	vul	vul	0	Nuc I

Genus	Species	Subspecies	Common Name	CAMP	CAP	Change	Action
Urocyon	***cinereoar-genteus***		grey fox	safe	safe	0	eliminate
Urocyon	***littoralis***		island grey fox	vul	vul	0	
Urocyon	*littoralis*	San Nicholas		critical	vul		Nuc I
Urocyon	*littoralis*	N.Channel Is		endangered	vul		Nuc I
Urocyon	*littoralis*	S.Channel Is		endangered	vul		Nuc I
Vulpes	***cana***		Blanford's fox	vul	unknown	0	Nuc I
Vulpes	*velox*		swift or kit fox	safe	safe		eliminate
Vulpes	*velox*/kit		kit fox	safe	unknown	0	Nuc II
Vulpes	*velox*/swift		swift fox	safe	unknown	0	Nuc II
Vulpes	*velox*	San Joaquin		endangered	unknown		Nuc I
Vulpes	***bengalensis***		Bengal fox	safe	vul	-	eliminate
Vulpes	***chama***		Cape fox	safe	safe	0	eliminate
Vulpes	***corsac***		Corsac fox	safe	unknown	0	eliminate
Vulpes	***ferrilata***		Tibetan sand fox	safe	safe	0	eliminate
Vulpes	***pallida***		Pale fox	safe	unknown	0	none
Vulpes	***rueppelli***		Ruepell's fox	safe	unknown	0	eliminate
Vulpes	***velox***	other kit	kit fox	safe	unknown		Nuc II
Vulpes	***velox***	swift	swift fox	safe	unknown	0	Nuc II
Vulpes	***vulpes***		red fox	safe	safe	0	eliminate
Hyaena	***brunnea***		brown hyaena	vul			Nuc I
Hyaena	***hyaena***		striped hyaena	safe			Nuc II
Proteles	***cristatus***		aardwolf	safe			Nuc II

Relationship Between the Conservation Assessment and Management Plan Working Group and the AAZPA Taxon Advisory Group

by Robert Wiese
Assistant Director, AAZPA Conservation and Science
Bethesda, Maryland

Members of the AAZPA Taxon Advisory Groups (TAGs) often wear several hats in the conservation community and may serve as members of both regional and global working groups. Because of this overlap, it is often easy to become confused as to the role of each group. The intent of this statement is to help clarify the role of AAZPA TAG members in the development of a North American Regional Collection Plan (RCP) and explain the RCP's relationship to the Conservation Assessment and Management Plan (CAMP) developed by the IUCN/SSC CBSG.

The primary responsibility of an AAZPA TAG is to develop and implement a North American Regional Collection Plan. In many cases, development of a CAMP is the first step in this process. CAMPs are developed as collaborative efforts of the IUCN/SSC CBSG with the IUCN/SSC Taxonomic Specialist Groups and the Regional TAGs which represent the SSP, EEP, ASMP, etc.

The CAMP process is designed to bring together a wide diversity of individuals, representing *in situ* and *ex situ* conservation efforts and sharing a common taxon of interest. The goal of this process is to review the wild and captive status of all relevant taxa and develop a list of <u>conservation needs</u> that can serve as recommendations for both the field and captive communities. Needs are based upon the perceived threat to the taxa as determined by the Mace/Lande Criteria. These criteria use the size, distribution and trend of the population and the habitat condition to assess risk of extinction. Recommended actions provided by the CAMP include, but are not limited to:

- Population and Habitat Viability Assessment
- Conservation Management Plan Workshops
- Intensive protection and management in the wild
- *In situ* and *ex situ* research needs
- Captive propagation programs

One product of the CAMP process is the Global Captive Action Plan (GCAP) -- a listing of species in need of captive breeding. With the limited resources available, development of the CAMP is a critical first step in setting conservation priorities.

Following the CAMP process, it is the Regional TAG's responsibility to consider the GCAP recommendations <u>within a regional context</u> and to develop and implement a Regional Collection Plan. The RCP evaluates the actions recommended in the GCAP and determines which taxa should be a priority for AAZPA institutions. This differs from the CAMP in that it involves examination of realistic factors affecting all captive breeding programs. The CAMP/GCAP recommendations are just one of many factors that need to be evaluated in this process. Other factors include:

- Availability of sufficient founders
- Ability to manage and breed the taxon in captivity
- Exhibit value and institutional interest
- Taxonomic uniqueness
- Ability to serve as a "flagship" species
- Probability for success

Once regional priorities are set, the TAG is responsible for recommending new taxa for studbook and SSP designation and thereby affecting the development of institutional collection plans that meet regional goals. Ideally, the GCAP and RCP are both dynamic documents that develop in a highly iterative and interactive process with one another and with other regional programs. Thus, IUCN/SSC CBSG is responsible for development of the Global Captive Action Plan and the TAG is responsible for development and implementation of the Regional Collection Plan.

Because resources are limited, prioritization must occur. This difficult approach recognizes that we cannot save every species through captive breeding. However, it is the only truly responsible course of action.

AAZPA Canid, Hyena, Aardwolf Taxon Advisory Group
Space Priority for Captive Species

by Jack Grisham, General Curator
Oklahoma City Zoological Park

Based upon the CAMP process for determining the species in most need of captive conservation, the AAZPA Taxon Advisory Group (TAG) utilized the Carnivore Space Survey for AAZPA Zoos, compiled by Jill Mellen, Cynthia Cheney and Jan Barker of Metro Washington Park Zoo, Portland, Oregon, to determine the amount of space available and which species should be kept in captivity. The space survey is first broken down into categories according to weight and then on the basis of current population, current capacity and future capacity. These recommendations are based upon the current space available in AAZPA institutions and the recommendations of the CAMP process. Currently there are numerous species of canids, hyenas and aardwolves that are exhibited in AAZPA institutions. Our goal is to provide direction and guidance on the species that need to be worked with in a captive situation. Realizing that some exhibit space is dedicated to specific zoogeographic species and theme exhibits that cannot be changed, we make the following recommendations based upon current knowledge and availability of species for captive populations.

CANIDS: In species that weigh < 10 kg, the recommendations are:	
50 spaces	for Island Gray Fox (divided between San Nicholas and one of the other Channel Islands), pending the availability of these subspecies.
25 spaces	for bushdogs
25 spaces	for fennec foxes
64 spaces	for *Vulpes, pallida* and *fulvipes*.
Eliminate populations of Arctic foxes, gray foxes and generic foxes.	

CANIDS: In species that weigh 10-21 kg, the recommendations are:
All captive spaces should be made available if Ethiopian wolves become available for captive conservation work in cooperation with the Ethiopian government.
The dhole is to receive any and all spaces available for captive conservation work. Currently, there is a small population of dholes in North America. There should be an effort to establish a nuclear population in AAZPA institutions.
Eliminate populations of jackal, red fox, coyote, generic jackal and domestic dog from population. Spaces can also be used for <10 kg species if necessary.

CANIDS: In species that weigh > 21 kg, the recommendations are:
Divide up space equally between the existing three SSPs (Maned Wolf, Red Wolf and African Wild Dog); also allocate spaces for Mexican Wolf. The South African population of African wild dog should be decreased in captivity with an emphasis on working on the East African Wild Dog, if animals become available.
Eliminate all generic wolves, timber (gray) wolves and generic canids.

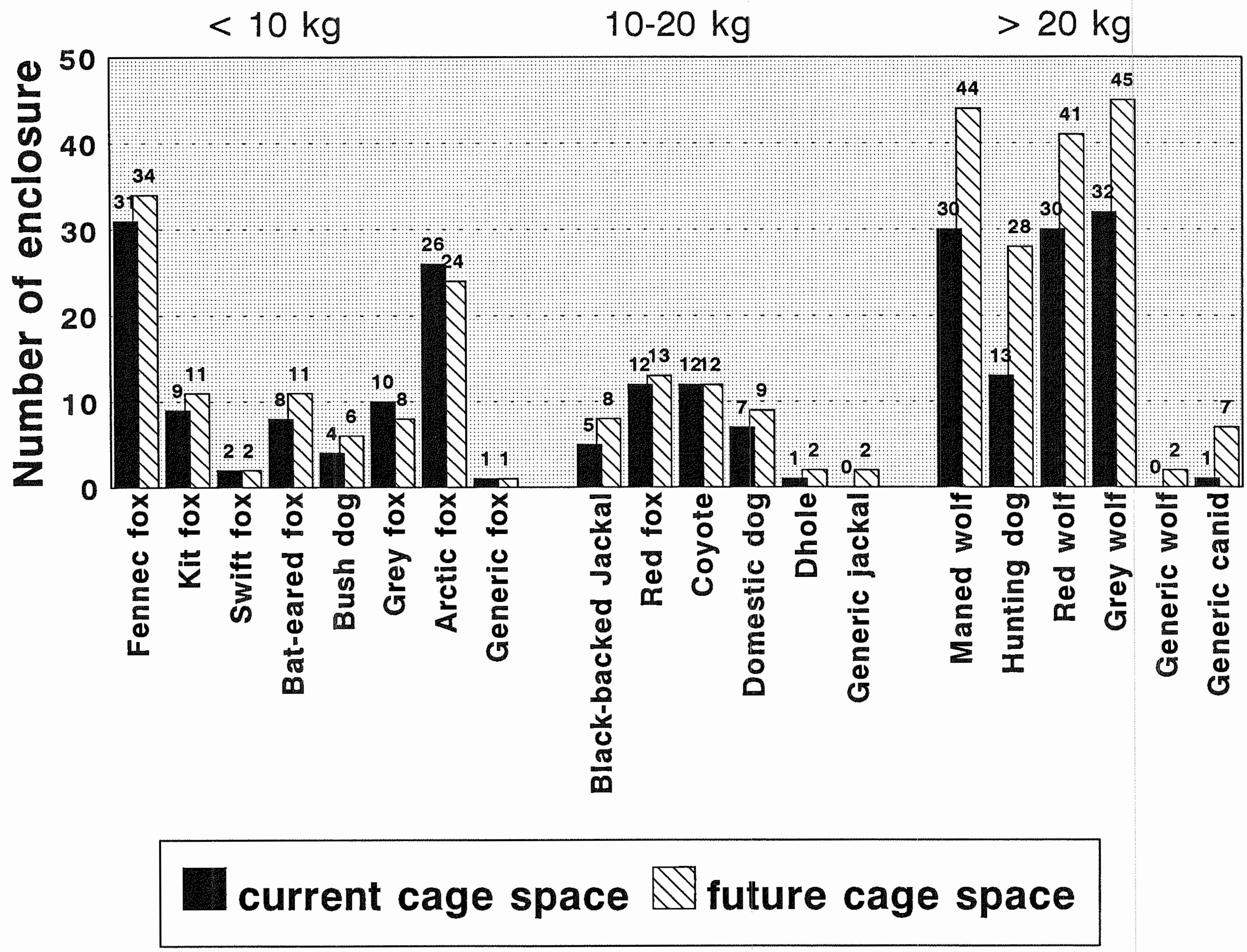
HYENAS/AARDWOLVES: Recommendations are:
Divide the existing spaces between aardwolves and spotted hyena. New founders are needed for aardwolves. Phase out the brown and striped hyenas through attrition.

The goal of the Canid, Hyena and Aardwolf TAG is to recommend the elimination of Safe species and work toward developing a nucleus for Endangered and Threatened species. The elimination of the Safe species can be done through attrition of animals from collections and possible development of new spaces for the threatened species.

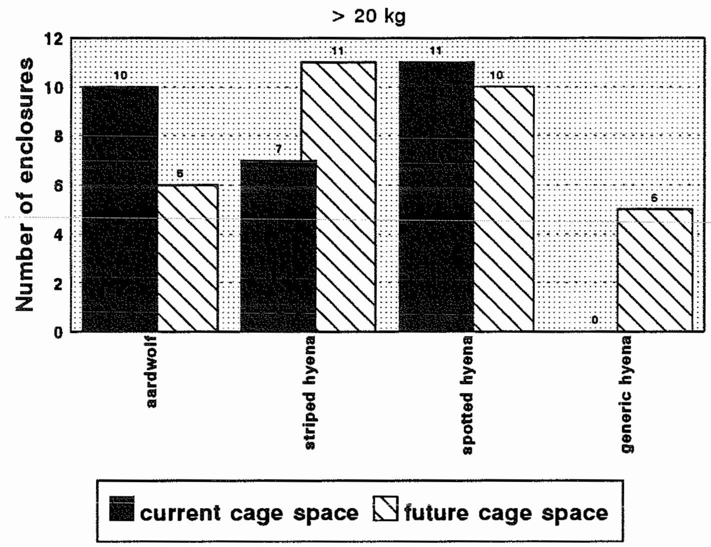
Canid Space Survey - North America				
Parameter	<10kg	10-21kg	>21kg	Total
Current Population				
Cages	91	37	106	234
Adults	164	85	239	488
Juveniles	15	6	32	53
Current Capacity				
Adults	194	96	314	604
Juveniles	170	41	282	504
Future Capacity				
Adults	198	116	423	737
Juveniles	181	65	394	640

Hyena/Aardwolf Space Survey - North America				
Parameter	<10kg	10-21kg	>21kg	Total
Current Population				
Cages	-	-	28	28
Adults	-	-	48	48
Juveniles	-	-	1	1
Current Capacity				
Adults	-	-	42	42
Juveniles	-	-	30	30
Future Capacity				
Adults	-	-	63	63
Juveniles	-	-	54	54

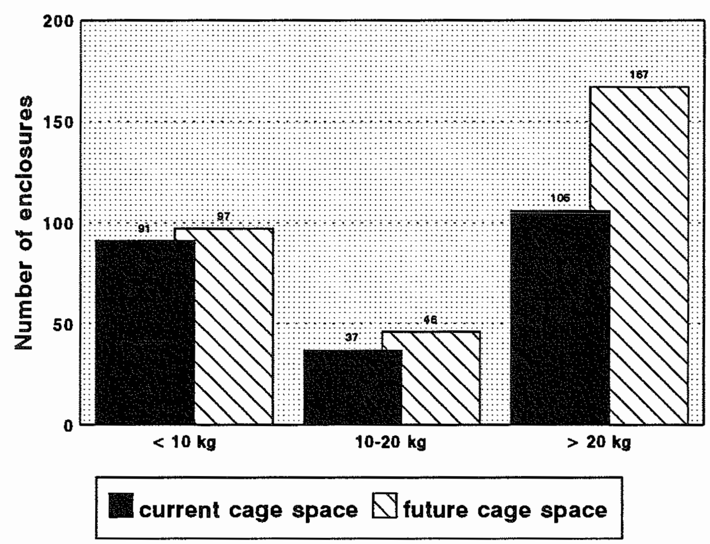
North America
Canid Current and Future Enclosure Space



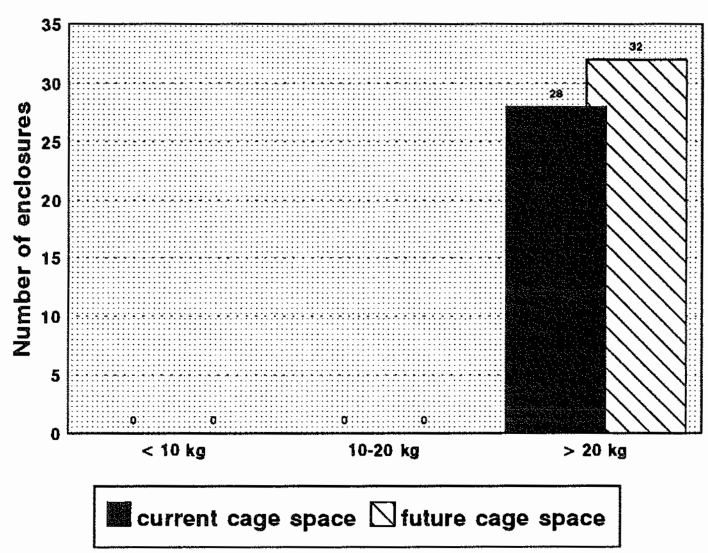
North America
Hyaenid Current and Future Enclosure Space



North America
Current and Future Enclosure Space for Canids by Size Class



North America
Current and Future Enclosure Space for Hyaenids by Size Class



Canid Population Survey Techniques

by Todd K. Fuller
Department of Forestry and Wildlife Management
University of Massachusetts

Listed below are suggested techniques for surveying of wild populations of canids. This is intended only as a starting point for further elaboration.

Presence/absence:

- Interviews with locals/compare with photos
- Hunting/trapping reports/returns
- Opportunistic sightings
- Scent stations/track boards/track identification
- Camera stations
- Howling/vocalizations
- Bile acids in scats
- Hair collection
- Live captures
- Species-specific sign (digging, scratchings, dens, scats, prey remains)

Abundance:

Systematic sign surveys (tracks, photos, scats, other signs, etc.) if sample sizes are large and adequately stratified (plots, transects, etc.)

Capture/recapture estimates

re-trapping
re-observations
photos
marked scats (isotopes, beads)

Radiotelemetry

movements - range size, territorial or not

Population changes (other than irruption or catastrophic decline):

Density - intensive "abundance" estimation

Demographic modeling - reproductive and survival rates

Summary of Status of South American Canids

Nine species and one subspecies, *Dusicyon griseus fulvipes*, were considered. It has been suggested that this subspecies should be classified as a separate species and it was treated as such here.

Ranking of Captive Programs by Mace-Lande		
Atelocynus microtis (Dusicyon?)	Endangered	Establish 90/100 I pop
Chrysocyon brachyurus	Endangered	Establish 90/100 I pop
Speothos venaticus	Vulnerable	Establish Nucleus I pop
Dusicyon vetulus	MIR	Establish Nucleus I pop
Dusicyon sechurae	MIR	Establish Nucleus I pop
Dusicyon fulvipes	Vulnerable	Establish Nucleus I pop
Dusicyon griseus	Vulnerable	Establish Nucleus II pop
Cerdocyon thous	Safe	Eliminate from captivity
Dusicyon gymnocercus	Safe	Eliminate from captivity
Dusicyon culpaeus	Safe	Eliminate from captivity

General Recommendations and Research Priorities:

1. **Clarify taxonomic issues, specifically for *Dusicyon* and *Speothos*.**

2. **Conduct surveys and collect basic ecological information for all South American canids, particularly the little-known *D. vetulus* and *D. sechurae*. This should include distribution data, habitat requirements, population trends, and mortality factors.**

3. **Monitor the southward range expansion of northern species such as *C. latrans*.**

Summary of Status of North American Canids

Ranking of Status of Captive Programs by Mace-Lande				
Alopex	*lagopus*		Safe	
Canis	*latrans*		Safe	Eliminate
Canis	*lupus*	*baileyi*	Critical	90/100 I
Canis	*lupus*	various subspecies	Safe/Vulnerable/ Endangered	
Canis	*rufus*	*gregoriyi*	Critical	90/100 I
Urocyon	*cineroargentus*		Safe	
Urocyon	*littoralis*	San Nicholas	Critical	Nucleus I
Urocyon	*littoralis*	N. Channel Islands	Endangered	Nucleus I
Urocyon	*littoralis*	S. Channel Islands	Endangered	Nucleus I
Vulpes	*vulpes*		Safe	
Vulpes	*velox*	San Joaquin kit fox	Endangered	Nucleus I
Vulpes	*velox*	Other kit foxes	Safe	Nucleus II
Vulpes	*velox*	Swift fox	Safe	Nucleus II

General research priorities and recommendations on following pages:

North American Canid Research and Recommendations						
Scientific Name			**Recommendations**	**Research**	**PHVA**	**Captive Prog**
Alopex	*lagopus*					
Canis	*latrans*		**Eliminate captive populations.**			
Canis	*lupus*	*baileyi*		**Survey of status and distribution in Mexico (p94) and adjoining border areas of AZ and NM. Determine genetic purity of uncertified population. Monitor possible inbreeding depression.**	**Complete PVA; develop individually based model for metapopulation.**	**90/100 I w/top priority being reintroduction**
Canis	*lupus*		**Survey additional populations with additional genetic techniques. Encourage reestablishment efforts within historical range.**			
Canis	*rufus*	*gregoriyi*		**Additional taxonomic research; pot.RW/ coyote interaction; sperm collecting/AI, developmental behavior study.**		**90/100 I; continue SSP**
Urocyon	*cinero-argentus*					

North American Canid Research and Recommendations						
Scientific Name			Recommendations	Research	PHVA	Captive Prog
Urocyon	*littoralis*	San Nicholas		Continue census on annual basis; continued disease monitoring.	Yes	Nuc I
Urocyon	*littoralis*	North Channel Islands		Continue census on annual basis; continued disease monitoring.	Yes for all	Nuc I for San Miguel
Urocyon	*littoralis*	S. Channel Islands		Continue census on annual basis; continued disease monitoring.	Yes for all	Nuc I for San Clemente
Vulpes	*vulpes*			Taxonomic survey should be done to determine whether endemic form of the red fox in N. America is threatened by hybridization with the European red fox.		
Vulpes	*velox*	San Joaquin Kit fox		Taxonomic revision of the group is needed; determine if truly isolated genetically; need better distribution and census studies; investigate interaction with coyotes; get latest survey numbers from K. Ralls and T.P. O'Farrell.	Yes	Nuc I
Vulpes	*velox*	other kit foxes		Clarify taxonomic status and investigate interactions with coyotes.		Nuc II

North American Canid Research and Recommendations						
Scientific Name			Recommendations	Research	PHVA	Captive Prog
Vulpes	*velox*	Swift fox		Clarify taxonomic status, esp. S. Dakota population and investigate interactions with coyotes. Captive population in Calgary for purposes of reintroduction.		Nuc II

Summary of Status of Asian Canids

by Paul Joslin

Eleven species and seven subspecies were considered. The following table represents the ranking of captive programs by Mace & Lande:

Ranking of Captive Programs by Mace & Lande				
Cuon	*alpinus*	*sumatrensis*	Critical	Nucleus I
Cuon	*alpinus*		Endangered	Nucleus I
Canis	*lupus*	*arabs*	Endangered	Nucleus I
Canis	*familiaris*	*dingo*	Vulnerable	Nucleus I
Canis	*lupus*	*pallipes*	Vulnerable	Nucleus II
Vulpes	*cana*		Vulnerable	Nucleus I
Canis	*aureus*		Safe	Eliminate
Canis	*aureus*	*lanka*	Safe	Eliminate
Canis	*lupus*		Safe	Eliminate
Canis	*lupus*	*lupus*	Safe	Eliminate
Canis	*lupus*	*campestris*	Safe	Eliminate
Canis	*lupus*	*chanco*	Safe	Eliminate
Nyctereutes	*procyonoides*		Safe	Eliminate
Vulpes	*bengalensis*		Safe	Eliminate
Vulpes	*corsac*		Safe	Eliminate
Vulpes	*ferrilata*		Safe	Eliminate
Vulpes	*rueppelli*		Safe/Unk	Eliminate
Vulpes	*vulpes*		Safe	Annihilate

GENERAL RECOMMENDATIONS:

1. Clarify taxonomy, particularly of wolf subspecies and island populations. Karyotypic description of each species is recommended where it is not already available.

2. Surveys for distribution and particularly density estimates are needed. Absolute density estimates and patterns of social grouping should be studied.

3. Limiting factors (e.g., habitat loss, disease, prey abundance, interspecific interactions) should be examined.

RESEARCH NEEDS FOR "UNSAFE" STATUS ASIAN CANIDS:

Research Needs for Critical Status Asian Canids			
Cuon	*alpinus*	*sumatrensis*	**Surveys - status unknown. Ecology - field study (if warranted).**
Canis	*familiaris*	*hallstromi*	**Status and distribution. Field ecology and life history.**

Research Needs for Endangered Status Asian Canids			
Canis	*lupus*	*arabs*	**Taxonomy - distinct from *C. l. pallipes*? Survey - <500 individuals? Ecology - field study.**
Cuon	*alpinus*		**Taxonomy - and subspecies throughout wide, fragmented range? Survey - distribution and status of subspecies. Ecology - second field study.**

Research Needs for Vulnerable Status Asian Canids			
Canis	*familiaris*	*dingo*	**Genetic - identify hybrids.**
Canis	*lupus*	*pallipes*	**Distribution/status if warranted.**
Canis	*lupus*	*chanco*	**Status/impact of potentially high harvest on fragmented population.**

More Information Required			
Canis	*aureus*	*lanka*	**Nothing known on potential island subspecies.**
Vulpes	*cana*		**Assess taxonomy of fragmented population, esp. in east surveys through potential range.**

Summary of Status of African Canids

Ranking of Captive Programs by Mace-Lande				
Canis	*simensis*	*simensis*	Critical	90/100 I
Canis	*simensis*	*citernii*	Critical	90/100 I
Canis	*aureus*	*lupaster*	MIR	Nucleus II
Lycaon	*pictus*	South	Vulnerable	Reduce to Nucleus I
Lycaon	*pictus*	East	Endangered	90/100 I
Lycaon	*pictus*	West	Critical	90/100 I
Fennecus	*zerda*		MIR	Nucleus II
Vulpes	*pallida*		MIR	Nucleus II
Otocyon	*megalotis*		Safe	Nucleus II
Canis	*adustus*		Safe	Eliminate
Canis	*aureus*		Safe	Eliminate
Canis	*mesomelas*		Safe	Eliminate
Vulpes	*chama*		Safe	Eliminate
Vulpes	*ruppelli*		Safe	None

Research and Recommendations for African Canids

1. Develop immediate action plan for *in situ* and *ex situ* conservation work for simien jackal.

2. Disease monitoring on *Canis simensis* and *Lycaon pictus* populations.

3. Genetic work on African wild dog population, surveying all three populations.

4. Survey work on West African and East African wild dog population.

Summary of Status of African Hyaena/Aardwolf				
Lycaon pictus	South		Vulnerable	Reduce to Nuc I
			Endangered	90/100 I
	West		Critical	90/100 I
Crocuta	*crocuta*		Safe	Nucleus II
Hyaena	*brunnea*		Vulnerable	Nucleus I
Hyaena	*hyaena*	*barbara*	Critical	90/100 I
Hyaena	*hyaena*		Safe	Nucleus II
Proteles	*cristatus*		Safe	Nucleus II

CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP) SPREADSHEET CATEGORIES

The Action Plan Spreadsheet is a working document that provides information that can then be used to assess degree of threat and recommend conservation action.

The first part of the spreadsheet summarizes information on the status of the wild and captive populations of each taxon. It contains taxonomic, distributional, and demographic information useful in determining which taxa are under greatest threat of extinction. This information can be used to identify priorities for intensive management action for taxa.

TAXON

Scientific Name: These three columns contain the scientific names of the extant taxa: genus, species and subspecies.

The next 10 columns contain information on wild populations.

Wild Population:

Range: Geographic area where a species and its subspecies occur.

Est #: Estimated number in wild population. Best estimates of numbers in wild. Try at least to place all species in one of four categories (that correspond to boundaries of one of the Mace-Lande criteria for assessing category of threat):

< 250
< 2,500
< 10,000
> 10,000

More precise estimates are preferable if possible.

Sub pop: Number (and if possible, sizes) of subpopulations of a species. This indicates the degree of fragmentation. Ideally, this is described in terms of boundary conditions as delineated by Mace-Lande.

Trend: Indicates whether a species' numbers are increasing (I), decreasing (D), or stable (S). (If possible providing more numeric estimates relative to Mace-Lande.)

Area: A quantification of a species' geographic distribution.
A: < 50,000 sq km
AA: < 50,000 sq km but on a geographic island
B: 50-99,000 sq km
C: 100-499,000 sq km
D: 500-999,000 sq km
E: > 1,000,000 sq km

RDB: Red Data Book Category:
- Ex = Extinct
- E = Endangered
- V = Vulnerable
- R = Rare
- I = Indeterminate
- K = Insufficiently Known

CITES: CITES Listing: I, II or III

CSG: IUCN/SSC Canid Specialist Group Category

M/L Sts: Status according to Mace/Lande criteria (see attached explanation). Can also assign numerical values to facilitate combination with taxonomic uniqueness.
- C = Critical
- E = Endangered
- V = Vulnerable
- S = Safe

THRTS: This column contains information about the primary factors behind the population decreases of certain canids. The abbreviations denote the following threats:
- D = Disease
- H = Hunting
- L = Loss of habitat
- P = Predation
- T = Trade for the live animal market

Some taxa will be subject to more than one of the above threats.

The remaining columns are for recommendations that will be generated at the workshop and for current information.

PVA/WKSP: Is a Population and Habitat Viability Assessment Workshop recommended? Yes or No.

Wild Mgmt: Is more intensive *in situ* management indicated? Yes or No.

Rsrch: Research

Tax/Srv/Husb: Is there a need for taxonomic clarification investigations (TX), more survey (quantitative) work (SRV), and/or husbandry research (HB) to permit captive program?

Captive Program

NUM: Numbers in Captivity.

CAP Rec: Recommendations for level of captive program, defined by its genetic and demographic objectives and hence the target population required to achieve these objectives.

90/100 I: 90% for 100 Years I. Population sufficient to preserve 90% average genetic diversity for 100 years, developed as soon as possible (1-5 years).

90/100 II: 90% for 100 Years II. Population sufficient to preserve 90% average genetic diversity for 100 years, but developed more gradually (5-10 years).

Nuc I: Nucleus I. A captive nucleus (50-100 individuals) to always represent 98% of the wild gene pool. This type of program will require periodic, but in most cases, modest immigration (importation) of individuals from the wild population to maintain this high level of genetic diversity in such a limited captive population.

Nuc II: Nucleus II. A captive nucleus (25-100 individuals) for taxa not of current conservation concern but present in captivity or otherwise of interest; the captive nucleus should be managed as well as possible.

Elim: Eliminate from captivity; the captive population should be managed to extinction.

Canids Classified as Critical

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*simensis*	*simensis*	NW Rift Ethiopia	75-150	4	d	450 sq km		no		C	h,l,d	yes	yes	tax/srv	no	no
Canis	*rufus*	*gregoryi*	SE USA	22-23		i		e	App I	e	C	l	no	yes	tax/husb	200	90/100 I
Canis	*lupus*	*baileyi*	Mexico	50		d		e	App I	v	C	l,h	yes	yes	srv/tax/ husb	24.15	90/100 I
Canis	*lupus*	*lupus*	Italy-critical Sweden/Norway-endangered Finland-safe								C (It.) E (S,N)					9.13	italy nuc I sweden /norway-none,finland-none
Canis	*simensis*	*citernii*	SE Rift Ethiopia	270-370	4	d	800 sq km	E	no		C	h,l,d	yes	yes	tax/srv	no	90/100 I
Cuon	*alpinus*	*sumatrensis*	Sumatra	250	1	d	b				C	h,p	yes	yes	srv/tax/ husb		nuc I
Lycaon	*pictus*	*somalicus west*	W. Africa	1000?	n	d			App I		C	d,h,l	done	yes	tax/srv	no	90/100 I
Urocyon	*littoralis*	*dickeyi*	San Nicholas	200-300		s		n	n	r	C	p,d	yes	yes	srv		nuc I

Canids Classified as Endangered

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	Trnd	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*lupus*	*signatus*	Portugal/Spain-endangered								E					0.1	nuc I
Canis	*lupus*	*arabs*	Arabian Pen, Egypt, Israel	500	1	d	c	nl	nl	v	E	h,p	yes	yes	tax/srv	?	nuc I
Chrysocyon	*brachyurus*		Brazil, N Argentina	2500	2	d	c	V	APP.II	Remove	E	d,h,l	yes	yes	srv/husb	93.99 about 400	90/100 I

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	Trnd	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Cuon	*alpinus*		Thailand, SE Asia, Burma	15000	10	d	e	V	APP.II	v	E	d,l,h	yes	yes	tax/srv/husb	11.9	nuc I
Lycaon	*pictus*	*sharicus east*	E Africa	1500	n	d			APP.I		E	d,h,l	done	yes	tax/srv	no	90/100 I
Urocyon	*littoralis*	*littoralis*	Northern Channel Island	2500		s		nl	nl	r	E	d	yes	yes	srv		nuc I
Urocyon	*littoralis*	*catalinae*	Southern Channel Island	2500		s		nl	nl	r	E	p	yes	yes	srv		
Vulpes	*velox*	*mutica*	San Joaquin	7000		d		nl	nl	n	E	l	yes	yes	tax/srv	1.0	nuc I

Canids Classified as Vulnerable

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	Trnd	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ WKSP	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*familiaris*	*dingo*	Australia, SE Asia	10000	3	d	c	nl	nl	np	V	h,v	no	yes	tax/srv	34.35	nuc I
Canis	*lupus*	*pallipes*	Middle East	10000	1	d	e	nl	nl	no	V	h,p	no	yes	tax/srv	9.8.1	nuc II
Canis	*lupus*		Holarctic	100000	whole bunch	d	e	V	App II & I	v/r	SV	l,h,p	no	no	tax/srv	68.79.5	elim
Dusicyon	*griseus*	*gracilis*									V						
Dusicyon	*microtis*		Brazil, Ecuador, Colombia	10000	y	d	c	K		k	V	l	no	no	srv/tax		nuc I
Dusicyon	*vetulus*		South Central Brazil	10000	no	unk	B	K		k	V	h,l	no	no	srv/tax		nuc I
Dusicyon	*griseus*	*domeykoanus*									V						
Dusicyon	*griseus*		Chile, Argentina	10000	5	unk	b	V	App II	v	V	h	no	yes	srv/tax		nuc II
Dusicyon	*sechurae*		Peru	2500	no	d	b	K		k	V	h	no	no	srv/tax		nuc I
Dusicyon	*griseus*	*fulvipes*	Chile, Argentina	2500	n	d?	aa				V	h,l	no	yes	srv/tax		nuc I
Dusicyon	*griseus*	*maullinicus*									V						
Dusicyon	*griseus*	*griseus*									V						
Lycaon	*pictus*	*pictus south*	South Africa	2500	n	d			App I		V	d,h,l	done	yes	tax/srv	350	nuc I

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			*Range*	*Est #*	*Subpop*	*Trnd*	*Area*	*RDB*	*CITES*	*CSG*	*M/L status*	*Thrts*	*PVA/ WKSP*	*Wild Mgmt*	*Tax/Srv/Husb*	*ISIS #*	*CAP Rec*
Speothos	*venaticus*	*venaticus*									V					1.3	
Speothos	*venaticus*	*wingei*									V						
Speothos	*venaticus*		Brazil, Ven, Col, Peru	40000	y	d	c	V	App I	App II	V	l	no	no	srv/tax	31.30.1	nuc I
Vulpes	*cana*		Iran, Afghanistan	15000	2	d	v	K	App II	mi	V	h,p,l	yes	no	tax/srv/husb		nuc I

Canids Classified as Safe

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Alopex	*lagopus*		Holarctic	1 mil		si		none	none	n	S	h,l,d	no	no	tax/srv	39.49	elim
Canis	*aureus*		E. Africa/Asia	1 mil	3	stable	e	nl	nl	np	S	none	no	no	tax/srv	4.8	elim
Canis	*adustus*	*adustus*	E. & S. Africa	100000	?	S			nl		S	d,l	no	no	tax/srv	1.2	elim
Canis	*latrans*		North America	abundant	y	i	?	nl	nl	n	S		no	no	srv	16.15	elim
Canis	*lupus*	*chanco*	China, Mongolia	10000	1	v	e	nl	nl		S	h,p	no	no	tax/srv	8.5	elim
Canis	*aureus*	*lupaster*	Egypt/Libya	10000	no	5?			nl		S	no	no	no	tax	0	no
Canis	*aureus*	*lanka*	Sri Lanka	10000	?	?	a	nl	nl	np	S	l,h,p	no	no	tax/srv	o.o	elim
Canis	*mesomelas*		E. & S. Africa	1mil	2	5			nl		S	h	no	no	tax	17.23	elim
Canis	*lupus*	*lupus campestris*	Iran, Pakistan, Iraq, USSR	10000	1	v	e	nl	nl		S	h,p	no	no	tax/srv		elim
Cerdocyon	*thous*		Southeast Brazil, Northern South America	10000	2?	s	d				S	l	no	no	srv	1.0	elim
Dusicyon	*gymnocercus*		S. & C. Brazil, North Argentina	10000	?	unk	c		App II	no	S	h,l	no	as fur-bearer	srv		elim
Dusicyon	*culpaeus*		Chile, W. Argentina	10000	5	unk	b		App II	none	S	h,l	no	yes	srv		elim
Fennecus	*zerda*		N. Africa	unknown	no	unk		K	App II		S	t	no	no	srv	69.78	Nuc II
Nyctereutes	*procyonoides*		Japan, China, East Asia	200000	2	s	e				S	none	no	no	tax	16.17	elim
Otocyon	*megalotis*		E. & S. Africa	1 mil	2	s			nl		S	d	no	no	tax/srv	11.22	Nuc II
Urocyon	*cinereoargenteus*		North to Central America	100000		S		nl	nl	n	S	n	no	no	none	10.11.1	elim
Vulpes	*velox*	*swiftfox*	East of Rockies	100000		s		nl	nl	n	S	h,p	no	no	tax/srv		Nuc II
Vulpes	*ferrilata*		Tibetan Plateau, India, China, Nepal	10000	1	s	e	nl	nl	np	S	none	no	no	tax/srv		elim
Vulpes	*chama*		S. Africa	50-100000	n	s			nl		S	h,p	no	no	none	1.0	elim
Vulpes	*vulpes*		Holarctic	1 mil	2	s	e	nl	nl	np	S	none	no	no	none	23.28.4	elim

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Hush	ISIS #	CAP Rec
Vulpes	*bengalensis*		Indian Subcontinent	10000	1	s	e	I	nl	v	S	none	no	no	tax		elim
Vulpes	*corsac*		USSR, China, Mongolia	10000	1	s	e	K			S	h	no	no	tax/srv	0.1	elim
Vulpes	*velox*	*kitfox*	West of Rockies	100000		s		nl	nl	n	S	h,p	no	no	tax/srv	13.6	Nuc II
Vulpes	*pallida*		Sahell	100000	n	unk		K	nl		S	unk	no	no	tax/srv	no	no
Vulpes	*rueppelli*		N. Africa, Middle East	1 mil	4?	s		K	nl		S	p	no	no	tax	no	no
Canis	*lupus*		Holarctic	100000	whole bunch	d	e	V	App II & I	v/r	SV	l,h,p	no	no	tax/srv	68.79.5	elim

Canid Composite Population

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Alopex	*lagopus*		Holarctic	1 mil		si		none	none	n	S	h,l,d	no	no	tax/srv	39.49	elim
Alopex	*lagopus*	*beringensis*															
Alopex	*lagopus*	*fuliginosus*															
Alopex	*lagopus*	*groenlandicus*															
Alopex	*lagopus*	*hallensis*															
Alopex	*lagopus*	*lagopus*														6.10	
Alopex	*lagopus*	*pribilofensis*															
Alopex	*lagopus*	*sibiricus*															
Alopex	*lagopus*	*spitzbergensis*															
Alopex	*lagopus*	*ungava*															
Canis	*adustus*	*adustus*	E. & S. Africa	100000	?	S			nl		S	d,l	no	no	tax/srv	1.2	elim.
Canis	*adustus*	*bweha*															
Canis	*adustus*	*centralis*															
Canis	*adustus*	*kaffensis*															
Canis	*adustus*	*lateralis*															
Canis	*aureus*		E. Africa/Asia	1 mil	3	stable	e	nl	nl	np	S	none	no	no	tax/srv	4.8	elim
Canis	*aureus*	*algirensis*															
Canis	*aureus*	*anthus*															
Canis	*aureus*	*aureus*															
Canis	*aureus*	*bea*															
Canis	*aureus*	*lanka*	Sri Lanka	10000	?	?	a	nl	nl	np	S	l,h,p	no	no	tax/srv	o.o	elim
Canis	*aureus*	*lupaster*	Egypt/Libya	10000	no	5?			nl		S	no	no	no	tax	0	no
Canis	*aureus*	*maroccanus*															
Canis	*aureus*	*soudanicus*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*familiaris*	*dingo*	Australia, SE Asia	10000	3	d	c	nl	nl	np	V	h	no	yes	tax/srv	34.35	Nuc I
Canis	*latrans*		North America	abundant	y	i	?	nl	nl	n	S		no	no	srv	16.15	elim
Canis	*latrans*	*cagottis*															
Canis	*latrans*	*clepticus*															
Canis	*latrans*	*dickeyi*															
Canis	*latrans*	*frustor*															
Canis	*latrans*	*goldmani*															
Canis	*latrans*	*hondurensis*															
Canis	*latrans*	*impavidus*															
Canis	*latrans*	*incolatus*															
Canis	*latrans*	*jamesi*															
Canis	*latrans*	*latrans*														1.0	
Canis	*latrans*	*lestes*														1.2	
Canis	*latrans*	*mearnsi*														2.1	
Canis	*latrans*	*microdon*															
Canis	*latrans*	*ochropus*														2.3	
Canis	*latrans*	*peninsulae*															
Canis	*latrans*	*texensis*														1.1	
Canis	*latrans*	*thamnos*															
Canis	*latrans*	*umpquensis*															
Canis	*latrans*	*vigilis*														0.6	
Canis	*lupus*		Holarctic	100000	whole bunch	d	e	V	App II & I	v/r	SV	l,h,p	no	no	tax/srv	68.79.5	elim
Canis	*lupus*	*albus*															
Canis	*lupus*	*alces*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*lupus*	*arabs*	Arabian Pen, Egypt, Israel	500	1	d	c	nl	nl	v	E	h,p	yes	yes	tax/srv	?	nuc I
Canis	*lupus*	*arctos*															
Canis	*lupus*	*baileyi*	Mexico	50		d		e	App I	v	C	l,h	yes	yes	srv/tax/hus	24.15	90/100 I
Canis	*lupus*	*bernardi*															
Canis	*lupus*	*chanco*	China, Mongolia	10000	1	v	e	nl	nl		S	h,p	no	no	tax/srv	8.5	elim
Canis	*lupus*	*columbianus*														1.1	
Canis	*lupus*	*crassodon*															
Canis	*lupus*	*fuscus*															
Canis	*lupus*	*griseoalbus*															
Canis	*lupus*	*hudsonicus*														13.9	
Canis	*lupus*	*irremotus*														1.1.1	
Canis	*lupus*	*labradorius*															
Canis	*lupus*	*ligoni*															
Canis	*lupus*	*lupus*	Italy-critical, Sweden/Norway-endangered, Finland- safe								C (It.) E (S,N)					9.13	italy nuc I sweden/norway-none,finland-none
Canis	*lupus*	*lupus campestris*	Iran, Pakistan, Iraq, USSR	10000	1	v	e	nl	nl		S	h,p	no	no	tax/srv		elim
Canis	*lupus*	*lyacon*														26.29	
Canis	*lupus*	*mackenzii*															
Canis	*lupus*	*nubilus*															
Canis	*lupus*	*occidentalis*														25.24	
Canis	*lupus*	*orion*															
Canis	*lupus*	*pallipes*	Middle East	10000	1	d	e	nl	nl	no	V	h,p	no	yes	tax/srv	9.8.1	nuc II
Canis	*lupus*	*pambasileus*														6.2	

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Canis	*lupus*	*signatus*	Portugal/Spain-endangered								E					0.1	nuc I
Canis	*lupus*	*tundrarium*														6.14.1	
Canis	*mesomelas*		E. & S. Africa	1 mil	2	5			nl		S	h	no	no	tax	17.23	elim
Canis	*mesomelas*	*achrotes*															
Canis	*mesomelas*	*arenarum*															
Canis	*mesomelas*	*elgonae*															
Canis	*mesomelas*	*mesomelas*														1.2	
Canis	*mesomelas*	*schmidti*															
Canis	*rufus*							E	App I							15.13	
Canis	*rufus*	*gregoryi*	SE USA	22-23		i		e	App I	e	C	l	no	yes	tax/husb	200	90/100 I
Canis	*rufus*	*rufus*		8 reintro'd												1.0	
Canis	*simensis*	*citernii*	SE Rift Ethiopia	270-370	4	d	800sqkm	E	nl		C	h,l,d	yes	yes	tax/srv	no	90/100 I
Canis	*simensis*	*simensis*	NW Rift Ethiopia	75-150	4	d	450 sq km		nl		C	h,l,d	yes	yes	tax/srv	no	no
Cerdocyon	*thous*		SE Brazil, Northern South America	10000	2?	s	d				S	l	no	no	srv	1.0	elim
Cerdocyon	*thous*	*aquilus*														0.1	
Cerdocyon	*thous*	*azarae*															
Cerdocyon	*thous*	*entrerianus*															
Cerdocyon	*thous*	*germanus*															
Cerdocyon	*thous*	*thous*															
Chrysocyon	*brachyurus*		Brazil, N. Argentina	2500	2	d	c	V	App II	Remove	E	d,h,l	yes	yes	srv/husb	93.99 about 400	90/100 I
Cuon	*alpinus*		Thailand, SE Asia, Burma	15000	10	d	e	V	App II	v	E	d,l,h	yes	yes	tax/srv/husb	11.9	nuc I

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Cuon	*alpinus*	*adustus*															
Cuon	*alpinus*	*alpinus*															
Cuon	*alpinus*	*dukhunensis*														0.1	
Cuon	*alpinus*	*fumosus*															
Cuon	*alpinus*	*hesperius*															
Cuon	*alpinus*	*infuscus*															
Cuon	*alpinus*	*javanocus*															
Cuon	*alpinus*	*laniger*															
Cuon	*alpinus*	*lepturus*														5.4	
Cuon	*alpinus*	*primaevus*															
Cuon	*alpinus*	*sumatrensis*	Sumatra	250	1	d	b				C	h,p	yes	yes	tax/srv/husb		nuc I
Dusicyon	*culpaeus*		Chile, W. Argentina	10000	5	unk	b		App II	none	S	h,l	no	yes	srv		elim
Dusicyon	*culpaeus*	*andinus*															
Dusicyon	*culpaeus*	*culpaeolus*															
Dusicyon	*culpaeus*	*culpaeus*															
Dusicyon	*culpaeus*	*lycoides*															
Dusicyon	*culpaeus*	*magellanicus*															
Dusicyon	*culpaeus*	*reissii*															
Dusicyon	*culpaeus*	*smithersi*															
Dusicyon	*griseus*		Chile, Argentina	10000	5	unk	b	V	App II	v	V	h	no	yes	srv/tax		nuc II
Dusicyon	*griseus*	*domeykoanus*									V						
Dusicyon	*griseus*	*fulvipes*	Cbile, Argentina	2500	n	d?	aa				V	h,l	no	yes	srv/tax		nuc I
Dusicyon	*griseus*	*gracilis*									V						
Dusicyon	*griseus*	*griseus*									V						

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Dusicyon	*griseus*	*maullinicus*									V						
Dusicyon	*gymnocercus*		S. & C. Brazil, North Argentina	10000	?	unk	c		App II	no	S	h,l	no	as furbearer	srv		elim
Dusicyon	*gymnocercus*	*antiquus*															
Dusicyon	*gymnocercus*	*gymnocercus*															
Dusicyon	*gymnocercus*	*inca*															
Dusicyon	*microtis*		Brazil, Ecuador, Colombia	10000	y	d	c	K		k	V	l	no	no	srv/tax		nuc I
Dusicyon	*sechurae*		Peru	2500	no	d	b	K		k	V	h	no	no	srv/tax		nuc I
Dusicyon	*vetulus*		South Central Brazil	10000	no	UNK	B	K		K	V	h,l	no	no	srv/tax		nuc I
Fennecus	*zerda*		N. Africa	unknown	no	unk		K	App II		S	t	no	no	srv	69.78	nucII
Lycaon	*pictus*			2000?				E								52.42	
Lycaon	*pictus*	*lupinus*															
Lycaon	*pictus*	*manguensis*															
Lycaon	*pictus*	*pictus south*	S. Africa	2500	n	d			App I		V	d,h,l	done	yes	tax/srv	350	nuc I
Lycaon	*pictus*	*sharicus east*	E. Africa	1500	n	d			App I		E	d,h,l	done	yes	tax/srv	no	90/100 I
Lycaon	*pictus*	*somalicus west*	W. Africa	1000?	n	d			App I		C	d,h,l	done	yes	tax/srv	no	90/100 I
Nyctereutes	*procyonoides*		Japan, China, E. Asia	200000	2	s	e				S	none	no	no	tax	16.17	elim
Nyctereutes	*procyonoides*	*koreensis*															
Nyctereutes	*procyonoides*	*orestes*															
Nyctereutes	*procyonoides*	*procyonoides*															
Nyctereutes	*procyonoides*	*ussuriensis*															
Nyctereutes	*procyonoides*	*viverrinus*														1.0	
Otocyon	*megalotis*		E. & S. Africa	1 mil	2	s			nl		S	d	no	no	tax/srv	11.22	nuc II
Otocyon	*megalotis*	*megalotis*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpo p	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/H usb	ISIS #	CAP Rec
Otocyon	*megalotis*	*virgatus*															
Speothos	*venaticus*		Brazil, Ven, Col, Peru	40000	y	d	c	V	App I	App II	V	1	no	no	srv/tax	31.30.1	nuc I
Speothos	*venaticus*	*venaticus*									V					1.3	
Speothos	*venaticus*	*wingei*									V						
Urocyon	*cinereoargenteus*		North to Central America	100000		S		N	nl	nl	S	none	no	no	none	10.11.1	elim
Urocyon	*cinereoargenteus*	*borealis*														1.0	
Urocyon	*cinereoargenteas*	*californicus*														1.1	
Urocyon	*cinereoargenteus*	*cinereoargenteus*														3.2	
Urocyon	*cinereoargenteus*	*colimensis*															
Urocyon	*cinereoargenteus*	*costaricensis*															
Urocyon	*cinereoargenteus*	*floridanus*														0.1	
Urocyon	*cinereoargenteus*	*fraterculus*															
Urocyon	*cinereoargenteus*	*furvus*															
Urocyon	*cinereoargenteus*	*guatemalae*															
Urocyon	*cinereoargenteus*	*madrensis*															
Urocyon	*cinereoargenteus*	*nigrirostris*														1.2	
Urocyon	*cinereoargenteus*	*ocythous*														1.0	
Urocyon	*cinereoargenteus*	*orinomus*															
Urocyon	*cinereoargenteus*	*peninsularis*															
Urocyon	*cinereoargenteus*	*scottii*														2.2	
Urocyon	*cinereoargenteus*	*townsendi*															
Urocyon	*cinereoargenteus*	*venezuelae*															
Urocyon	*littoralis*							R									
Urocyon	*littoralis*	*catalinae*	Southern Channel Island	2500		s		n	nl	r	E	p	yes	yes	srv		

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Urocyon	*littoralis*	*clementi*	Combined above	---	--	--	--	--	--	--	--	---	--	--	--	1.0	Nuc I
Urocyon	*littoralis*	*dickeyi*	San Nicholas	200-300		s		n	nl	r	C	p,d	yes	yes	srv		Nuc I
Urocyon	*littoralis*	*littoralis*	Northern Channel Island	2500		s		n	nl	r	E	d	yes	yes	srv		Nuc I
Urocyon	*littoralis*	*santacruzae*	Northern Channel Island	---	---	--	--	--	--	--	--	--	--	--	---	--	--
Urocyon	*littoralis*	*santarosae*	Northern Channel Island	---	--	--	--	--	-	--	-	--	--	--	--	--	--
Vulpes	*bengalensis*		Indian Subcontinent	10000	1	s	e	I	nl	v	S	none	no	no	tax		elim
Vulpes	*cana*		Iran, Afghanistan	15000	2	d	v	K	App II	mi	V	h,p,l	yes	no	tax/srv/husb		nuc I
Vulpes	*chama*		S. Africa	50-100000	n	s			nl		S	h,p	no	no	none	1.0	elim
Vulpes	*corsac*		USSR, China, Mongolia	10000	1	s	e	K			S	h	no	no	tax/srv	0.1	elim
Vulpes	*corsac*	*corsac*														2.1	
Vulpes	*corsac*	*kalmykorum*															
Vulpes	*corsac*	*turkmenica*															
Vulpes	*ferrilata*		Tibetan Plateau, India, China, Nepal	10000	1	s	e	nl	nl	nl	S	none	no	no	tax/srv		elim
Vulpes	*pallida*		Sahell	100000	n	unk		K	nl		S	unk	no	no	tax/srv	no	no
Vulpes	*pallida*	*edwardsi*															
Vulpes	*pallida*	*harterti*															
Vulpes	*pallida*	*oertzeni*															
Vulpes	*pallida*	*pallida*															
Vulpes	*raeppelli*		N. Africa, Middle East	1 mil	4?	s		K	nl		S	p	no	no	tax	no	no
Vulpes	*rueppelli*	*caesia*															
Vulpes	*rueppelli*	*cufrana*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/H usb	ISIS #	CAP Rec
Vulpes	*rueppelli*	*rueppelli*															
Vulpes	*rueppelli*	*somaliae*															
Vulpes	*velox*	*devia*															
Vulpes	*velox*	*hebes*														33.30.5	
Vulpes	*velox*	*kitfox*	West of Rockies	100000		s		n	nl	nl	S	h,p	no	no	tax/srv	13.6	nuc II
Vulpes	*velox*	*macrotis*														1.0	
Vulpes	*velox*	*mutica*	San Joaquin	7000		d		n	nl	nl	E	l	yes	yes	tax/srv	1.0	nuc I
Vulpes	*velox*	*neomexicana*															
Vulpes	*velox*	*nevadensis*															
Vulpes	*velox*	*swiftfox*	East of Rockies	100000		s		n	nl	nl	S	h,p	no	no	tax/srv		nuc II
Vulpes	*velox*	*tenuirostris*															
Vulpes	*velox*	*velox*														2.4.1	
Vulpes	*velox*	*zinseri*															
Vulpes	*vulpes*		Holarctic	1 mil	2	s	e	nl	nl	nl	S	none	no	no	none	23.28.4	elim
Vulpes	*vulpes*	*abietorum*															
Vulpes	*vulpes*	*aeygptiaca*															
Vulpes	*vulpes*	*alascensis*															
Vulpes	*vulpes*	*alpherakyi*															
Vulpes	*vulpes*	*alticola*															
Vulpes	*vulpes*	*anatolica*															
Vulpes	*vulpes*	*arabica*															
Vulpes	*vulpes*	*atlantica*															
Vulpes	*vulpes*	*barbaras*															
Vulpes	*vulpes*	*beringiana*															
Vulpes	*vulpes*	*cascadensis*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Vulpes	*vulpes*	*caucasica*															
Vulpes	*vulpes*	*crucigera*														4.2	
Vulpes	*vulpes*	*daurica*															
Vulpes	*vulpes*	*diluta*															
Vulpes	*vulpes*	*dolichocrania*															
Vulpes	*vulpes*	*dorsalis*															
Vulpes	*vulpes*	*flavescens*															
Vulpes	*vulpes*	*fulva*														12.8	
Vulpes	*vulpes*	*griffithi*															
Vulpes	*vulpes*	*harrimani*															
Vulpes	*vulpes*	*hoole*															
Vulpes	*vulpes*	*ichnusae*															
Vulpes	*vulpes*	*induta*															
Vulpes	*vulpes*	*jakutensis*															
Vulpes	*vulpes*	*japonica*															
Vulpes	*vulpes*	*karagan*															
Vulpes	*vulpes*	*kenaiensis*															
Vulpes	*vulpes*	*krimeamontana*															
Vulpes	*vulpes*	*kurdistanica*															
Vulpes	*vulpes*	*macroura*															
Vulpes	*vulpes*	*montana*															
Vulpes	*vulpes*	*necator*															
Vulpes	*vulpes*	*ochroxantha*															
Vulpes	*vulpes*	*palaestina*															
Vulpes	*vulpes*	*peculiosa*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	TRND	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/Husb	ISIS #	CAP Rec
Vulpes	*vulpes*	*pusilla*															
Vulpes	*vulpes*	*regalis*															
Vulpes	*vulpes*	*rubricosa*															
Vulpes	*vulpes*	*schrenki*															
Vulpes	*vulpes*	*silacea*															
Vulpes	*vulpes*	*splendidissima*															
Vulpes	*vulpes*	*stepensis*															
Vulpes	*vulpes*	*tobolica*															
Vulpes	*vulpes*	*tshiliensis*															
Vulpes	*vulpes*	*vulpes*															

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	Trnd	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/Srv/H usb	ISIS #	CAP Rec
Crocuta	*crocuta*		Sub-Sahara	100000 to 1 mil	1	d	e		nl		S	h,l	no	no	srv	86	nuc II
Hyeana	*brunnea*		South Africa	25000	1	e			I		V	h,l	no	yes	srv/husb	34	nuc I
Hyeana	*hyaena*		North Africa, India	50000-100000	5?	s	3		nl		S	h	no	no	tax/srv	43	nuc II

TAXON			WILD POPULATION												Rsrch	Captive Program	
SCIENTIFIC NAME			Range	Est #	Subpop	Trnd	Area	RDB	CITES	CSG	M/L status	Thrts	PVA/ Wksp	Wild Mgmt	Tax/srv/hu sb	ISIS #	CAP Rec
Proteles	*cristatus*		East Africa, South Africa	5000	3	5			nl		S	h	no	no	tax/srv	36	nuc II

Canis adustus (Side-striped jackal)			
Mace-Lande Status: Stable	USFWS: None	CITES: None	Other:
Taxonomic Status: Clarification of subspecies? More work needed.	Distribution: Central and southern Africa	Wild Populations: >100,000	Field studies: Poorly researched. Rwanda-J. Kalpers, Fuller-Kenya, Serengeti-Moehlman
Threats: Disease, habitat loss, few recognized threats, local utilization	Comments: Very cute, widespread, wide-ranging, low density. Contact Van Valkenburgh for morphology data for all jackals.	Recommendations:	Research: Need taxonomic work, incidental surveys.
PHVA: No	Captive Populations: 1.2 in one installation	Captive Programs: None exist, none needed. Eliminate.	

Canis aureus (Golden jackal)			
Mace-Lande Status: Stable	USFWS: None	CITES: None	Other:
Taxonomic Status: *C.a. leupaster* and *C.a. lanka* (Sri Lankan) possibly unique.	Distribution: North, West and East Africa, SE Europe, South Asia	Wild Populations: >1,000,000	Field studies: East Africa: Moehlman, Lamprecht, Kat, Fuller, Israel: Macdonald, Yom-Tov.
Threats: None known.	Comments: African range expanding? Perhaps really always there, just recently reported.	Recommendations: Look at Egyptian and Sri Lankan populations.	Research:
PHVA: No.	Captive Populations: 4.8 in six installations	Captive Programs: None.	

Canis aureus leupaster (Egyptian jackal)			
Mace-Lande Status: More information required (MIR)	USFWS: None	CITES: None	Other:
Taxonomic Status: Unknown, sometimes classified as wolf.	Distribution: Egypt and Libya	Wild Populations: >10,000	Field studies: None
Threats: None known.	Comments: Might represent a very distinct canid form.	Recommendations:	Research: Needs taxonomic research.
PHVA: No	Captive Populations: None known.	Captive Programs: Nuc II	

Canis mesomelas (Black-backed jackal)			
Mace-Lande Status: Safe	USFWS: None	CITES: None	Other:
Taxonomic Status: East and southern populations are distinct.	Distribution: East and southern Africa. Two populations exist.	Wild Populations: 1,000,000	Field studies: Moehlman, Rowe-Rowe, diet studies in Namibia, Lamprecht, Stuart, Campbell and Borner, Fuller, Wayne.
Threats: Persecuted in southern Africa for livestock (sheep, goats) predation.	Comments: Investigate taxonomic uniqueness of East and South.	Recommendations:	Research: Check potential as disease vector, study underway in Zimbabwe by Atkinson; in Kenya by Kat, Alexander and Richardson.
PHVA: No	Captive Populations: 17.23 in seven installations.	Captive Programs: None. Eliminate.	

Canis simensis citernii (Ethiopian wolf)			
Mace-Lande Status: Critical	USFWS: Endangered	CITES: None	Other: In Ethiopia by law, schedule VI.
Taxonomic Status: One of two potential subspecies.	Distribution: Southeast of Rift Valley, Bale Mountains NP, West Bale Mountains, Arssi Mountains.	Wild Populations: 270 to 370 adults.	Field studies: Gottelli and Sillero-Zubiri 1988-1992. Behavioral ecology, demography, ongoing genetic study.
Threats: Disease, habitat loss, humans, dogs (hybridization, competition), roadkills. Dogs primary threat.	Comments: Control dog populations. Enhance conservation in Bale Mountains NP, community education vital.	Recommendations: Long-term monitoring, taxonomic elucidation necessary, variability between and among populations and hybridization.	Research: Taxonomic work ongoing.
PHVA: Yes. Recommended.	Captive Populations: None	Captive Programs: 90/100/I Ideally combined *in situ/ex situ.*	

Canis simensis (Ethiopian Wolf)			
Mace-Lande Status: Critical	USFWS: Endangered	CITES: None	Other: In Ethiopia by law, schedule VI.
Taxonomic Status: One of two potential subspecies.	Distribution: Northern Ethiopian highlands, northwest of Rift Valley; four separate populations-Simien Mt, Mount Guna, northeast Shoea (two separate groups there, 80 km apart).	Wild Populations: 75 to 100 adults.	Field studies: None underway; Shoa populations surveyed 1990, 1992.
Threats: Habitat loss, humans, disease, dogs (hybridization, competition), roadkills.	Comments: Simien Mountains best area to concentrate support. Must control dog populations.	Recommendations:	Research: Further surveys needed; taxonomic work ongoing. Amount of genetic variability in each subspecies must be determined.
PHVA: Yes. Recommended.	Captive Populations: None.	Captive Programs: 90/100/I	

Fennecus zerda (Fennec fox)			
Mace-Lande Status: MIR	USFWS: No	CITES: No	Other:
Taxonomic Status:	Distribution: Deserts of North Africa	Wild Populations: Unknown	Field studies: None
Threats: Harvested for fur and pets.	Comments: Needs basic survey.	Recommendations: Survey.	Research:
PHVA: No	Captive Populations: 69.78 in 42 installations.	Captive Programs: Nucleus II.	

Lycaon pictus East (African Wild Dog)			
Mace-Lande Status: Endangered	USFWS: Endangered	CITES: I	Other:
Taxonomic Status: Monotypic genus, three subspecies?	Distribution: Sub-Saharan Africa east of Lake Chad, north of Zambesi River in Africa.	Wild Populations: 1,500	Field studies: Creel, Kat, Malcolm
Threats: Disease, humans, habitat, roadkills.	Comments: Disease problems.	Recommendations:	Research: Need to check disease vectors.
PHVA: 1992	Captive Populations: None; PHVA suggests establishing captive population	Captive Programs: 90/100/I	

Lycaon pictus South (African Wild Dog)			
Mace-Lande Status: Vulnerable	USFWS: Endangered	CITES: I	Other:
Taxonomic Status: Monotypic genus, three subspecies ?	Distribution: South of Zambesi River in Africa.	Wild Populations: 2,500	Field studies: Ginsberg, Gorman, Maddock, Mills, McNutt, Reich
Threats: Disease, humans, habitat, roadkills.	Comments: Overrepresented in captivity.	Recommendations: Replace some with east or west forms.	Research:
PHVA: 1992	Captive Populations: 350 in 50 installations	Captive Programs: SSP, EEP and ASMP in formation. Nucleus II	

Lycaon pictus West (African Wild Dog)			
Mace-Lande Status: Critical ?	USFWS: Endangered	CITES: I	Other:
Taxonomic Status: Monotypic genus, three subspecies ?	Distribution: Sub-Saharan Africa west of Lake Chad	Wild Populations: 1,000 ?	Field studies: None
Threats: Disease, humans, habitat, hunting, roadkills.	Comments:	Recommendations: Surveys needed	Research: Taxonomic relationship to western populations should be investigated.
PHVA: 1992	Captive Populations: None	Captive Programs: 90/100/I	

Otocyon megalotis (Bat-eared fox)			
Mace-Lande Status: Safe	USFWS: None	CITES: None	Other:
Taxonomic Status: Monotypic genus	Distribution: Two disjunct populations, East and South Africa	Wild Populations: 1,000,000	Field studies: Malcolm, Maas, Lamprecht, Moehlman, Stuart
Threats: Disease	Comments: Cyclic, in apparent abundance.	Recommendations:	Research:
PHVA: No	Captive Populations: 11.22 in 12 installations	Captive Programs: Nucleus II in Africa	

Vulpes chama (Cape fox)			
Mace-Lande Status: Safe	USFWS: None	CITES: None	Other:
Taxonomic Status:	Distribution: Southern Africa	Wild Populations: 50,000-100,000	Field studies: Bester
Threats: Roadkills, humans.	Comments:	Recommendations:	Research:
PHVA: No	Captive Populations: 1.0 in one installation	Captive Programs: Eliminate	

Vulpes pallida (Pale fox)			
Mace-Lande Status: MIR	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution: Sahel	Wild Populations: 100,000	Field studies: None
Threats: Unknown	Comments: Needs work	Recommendations: Survey needed	Research: None
PHVA: No	Captive Populations: None	Captive Programs: Nucleus II	

Vulpes rueppelli (Ruppell's fox)			
Mace-Lande Status: Safe	USFWS: None	CITES: None	Other:
Taxonomic Status:	Distribution: North Africa and Middle East	Wild Populations: 1,000,000	Field studies: Macdonald
Threats: Local poisoning and competition	Comments:	Recommendations: Taxonomic research needed.	Research: None underway
PHVA: No	Captive Populations: None	Captive Programs: None recommended	

Canis aureus lanka (?)			
Mace-Lande Status: Vulnerable/MIR	USFWS: NL	CITES: NL	Other:
Taxonomic Status: Morphologically unique (Van Valkenburgh pers. comm.). No known info on genetics.	Distribution: Sri Lanka	Wild Populations: No information.	Field studies: None
Threats: Loss of habitat, human predation ?	Comments: Nothing known other than morphological data indicating it may be unique. Potential isolated island subspecies?	Recommendations: See above and below.	Research: Taxonomy and survey needed.
PHVA: Not recommended.	Captive Populations: None.	Captive Programs: Nucleus II	

Canis familiaris hallstromi			
Mace-Lande Status: Critical	USFWS: NL	CITES: NL	Other:
Taxonomic Status: Morphologically and genetically distinct.	Distribution: New Guinea	Wild Populations: <250	Field studies: Unknown
Threats: Human persecution	Comments: Ecology unknown ?	Recommendations: More intensive *in situ* management indicated.	Research: Field studies of ecology needed and surveys to elucidate distribution and status
PHVA: No	Captive Populations:	Captive Programs: 90/100/I in Australia	

Canis lupus arabs			
Mace-Lande Status: Endangered	USFWS:	CITES:	Other:
Taxonomic Status: Four specimens exam'd but further genetic and morphological work required to determine if *C.l. arabs* is distinct from *pallipes*.	Distribution: Arabian peninsula, Egypt, Israel, Jordan(?), Syria(?)	Wild Populations: <500, declining	Field studies: None
Threats: Human persecution	Comments:	Recommendations: More intensive management is required, settle the taxonomy of *pallipes* and *arabs*. Intensive field studies needed to elucidate ecology.	Research: Taxonomy, survey.
PHVA: Yes	Captive Populations: None	Captive Programs: Nucleus I	

Canis lupus lupus/campestris/signatus (European conglomerate)			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Sort out European subspecies	Distribution: Europe, northern Middle East and all of the CIS (former USSR)	Wild Populations: >25,000	Field studies: Many, especially of isolated populations in Europe (Norway/Sweden, Italy, Spain-Portugal).
Threats: Human persecution, harvesting and hybridization (Italy).	Comments:	Recommendations: Manage subpopulations *in situ* and liaise with Russian authorities to secure information. Validity of subspecies needs to be determined.	Research: Taxonomy.
PHVA: No	Captive Populations: None	Captive Programs: None, eliminate in North America	

Canis lupus pallipes			
Mace-Lande Status: Vulnerable	USFWS:	CITES:	Other:
Taxonomic Status: Subspecific status of Asian wolves needs addressing.	Distribution: Middle East	Wild Populations: <10,000	Field studies: None known.
Threats: Persecution, habitat destruction.	Comments: See *C.l. arabs*' table.	Recommendations: Distribution and status may need to be assessed if warranted.	Research: Taxonomy, surveys (?)
PHVA: No	Captive Populations: 18	Captive Programs: Nucleus II	

Cuon alpinus			
Mace-Lande Status: Endangered	USFWS:	CITES: I & II	Other:
Taxonomic Status: Population may be at least 10 subpopulations. Population highly fragmented, but historical isolation of Sumatran subspecies may be of particular interest.	Distribution: East and South Asia	Wild Populations: <5,000	Field studies: India; also Todd Fuller has a graduate student performing research in China.
Threats: Habitat fragmentation, human persecution and disease.	Comments:	Recommendations: More intensive management in the wild.	Research: Taxonomy - determine if genetically identifiable subspecies exist; surveys - identify distribution and status of subpopulations; conduct second field study in China or S.E. Asia; husbandry - develop protocol for captive breeding and management.
PHVA: Yes	Captive Populations: Small.	Captive Programs: Nucleus I	

Nyctereutes procyonoides			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Surveys required	Distribution: Japan, China, East Asia, introduced in Europe	Wild Populations: >200,000	Field studies: In Japan, extensive research.
Threats: None	Comments: Island populations are potentially endangered if shown to be taxonomically unique. Chinese and Japanese populations are genetically distinct. Abundant and safe throughout most of range including as an exotic throughout European range and western Asia.	Recommendations: Assess genetics of island populations.	Research: Taxonomic work
PHVA: No	Captive Populations: Eliminate	Captive Programs:	

Vulpes cana			
Mace-Lande Status: Vulnerable/MIR	USFWS:	CITES: II	Other:
Taxonomic Status: Unknown	Distribution: Israel, Iran, Afghanistan, CIS, Saudi Arabia and Arabian Peninsula (?)	Wild Populations: <5,000	Field studies: One study in Israel, Eli Geffen
Threats: Human persecution and harvesting.	Comments: Apparently disjunct populations but surveys may be incomplete.	Recommendations: Assess taxonomic distinctiveness of current populations because of fragmented distribution (desert mountain tops). Conduct surveys in suitable habitat where currently not known to occur.	Research: Taxonomic assessment and surveys.
PHVA: Yes	Captive Populations: One in Israel	Captive Programs: Nucleus I	

Vulpes ferrilata			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Unknown	Distribution: Tibetan plateau, India, China, Nepal, Bhutan (?).	Wild Populations: >10,000	Field studies: None (G. Schaller?)
Threats: None	Comments: G. Schaller indicates the species is in good shape.	Recommendations:	Research:
PHVA: No	Captive Populations: Eliminate	Captive Programs:	

Vulpes vulpes			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Unknown	Distribution: Holarctic and introduced to Australia	Wild Populations: >1,000,000 but probably few in Asia	Field studies: Countless, outside Asia
Threats: None	Comments:	Recommendations:	Research: None
PHVA: No	Captive Populations: Eliminate	Captive Programs:	

Canis aureus			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Unknown	Distribution: Asiatic/African including Sri Lanka	Wild Populations: >1,000,000	Field studies: In Africa and Israel
Threats: None	Comments:	Recommendations: Assessment of taxonomy because widespread distribution may have caused creation of important subpopulations (esp. Sri Lanka).	Research: Taxonomy
PHVA: No	Captive Populations: Eliminate	Captive Programs: Eliminate	

Canis familiaris dingo			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status: Introgression with domestic dogs is extensive	Distribution: From Burma through Indonesia to Australia	Wild Populations: Except for isolated areas, most dingoes are hybrids. Good dingo populations probably only exist in areas where people are absent. Central Australia and in some of the more remote Indonesian islands.	Field studies: Extensive field work on ecology and behavior; see Action Plan.
Threats: Extensive introgression from domestic dogs. Human persecution.	Comments:	Recommendations: More intensive *in situ* management indicated.	Research: Genetic research required to find populations not hybridized.
PHVA: No	Captive Populations: Screen for introgression from domestics.	Captive Programs: Nucleus I	

Canis familiaris halstromi			
Mace-Lande Status: Critical	USFWS:	CITES:	Other:
Taxonomic Status: Unique among domestic dog feral subspecies	Distribution: Papua-New Guinea	Wild Populations: In the wild, only found above 5,000 feet.	Field studies: Few.
Threats: Human persecution.	Comments:	Recommendations: More intensive *in situ* management indicated	Research: Genetic research required to confirm
PHVA: No	Captive Populations: Preferably *in situ* or regional	Captive Programs: 90/100/I	

Canis lupus chanco			
Mace-Lande Status: Vulnerable	USFWS:	CITES: I & II	Other:
Taxonomic Status: Good, distinct subspecies according to genetic work (but sample size small, N=2).	Distribution: China, Mongolia, Afghanistan	Wild Populations: >10,000	Field studies: None known; Prof. Gao in Harbin may have information.
Threats: Human pers./harvesting.	Comments: Potential for pop. to become fragmented. Also harvesting in Mongolia is high (>10,000 pelts/5 yr).	Recommendations: Status and impact of harvest needs to be addressed throughout range.	Research: Surveys.
PHVA: No	Captive Populations: 13 known	Captive Programs: Eliminate	

Canis lupus			
Mace-Lande Status: Safe	USFWS: E/TE Lower 48	CITES: I & II	Other:
Taxonomic Status: Subspecific status of Asian subspecies needs addressing.	Distribution: Holarctic	Wild Populations: Decline in Indian populations; potential overharvesting in Mongolia. Harvested elsewhere.	Field studies: Extensive European, N. American, and Asian (Russian) studies; survey work in India (Jhala); little work done in South Asia.
Threats: Persecution, habitat destruction, and harvest.	Comments: Subspecies evaluations on separate sheets.	Recommendations: For Middle East, India, and Southwest Asia, education, protection and surveys for status and distribution.	Research: As above.
PHVA: Not for entire species.	Captive Populations: Eliminate all but known E/V	Captive Programs: "Studbook" for E/V subspecies	

Chrysocyon brachyurus			
Mace-Lande Status: Endangered	USFWS: Endangered	CITES: Appendix II	Other:
Taxonomic Status: No subspecies	Distribution: South and central Brazil, eastern Bolivia, Paraguay and southeast Peru	Wild Populations: Possible disjunct population in eastern Peru.	Field studies: One rumored by Rogerio Lange et al.; also Dietz (historical, but best to date); & radiocollaring a population north of Brasilia.
Threats: Disease, habitat loss, hunting as pest.	Comments:	Recommendations:	Research: Field and husbandry research needed.
PHVA: Yes, recommended within the next 2 years.	Captive Populations: Continue already established captive breeding programs with the goal of preserving 90% heterozygosity for 100 years.	Captive Programs: Already established; SSP, EEP, Management Program (Brazil-SZB), Australian management plan.	

Dusicyon gymnocercus (Azara's zorro)			
Mace-Lande Status: Safe	USFWS: Not listed	CITES: Appendix II	Other:
Taxonomic Status: Needs clarification	Distribution: Southeastern Brazil, Uruguay, Paraguay, and northern Argentina.	Wild Populations:	Field studies: None known
Threats: Hunting for fur and pest.	Comments:	Recommendations: Manage locally *in situ* as fur species.	Research: Survey and basic ecological research needed, esp. relationships with sympatric canids.
PHVA: Not recommended at this time.	Captive Populations: None known outside South America.	Captive Programs: Recommend eliminating from captivity.	

Dusicyon vetulus (Hoary zorro)			
Mace-Lande Status: MIR	USFWS: Not listed	CITES: Not listed	Other:
Taxonomic Status: Needs clarification	Distribution: South central Brazil	Wild Populations:	Field studies: Comparative coop study involving Belo Horizonte & Oxford Univ.
Threats: Hunting, loss of habitat	Comments:	Recommendations: Clarify taxonomy; survey and basic ecological research needed.	Research:
PHVA: Not recommended at this time.	Captive Populations: None outside South America	Captive Programs: Establish Nuc I pop.	

Dusicyon sechurae (Sechuran fox)			
Mace-Lande Status: MIR	USFWS: Not listed	CITES: Not listed	Other:
Taxonomic Status: Needs clarification	Distribution: Northern Peru and southern Ecuador	Wild Populations:	Field studies: One study, unpubl., by Cheri Asa, St. Louis Zoo.
Threats: None known	Comments:	Recommendations: There is very little known about this species. Taxonomic and basic ecological research needed.	Research:
PHVA: Not at this time.	Captive Populations: None known.	Captive Programs: Establish a Nucleus I population.	

Dusicyon microtis (Atelocynus?) (Small eared dog)			
Mace-Lande Status: Vulnerable	USFWS: Not listed	CITES: Not listed	Other:
Taxonomic Status: Needs clarification - *Dusicyon* or *Atelocynus*?	Distribution: Tropical forest Brazil, Peru, Colombia, Ecuador	Wild Populations: Unknown	Field studies: Unknown
Threats: Habitat loss	Comments: The evidence indicates this species occurs very rarely in its range. There have been only two or three sightings reported in the past several years.	Recommendations: Survey and basic ecological research are of prime importance.	Research:
PHVA: Not at this time	Captive Populations: None known.	Captive Programs: Establish a captive population with a goal of retaining 90% heterozygosity over 100 years.	

Speothos venaticus (Bush dog)			
Mace-Lande Status: Vulnerable	USFWS: Vulnerable	CITES: Appendix I	Other:
Taxonomic Status: Monospecific	Distribution: From Central America south through western Brazil	Wild Populations: Northern and southern populations are morphologically distinct.	Field studies: None known.
Threats: Loss of habitat.	Comments:	Recommendations: Clarify subspecies question.	Research: Survey and basic ecological research needed.
PHVA: Not recommended.	Captive Populations: Established, but inbred in Europe and North America. One large population in Paraguay, three small in Brazil.	Captive Programs: Great interest was generated in developing a collaborative captive breeding program between Paraguay, Brazil and Europe at the SZB Congress in March 1992. It is recommended that a Nucleus I population be established.	

Dusicyon griseus (gray fox)			
Mace-Lande Status: Vulnerable	USFWS: Vulnerable	CITES: Appendix II	Other:
Taxonomic Status: Needs clarification of subspecies issue.	Distribution: Argentina and Chile	Wild Populations: Subspecies?	Field studies: Javier Bellati; study of predator-prey interactions ongoing since 1983.
Threats: Hunting for fur and as a pest.	Comments:	Recommendations: Monitor and manage as game species in some localities.	Research: Clarify taxonomy.
PHVA: Not recommended at this time.	Captive Populations: None known outside of South America	Captive Programs: Establish Nucleus I population.	

Dusicyon culpaeus (red fox)			
Mace-Lande Status: Safe	USFWS: Not listed	CITES: Appendix II	Other:
Taxonomic Status: Needs clarification of subspecies issue	Distribution: From highlands of southern Peru through Chile and western Argentina, throughout Patagonia.	Wild Populations: Subspecies?	Field studies: J. Bellati: long-term projects studying predator-prey interactions and the impact of culpeo on sheep farming in Patagonia. Peter Meserve and Fabian Jaksie: ecological study in central Chile.
Threats: Hunting, mainly for fur but also as a pest species.	Comments:	Recommendations: Clarify taxonomy and monitor population.	Research:
PHVA: Not at this time.	Captive Populations: None outside of South America	Captive Programs: Recommend elimination from captivity.	

Cerdocyon thous			
Mace-Lande Status: Safe	USFWS: Not listed	CITES: Not listed	Other:
Taxonomic Status: Needs clarification of subspecies issue.	Distribution: Colombia, Venezuela, Surinam, eastern Peru, Bolivia, Paraguay, Uruguay, Brazil and northern Argentina.	Wild Populations:	Field studies: D. MacDonald and O. Courtenay examining the role of *C. thous* in the epidemiology of visceral leishmaniases on Marajo Island, Brazil.
Threats: Occasionally shot as pest.	Comments:	Recommendations: Monitor (survey)	Research: Clarify taxonomy
PHVA: Not at this time	Captive Populations: Not reported outside South America	Captive Programs: Recommend elimination from captivity.	

Dusicyon fulvipess (Chiloe Island fox)			
Mace-Lande Status: Vulnerable	USFWS: Not listed	CITES: Not listed	Other:
Taxonomic Status: Needs clarification of subspecies issue	Distribution: Chiloe Island off coast of Chile	Wild Populations:	Field studies:
Threats: Loss of habitat - restricted to one island	Comments:	Recommendations: Clarify taxonomy and monitor population	Research:
PHVA: Not at this time	Captive Populations: None outside of South America	Captive Programs: Establish Nucleus II pop.	

Cuon alpinus sumatrensis			
Mace-Lande Status: Critical	USFWS:	CITES: II	Other:
Taxonomic Status: Unknown, may be a unique island population	Distribution: Sumatra	Wild Populations: Unknown, less than 250 (?)	Field studies: None
Threats: Habitat loss and disease, human persecution(?)	Comments: Within the species this may be the most threatened population but status unknown. More information required about status and distribution of subspecies in the wild.	Recommendations: If taxonomically unique, then intensive *in situ* management required.	Research: Taxonomy and surveys.
PHVA: Yes	Captive Populations: None known	Captive Programs: Nucleus I	

Alopex lagopus			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution:	Wild Populations:	Field studies:
Threats:	Comments:	Recommendations:	Research:
PHVA:	Captive Populations: Eliminate	Captive Programs: None	

Canis latrans			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status: Species well-defined, no evidence for subspecific distinctions.	Distribution: North America through Panama south	Wild Populations: Increasing	Field studies: Numerous
Threats: No threat	Comments: Threatens grey wolf population mainly as "pest species."	Recommendations:	Research:
PHVA:	Captive Populations: Eliminate	Captive Programs: None	

Canis lupus baileyi			
Mace-Lande Status: Critical	USFWS: Endangered	CITES: Appendix II	Other:
Taxonomic Status: Unique mtDNA genotype more distinct than other gray wolf genotype and morphologically unique (given populations that have been examined). Refr. work by Brewster and Fritts (in prep.).	Distribution: Fragmented population (4-5) in mountainous foothills of Sierra Madres	Wild Populations: <50 (unk) fragmented	Field studies: One proposed study, World Bank study
Threats: Forestry development projects in Sierra Madres assessment relative to potential impacts and hunting.	Comments: Low founder representation (4) relative relatedness. ID suitability of uncertified lineages. Improved coordination communication between Mexico and US. Proposed release in Mexico by SEDUE (premature). Education of Mexican residents. Genetic evidence that Mexican wolves existed in eastern Texas in recent times.	Recommendations:	Research: Survey of status and distribution in Mexico (p. 94) and adjoining border areas of AZ and NM. Determine genetic purity of uncertified population. Monitor possible inbreeding depression.
PHVA: Complete PVA. Develop individually based model for metapopulation.	Captive Populations: 50 (SB) plus two known uncertified lines 16 and 8, respectively.	Captive Programs: 90/100/I with top priority being reintroduction.	

Canis lupus			
Mace-Lande Status: Safe/Vulnerable/Endangered	USFWS: Endangered/Threatened	CITES: Appendix II	Other: IUCN-V(RDB)
Taxonomic Status: Species well-defined review of subspecific status	Distribution: Holarctic	Wild Populations: <60,000	Field studies: Numerous
Threats: Increasing human population; ranching industry habitat fragmentation; hybridization with dogs and coyotes.	Comments: Safe in core of occupied range and individual populations are vulnerable to critical along periphery of range.	Recommendations: Survey additional populations with additional genetic techniques. Encourage reestablishment efforts within historical range.	Research: Investigate hybridization with dogs and coyotes.
PHVA:	Captive Populations: Approx. 200	Captive Programs: Eliminate	

Canis rufus (gregoriyi)			
Mace-Lande Status: Critical	USFWS: Endangered	CITES: Appendix I	Other: IUCN-E
Taxonomic Status: Under review	Distribution: Reintroduced current population ARNWR and GSMNP	Wild Populations: 22-23 and three in Smokies	Field studies: Radio-tracking and corresponding data.
Threats: Population size, coyote inbreeding, human interactions	Comments:	Recommendations:	Research: Additional taxonomic research; potential RW/coyote interaction; sperm collecting/AI, developmental behavior study.
PHVA:	Captive Populations: 172	Captive Programs: 90/100/I; continue SSP	

Urocyon cineroargentus			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution:	Wild Populations:	Field studies:
Threats: In some areas, red foxes have successfully excluded grey wolves.	Comments:	Recommendations:	Research:
PHVA:	Captive Populations: Eliminate	Captive Programs: None	

Urocyon littoralis (San Nicholas)			
Mace-Lande Status: Critical	USFWS: Category II	CITES: None	Other:
Taxonomic Status: Unique mtDNA genotype	Distribution: San Nicholas Island	Wild Populations: 300	Field studies: Census, telemetry done by Navy
Threats: Roadkill; stochastic events of small isolated populations such as disease; feral cats.	Comments: Should be listed as Endangered by California Fish and Game; efforts should be made to eliminate feral cats.	Recommendations:	Research: Continue census on annual basis; continued disease monitoring.
PHVA: Yes	Captive Populations: None	Captive Programs: Nucleus I	

Urocyon littoralis (N. Channel Island)			
Mace-Lande Status: Endangered	USFWS: Category II	CITES:	Other:
Taxonomic Status: See above	Distribution: Santa Cruz, Santa Rosa, San Miguel	Wild Populations: <2,500	Field studies: Some unpublished census studies
Threats: Disease	Comments: San Miguel population is isolated and small (<250)	Recommendations: See above	Research:
PHVA: Yes for all	Captive Populations: None	Captive Programs: Nucleus I for San Miguel	

Urocyon littoralis (S. Channel Islands)			
Mace-Lande Status: Endangered	USFWS: Category II	CITES:	Other:
Taxonomic Status: See above	Distribution: San Clemente, Santa Catalina	Wild Populations: <2,000	Field studies: Census, telemetry, diet
Threats: Cats; disease; development on Santa Catalina; Navy operations on San Clemente.	Comments: Eliminate cats; guard against disease introduction.	Recommendations:	Research: Same as above
PHVA: Yes for all	Captive Populations: None	Captive Programs: Nucleus I for San Clemente	

Vulpes vulpes			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution:	Wild Populations:	Field studies:
Threats:	Comments: Some evidence that New and Old World red foxes can be morphologically and genetically distinguished. With the arrival of Europeans, Old World red foxes were introduced throughout the eastern US for hunting purposes.	Recommendations:	Research: Taxonomic survey should be done to determine whether endemic form of the red fox in North America is threatened by hybridization with the European foxes.
PHVA:	Captive Populations:	Captive Programs:	

Vulpes velox (San Joaquin kit fox)			
Mace-Lande Status: Endangered	USFWS:	CITES:	Other:
Taxonomic Status: Subspecies status is debated	Distribution: San Joaquin Valley, California	Wild Populations: <7,000 individuals	Field studies: Numerous
Threats:	Comments:	Recommendations:	Research: Taxonomic revision of the group is needed; determine if truly isolated genetically; need better distribution and census studies; investigate interaction with coyotes; get latest survey numbers from Katherine Ralls and T. P. O'Farrell.
PHVA: Yes	Captive Populations: One in ISIS	Captive Programs: Nucleus I	

Vulpes velox (other kit foxes)			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution:	Wild Populations:	Field studies:
Threats: Coyotes and poison aimed at coyotes	Comments:	Recommendations:	Research: Clarify taxonomic status and investigate interactions with coyotes
PHVA:	Captive Populations:	Captive Programs: Nucleus II	

Vulpes velox (Swift fox)			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status:	Distribution:	Wild Populations:	Field studies:
Threats: Coyotes and poison aimed at coyotes	Comments: Exterminated from Canada; being reintroduced from captive population in Calgary	Recommendations:	Research: Clarify taxonomic status, esp. in South Dakota population, and investigate interactions with coyotes
PHVA:	Captive Populations:	Captive Programs:	

Nyctereutes procyonoides (Island subspecies)			
Mace-Lande Status: MIR	USFWS:	CITES:	Other:
Taxonomic Status: Surveys required; indications that subspecies is distinct. Doris Wurster-Hill should be contacted re: status.	Distribution: Japan, China	Wild Populations: Unknown	Field studies: In Japan, some research
Threats: Habitat loss, persecution for fur and food.	Comments:	Recommendations:	Research: Taxonomic work
PHVA: No	Captive Populations: Eliminate	Captive Programs: Eliminate	

Vulpes bengalensis			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Unknown	Distribution: Indian subcontinent	Wild Populations: >10,000	Field studies: None known
Threats: None	Comments: Supposedly most common fox of the Indian plains, but little is known about its ecology and distribution	Recommendations: Indian Wildlife Institute should provide accurate information about the species.	Research: Taxonomy - identify genetic variability; surveys - better determine populations' distribution and status.
PHVA: No	Captive Populations: Eliminate	Captive Programs: Eliminate	

Vulpes corsac			
Mace-Lande Status: Safe	USFWS:	CITES: I & II	Other:
Taxonomic Status: Unknown	Distribution: China, Afghanistan, Mongolia	Wild Populations: >10,000	Field studies: None
Threats: Possibly harvesting.	Comments: Ecology virtually unknown.	Recommendations: Assessment of taxonomic status and field surveys needed because of potentially disjunct nature of population which is spread between northeastern Iran and northern Manchuria.	Research: Taxonomy and survey work.
PHVA: No	Captive Populations: Eliminate	Captive Programs:	

Vulpes rueppelli			
Mace-Lande Status: Safe	USFWS:	CITES:	Other:
Taxonomic Status: Unknown	Distribution: North Africa to Arabia	Wild Populations: >10,000	Field studies: Yes, in North Africa and Arabia
Threats: Potential competition with red fox associated with human settlements.	Comments: Probably occurs in greater numbers than indicated above because species is nocturnal and not often observed. Few produced in captivity and little may be known about husbandry.	Recommendations: Assess taxonomy because widespread distribution may have brought about the development of important subpopulations.	Research: Taxonomy
PHVA: No	Captive Populations: Eliminate	Captive Programs:	

Hyaena brunnea (Brown hyaena)			
Mace-Lande Status: Vulnerable	USFWS: Endangered	CITES: I	Other:
Taxonomic Status: Unique; perhaps separate genus (Werdelin and Solounias, 1990).	Distribution: Southern Africa	Wild Populations: 1,000 to 2,500	Field studies: Mills, Owens
Threats: Habitat loss, human persecution	Comments: Rabies a potential problem, but rare.	Recommendations: Need to know more about captive management.	Research: Survey underway on all hyaenas by SSP hyaena group. Need research on social habits in captivity.
PHVA: No	Captive Populations: 21.13 in 13 installations	Captive Programs: International studbook exists but may not survive, at least not for captive animals outside Africa. Nucleus I in Africa	

Hyaena hyaena (Striped hyaena)			
Mace-Lande Status: Safe (as species)	USFWS:	CITES:	Other:
Taxonomic Status: II, perhaps 5 subspecies (?)	Distribution: North, Eastern Africa, Middle East, India.	Wild Populations: 50,000 to 100,000	Field studies: Kruuk, MacDonald
Threats: Human persecution	Comments: Little known, need surveys.	Recommendations: More information needed on Asiatic forms.	Research: Survey underway on all hyaenas by SSP hyaena group.
PHVA: No	Captive Populations: 20.23 in 17 installations	Captive Programs: Nucleus II	

Canid Taxonomic General and Specific Problems

by Robert K. Wayne, Ph.D.
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A general concern is the great number of subspecies designations. It should be appreciated that canids, especially large canids, are highly mobile creatures and high rates of gene flow may stifle genetic differentiation among even widely separated populations. It is clear in many cases that subspecies were defined long ago on very few specimens when naming new local varieties was an expected outcome of explorations and a gentleman's pastime. Modern definitions of subspecies incorporate the notion of phylogenetic concordance, that is several techniques define phylogenetic grouping of populations that are generally allopathic. Such groupings may be considered subspecies rather than species if they freely interbreed when topographic or habitat barriers are removed (Avise and Ball, 1990).

In light of a more modern subspecies definition, many subspecies designations are not supported. For example, we have shown, using molecular genetic techniques, that there are no apparent subdivisions among North American coyotes although 19 subspecies have been defined. More subdivisions seem apparent of the Old and New World but no number near the 26 defined subspecies can be supported. In North America the Mexican wolf appears distinct and there is the hint of differences existing between Alaskan and Northwest Territory wolves. In the Old World, there is clearly more subdivision among gray wolves, but the observed genetic differences among European populations are small. Tentatively, until more samples are available, Europe, Middle East, Indian Subcontinent, China and C.I.S. populations should be treated separately.

The mobility of small canids is much less than that of their larger cousins which may lead to more subspecific differentiation. In kit and swift foxes (*V. velox*), we have defined a significantly distinct population on either side of the Rocky Mountains corresponding to the traditional divisions of kit and swift foxes. In a paper in review, we argue that they should be considered as a separate species, and we should have at least considered them a distinct unit for conservation purposes. Within kit foxes, the San Joaquin Valley kit foxes formed a distinct clade and Arizona populations to the east of the Colorado River may be distinct.

The North American species showing the most subdivision was clearly the Island Fox (*Urocyon littoralis*). This unique species is found only on the Southern California Channel Islands and has been divided into six subspecies, each corresponding to a population on a separate Channel Island. Using a variety of morphologic and genetic techniques, we found evidence for at least three subdivisions in Island foxes.

In the Old World, we have molecular and morphologic data on the African hunting dogs. East and South populations are clearly distinct. This is somewhat disturbing as East African wild dogs are not held in captivity although their populations are declining and may need augmentation. Nothing is known about the potentially most distinctive West African wild dog population.

For the many species about which we have little data, I recommend we take a logical approach and tentatively define subspecies by apparent barriers to gene flow and by assuming those populations that are separated by the greatest distance will tend to be the most distinct. These judgments should be tempered by the dispersal abilities of the species and the observed degree of habitat fragmentation.

In general, little debate exists about the species level taxonomy of canids. There are two exceptions, one being the Chiloe Island fox, *Dusicyon fulvipes*, which may be a distinct island endemic or may be a subspecies of *D. griseus*, the widely distributed mainland fox. The other problematic species is the red wolf, *Canis rufus*, which may be a distinct subspecies of the gray wolf and coyote. We are currently investigating the taxonomic status of red wolves and should have more information by the end of the Summer 1992. Until then, I recommend initiation of captive breeding for the Chiloe Island fox, as it is likely to be distinct, and no change in captive breeding plans for the red wolf.

Several endangered species of canid show high levels of phylogenetic distinction but are not currently bred in captivity. Most notable are the short-eared Zorro, *Atelocynus microtis*, and the Simien jackal, *Canis simensis*. The former species inhabits Brazilian rain forests and only anecdotal reports of its existence are known. It is one of the most distinctive of the South American canids, and clearly belongs in a monotypic genus. The last captive specimen died in 1962.

Contrary to its common name (Simien jackal), it is not closely related to the African jackal and is, instead, a close relative of wolves and coyotes. Its presence in Africa is likely a remnant population of a once more widely abundant wolf-like canid. Considering its taxonomic uniqueness, small population size and the uniqueness of the habitat it occupies, highest priority should be given to establishing a breeding program for this species.

Finally, there is a clear need for taxonomic research on the canids, especially below the species level. The two important issues concern hybridization and subspecies designation. Hybridization potentially threatens the genetic integrity of several species and captive stocks may not fully represent the pure forms. Hybridization is known to have occurred between red wolves and coyotes, gray wolves and coyotes, gray wolves and domestic dogs and may have occurred between Simien jackals and domestic dogs. Simien jackals may be severely threatened in some areas as feral domestic dogs hybridize with wolves on the outskirts of cities. Because of a reduced prey base, Italian wolves increasingly visit garbage dumps near small towns. Research is needed to determine the importance of hybridization in wild populations.

Nearly all endangered canids need taxonomic revision at the subspecies level. Little is known about genetic subdivision within small Old World foxes such as the fennec fox, the pale fox, the Bengal fox and Blanford's fox. Species such as the bat-eared fox or the cape fox, although abundant, may be composed of genetically distinct subpopulations. We know that at least genetic subdivisions are apparent between East and South African canids.

A pressing concern is funding for taxonomy research of canids. Both morphological and molecular techniques should be used and it should be expected that support is available as a prerequisite to such studies.

Two other concerns need to be mentioned; the first is that the samples must be sufficient to answer the question that is posed. For example, to define subspecies, about 20 individuals are generally needed for each putative subspecies to accurately determine its distinctiveness. It should be kept in mind that even highly degraded material (e.g., bones, old skins, hair), can be used for DNA analyses using modern molecular techniques. Finally, the scientific interest of the problem must also be considered. Most of the research is done by academics and must be defensible on scientific grounds as advancement and continued funding is often dependent on the number and merit of peer-reviewed publications. Many important conservation questions are narrowly focused such that a publication will rarely result. Thus, effort should be made to broaden the analyses such that the needs of pure and applied science are balanced.

Synopsis

Captive management of endangered canids requires definition of taxonomic units worthy of separate conservation. Because canids have high dispersal capabilities, high rates of gene flow among populations may stifle population differentiation. The numerous subspecies defined for many taxa are unlikely to be valid. In North America, the Mexican wolf is distinct and the Alaskan wolf may be as well. Kit and swift foxes may be distinct species and with the kit fox, the San Joaquin form is distinct. The Channel Island fox is the only endemic U.S. canid; it is a morphologic unique and dwarfed island form which is divided into at least three subspecies.

In the Old World, East and South Africa wild dog populations are distinct on morphologic and molecular genetic grounds. Other canids, especially small fox-like forms, may have subspecific divisions and more taxonomic work is needed.

On the species-level, the specific status of the red wolf and the Chiloe Island fox is undecided and needs closer taxonomic study. The short-eared fox, *Atelocynus microtis* is a monotypic, Brazilian taxon, not widely abundant and not bred in zoos. Similarly, the Simien jackal is a distinct wolf-like canid with a highly restricted range not found in any captive collection.

Finally, taxonomic research is needed on endangered canids at the subspecies level. However, funding resources have not been identified and in many cases samples need to be collected in order to define evolutionary significant units.

Species Survival Commission

Species Survival Commission
IUCN - The World Conservation Union

Commission de la sauvegarde des espèces
UICN - l'Union mondiale pour la nature

Comisión de Supervivencia de Especies
UICN - La Unión Mundial para la Naturaleza

George B. Rabb,
Commission Chairman

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August 11, 1992

The Honorable Dr. Mesfin Abebe
Vice-Minister
Environmental Protection and Development Department
Ministry of Agriculture
Addis Ababa
ETHIOPIA

Dear Dr. Mesfin Abebe:

Recent meetings of the Canid, Antelope and Captive Breeding Specialist Groups of the Species Survival Commission (SSC) of IUCN-The World Conservation Union-have noted with concern the perilous conservation status of three endemic taxa--mountain nyala, Swayne's hartebeest, and the Ethiopian wolf (Simien jackal)--in Ethiopia. They have asked me to bring the SSC's concern about the survival of these species to your attention and to offer the assistance of the SSC on actions to address these urgent conservation problems.

A canid Conservation Assessment and Management Plan workshop held in May 1992 with the participation of some of the foremost specialists on canid species and captive breeding, identified the urgent need for a captive breeding program for the Ethiopian wolf. Their concerns are expressed in the enclosed resolution. On behalf of the SSC I wish to express my full endorsement of this resolution and reaffirm its offer of technical assistance to the Ethiopian Government in pursuing an appropriate captive management program, both within and outside of Ethiopia.

A similar workshop for antelope, held in South Africa in June 1992, also recommended urgent actions to establish a captive breeding nucleus for both mountain nyala and Swayne's hartebeest. Again, the appropriate SSC Specialist Groups offer their assistance in developing captive breeding programs for these species.

Both workshops recognized that while establishment of captive breeding programs for these species is of critical importance, it can not be a substitute for continued *in-situ* conservation and management. The SSC recognizes the conservation efforts made to this point by the Ethiopian Government and encourages the continued support of these activities.

I welcome your suggestions as to how the SSC can be of most assistance to the Ethiopian Government at this time. In particular, please inform me if there are steps that can be taken in the near future to begin work on captive breeding programs for these three species. If you have any questions or concerns about the proposals of the SSC Specialist Groups, please contact me at your earliest convenience.

Sincerely,

George B. Rabb

George B. Rabb
Chairman

cc: Ato Tadese Bare Micheal
David Macdonald
Richard Estes
Ulysses S. Seal
Tim Allen-Rowlandson
John Robinson
Alexandra Dixon

The World Conservation Union
Species Survival Commission

Canid Specialist Group

Chairman:
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A Resolution Supporting A Captive Breeding Program for the Ethiopian Wolf.

The Ethiopian wolf (Canis simensis) is the rarest canid in the Old World; the species is found only in a few isolated mountains of Ethiopia. Fewer than 500 adult animals survive, most of them in the Bale Mountains. This represents a decline of 30% of the known population in the last two years. The reasons for the decline in population levels are numerous: loss of habitat; habitat fragmentation; disease; and persecution by pastoralists. Additional threats to the ever smaller populations include inbreeding and loss of genetic diversity and those arising from local populations of domestic dogs, i.e. competition, disease and risk of hybridization.

Ethiopia, and the rest of the world, are at a great risk of losing the species if action is not taken immediately. Each of the remaining populations of Ethiopian wolf is faced with a near certain risk of extinction. Actions are required both in Ethiopia and elsewhere. In particular, we believe that immediate action is needed to obtain a representative sample of the population for intensive captive breeding.

To this end, the Canid Conservation Assessment and Management Plan (Canid-CAMP) Workshop, held under the auspices of the American Association of Zoological Parks and Aquariums Canid Taxon Advisory Group (AAZPA Canid TAG) and the IUCN Canid and Captive Breeding Specialist Groups, strongly recommends the following actions be taken immediately:

1) Establish an integrated in-country and out-of-country captive breeding program. The priority is to establish the program as effectively and quickly as possible. Each site has equal priority and efforts should be made to facilitate construction and implementation in Ethiopia and at an out-of-country facility. Because such facilities already exist at many out-of-country zoos and captive breeding centers, propagation outside of the range state could proceed while an establishment is being built in Ethiopia.

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2) We understand that the captive breeding of endangered species is a difficult task. The IUCN Species Survival Commission and the AAZPA Canid TAG offer the Ethiopian Government whatever technical assistance they require to pursue their goals. There is no previous experience in breeding Ethiopian wolves in captivity hence extensive research on husbandry techniques may be required. As a result, the out-of-country location(s), where expertise and extensive laboratory facilities already exist, may be able to offer the Ethiopian Government immediate assistance in establishing a protocol for captive breeding to be used at both the in-country and out-of-country captive sites. In the long term, in-country captive breeding offers direct access to, and simpler provision of, the unique prey and habitat the species requires for long term survival.

3) The establishment of a captive breeding program, while of critical necessity, can not be seen as a replacement for further in situ habitat and species conservation and management. We acknowledge the efforts to date of the Ethiopian Government and urge them to continue support of such activities. We also urge the world conservation community to support the lead role of the Ethiopian Government.

Dr. J. Grisham, Co-Chair AAZPA Canid-TAG

Dr. D. Macdonald, Chairman, IUCN-SSC CSG

Dr. R. Smith, Co-Chair AAZPA Canid-TAG

Dr. U. Seal, Chairman, IUCN-SSC CBSG

J. Jackson, Director, Fossil Rim Breeding Center

Dr. J. Ginsberg, Deputy-Chair, IUCN-SSC CSG

Research Priorities for Disease Monitoring in Canids

by Linda Munson, DVM, PhD
University of Tennessee College of Veterinary Medicine

Disease monitoring and medical management are integral components of a Canid Global Action Plan. For *in situ* conservation, early recognition of catastrophic disease events is essential to determine when intervention is necessary to avert population declines and extinction. Currently, the impact of disease on wild populations cannot be assessed because no centralized reporting system for canid diseases exists. Unfortunately, the very species that require the most intensive management are those that we know least about.

As habitat constraints isolate and concentrate populations, the risk of a catastrophic infectious disease outbreak within a population multiplies. The impact of disease on *in situ* conservation efforts also may increase with canid reintroductions or translocations. The reintroduced or translocated canids can expose the indigenous wildlife to new variants of pathogens or parasites, and the captive-reared canid may be immunologically naive to most organisms in the new environment. Strict quarantine, good preventive medical programs and constant disease monitoring will be required to avert post-reintroduction epidemics.

Captive propagation programs also will have limited success if the general and reproductive health of the canids cannot be assured and longevity extended through preventive medical programs. For most canids, knowledge of diseases has been confined to those causing death. However, subclinical diseases can have a major impact on reproductive function or general well-being. Development of effective preventive medical programs requires knowledge of what diseases affect each species. Lack of information on species susceptibility to infectious diseases and on species-specific diseases is the single greatest limitation to developing effective preventive medical programs for canids. Lack of knowledge of genetic diseases restricts the possibility of eliminating these diseases from populations through selective breeding.

Formation of a centralized disease reporting system for canids should be a top priority for the North American Canid TAG (NAC TAG). The NAC TAG is willing to take the lead on North American samples and is willing to coordinate an international effort in coordination with the IUCN Canid Specialist Group and IUCN Veterinary Specialists. The foundation of an effective disease reporting system should include data from complete necropsy exams and medical records, and not just "causes of death." For an individual animal, the reported "cause of death" is only the <u>most</u> significant disease in the animal that lead to its demise and usually does not reflect the spectrum of other diseases in the individual. Information on all diseases will be necessary to calculate disease prevalences in the canid population. Disease prevalences in captive canids then can serve as the basis for developing the best medical strategies for conserving canids.

Species in critical status also may require *in situ* medical management (such as rabies vaccination) periodically to assure population survival. If these animals carry vital genes for disease resistance, temporary medical intervention to avert extinction should not interfere with long-term evolutionary trends in disease resistance. In very small populations, we cannot afford the luxury of sacrificing the individual just to assure that the continued evolution of disease resistance is not temporarily interrupted.

Because infectious diseases pose one of the greatest threats to existing populations of canids, the short-term goal of the veterinary advisors to the Canid Action Plan should be to determine the geographic and species ranges of the common infectious diseases. Species-specific diseases, which usually signify a genetic predisposition, also should be determined, because the prevalence of these diseases will increase in populations with few founders and will pose a significant threat to the survival of these populations. In order to determine the optimal systems for disease management in canids in the future, the present emphasis should be on definition of the disease problems in canid populations.

RESEARCH PRIORITIES

1. Develop a disease-monitoring network for canids that includes field biologists, veterinary pathologists, zoo and field veterinarians, microbiologists, and epidemiologists.

2. Acquire infectious disease serology and hematoparasite data on wild canids whenever handling free-ranging animals. Serology should be performed in a centralized laboratory for consistency of results, and the results should be reported to a centralized disease database.

3. Provide both retrospective and prospective disease information to a centralized database. Initiate systematic collection of tissues from all canids that die (both captive and free-ranging when possible) for histopathology. The MEDARKS medical records and (soon-to-be-developed) pathology programs will provide a standardized means to input data into this database.

4. Assign veterinary and veterinary pathology advisors to all SSPs or SSCs for canids.

RECOMMENDATIONS FOR DISEASE MONITORING OF FREE-RANGING CANIDS

SEROLOGICAL SCREENING

Continuous serological screening for infectious disease in free-ranging populations provides invaluable baseline data for predicting changing disease patterns and for averting devastating enzootics. Serum should be obtained during any immobilization procedure for radiocollaring, translocations, or other research studies. If possible, all sera should be evaluated in the laboratories recommended by the Canid TAG (see below) and reported to a central databank for consistency and effectiveness of this disease screening.

Dr. Linda Munson, the Canid TAG pathologist, will maintain the central Canid Infectious Disease Serology Databank. Data submitted to the Canid Infectious Disease Serology Databank will be used to alert conservationists of disease trends and epizootics in wild canid populations and will not be used for publication without authorization from the submitting scientist. To assist the field biologists in submitting serum for screening, Dr. Munson is acquiring permits for importation of canid serum, can forward serum samples to the appropriate laboratories, and report results back to the field biologists. TO SUBMIT SERUM SAMPLES OR SEROLOGICAL DATA TO THE CANID INFECTIOUS DISEASE SEROLOGY DATABANK, CONTACT:

Dr. Linda Munson
Dept. of Pathobiology
College of Veterinary Medicine
University of Tennessee
P.O. Box 1071
Knoxville, Tennessee 37901
USA
Fax (615) 974-5616
(615) 974-8235

SERUM COLLECTION AND STORAGE

MATERIALS:

Catalogue numbers are from Baxter Scientific Products, 1430 Waukegan Rd., McGaw Park, IL 60085 USA, (708) 689-8410. Other general distributers such as Fisher Scientific also would have these products.

Vacutainer serum tubes (red top) (#B2980-54)
Vacutainer needles (20 or 22 g) (#B3032-1 or #B3032-3)
Vacutainer needle holders (#B 3035-4)
Nalgene cryovials 2 ml capacity (#T4050-8)
Transfer pipettes (#P5214-10)
Water-resistant marking pens (#P1224-1)

SHIPPING CONTAINERS: if needed, insulated shipping containers also can be purchased from Baxter Scientific Products (M1065-1).

CENTRIFUGE [Mobilespin from Vulcon Technologies, 718 Main, Grandview, MO 64033; (816) 966-1212 or Fax (816) 966-8879]. This centrifuge is portable, runs on 12 volts, and is easily adapted for field use.

BLOOD COLLECTION PROCEDURES:

Gloves should be worn by anyone handling canids or canid blood. A sterile needle and tubes should be used for each canid to prevent spread of disease.

The skin over the vein to be bled should be thoroughly cleaned and wiped with alcohol and clean gauze or cotton. Approximately 10 mls of blood should be collected by sterile techniques in a Vacutainer serum collection tube (clot tube = red top tube). The blood should be allowed to clot for approximately 30 min, then the tube should be centrifuged at approximately 2000g for 20 min. When a centrifuge is not available, refrigerate (not freeze) the blood sample until

at the laboratory. After centrifugation, the serum should be removed from contact with the red blood cell layer and placed in four (4) 1 ml aliquots in airtight, non-breakable tubes (cryovials). The vials should be labeled with the species, animal ID (ISIS number and/or studbook number), date, and owner (e.g., country and park) using a waterproof marker. These serum aliquots then can be frozen at -20° or -70°C until all samples within the population are obtained.

SERUM SUBMISSION RECOMMENDATIONS

Samples should be sent by EXPRESS MAIL, frozen on dry ice, and WITH THE PROPER PERMITS. AN OFFICIAL LETTER OF PERMISSION TO CONDUCT SEROLOGY STUDIES FROM THE COUNTRY OF ORIGIN should accompany any samples.

For consistency in results, THE FOLLOWING LABORATORIES ARE RECOMMENDED BY THE CANID TAG FOR SERUM ANALYSIS:

1. Rabies and Ehrlichia serology

Viral and Rickettsial Zoonoses Branch
Center for Disease Control
Building 15, Mail Stop G-33
1600 Clifton Road, N.E.
Atlanta, Georgia 30333
Attn: Dr. Makonnen Fekadu
(404) 639-1050

Dr. Makonnen is willing to perform these serological tests at no charge if field researchers will agree to publish the results in collaboration with the Center for Disease Control. If the submitting researchers are unwilling to publish the results, serology will be done on a fee basis.

2. Canine distemper, parvovirus, canine adenovirus, canine coronavirus, canine herpesvirus:

Dr. Max Appel
James Baker Institute
Cornell University
Ithaca, New York 14853
(607) 277-3044; Fax (607) 277-8399

Dr. Max Appel has generously offered to provide serum titers for canine distemper, parvovirus, canine adenovirus, canine coronavirus, and canine herpesvirus. If you have serum you wish to have analyzed, please call Dr. Appel first, (607) 277-3044, to make arrangements for the shipping and handling of sera.

Dr. Appel will not charge for this service, but would appreciate any grant money allocated for serology be donated to THE JAMES A. BAKER INSTITUTE FOR ANIMAL HEALTH. These donations will be used to benefit all canids by supporting ongoing and future research on canid infectious diseases.

3. Rinderpest, African horse sickness, and Rift Valley fever

Dr. Al Torres
Plum Island Animal Disease Center
P.O. Box 848
Greenport, LI, New York 11944-0848
(516) 323-2500

PARASITOLOGICAL BLOOD SCREENING

Several blood smears should be made to screen for parasites when blood is collected for serology. Babesiosis, ehrlichiosis, and heartworm can be detected by a blood smear. Dr. Linda Munson, the Canid TAG pathologist, is willing to screen the slides for hemoparasites. Send fixed slides that have been carefully padded to prevent breakage to:

Dr. Linda Munson
Dept. Pathobiology
College of Veterinary Medicine
University of Tennessee
P.O. Box 1071
Knoxville, Tennessee 37901
(615) 974-8235; Fax (615) 974-5616

Materials to make blood smears:

Catalogue numbers are from Baxter Scientific Products, 1430 Waukengan Rd. McGaw Park, IL 60085 USA, (708) 689-8410. Other general distributers such as Fisher Scientific also would have these products.

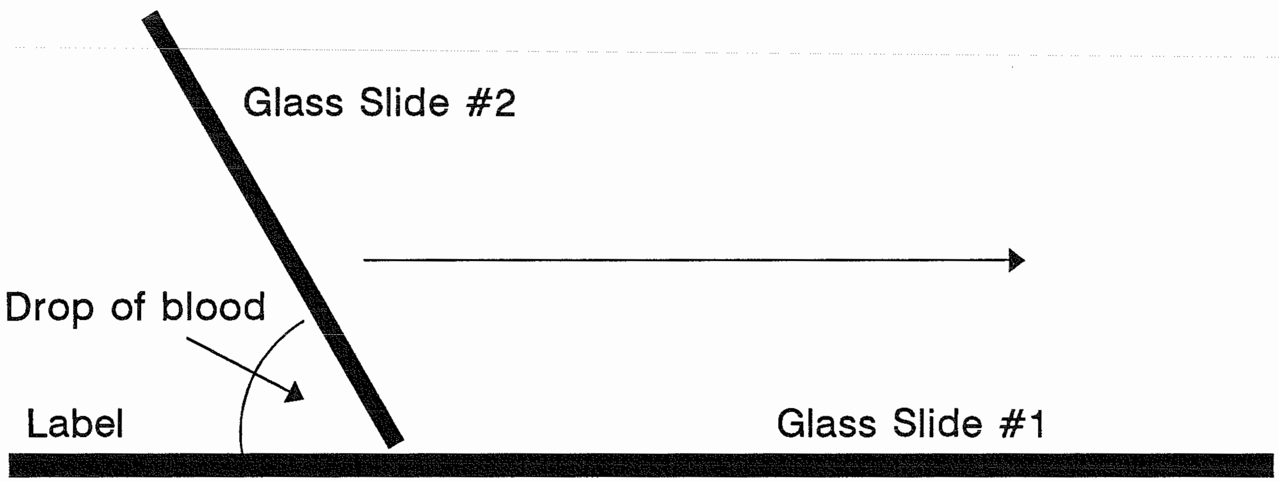
EDTA tubes (3 mls) (No. B2951-75)
Glass slides with frosted end (#M6147)
Transfer pipettes (#P5214-10)
Secureline Marker II/Superfrost (solvent resistant) Markers (P1220) or pencil
Slide mailers (#M6271)

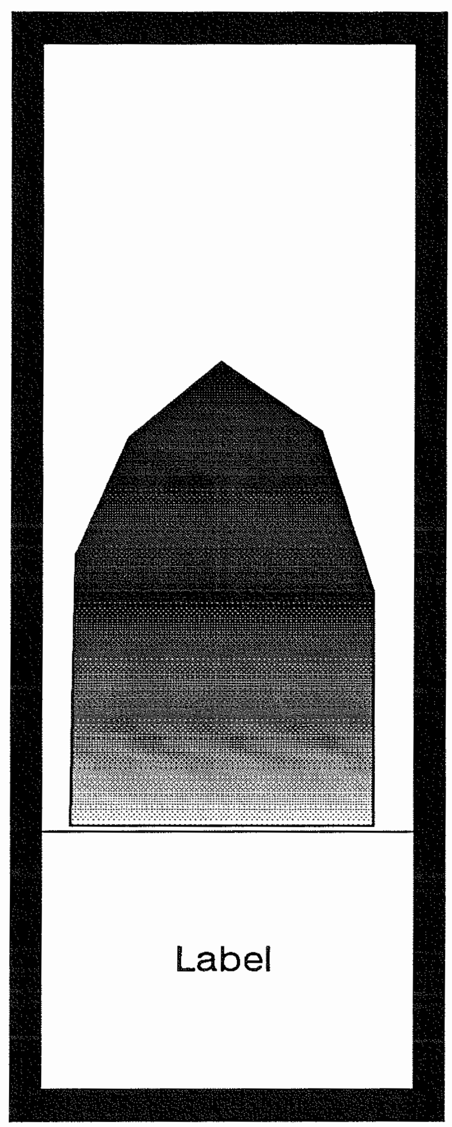
Procedure to make a blood smear:

Collect blood using procedure on page 82 as for serum. Place one ml of blood in EDTA tube and invert to prevent clotting. To make a smear, a single small drop of whole blood (from the EDTA tube) should be placed near the frosted end of a clean, dust-free microscope slide and then the end of a second slide (held at a 45° angle) drawn up to the drop until the drop disperses along the edge of the second slide. Then the second slide is pushed quickly and evenly toward the opposite end of the first slide. The results should appear as in the illustration on page 87. When the smear is dry, label the frosted end (with a solvent-resistant pen) with the date, species, animal ID, and location. Then fix the slide (commercial spray fixative or 100% methanol for 5 minutes) and place UNSTAINED SLIDES in a slide holder and package to prevent breakage. If slides are to be read locally, the blood smears should be

stained with Wright's giemsa and examined by a veterinarian or parasitologist familiar with the organisms.

Technique:





Physical Examination Form for Field Anesthesia		
Date	Species	Sex
Identification	Location	Anesthetic Drug and Dose
Body Temperature	Heart Rate	
Physical Examination: Record the condition of the following:		
Skin (include wounds, tumors, abscesses, etc.)		
Teeth		
Eyes		
Mucous Membranes		
Ears		
External Genitalia		
Legs		
Feet		
External Parasites (preserve in alcohol)		
Comments		

FIELD ANESTHESIA

(Taken from "A review of chemical immobilization of wild canids." Terry J. Kreeger, DVM, PhD. from The Proceedings of 1992 American Association of Zoo Veterinarians and American Association of Wildlife Veterinarians meeting.)

Many wild canids can be safely caught by padded foothold traps of the appropriate size or by box traps. Then a pole syringe is used to administer the anesthetic. Larger canids, such as the wolf, can be anesthetized by a dart gun. Dart needles should be disinfected between canids or new sterile needles used for each canid. Prophylactic antibiotics should be given to avoid abscess formation at the site of darting or antibiotic ointment placed in the dart site.

Drugs and doses deemed safe for any canid (all drugs given intramuscularly):

1. Ketamine (10.0 mg/kg) plus promazine (1.0 mg/kg)
2. Telazol (10.0 mg/kg)
3. Ketamine (10.0 mg/kg) plus Xylazine (2.0 mg/kg)

These doses should result in anesthesia, not sedation. If an animal is not anesthetized within 10-15 minutes, give one-half the dose of ketamine but NO ADDITIONAL TRANQUILIZER. When using Telazol, supplementary doses should be of KETAMINE ONLY (5 mg/kg), and not Telazol (contains a tranquilizer). Anesthetic complications are generally rare unless the potent opioids are used. Opioids such as etorphine and carfentanil result in high incidences of respiratory depression or arrest. Renarcotization can also occur with the potent opioids.

HYPERTHERMIA (rectal temperature greater than 105° F) is a major problem in chased or trapped canids. Immediately cool hyperthermic canids by whole body immersion in cold water (ice water if possible).

PROLONGED ANESTHESIA is to be avoided in pack species, because reintroduction after separation may result in fighting.

DRUG DOSES

The following section identifies those canids for which immobilization doses have appeared in the literature. However, all the doses given do not necessarily reflect those found in the literature since many of these referenced drugs are no longer available for general use (e.g., phencyclidine and etorphine). There are several drugs and drug combinations that are efficacious, but not listed. The reader will note the virtual absence of opioid anesthetics. As stated before, the potent opioids such as etorphine and carfentanil often result in severe respiratory depression in canids. Fentanyl or combinations with fentanyl can be successfully used on canids and have the advantage of having specific antagonists. The bias for the use of cyclohexamines and phenothiazines reflects the author's experience with these agents in approximately 3,000 wild canid immobilizations.

Coyote, *Canis latrans*	
Weight	9-12.7 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	5.0 mg/kg ketamine plus 2.0 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine
Comments	If using xylazine, wait at least 45 minutes after last ketamine injection before administering yohimbine.
References	2, 3, 5, 6, 11, 21, 24, 29, 36, 37, 41, 57, 60, 64, 65, 66, 68

Dhole, *Cuon alpinus*	
Weight	5-7 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol

Dingo, *Canis dingo*	
Weight	12-15 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	5.0 mg/kg ketamine plus 2.0 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine.
	0.04 mg/kg etorphine plus 1.0 mg/kg promazine, antagonize with 0.2 mg/kg naloxone
Comments	If using xylazine, wait at least 45 minutes after last ketamine injection before administering yohimbine.
References	23, 28

Dog, Bush, *Speothos venaticus*	
Weight	5-7 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	6, 65, 66

Dog, Cape Hunting, *Lycaon pictus*	
Weight	16-23 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	5.0 mg/kg ketamine plus 0.05 mg/kg medetomidine, antagonize with 0.15 mg/kg atipamezole
References	6, 17, 64, 65, 66, 74, 75, 80

Dog, Raccoon, *Nycterautes procyonoides*	
Weight	5-7.5 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	6.6 mg/kg Telazol
References	6, 64, 65, 66

Dog, Small-eared, *Atelocynus microtis*	
Weight	9 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	6, 66

Fox, Arctic, *Alopex lagopus*	
Weight	**2.5-9 kg**
Recommended Drug	**20.0 mg/kg ketamine plus 2.0 mg/kg promazine**
Supplemental Drug	**10.0 mg/kg ketamine**
Alternative Drugs	**10.0 mg/kg Telazol**
	2.5 mg/kg ketamine plus 0.05 mg/kg medetomidine
References	**6, 33, 34, 65, 66, 68**

Fox, Big (bat)-eared, *Otocyon megalotis*	
Weight	**3-4.5 kg**
Recommended Drug	**20.0 mg/kg ketamine plus 2.0 mg/kg promazine**
Supplemental Drug	**10.0 mg/kg ketamine**
Alternative Drugs	**10.0 mg/kg Telazol**
References	**6, 65, 66**

Fox, Crab-eating, *Cerdocyon thous*	
Weight	
Recommended Drug	**20.0 mg/kg ketamine plus 2.0 mg/kg promazine**
Supplemental Drug	**10.0 mg/kg ketamine**
Alternative Drugs	**10.0 mg/kg Telazol**
References	**6, 65, 66**

Fox, Fennec, *Fennecus zerda*	
Weight	**1.5 kg**
Recommended Drug	**20.0 mg/kg ketamine plus 2.0 mg/kg promazine**
Supplemental Drug	**10.0 mg/kg ketamine**
Alternative Drugs	**10.0 mg/kg Telazol**
References	**6, 64, 65, 66**

Fox, Gray, *Urocyon cinereoargenteus*	
Weight	2.5-7 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	8.8 mg/kg Telazol
References	6, 36, 37, 64, 65, 66, 68

Fox, Kit (Swift), *Vulpes velox*	
Weight	3 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	6, 36, 37, 65, 66, 68

Fox, Pale, *Vulpes pallida*	
Weight	3 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	6, 65, 66

Fox, Red, *Vulpes vulpes*	
Weight	4-5 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	20.0 mg/kg ketamine plus 1.0 mg/kg xylazine, antagonize with 0.1 mg/kg yohimbine
	25.0 mg/kg ketamine plus 1.0 mg/kg midazolam
Comments	If using xylazine, wait at least 45 minutes after last ketamine injection before administering yohimbine. Foxes should be allowed to recover smoothly; prolonged muscular contractions can result in hyperthermia[49].
References	6, 8, 21, 29, 36, 37, 46, 47, 49, 60, 64, 65, 66, 68

Fox, South American (Zorro), *Dusicyon culpaeuss*	
Weight	
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol

Jackal, Black-backed, *Canis mesomelas*	
Weight	7-11 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	18, 23, 63, 80

Jackal, Golden, *Canis aureus*	
Weight	6-7.5 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	6, 18, 21, 65, 66

Jackal, Side-striped, *Canis adustus*	
Weight	6-7.5 kg
Recommended Drug	20.0 mg/kg ketamine plus 2.0 mg/kg promazine
Supplemental Drug	10.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
References	18

Jackal, Abyssinian, *Canis simensis*	
Weight	Unknown, perhaps 20-40 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol

Wolf, Gray, *Canis lupus*	
Weight	27-55 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	10.0 mg/kg ketamine plus 0.8 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine
	4.0 mg/kg ketamine plus 0.8 mg/kg medetomidine
Comments	If using xylazine, wait at least 45 minutes after last ketamine injection before administering yohimbine; otherwise, recovery can be rough. Telazol can cause hypersalivation and, rarely, self-mutilation in wolves.[50] Xylazine (0.5 mg/kg) can be added to Telazol and then subsequently antagonized by yohimbine (Kreeger, unpubl. data). Ketamine plus diazepam/midazolam (0.5 mg/kg) requires a large volume to be delivered (app. 8 ml). Etorphine (0.02 mg/kg) or carfentanil (0.005 mg/kg) can be used to immobilize wolves, but results are variable and the incidence of respiratory depression is high (Kreeger, unpubl. data).
References	1, 4, 6, 8, 16, 19, 20, 21, 26, 27, 30, 34, 40, 42, 43, 44, 45, 48, 50, 59, 66, 73, 76

Wolf, Maned, *Chrysocyon brachturus*	
Weight	23 kg
Recommended Drug	10.0 mg/kg ketamine plus 1.0 mg/kg promazine
Supplemental Drug	5.0 mg/kg ketamine
Alternative Drugs	10.0 mg/kg Telazol
	2.5 mg/kg ketamine plus 0.08 mg/kg medetomidine
References	6, 34

Wolf, Red, *Canis rufus*	
Weight	**15-25 kg**
Recommended Drug	**10.0 mg/kg ketamine plus 1.0 mg/kg promazine**
Supplemental Drug	**5.0 mg/kg ketamine**
Alternative Drugs	**10.0 mg/kg Telazol**
	10.0 mg/kg ketamine plus 2.0 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine
Comments	**If using xylazine, wait at least 45 minutes after last ketamine injection before administering yohimbine**
References	**6, 66, 68**

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FIELD NECROPSY PROTOCOL

The field necropsy usually is less detailed of necessity than that performed under ideal conditions in zoos. Rapid tissue harvesting is essential to minimize tissue autolysis. FIX THE REQUESTED TISSUES EVEN IF AUTOLYZED, because evidence of infectious disease may still be evident histopathologically. Tissues should be collected and fixed in 10% buffered formalin. They then can be stored indefinitely until sent to a pathologist. Histopathological analysis should be performed by veterinary pathologists familiar with the diseases of canids. Dr. Linda Munson, the AAZPA Canid TAG pathology advisor, is willing to provide this service free of charge. If sent to another laboratory, the results should be reported to Dr. Munson for entry into the Canid Disease Databank.

TO SHIP TISSUES (FORMALIN FIXED ONLY), PLEASE CONTACT DR. MUNSON FIRST SO THAT PROPER IMPORT PERMITS CAN BE ARRANGED:

Dr. Linda Munson
Dept. Pathobiology
College of Veterinary Medicine
University of Tennessee
2407 River Drive
Knoxville, Tennessee 37996
USA
(615) 974-8235
Fax (615) 974-5616

No one should handle a canid carcass unless they have been vaccinated against rabies. Always wear gloves when performing a necropsy!

SEND SAMPLES OF ALL DISCRETE LESIONS. ALSO SEND THE FOLLOWING TISSUES (IN ORDER OF PRIORITY):

Brain
Lungs
Small intestines
Kidney
Liver
Lymph nodes
Spleen
Reproductive tract
Large intestines
Adrenal glands
Urinary bladder
Pancreas
Heart
Stomach

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CANID TISSUE REQUESTS
FIELD NECROPSY PROTOCOL

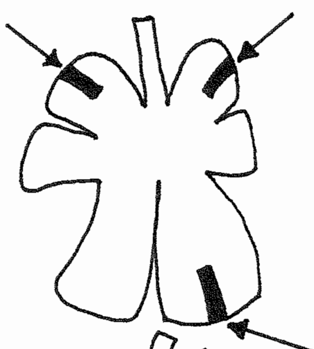
Please protect yourself from infectious agents by wearing gloves (double set) and a mask. Be cautious with sharp instruments and avoid spraying tissue fluids.

Please fix tissues in 10 percent buffered formalin at a ratio of 10 parts formalin to 1 part tissue. Tissues should not be thicker than one-half inch or they will not fix. Please place in a leak-proof container. Ship tissues by standard mail or UPS to:

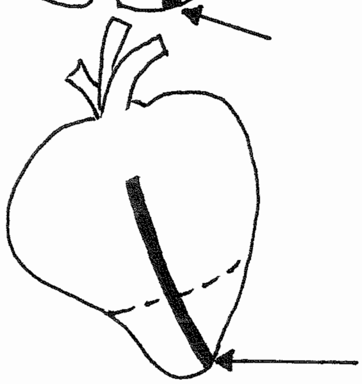
Dr. Linda Munson
Dept. Pathobiology
College of Veterinary Medicine
University of Tennessee
2407 River Drive
Knoxville, Tennessee 37996
USA
(615) 974-8235
FAX (615) 974-5616

Tissues requested are highlighted in black and designated by arrows:

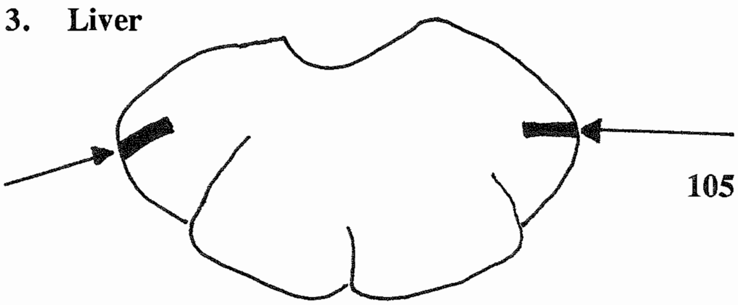
1. Lung



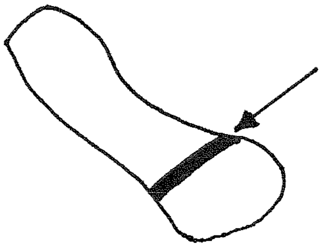
2. Heart



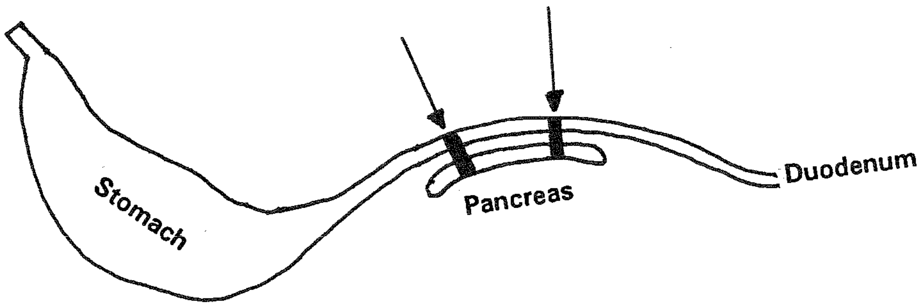
3. Liver



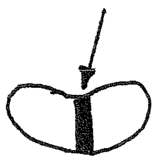
4. **Spleen**



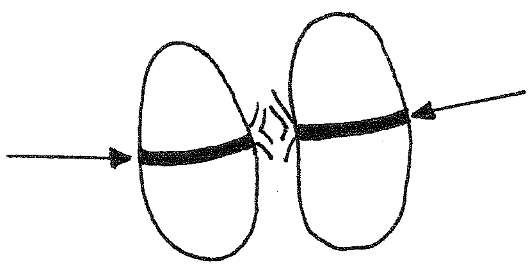
5. **Pancreas**



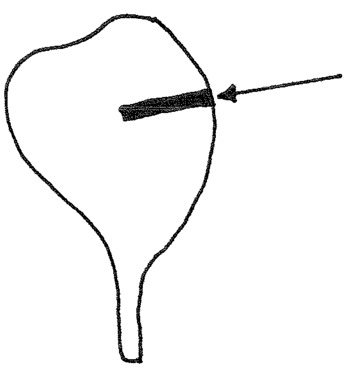
6. **Adrenal gland**



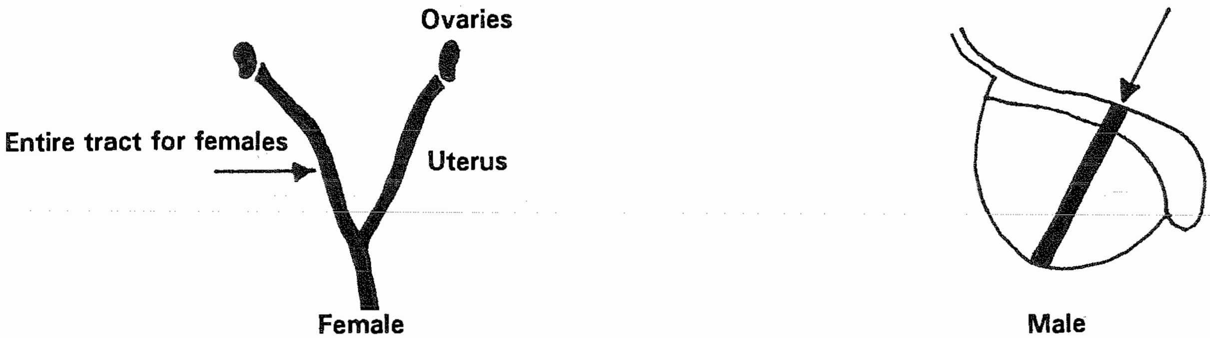
7. **Kidneys**



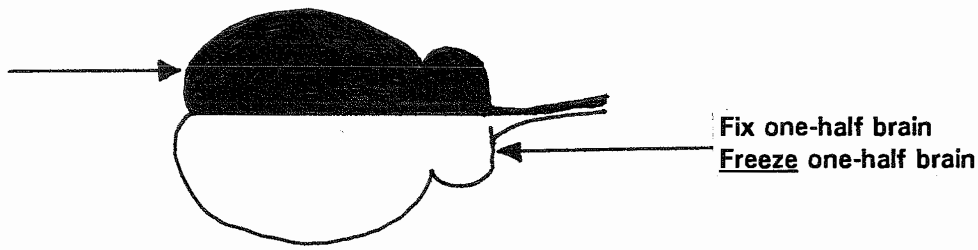
8. **Urinary Bladder**



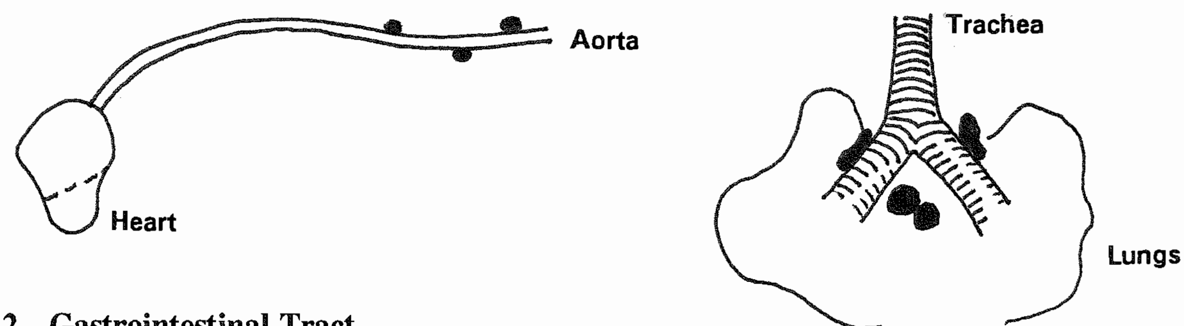
9. **Reproductive Tract**



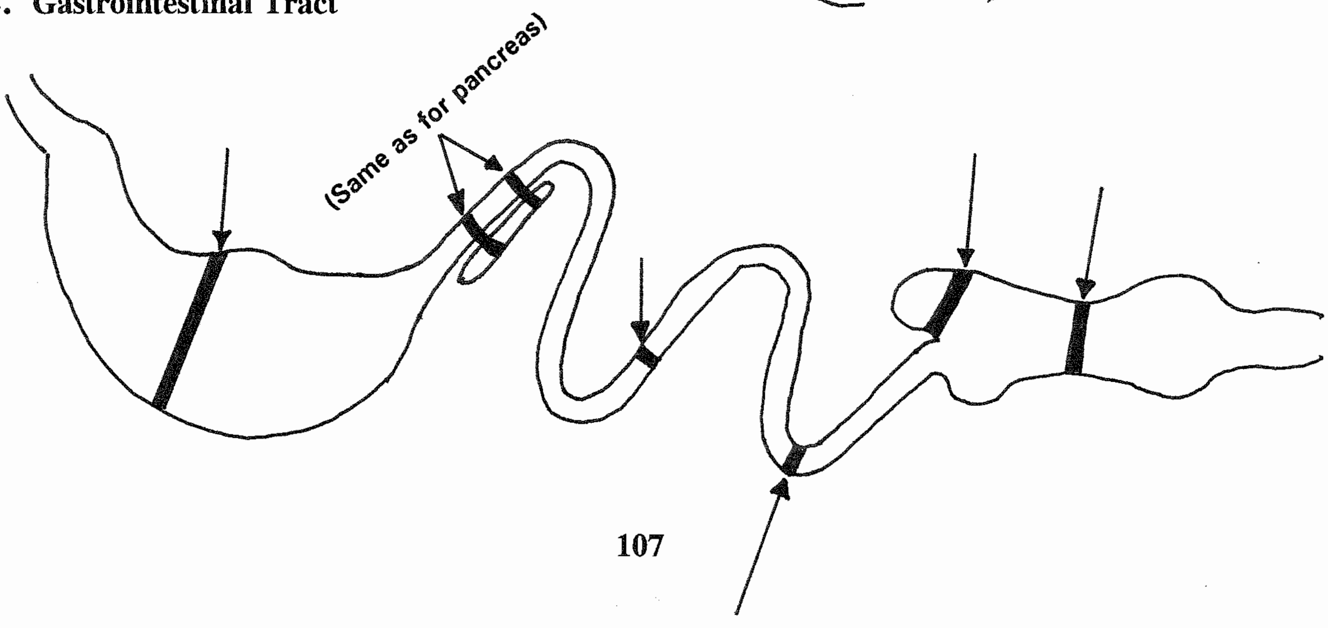
10. **Brain**



11. **Lymph Nodes along the aorta or near where the trachea attaches to the lungs**



12. **Gastrointestinal Tract**



HEALTH MANAGEMENT OF CAPTIVE CANIDS

The medical and surgical care of captive canids has become easier with advancements in anesthetic techniques, dietary management, and vaccine development. Major nutritional problems have become rare and the majority of contagious infectious diseases can be prevented by appropriate vaccines. External and internal parasites can be effectively controlled or eliminated with new anthelmintics. The present challenge to managers is to establish and maintain a strong preventive medical program.

PREVENTIVE MEDICAL PROCEDURES

Preventive medical procedures should extend through the life of the animal from the time the animal enters captivity (i.e., born or captured) until death. Medical records should accompany an animal if shipped between facilities to provide consistency in preventive medical procedures. Preventive medical programs include quarantine, vaccination, parasite control, annual physical exams, diet supervision, and enclosure management (type, content, and cleaning procedures). Shipping procedures also should be evaluated to prevent injury. Also, a complete postmortem examination should be considered part of a preventive medical program, because the diseases identified at necropsy are an indicator of the success of the program.

To develop an effective preventive medical program for canids, the diseases of each species need to be identified. Centralized reporting of existing and emerging new diseases should be developed to form a database of information on canid diseases. Nondomestic canids have many of the same anatomical and physiological features and are susceptible to many of the same medical conditions as domestic canids. This allows extrapolation from experiences and expertise acquired in domestic dogs. However, many species of canid have diseases that are unique or more prevalent in that species. Furthermore, the species susceptibility and clinical manifestations of all canid infectious diseases are not known for some of the threatened and endangered canids that are poorly represented in captivity (e.g. aardwolf, hyena, Ethiopian wolf). The current recommendations for a preventative medical program for captive canids may need modification in the future as disease reporting increases within the Canid community.

QUARANTINE PROCEDURES

Before a new canid is introduced into an existing population, the animal should be quarantined. Adequate quarantine time varies by disease, but 30 days is adequate for most canid diseases, except rabies and heartworm. <u>Recently captured</u> or <u>translocated</u> animals or animals from foreign zoos may require a longer quarantine. Ideally the canid is held in a separate facility and cared for by different keepers than those who care for other canids. However, the social nature of canids should be considered and, when possible, several individuals should be held in quarantine together to minimize social stress during this period. Personnel working with or near a quarantined animal should wear coveralls and rubber boots designated for the quarantine area. A foot bath of 10% Chlorox^R (Chlorox = 5% sodium hypochlorite, so 10% Chlorox = 0.5% sodium hypochlorite) at entries and exits to the facility will reduce spread of infectious agents. The quarantine area also should have separate drainage that does not cross-contaminate other canid areas and should be disinfected with Chlorox^R (Chlorox = 5% sodium hypochlorite, so 10% Chlorox = 0.5% sodium hypochlorite).

During the quarantine, health evaluation includes a complete physical and dental exam, hematological and serological evaluations, and examinations for endoparasites (gastrointestinal and hematological) and ectoparasites. Serological evaluations should include serum chemistries and antibody titers against *Dirofilaria immitus*. Serological evaluations of <u>recently captured</u> canids also should include antibody titers against rabies, distemper, parvovirus, *Ehrlichia* sp., *Babesia* spp., canine adenovirus type 2, canine herpesvirus, and leptospirosis. Previous medical records including past immunizations should be reviewed and complete medical records should be kept during quarantine and continued for the life of the animal. It is recommended that each canid be individually identified with a subcutaneous microchip (a transponder between the scapulae) and a tattoo.

VACCINATIONS

Vaccinations are given during the first week of quarantine to allow time for an antibody response before releasing the canid into the collection. Highly stressed animals may not mount appropriate titers and should be revaccinated at appropriate intervals. Questionable antibody protection may preclude release from quarantine or at least require repeated revaccination when stress is reduced.

<u>ADULTS</u> should be vaccinated annually with the following vaccines:

****DO NOT USE MODIFIED LIVE VIRUS VACCINES OF CANINE CELL ORIGIN****

1. **Rabies (e.g., Imrab^R, Rhone Merieux, Athens, GA, USA) - killed vaccine only**

2. **Fromm D^R (Solway, Mendota Heights, MN, USA) - Canine distemper virus (modified live virus chick embryo origin).**

3. **Parvovirus (e.g., Vanguard CPV^R, Smith Kline Beecham, Exton, PA, USA) - killed vaccine.**

4. **Leptospirosis (Leptoferm-5 way, Smith Kline Beecham, Exton, PA, USA) - recommended in endemic areas or in the face of an outbreak; should vaccinate every 6 months.**

<u>PUPS</u> should be vaccinated as follows:

1. **Fromm D^R (Solway, Mendota Heights, MN, USA) - Canine distemper (MLV chick embryo origin) at 8, 10, 12, 14 and 16 weeks.**

2. **Parvovirus, killed virus at 8, 10, 12, 14, 16, 18 and 20 weeks.**

3. **Rabies - killed virus <u>at 16 weeks</u>.**

PARASITOLOGICAL EVALUATIONS

1. **Heartworm** (*Dirofilaria immitis*): Canids should be tested for infection by direct (microfilaria in blood) and occult (antibody) heartworm tests. Animals with a negative test should be placed on heartworm preventive medication: either monthly administration of Ivermectin (3-6 µg/kg, per os) (Ivomec, Merck & Co., Rahway, NJ 07065) or daily administration of diethylcarbamizine (5-7 mg/kg per os).

2. **Hookworms** (*Ancylostoma caninum* and *Uncinaria sp.*) and **Roundworms** (*Ascaris caninum*). For adults, fecal floatations should be performed during the quarantine exam, four weeks later, and annually thereafter. Anthelmintic recommendations are:

A. Pyrantel Pamoate (5 mg/kg per os) (Strongid-T, Pfizer Inc., New York, NY 10017)

   1) Puppies: at 10 days and every other week for 6 weeks regardless of fecal examination results.

   2) Juveniles and adults: if fecal floatation is positive for ova.

B. Fenbendazole (Panacur, American Hoescht, Somerville, NJ 08876) (50 mg/kg daily for 3 days). Treat any female with a history of hookworm or roundworm infestation before breeding and again during pregnancy.

C. Ivermectin (0.2 mg/kg SQ or PO).

3. **Whipworms** (*Trichruis vulpis*): Fecal floatations should be performed during the quarantine exam, 4 weeks later, and annually thereafter. Pups should be checked at 8, 12, 16, and 20 weeks and annually thereafter. Anthelmintic recommendations are:

   Fenbendazole (50 mg/kg) daily for 3 days. Treat canids with positive fecal floatation exams and with tenesmus or mucus and blood in the stool (without evidence of toxic or infectious disease) because *Trichuris* sp. produces low numbers of ova, frequently resulting in false negative fecal floatations.

4. **Strongyloides** (*Strongyloides stercoralis*): Diagnosis as for Whipworms. Anthelmintic recommendations are:

   Fenbendazole (50 mg/kg) per os for 5 days.

5. **Tapeworms** (Cestodes): Diagnosis by identifying parasite segments in feces or anus, or in the case of flea infestation. Treatment recommendations are:

   Eliminate the intermediate host: fleas or rodents. Praziquantel (Droncit[R], Haver-Lockhart, Shawnee, KS 66201) (oral or injectable), see packet insert for graded doses.

DO NOT USE IN PUPS LESS THAN 4 WEEKS OLD

6. <u>Coccidia</u>: Diagnosis by fecal floatation. Sulfadimethoxine (Albon, Roche Chemical Div., Nutley, NJ 0711O) 50 mg/kg parenteral or per os, on the first day, then 25 mg/kg once a day for 14 days. This parasite may be particularly pathogenic in young canids or in canids naive to coccidia.

CONTROL OF REPRODUCTION

Reversible control of reproduction has been achieved by using contraceptive implants placed subcutaneously in canids. The implant is a medical-grade silastic compound impregnated with a progestogen, melengestrol acetate (MGA) (U.S. Seal, personal communication). The slow continuous release of this progesterone-like chemical prevents estrus and suppresses follicular development in most cases. Each implant is usually effective for a 2-year period after which the implant can be replaced if further contraception is desired. MGA implants can be obtained by submitting a written request to Dr. Ed Plotka, Marshfield Medical Foundation, 510 North St. Joseph Avenue, Marshfield, Wisconsin 54449.

Some canids on long-term (>4 year) progestagen treatment developed cystic endometrial hyperplasia, pyometra, and mammary gland adenocarcinomas, but a direct association between these diseases and the drug has not been confirmed. While studies investigating these effects are in progress, the current recommendation for canid contraception are to use MGA implants for temporary contraception (< 4 years) and to castrate or ovariohysterectomize any canid that is permanently removed from breeding programs. Oviductal ligation (tubal ligation) or vasectomy are alternative procedures, but should be considered permanent sterilization techniques and do not eliminate the potential for endogenous steroids to cause the same pathological problems as the MGA implants.

Several temporary contraceptives for males are being tested clinically to provide alternatives to these currently available methods.

INSECT AND RODENT PESTS

Feral rodents and insects should be controlled in the environment of canids because these pests can be a source of ectoparasites for canids (e.g., ticks and fleas), can be intermediate hosts for canid pathogens or parasites, or can be sources of pathogens such as rabies, yersiniosis, leptospirosis, and salmonellosis.

ANESTHESIA

The canid should be taken off food for at least 12-18 hours prior to being anesthetized. Water should be withheld for at least 12 hours unless medical concerns or extremely hot weather preclude it. The patient should be shifted to a small area, preferably a squeeze cage, for drug administration. Animals that are calmer at this time usually require less drug and have a smoother induction period.

Injectable anesthesia: See section under Field Anesthesia for drugs and doses.

Inhalation Anesthesia: For prolonged medical treatment or surgical procedures especially in aged and/or ill patients, inhalation anesthesia is recommended. Following initial anesthesia with injectable drugs and intubation with a cuffed endotracheal tube, either halothane (Halothane USP, Holocarbon Labs., Hackensack, NJ 07601) or isoflurane (Forane, Ohio Medical Anesthetics, Madison, WI 53713) can be given. Body temperature during prolonged surgical procedures should be monitored for hypothermia. Elevation of temperature may be seen with convulsions, preanesthetic excitement, high environmental temperature, and exposure to direct sunlight. Temperatures greater than 39.4°C in a patient should be an indication for cooling with water and air circulation. Severe hyperthermia, >40.6°C, requires more aggressive therapy including water immersion, cold water enemas, IV fluids, corticosteroids, and antibiotics.

Prolonged anesthesia or cold temperatures may result in hypothermia. Provisions should be available to treat hypothermia if it occurs.

HAND-REARING
(from MANED WOLF SSP HAND REARING RECOMMENDATIONS)

I. **Removing Pups.** Pups should be video monitored and then removed from the dam when it is safest to do so. Up to 7 hours may elapse between subsequent births, or sometimes less than 1 hour. Pups often do not nurse until all are born. Each manager will have to use his/her judgment regarding locking the female into the den, and/or separating out the male. These decisions depend in great part on the animals' individual personalities, as well as the physical location and situation of the den area.

Except for the most genetically valuable animals in the population, it is acceptable to leave pups with the parent(s) as long as the litter is closely monitored via video camera and preparations have been made to pull pups immediately should the situation warrant. If a dam begins acting restless, i.e., moving around the den or going outside, or if she begins to pick up or mouth the pups frequently, experience indicates that the situation is beginning to deteriorate, and she should be watched constantly. Females will move pups occasionally, but if she begins carrying pups frequently, it is unlikely that she will rear the litter successfully. Zoos planning to try mother-rearing should provide the female with more than one den area.

It is commonly felt that rearing pups alone should be avoided, and that like-aged pups should be moved to one location for hand-rearing and socialization. The birth or survival of a singleton pup should immediately be reported to the Species Coordinator in order to determine the feasibility of rearing the pup in a group situation.

II. **Passive Immunity.** If sucking is not observed, preserved serum from an adult [maned wolves] should be administered as soon as possible. Whole blood should be collected from maned wolves in your collection and the serum processed under sterile conditions. Serum can be collected and kept frozen in a standard freezer for up to 6 months in advance of a birth. Administer 10cc serum/pup - 5cc orally and 5cc SQ or IP. Institutions expecting a birth should have 50cc of serum on hand for each litter expected.

III. **Feeding.** The previous controversy surrounding the use of Esbilac concerned the development of protein deficiency cataracts in several species of canid (timber wolves, domestic dogs, maned wolves) raised on Esbilac alone for a period of several weeks. Borden sold Esbilac to Pet Ag., Inc., in 1986. In 1989 the company began adding arginine and methionine to the Esbilac formula in order to prevent cataract development and improve coat formation.

Feeding Recommendations:

A. Use the new Esbilac formula. Powdered or liquid Esbilac with an expiration date <u>after February 1992</u> contains the modified formula.

B. It is recommended that the enzyme additive Lactaid be added to the formula to increase digestibility of the milk sugars. Lactaid can be purchased at any pharmacy; follow directions on the bottle.

C. Use human preemie or extra-preemie nipples. Offer pups approximately 20-25% of their body weight over a 24-hour period, divided into several evenly spaced feedings. Dilute Esbilac with Pedialyte for the first 24-48 hours.

D. Begin introducing solids at 2 weeks of age to further reduce the risk of cataract development. Strained beef baby food, liver homogenate, or moistened puppy chow are all good choices.

E. Wean pups onto commercial puppy chow. Science Diet Growth and Purina ProPlan have been readily accepted by pups.

F. Pups should be examined daily for signs of developing cataracts, particularly during the second and third weeks of life.

IV. **Housing.** Pups should be maintained at an ambient temperature of 85°F and relative humidity of 50-60 percent until they can self-regulate to the normal body temperature of 99-101°F at about 21 days. Temperatures and humidity higher than recommended may result in hair loss.

V. **Documentation.** Daily logs should be maintained regarding feeding schedules, amounts fed and consumed, feeding methods (tube, bottle, bowl) and weight gain; body weights should be taken daily, in the morning prior to feeding. Records should also be kept of medical procedures, physical and behavioral development, and human interactions with pups.

Critical events to watch for include:

A. Developing cataracts.
B. General hair loss.

C. Overly aggressive behavior beginning around 3-4 weeks of age. This may require temporary separation of pups to prevent injuries, but aggressive behavior usually decreases within 2-3 weeks without injuries.

Note: Both mother-raised and hand-raised pups that die should be necropsied.

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4. Vainisi, S.J., et al. Nutritional Cataracts in Timber Wolves. JAVMA 1979:1775-1180, 1981.

DISEASE MONITORING IN CAPTIVE CANIDS

The most effective and complete disease monitoring in captive canids can be accomplished through a centralized pathology database. ALL CAPTIVE CANIDS THAT DIE SHOULD RECEIVE A COMPLETE NECROPSY AND ALL TISSUES SHOULD BE ANALYZED HISTOPATHOLOGICALLY. Results of the gross and histopathological examinations (Final necropsy report) should be submitted to the Canid TAG Pathologist (Dr. Linda Munson) for entry into the Canid Disease Database. This database then will be available to zoological veterinarians for developing optimal medical management programs for specific species of canids. The Canid Disease Database also will be available to monitor disease trends in the captive population and to compare disease prevalences between free-ranging and captive canids.

Submit necropsy reports to:

Dr. Linda Munson
Dept. Pathobiology
College of Veterinary Medicine
University of Tennessee
P.O. Box 1071
Knoxville, Tennessee 37901
(615) 974-8235
Fax (615) 974-5616

POSTMORTEM EXAMINATION OF CAPTIVE CANIDS

A complete necropsy should be performed on any captive canid that dies. A thorough necropsy provides data for the Canid disease database on that species and is a means to assess the success of captive management and preventive disease programs. The following is the recommended protocol for canids, so that a complete dataset can be collected on each individual.

NEONATAL NECROPSY PROTOCOL

Please follow the adult protocol in addition to the following:

1. Fix umbilical stump and surrounding tissues.

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

3. Assess hydration (tissue moistness) and evidence of nursing (milk in stomach).

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

Canid Necropsy Protocol	
Institution/Owner	**Address**
Species	**Animal ID #**
Birth Date/Age	**Weight**
Date of Death	**Date of Necropsy**
History (include clinical signs, circumstances of death):	

Gross Examination Worksheet *Please refer to section on species-specific diseases*
Prosector
General condition (nutritional condition, physical condition):
Musculoskeletal system (bones, joints, muscles):
Body cavities (fat stores, abnormal fluids):
Hemolymphatic (spleen, lymph nodes, thymus):
Respiratory system (nasal cavity, larynx, trachea, lungs, regional lymph nodes):
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, vagina, penis, prepuce, accessory glands, mammary glands, placenta):

Endocrine system (adrenals, thyroid, parathyroids, pituitary):

Nervous system (brain, spinal cord, peripheral nerves):

Sensory organs (eyes, ears):

Preliminary diagnosis:

Laboratory studies (List bacterial and viral cultures submitted and results, if available):

Comments:

TISSUE CHECK LIST

Preserve the following 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 OF ALL LISTED TISSUES. For NEONATES, see the additional tissues on the NEONATAL PROTOCOL.

Information on specific TISSUE SECTIONING PROCEDURES is on the following page and on pages 105-107.

TISSUES TO SAMPLE:

Heart
Trachea
Thyroid/parathyroid glands
Lungs
Thymus
Lymph nodes
Spleen
Liver
Stomach
Small intestines
Pancreas
Large intestines
Adrenal
Kidneys
Urinary bladder
Testis/Ovary
Uterus
Brain
Skin
Skeletal muscle
Bone marrow

ESSENTIAL FROZEN TISSUE: Please store in plastic bags at -70 or -20°C for toxicology: Liver, brain, kidney. If possible, antemortem serum and plasma frozen.

SHIPPING TISSUES:

After at least 72 hours in fixative, ship tissues in a leak-proof container in adequate formalin to keep tissues moist. Tissues can be shipped by U.S. Mail or UPS to:

Dr. Linda Munson
Dept. Pathology, VHT A329
College of Veterinary Medicine
University of Tennessee
2407 River Drive

Knoxville, Tennessee 37901 USA

Recommended Tissue Sampling Procedures	
Adrenal glands	Entire gland with tranverse incision.
Brain	Sliced longitudinally along the midline; submit all but frozen sections.
Eye	Left intact.
Gastrointestinal tract	3-cm long section of esophagus, stomach (cardia, antrum, pylorus), duodenum, jejunum, ileum, cecum, colon,and omentum. Open carefully along the long axis.
Heart	Longitudinal section including atrium, ventricle and valves from both right and left heart. Include large vessels.
Kidneys	Section from both kidneys (cortex, medulla, and pelvis).
Liver	Sections from 3 lobes with capsule and gall bladder.
Long bone	Submit one-half of a femur.
Lungs	Sections from several lobes including a major bronchus.
Lymph nodes	Cervical, anterior mediastinal, bronchial, mesenteric, and lumbar with a transverse cut.
Pancreas	Representative sections from two areas.
Pituitary gland	Entire gland including dura.
Reproductive tract	Entire uterus and ovaries with longitudinal cut into lumen. Entire testis with transverse cut, entire prostate with transverse cut.
Sciatic nerve	3-cm section.
Skeletal muscle	Cross section of thigh muscles.
Skin	Full thickness of abdominal skin.
Spinal cord	Sections from cervical, thoracic and lumbar cord.
Spleen	Cross sections including capsule.
Thymus	Representative section.
Thyroid/parathyroids	Leave glands intact.
Tongue	Cross section near tip including both mucosal surfaces.
Urinary bladder/ureter/urethra	Cross section of bladder and 2-cm sections of tubular structures.

DISEASES OF CONCERN FOR ALL CANIDS

The diseases listed below are the major infectious diseases for canids. Domestic canids may serve as reservoirs for all of these diseases. The susceptibility of all canid species to these diseases is unknown. These brief summaries are provided to increase recognition and reporting of these diseases in wild canids.

Rabies		
Cause	Rabies virus (and/or other rhabdoviruses?). Shed in body secretions. Viable in carcasses after death. Usually transmitted by bites. Incubation period from a few weeks to more than 6 months.	
Clinical signs	Usually neurologic with either paralytic or aggressive presentations ("furious" form).	
Diagnosis	Live animal	Indirect fluorescent antibody (IFA) test on skin biopsy of sensory vibrissae on the maxilla.
	Necropsy	No gross lesions. IFA on brain or identify Negri bodies in neurons (hippocampus is best).
Treatment/ prevention	No treatment. Prevent by annual vaccination with killed virus.	
Zoonosis/ contagiousness	Serious zoonotic potential. All warm-blooded animals are susceptible. Rapid spread through groups of social canids.	

Canine Distemper	
Cause	Canine distemper virus spread by body secretions, ingested or inhaled. Can be caused by using modified live vaccines of canine-cell origin.
Clinical signs	Generalized systemic illness, pneumonia and/or neurological signs.
Diagnosis	Live animal: Direct immunofluorescence of buffy coat cells.
	Postmortem: Lungs may be firm and red. Intracytoplasmic inclusions in lungs, biliary epithelium, bladder, epididymis, etc. by histopathology.
Treatment/ prevention	No specific treatment. Prevent by annual vaccination with modified live virus of chick embryo origin.
Zoonosis/ contagiousness	No known zoonotic potential. Highly contagious among canids. Non-canid carnivores may serve as sources of the virus.

Parvovirus	
Cause	Canine parvovirus, fecal shed, fomite-borne, ingested.
Clinical signs	Vomiting and diarrhea.
Diagnosis	Live animal: Electron microscope identification of virus in feces.
	Postmortem: Small intestines are dilated and hemorrhagic. Intestinal crypt necrosis by histopathology.
Treatment/ prevention	No specific treatment. Vaccination with killed virus annually. Clean contaminated area with 10 percent Clorox® (Clorox = 5% sodium hypochlorite, so 10% Chlorox = 0.5% sodium hypochlorite).
Zoonosis/ contagiousness	No known zoonotic potential. Highly contagious among all canids.

Infectious Canine Hepatitis	
Cause	Canine adenovirus 1, dog and fox reservoirs, urine shed, ingested or inhaled.
Clinical signs	Systemic illness, hepatitis, anterior uveitis. Causes neurological signs in foxes.
Diagnosis	Live animal: Rising titer, inclusion bodies in tissue culture inoculated with oropharyngeal swab or tissue.
	Postmortem: Hemorrhages on the surfaces of body organs and in the brain and skin. Inclusion bodies in liver, kidney by histopathology.
Treatment/ prevention	No specific treatment. Prevent by annual vaccination with canine adenovirus Type 2.
Zoonosis/ contagiousness	No known zoonotic potential. Contagious among canids and some other carnivores (e.g., *Ursidae*).

Canine Brucellosis	
Cause	*Brucella canis* bacteria. Transmitted by fetal fluids, vaginal discharge, semen. Contact or aerosol spread. Penetrates mucous membranes.
Clinical signs	Discospondylitis or reproductive disease.
	Females: Abortion or reduced fertility.
	Males: Orchitis or epididymitis.
Diagnosis	Rapid slide agglutinin test (RSAT) or agar gel immunodiffusion (AGID) with serum. Bacterial isolation in *Brucella* broth. Testis swollen (acute disease) or atrophied (chronic disease).
Treatment/ prevention	Most treatments ineffective. Combined antibiotic treatments: 1) Minocycline (25 mg/kg/day BID and Streptomycin 20 mg/kg/day BID. 2) Oxytetracycline 20 mg/kg IM weekly for 4 weeks and streptomycin 7 mg/kg/day BID for 7 days. No vaccine available. Castration and ovariohysterectomy recommended in confirmed cases.
Zoonosis/ contagiousness	Can infect humans. Highly contagious through mating.

Leptospirosis		
Cause	Bacteria, *Leptospira interrogans* (multiple serogroups). Usually serovars *Icterohemorrhagiae* and *canicola* in canids. Urine shed. Many species are reservoirs, particularly rodents. Bacteria invade mucous membranes.	
Clinical signs	Generalized disease with hemorrhages, icterus, nephritis. Chronic form causes kidney or liver failure.	
Diagnosis	Live animal: Identify organisms in urine by dark field microscopy. Rising serum antibody titer.	
	Postmortem: Kidneys swollen, all tissue icteric, hemorrhages throughout the body. Identify organisms in kidney by silver stains on histopathology.	
Treatment/ prevention	Procaine penicillin (40,000 U/kg IM BID for 2 weeks). Vaccinate with multivalent bacterins every 6 months.	
Zoonosis/ contagiousness	Humans are susceptible. Contagious to other canids through urine contamination of water or directly from urine.	

Heartworm Disease	
Cause	Filarial worm, *Dirofilaria immitus*. Mosquito transmission. Wild and domestic canid reservoirs. Vascular damage by adult worms.
Clinical signs	Massive infections cause vascular obstruction and circulatory collapse. Cardiopulmonary signs, cough, fatigue. Liver failure if massive infections ("caval syndrome").
Diagnosis	Live animal: Identify circulating microfilaria. Serum antibody tests.
	Postmortem: Identify adult worm in right heart.
Treatment/ prevention	Thiacetarsamide 0.22 mg/kg IV BID for 2 days, then Ivermectin (50-200 μg/kg) 3 weeks later. Prevented by monthly Ivermectin (3-6 μg/kg).
Zoonosis/ contagiousness	Humans can have nonproductive infections. Contagious to other canids through mosquito intermediate host.

Babesiosis (Piroplasmosis)	
Cause	Protozoa, *Babesia gibsoni, B. canis, B. vogeli.* Transmission by ticks (*Rhipicelphalus sanguineus, Dermacentor spp., Haemaphysalis spp.*). Domestic and wild canids may be reservoirs.
Clinical signs	Anemia, splenomegaly, hemoglobinuria.
Diagnosis	Organisms in Giemsa-stained blood smear or high antibody titer.
Treatment/ prevention	Diminazene aceturate (3.5 mg/kg SQ for 2 days), or Pentamindine and phenamidine isethionate (15 mg/kg SQ for 2 days). Consult Handbook of Small Animal Practice (referenced in bibliography) for side effects. None approved in United States. Tick control.
Zoonosis/ contagiousness	No known zoonotic potential. Contagious to other canids via tick intermediate host.

Ehrlichiosis	
Cause	*Ehrlichia canis*. Transmission by tick, *Rhipicephalus sanguineus*.
Clinical signs	Vague systemic signs due to leukopenia, anemia, thrombocytopenia.
Diagnosis	Live animal: Identify organism in buffy coat smear. Positive serum IFA.
	Postmortem: Tissues may be pale. Identify organism in monocytes in bone marrow by histopathology.
Treatment/ prevention	Tetracycline 22 mg/kg TID for 14 days. Tick control.
Zoonosis/ contagiousness	No known zoonotic potential. Contagious to other canids via tick intermediate host.

Hookworms	
Cause	*Ancylostoma caninum* and *Uncinaria stenocephala*. Eggs in feces, larvae can penetrate skin, transmammary and transplacental transmission to pups.
Clinical signs	Anemia, bloody diarrhea.
Diagnosis	Identify egg in feces. Small size of adult worm makes identification in the intestines at postmortem difficult.
Treatment/ prevention	Pyrantel Pamoate (10 mg/kg per os). Treat puppies at 10 days and every other week for 6 weeks regardless of fecal examination results. For adults, Fenbendazole (50 mg/kg daily for 3 days). Prevent via sanitation and routine treatment, especially in pregnant females.
Zoonosis/ contagiousness	Causes larval migrans in humans. Severity of infection will increase in crowded conditions.

Other Diseases of Canids

Refer to the books in the bibliography for complete descriptions of canid diseases.

Species-Specific Diseases

The following are specific diseases known to affect certain species of canids:

Maned Wolves	
Cystinuria	Renal defect in absorption of cystine and other dibasic amino acids results in renal and bladder stones which can cause urinary tract obstruction. Has been noted in wild and captive maned wolves.
Gingival hyperplasia	Extensive hyperplasia of all gingival tissue with extension into mandible and maxillary bones. In wild and captive wolves.
Ovarian dysgerminomas	High prevalence of ovarian germ cell tumors with possible familial tendency.

Red Wolves

Pododermatitis	**Very high prevalence of ulcers and necrosis of foot pads in captive-reared neonatal red wolf pups. Associated with superficial *Staphylococcus spp.* overgrowth and septicemia.**
Fennec Foxes	
Hepatomas	**High prevalence of liver tumors. Can rupture with subsequent hemoperitoneum.**
Hyenas (per Dr. Laurence Frank)	
Dystocia	**High prevalence of dystocias in primiparous females due to delivery of a large fetus through the narrow clitoral canal and orifice. Possible cause of high losses of primiparous females in the wild.**

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Reproductive Considerations for Canids

Summarized by David Wildt
National Zoological Park

The ability of any species to survive and thrive in the wild or in captivity is related first to its ability to reproduce. This alone is sufficient justification to increase our understanding of reproductive processes in wild canids. There is a vast amount of knowledge in the scientific literature about the fundamental mechanisms of reproductive control in the domestic female and male dog. Regulation of ovarian function, based upon peripheral fluctuations in gonadotropic and steroid hormones, now is well-established. The relationship of hypothalamic-pituitary-gonadal hormone secretion in the bitch has been correlated both with distinct reproductive behavioral patterns and direct observations of the ovary via laparoscopy and indirect monitoring via ultrasound. Thus, a rather extensive database exists on the hormonal relationships associated with the onset of proestrus and estrus and the events of ovulation and corpus luteum function. Hormonal norms also are known for the male domestic dog as well as breed-specific ejaculate characteristics (usually determined from semen samples collected by masturbation). Dog semen has been frozen successfully and routinely used to produce offspring by artificial insemination (AI). Despite years of research, no reliable technique yet exists for consistently induced ovarian activity (follicular development, estrous behavior and ovulation) in the domestic bitch. *In vitro* fertilization (IVF) using fresh semen and oocytes collected at laparotomy has been achieved, but little is known about culturing these embryos *in vitro* or *in vivo*. No domestic dog (or other canid) embryos produced by IVF yet have resulted in living offspring. However, a few pregnancies and puppies have been produced by transferring fresh embryos from one domestic bitch to another.

In general, our overall understanding of the reproductive biology of most wild canids is meager at best. There are some exceptions; for example, longitudinal studies of the relationship between circulating hormones and reproductive fitness within captive wolf packs. The literature contains substantial information associated with practical reproductive management, including AI, in species like foxes where commercial interests have spawned research dollars and thus research progress. However, for endangered canids, we know essentially nothing about any fundamental biological process including reproduction. This is in vast contrast to the exponential knowledge achieved in recent years in other carnivore taxa, especially the felids. For example, extensive reproductive databases now are available on gametes, embryos, hormonal relationships, gonadotropin regulation of follicular development and ovulation, oocyte maturation, sperm-oocyte interaction, artificial breeding and germ plasm cryopreservation in a wide array of felid species.

There is a reason for the inconsistency in reproductive knowledge between these two major carnivore taxa. Unlike felids, canids present some unique challenges to the reproductive biologist. In general, most felids maintained in captivity are reproductively active throughout the year. However, most canids appear to be seasonal breeders, greatly reducing the research window of opportunity (i.e., studies can be conducted only for brief times during the year). Progress with wild felids has benefited from simultaneous studies of the domestic cats used as "research models." Domestic dogs also can serve as models for wild canids, but the seasonality of this species and the expense of purchase and maintenance makes comparative cross-species studies extremely expensive. For this reason alone, few academic or commercial institutions in the United States now conduct any basic reproductive research in the domestic dog. Canids have a number of unique physiological characteristics, in addition to seasonality, that cause difficulties in conducting basic research. First, for those canids that have been examined, the ovaries almost always are encapsulated in a translucent ovarian bursa (pouch) that prevents routine examination by traditional techniques like laparoscopy. This inhibits the ability to characterize ovarian morphology, identify important events like ovulation or recover oocytes for basic examination or IVF attempts. Second, little organized effort has been directed at collecting semen from wild canids by electroejaculation. Because masturbation works well in domestic dogs as a method of recovering sperm, there has been no incentive to develop alternative procedures in this taxon. There are a few largely anecdotal reports of electroejaculating several wild canids under anesthesia, but there is a general impression that semen quality is inferior compared to that of samples collected from domestic dogs by masturbation. This has led to speculation that either these wild canid species normally produce inferior quality semen to dogs or that current anesthesia/electroejaculation technology is suboptimal. Regardless, electroejaculation in canids has not proven as useful as the same procedure in wild felids and, thus, the collection of high quality wild canid semen is not yet routine. Third, because reliable exogenous hormonal therapies for inducing ovarian activity have not been developed for the domestic dog, these therapeutic approaches also are unavailable for wild counterparts. For many species, the ability to stimulate follicle development and ovulation not only serves as an adjunct to natural or artificial breeding attempts, but also can be used diagnostically to determine the normality of ovarian function. Therefore, overall, the reproductive biologist has many fewer tools available to (i) study basic species norms, (ii) address causes of infertility and (iii) develop artificial breeding protocols useful to species management.

Despite these disadvantages, there are clear avenues for reproductive research in wild canid taxa. The first and most logical strategy is to survey all existing captive species and/or subspecies to estimate the degree of infertility or reproductive inefficiency for the taxon. This effort should be a prerequisite to the initiation of any other systematic approach. Data should be collected on a species-by-species and institution-by-institution basis, using studbook and SSP data whenever available. Information to be collected will include:

- Evidence of puberty in both genders
- Seasonal sexual behavior and parturition
- Types of sexual behavior displayed (urine marking, vulvar swelling, discharge)
- Duration of proestrus
- Estrus (number of days of mating) and pregnancy
- Number of copulations/estrus
- Litter size
- Sex ratio
- Generation interval

These data eventually will be essential to the development of a basic husbandry manual for each species. However, the survey also should be designed to identify any and all evidence of suboptimal or clinical infertility potentially related to such factors as:

- Incidence of sexual incompatibility
- Observed matings that result in failed pregnancies and offspring production
- Reproductive or related diseases
- Stress
- Inadequacies associated with husbandry and management

The latter information will be critical to identifying the absolute need and type of research required for each species. For example, the historically poor reproductive performance of the maned wolf in captivity has provided impetus for a widespread, multi-disciplinary, multi-institutional approach to identify one or more genetic, physiological, health or management causes.

Initial interpretation of the above baseline data will drive the need for specific types of research projects in specific species. There are at least six areas of research that could benefit all wild canid species, regardless of their captive breeding efficiency. The information to be collected from these studies is so fundamental as to greatly enhance the presently nonexistent database for most of these species. More importantly, when collected longitudinally and integrated with newly generated summaries of basic life history data (collected from the survey), these data eventually can be used to improve management opportunities. For example, confirming observed seasonal matings with endogenous hormone profiles may assist in timing animal introductions to improve pregnancy rates and/or litter size. The eventual ability to hormonally induce ovulation and collect and freeze semen eventually could eliminate the need to move animals between geographically disparate regions while serving as an adjunct for preserving existing genetic diversity.

Presently, the areas of highest research priority are as follows:

1. Because of its noninvasive utility, considerable emphasis should be placed upon the development, validation and use of fecal hormone technology for documenting seasonality and the hormonal profiles associated with the peri-estrus interval, gestation, parturition, postpartum lactation and the ensuing anestrus interval. It is essential that every attempt be made to conduct such studies in a longitudinal fashion (preferably throughout the year) and to simultaneously generate and correlate estrous behavior with hormone metabolite profiles. This project will provide, for the first time, a well-defined understanding of each species' reproductive cycle. However, these data also rapidly can be used for more applied purposes. For example, when differences in reproductive efficiency are known for particular population within species, then prospective studies can be designed using this new technology to determine the cause (husbandry, disease, genetic or other factors) of reproductive variation. A related (but independent) study includes the assay of glucocorticoid metabolites in these same samples as an index of basic adrenal activity and perhaps environmental stress.

2. Once hormonal metabolite technology is available, a high priority is to determine the existence and characterization of reproductive seasonality. One factor potentially contributing to canid reproductive inefficiency is asynchrony between the male and female. For example, the biology associated with failed attempts to breed native American canids in North America should be studied intensively because various environmental clues (e.g., light, temperature) have profound effects on regulating seasonal reproduction. One gender may be more or less sensitive to these "unnatural" environmental factors than another, thereby altering natural reproductive synchrony. This may explain anecdotal reports of sexual disinterest or incompatibility in certain canids. A first step to more detailed studies is confirming and characterizing gonadal seasonality in both females and males. For males, and depending on the improvement in semen collection technology (see below), it likely will be useful to superimpose serial semen collections with serial analyses of hormonal metabolites.

3. Considerable new knowledge could be gained from the systematic study of reproductive organs collected from individual canids that die naturally or are euthanized for medical reasons. For almost all wild canids, there is a paucity of descriptive information (gross and historical) concerning ovarian, uterine, cervical, vaginal, testis, ductus deferens,accessory gland, urethra and penile tissues. Within these materials, even more detailed descriptive information is required (for example, of ovarian follicles, mature versus immature gametes, etc.). Finally, a close examination of these materials will provide a massive data set on the incidence of reproductive health and the prevalence of disease factors potentially contributory to infertility. It is recommended that one or more laboratories be identified to serve as a central resource for collecting and developing this important database.

4. It already is well-established that captive breeding is not efficient for some canid species. For these, it is essential that systematic studies be organized at the level of the Canid TAG and/or SSP and/or Studbook Coordinator (if available) to determine the etiology of poor reproduction. There already is some precedent for this type of multi-disciplinary, multi-institutional approach in other canids (maned wolf) and carnivores (cheetah). Specific tools that may be useful for the field of reproduction include fecal hormonal monitoring, electroejaculation, laparoscopy, ultrasound, vaginal cytology and intensive monitoring of behavior.

5. For reasons described above, it is unreasonable at present to attempt to develop AI, IVF and embryo transfer technology for most canid species. These procedures may be useful in the future, but now would meet with minimal success, largely because of a lack of prerequisite baseline data. Particularly important is the need to enhance current anesthesia/electroejaculation protocols and to develop a reliable hormonal approach for artificially eliciting estrus. Basic research into both of these areas should be encouraged, especially the former. Finally, as soon as a reliable semen collection technique is available for the species of interest, the Canid TAG or appropriate SSP should contact the Captive Breeding Specialist Group's Resource Banking Coordination Committee. A specific action plan then can be developed to begin the formal storage of sperm from the most genetically valuable males in North America. This should proceed even in the absence of existing AI protocols, because (i) these techniques will be available in the

future and (ii) there is no advantage to further delaying the systematic storage of all existing genetic diversity.

6. The management of captive populations relies as much upon fertility inhibition as fertility enhancement. For this reason, immediate studies should be undertaken to comparatively evaluate the impact of various fertility regulation methods. Areas of high priority include the safety and efficacy of (i) steroidal implants for chronic suppression of ovarian activity and (ii) synthetic hormones, like diethylstilbestrol, for dealing with cases of mismating. Additionally, alternative and new methods of surgical and chemical control of reproduction in both females and males should be encouraged.

A prerequisite to all of these efforts is to identify one or more persons and laboratories willing to actively supervise, encourage, recruit and coordinate reproductive research within the Canid TAG venue. This particular taxon presents unique reproductive challenges requiring considerable scientific talent and commitment.

Finally, the Canid TAG should make every effort to develop an aggressive fund-raising campaign to financially support all basic and management-oriented research.

Highlights of the First Workshop on Management and Conservation of Bush Dogs

by Maria Cecília P. Buschinelli, MV
Bush Dog Management Plan's Coordinator

The First Workshop on Management and Conservation of the Bush Dog (*Speothus venaticus*) took place in Americana, Brazil, on March 27, 1992.

The aims of the meeting were to discuss the problems involving this species in South America and the development of a Management Plan for its conservation.

The following institutions were represented at the meeting:

- Brazilian Zoo Society (BZS)
- Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA)
- Itaipu (Paraguayan side)
- Cia Elétrica de São Paulo
- Instituto Pro Ecologia
- Dortmund Zoo
- Wildlife Conservation Research Unit
- AAZPA
- CBSG/IUCN

The major problems discussed were habitat destruction, lack of field work with this species and the problems related to the captive population, namely few founder representatives and inbreeding.

During the Workshop, the following was decided:

1. The Management Plan will be coordinated by Maria *Cecília* P. Buschinelli, with assistance from BZS.

2. A meeting with Dr. Rudiger Dmoch, the studbook keeper for this species, was scheduled for July or August 1992. At this meeting, plans for the pairing of animals and the expansion of the captive population will be discussed as well as a field work proposal on the ecology of bush dogs to provide data for possible future reintroduction.

We all know that the implementation of a conservation plan is a difficult task and the assistance of interested institutions is imperative. Therefore, we would like to count on everyone's collaboration for the *Speothus venaticus* Management Plan to be a success.

Maned Wolf Summary for North America

by Melissa Rodden
NZP Conservation and Research Center

DEMOGRAPHICS

- The maned wolf population grew slowly from the 1960s through mid-1980s. When the SSP began in 1985, there were 70 animals held at ~13 zoos in the United States.

- In 1985 the population crashed; for reasons still not fully understood, reproduction virtually ceased and numbers fell to a low of 57 in 1987 and 1988.

- The population has been recovering since 1988 and there are currently 72 (42.30) maned wolves held at 20 zoos in the SSP.

GENETICS

- There are 22 founders represented in the current SSP population which included 1.1 wildcaughts imported from Brazil in 1989. This pair reproduced for the first time last season.

- As a result of numerous exchanges of animals between U.S. and European zoos, there are only a very few founders not represented in the SSP population. There are, however, approximately 90 maned wolves in Brazilian collections, the majority of which are wild caught, and unrepresented outside of Brazil.

PROBLEMS FACING MANED WOLVES IN CAPTIVITY

A. *Cystinuria*. Over the past 10 years, several animals have died or required emergency surgery as a result of blockages caused by renal cystine calculi. The MWSSP has attacked this inherited metabolic disorder from two fronts: pharmaceutical and nutritional. Various medications have been tried including Catopril and Thiola, but none have proven particularly effective in reducing the size of existing calculi. We are also looking into dietary control of the disease by reducing the intake of cystine and methionine and/or increasing the pH of the urine to the point where existing calculi will dissolve. It appears that the clinical symptoms of cystinuria mainly affect the U.S. population, which may be related to differences in diet between continents.

B. *Reproduction*. The United States population has experienced a low reproductive rate for several years. In addition, a high incidence of neonatal mortality resulting from maternal trauma or neglect exists in captivity worldwide. The MWSSP has initiated research into reproductive physiology of both males and females. Fecal steroids look extremely promising for evaluating the female cycle, and excellent progress has been made in improving the techniques of semen collection from males. We have overcome the problem of maternal trauma by hand-rearing young for the past 3 years. Now that we have some young animals in the population, the SSP will begin to focus on solving the problem of neonatal mortality.

Maned Wolf Summary - Outside the United States
Data from 1990 Studbook - Current through December 31, 1990

1. As of December 31, 1990, there were 198.186 (384) maned wolves reported in captivity in 109 institutions worldwide.

2. The European population has climbed steadily from 63 in 1980 to 173 at the end of 1990. The Maned Wolf EEP was formed in 1990, coordinated by Dr. Bernd Matern, International Studbook Keeper, at Frankfurt Zoo.

3. Maned wolves are reproducing more successfully in Europe than in the United States. As a result, they are beginning to experience difficulties finding homes for pups. Additionally, since there have been very few founders imported in the past 10 years, the population mean inbreeding coefficient is .07 (twice the inbreeding coefficient of the United States population).

4. The South American captive population has grown slowly to 93 animals at the end of 1990. Eighty of those were wildcaught. A low rate of reproduction and high neonatal and juvenile mortality have kept the population from expanding rapidly; however, the species has experienced renewed interest recently. A cooperative management program modeled after the SSP was formed in 1990, headed by Cecilia Pessutti at Sorocaba Zoo.

An Account of the Canadian Swift Fox (*Vulpes velox*)
Reintroduction Attempt (1992)

by Clio Smeeton
Director, Cochrane Wildlife Reserve

The reintroduction of an extirpated species into the original range is immediately appealing to a general public which is yearly becoming more knowledgeable and more aware of the steady deterioration of the planet on which we all live. In Canada, this concern has resulted in the founding of several charitable special interest groups devoted to fostering the protection of endangered species and/or their habitat.

Historically, the action to save from extinction individual species has most often been initiated by single-minded individualists with sufficient money to gratify their passion. In recent years, this role has been taken over, in part, by reputable zoos. No longer the exhibitors of "living trophies," responsible zoos are now the leaders of an international conservation network. The general public's concerns about the global effect of species loss and ecosystem destruction, which are reflected in zoos' conservation actions, have only very recently begun to appear on the political and economic agendas of the world community.

A Canadian attempt at the successful recovery of an extirpated population of swift fox (*Vulpes velox/V.v.hebes*) has been in process since 1971.

This small fox of the Great Plains is unique to North America. Two subspecies of swift fox were first described by Merriam (1902), the Northern swift fox (*V.v.hebes*) and the Southern swift fox (*V.v.velox*). The species kit fox (*Vulpes macrotis*) is said to hybridize with *V.v.velox* where their ranges overlap (Rohwer and Kilgore, 1973). Merriam's 1902 subspecies classification of *V.v.velox* and *V.v.hebes* could well be substantiated by current genetic research, if funding to collect the blood samples from the South Dakota population is obtained before that population declines completely.

***Vulpes velox hebes*, the Northern swift fox, was briefly listed as endangered in the United States in 1979 but was delisted on the basis of an arbitrary decision that a valid subspecific variation did not exist. The Northern subspecies was proposed as an addition to the endangered species list for the United States in 1982 (U.S. Fish and Wildlife Service, 1982) and another petition for upgrading the swift fox in its northern range from a candidate 2 to an endangered species is currently before the Director of the U.S. Fish and Wildlife Service (Sharps, 1992).**

The swift fox, under the designation *Vulpes velox*, is listed as extirpated in Canada.

The known status of the swift fox over its original range in the United States is as follows:

- **South Dakota (1991 data): Status: state threatened species. Best estimate of population numbers statewide is 10 to 100 individuals (Sharps, 1992). Little or no swift fox management is being done and the population is continuing to decline.**

- North Dakota (1989 data): Status: extirpated. Although 25 percent of the state is estimated to possess suitable habitat for the swift fox, there have been no sightings since 1970. There is no swift fox management at present and none planned for the future.

- Montana (1989 data): Status: unknown. Protection regulation is a closed hunting season. No current records of swift fox status, no population density number available and very few sightings. At least one of the sightings was of radio-collared swift fox from the Canadian reintroduction. There is no current swift fox management.

- Nebraska (1990 data): Status: state endangered species. Five to 10 percent of the state is still suitable swift fox habitat. Population density numbers are unknown. Management is an annual natal den survey and road sign surveys. Nebraska's estimated population trends are that the swift fox is stable in one part of their Nebraska range and declining elsewhere.

- Wyoming (1989 data): Status: not common; unprotected. Fifty percent of the state is estimated as suitable swift fox habitat. Distribution estimates are based on general sightings. No management or protection is provided for the swift fox in considering a proposal whereby they would cease using Canadian captive-bred swift fox (minimum numbers of swift foxes available for release, 110 per annum) in their reintroduction program and rely instead on imported wild animals captured in Montana. Current distribution of swift fox in the United States consists of several small, highly disjunct populations ("An Ecological and Taxonomic Review of the Swift Fox," January 1991), it is from one of these small populations that the Canadian Swift Fox Recovery Team's wild-trapped animals of 1989, 1990 and 1991 have come.

- Colorado (1989 data): Status: not common; stable population, hunted and trapped. Population estimates are based on hunting/trapping questionnaires and field observations. Distribution and location of natal dens are unknown.

- Kansas (1989 data): Status: common, stable; protected by furbearer hunting/trapping regulations. No population density numbers are available. Thirty-three percent of Kansas is estimated as suitable swift fox habitat. Management consists of roadside surveys, department opinion survey, fur harvest survey and fur dealer records. Population estimates are based upon hunting/trapping questionnaires, fur dealer records and annual surveys.

- Oklahoma (1989 data): Status: unknown; protected by furbearer hunting/trapping regulations. Approximately 25 to 30 percent of the state is estimated to be suitable swift fox habitat. Management consists of landowner questionnaires, some data gathered from incidental sightings and scent stations.

- Texas (1989 data): Status: unknown; protected by furbearer hunting/ trapping regulations. *Vulpes velox* and *Vulpes macrotis* presently lumped as one. Distribution and population density unknown. No swift fox management provided.

- Minnesota (1989 data): **Status: unknown. No recent records of swift fox.**

- Iowa (1989 data): **Status: unknown. No current records of swift fox status. Unverified sightings along the Nebraska border.**

- New Mexico (1989 data): **Status: unknown; protected by furbearer hunting/trapping regulations. Distribution, population density, present occurrence are unknown. No management provided. *Vulpes velox* and *Vulpes macrotis* lumped as one. Only available records are those of the fur harvest. "This information indicates an average of 2,500 animals trapped per year for the last five years." (New Mexico Department of Game and Fish, 1989, "Petition to List Swift Fox," 1992.)**

Red Wolf Species Survival Plan

by Will Waddell
Point Defiance Zoo and Aquarium

The red wolf was listed as federally endangered in 1967 with a limited recovery program established that year. The red wolf was selected for priority treatment in 1973 following passage of the Endangered Species Act. A captive-breeding/ certification program was established and administered at Point Defiance Zoo in November 1973. This effort was coordinated through the Fish and Wildlife Service's field office in Beaumont, Texas. From the fall of 1973 to July 1980, over 400 wild canids were examined through the recovery program. Of that number, 43 wild canids were admitted to the breeding/certification program as probable red wolves. Red wolves were considered extinct in the wild in the fall of 1980 (Red Wolf Recovery Plan, 1990).

In 1984 the red wolf was approved for Species Survival Plan status with the AAZPA. Currently, 24 institutions participate in the red wolf SSP, with four additional facilities scheduled to receive wolves by the end of 1992. On average, 35-40 of the captive population are kept at a 5-acre off-site breeding facility approximately 30 miles southeast of Tacoma in Graham, Washington. Pairings for breeding seasons are coordinated at Point Defiance Zoo with input from the Fish and Wildlife Service and SSP cooperators.

Red Wolf Population Over the Past 5 Years

	1988	1989	1990	1991	1992
Births	13.10-23	21.23-44	23.24.2-49	29.32.2-63	34.34.1-69
Deaths	11.7-18	12.10-22	13.15.2-30	12.18.1-31	10.8.1-19
Population	36.49-85	45.62-107	55.71-126	72.85.1-159	91.106.3-200

The total red wolf population is 202 not including wild reproduction in 1992. Sixteen litters have produced 69 pups this year with 52 surviving to date.

This was the third year of the red wolf program's reproductive studies. Semen collecting and freezing techniques are progressing well. Measurements of progesterone and estrogen levels have helped to clarify results of vaginal cytology examinations and given an indication to the general estrous pattern of the red wolf. One litter (1.2) was produced in 1992 resulting from artificial insemination of electroejaculated fresh semen. Dr. Jim Koehler, University of Washington, is evaluating sperm using electron microscopy. This will:

- Establish baseline data on normal sperm structure.
- Determine if incubation in canine capacitation medium induces acrosome reaction.
- Determine if freezing and thawing techniques being used result in "normal" sperm.

Red Wolf Reintroduction

by Gary Henry
Red Wolf Recovery Team

ALLIGATOR RIVER NATIONAL WILDLIFE REFUGE

The release of an adult pair of red wolves (*Canis rufus*) on September 14, 1987, marked the beginning of the first-ever project designed to restore a carnivore species to the wild. Since then, 34 additional captive-born wolves and a minimum of 18 wild-born wolves have been involved in the reintroduction project, which is being conducted at the Alligator River National Wildlife Refuge ("Alligator River") on Department of Defense property and on adjacent private lands in northeastern North Carolina. In 1991, second generation wild-born animals were produced by one wild-born female. Thirty of the released wolves have died or were returned to captivity. In contrast, only two of the wild-born wolves have died; the fate of one wild-born wolf is unknown. As of March 1, 1992, there were 21 red wolves free-ranging in eastern North Carolina. Currently, the Fish and Wildlife Service is proposing a plan to release wolves on the Pocosin Lakes National Wildlife Refuge and adjacent private lands west of Alligator River. Ultimately, over 500,000 acres of private, federal and state land in northeastern North Carolina may be available to red wolves. Such an area would likely support 50 to 100 animals. This project is an unqualified success, with captive-born and reared animals surviving, filling habitat vacancies and reproducing.

GREAT SMOKY MOUNTAINS NATIONAL PARK

The second reintroduction was initiated on November 12, 1991, in the Great Smokey Mountains national Park ("Park") in eastern Tennessee, with a release of a family unit consisting of an adult pair and two female pups. The 10-year-old adult male was recaptured because he showed an unacceptable degree of tolerance for people and inhabited areas; he will not be rereleased into the wild. The wolves have successfully adapted to the habitat, established a territory, and secured adequate prey for subsistence. Plans are to place the adult female back into captivity, release a different family group into the same location, and release a second family group in a different location in 1992. The two juveniles currently in the wild may or may not be recaptured.

ISLAND PROPAGATION PROJECTS

In an attempt to bridge the gap between captive-reared animals and wild animals, a strategy was developed to gradually infuse wolves experienced with life in the wild into reintroductions. Adult red wolves and their 10- to 14-week-old pups are released onto three protected islands off the southeastern coast of the United States. From July 1988 through April 1991, seven adults produced 16 pups (four litters) on the islands. Of the 23 animals involved in island projects, two adults and one pup were transported to the Park, one adult and nine pups were transported to Alligator River, two pups were transported to other islands, and three pups were left on their natal islands and were provided mates in the hope that they would breed. The remaining five wolves died before being removed from the islands. Two island-reared wolves

were released at Alligator River, with one being killed by a vehicle 9 months after being released. Two "island" adults were transported to the Park and were released during November 1991. As indicated above, the male was returned to captivity because of his high degree of tolerance for people; the female is still free-ranging.

Mexican Wolf

by Peter Siminiski, Mexican Wolf Studbook Keeper
David Parsons, Mexican Wolf Recovery Team

BACKGROUND

The Mexican wolf (*Canis lupus baileyi*) is the smallest subspecies of the North American gray wolf. From prehistoric to fairly recent times, the Mexican wolf ranged from central and northern Mexico to western Texas, southern New Mexico and central Arizona.

Mexican wolves were common throughout their range through the mid-1800s. Decimation of native prey species such as deer and pronghorn coupled with high cattle stocking rates in the late 1800s resulted in increased predation on livestock by Mexican wolves, leading to their subsequent eradication in the United States. Wolves were trapped, shot, and poisoned by both private individuals and government agents. Public and private bounties were paid. By the mid-1900s, wolves had been effectively eliminated from the United States.

The Mexican wolf was listed by the U.S. Fish and Wildlife Service ("FWS") as an endangered species in May 1976 under the Endangered Species Act. It is now considered extinct in the wild in the United States. Occasional reports of Mexican wolves are received primarily from the U.S./Mexican border areas of Arizona and New Mexico; however, none of these reports have been confirmed to be authentic.

NATURAL HISTORY

Overall, our knowledge of the natural history of the Mexican wolf is sketchy at best. It was little studied before extermination measures were initiated. The average size and weight of wild Mexican wolves is known only from carcasses. Adult Mexican wolves weigh 50 to 90 pounds, average 4-1/2 to 5-1/2 feet in total length (nose to tail), and reach 26 to 32 inches in shoulder height. Captive female Mexican wolves usually breed between mid-February and mid-March. Gestation averages 63 days, with birth occurring in April or May. Only one litter is born each year and the average litter ranges from four to six pups.

Wolves in the Southwest were associated with many different vegetative communities. Most often, the Mexican wolf preferred montane woodlands, presumably because of the favorable combination of cover, water, and prey availability. The Mexican wolf preyed upon deer, antelope, javelina, rabbits, and small mammals. Mexican wolves are believed to have formed small family units or social packs consisting of the adult breeding pair and their offspring. Pack territories probably encompassed 100 to several hundred square miles.

RECOVERY EFFORTS

Under an agreement reached between the United States and Mexico, efforts to capture live wild wolves in Mexico were initiated in 1977. Five Mexican wolves (four males and one pregnant female) were captured between 1977 and 1980 in Durango and Chihuahua and were transferred to the Arizona-Sonora Desert Museum in Tucson, Arizona to establish a captive breeding program. Only these captive wolves and their offspring are certified to be pure Mexican wolves by the FWS.

Two additional populations of captive wolves, which may be Mexican wolves, exist. One is commonly referred to as the Ghost Ranch population and contains 15 known animals, all in the United States. The other is referred to as the Aragon population, which contains eight animals; all are held at the Aragon Zoo in Mexico City. DNA research is being conducted to attempt to determine if these populations are pure Mexican wolves.

The Mexican Wolf Recovery Team ("Team") was formed by the FWS in August 1979. The Team prepared the Mexican Wolf Recovery Plan, which contains the following objective:

To conserve and ensure the survival of *C. l. baileyi* by maintaining a captive breeding program and reestablishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000 square mile area within the Mexican wolf's historic range.

CAPTIVE BREEDING PROGRAM

The first birth of a litter of Mexican wolves in captivity occurred in 1978 at the Arizona-Sonora Desert Museum. A total of 109 Mexican wolves have been born in captivity through 1991. As of August 1, 1992, the captive population consisted of 50 Mexican wolves: 41 wolves at nine cooperating facilities in the United States and nine wolves at three facilities in Mexico.

RE-ESTABLISHMENT OF WILD POPULATIONS

As recommended by The Mexican Wolf Recovery Plan, the re-establishment of Mexican wolves into historically occupied habitat in the United States is now being considered. As currently planned, an initial reintroduction phase would be conducted as an experiment on one site. Subsequent releases would likely be conducted one site at a time until recovery objectives are met.

The FWS has proposed the experimental release of Mexican wolves on one of the five sites currently under consideration in Arizona and New Mexico. The reintroduced population would be designated experimental in accordance with Section 10(j) of the ESA, and would not be considered essential to the continued existence of the species. This would allow for greater flexibility in managing the released population. Data, information, and experience obtained from the experimental release will be used to formulate plans for future releases of Mexican wolves.

Compliance with various laws and regulations is required before wolves can be released. The National Environmental Policy Act (NEPA) requires full evaluation of effects and alternative courses of action prior to any agency decision to implement a proposal. In order to comply with the provisions of the NEPA, the FWS is preparing an environmental impact statement (EIS) on the proposed experimental release. Active public participation (such as public scoping meetings and public comment periods) will be integrated throughout the NEPA process.

Gray Wolf

by Mike Phillips
Red Wolf Recovery Team

STATUS OF GRAY WOLVES

In the lower 48 states, the gray wolf exists in:

- **Minnesota (1,550-1,750 animals)**
- **Wisconsin (about 40 animals)**
- **Michigan (probably less than 20 animals including those on Isle Royale)**
- **Montana (40-50 animals, including packs in Canada along the U.S. border)**
- **Washington (number of animals unknown but probably small)**
- **Idaho (less than 15 animals)**
- **North Dakota (occasional migrants from Canada)**

The following individuals continue to intensively study gray wolves in northeastern Minnesota and on Isle Royal, respectively:

Dr. L. David Mech
United States Fish and Wildlife Service (USFWS)
c/o North Central Forest Experiment Station
1992 Folwell Avenue
St. Paul, Minnesota 55108
(612) 649-5231

Dr. Rolf O. Peterson
School of Forestry
Michigan Technological University
Houghton, Michigan
(906) 487-2179

Wolves inhabiting Montana and Idaho are being monitored by USFWS personnel. Contact:

Mr. Joe Fontaine, USFWS
Federal Building
301 South Park
Helena, Montana 59626

(406) 449-5225

Mr. Bruce Zoellick, USFWS
4696 Overland Road, Room 578
Boise, Idaho 83705
(208) 334-1806

Gray wolves inhabiting Glacier National Park are also being monitored by National Park Service (NPS) personnel. Contact:

Mr. Jim Tilmant
Glacier National Park
West Glacier, Montana 59921
(406) 888-5441

Within the next few weeks, the USFWS will hire a biologist who will be stationed at Kalispell, Montana. This individual will be the primary biologist monitoring wolves inhabiting northwestern Montana. Additionally, within the next few weeks the NPS will hire a biologist to assume responsibility for monitoring wolves in Glacier Park.

Within the last few months, the USFWS (with assistance from other agencies) began preparing an environmental impact statement (EIS) concerning reintroduction of wolves to Yellowstone National Park and central Idaho. The project leader for the EIS is:

Mr. Ed Bangs, USFWS
Federal Building
301 South Park
Helena, Montana 59626
(406) 449-5225

United States Fish and Wildlife Service personnel in Washington are preparing for an intensive period of trapping during Summer 1992. Contact:

Mr. Jeff Haas, USFWS
Olympia Field Office
3704 Griffin Lane S.E., Suite 102
Olympia, Washington 98501-2192
(206) 753-9440

Mr. Art Beyer, a biologist for the red wolf recovery program, will be on detail to Washington for 4 months to assume responsibility for the trapping. Beyer's objective is to capture animals so they can be outfitted with radio-collars and subsequently monitored. If Beyer is successful, the USFWS expects to hire two permanent biologists to monitor the wolf population in the state.

African Wild Dog

by Bruce Brewer
Chicago Zoological Park

An International Studbook for the African Wild Dog (Brewer, in prep) is in final review and will be published in September 1992. The AAZPA has approved an SSP for the North American population. The African Wild Dog SSP will hold its first meeting in September 1992 in Toronto and will develop a Management Plan and Husbandry Manual in Spring 1993.

African Wild Dogs have been maintained in captivity since the turn of the century and have successfully bred in captivity as early as 1942. There are currently about 350 animals held in over 70 institutions. Large populations are in Australia, Europe and North America. The global population has a fairly stable age structure; 53 percent of the dogs are males.

All known captive African Wild Dogs are derived from the southern African population of dogs. Over 30 potential founders are in the population and approximately 93 percent of the wild diversity is retained. While depression has not been documented, some of the Australian population is highly inbred.

The North American population consists of 85 (49.36) dogs in 18 locations. Populations range in size from one to 15. Pups have been reared in 10 North American institutions, six of which currently have African Wild Dogs in their collections. The population age structure is imbalanced with a lack of mid-age cohorts. This reflects expansion following founder importation in the early 1980s followed by a period of little success, then renewed growth as the captive-bred pups began breeding.

The dogs have been successfully maintained and bred in a variety of social groupings and enclosures. While the earliest recorded age at pupping is 13 months, the median age at first reproduction is 38 months for females. Females as old as 10 have reared pups. Gestation is approximately 66 days. Litters may be as large as 18; the mode is 6. Fifty-seven percent of pups survive to 30 days and 32 percent to one year. Very few dogs live beyond 12 years of age. The oldest dog in the North American population is 14.

The dogs respond well to a variety of diets and to standard veterinary practice. Care must be taken in establishing and maintaining social groups. Even well-established social groups will frequently fight, especially when females are in estrus. While the dogs are very hardy, serious injuries are not uncommon.

GLOSSARY OF GLOBAL AND REGIONAL CAPTIVE STRATEGIC PROGRAMS

CAMP A Conservation Assessment and Management Plan (CAMP):

(1) reviews the wild and captive status of each taxon in a defined broad group of taxa (e.g., an order, family, subfamily, community);

(2) assesses the degree of threat for each taxon according to the Mace-Lande categories;

(3) recommends intensive management and information collection action to mitigate threat: PHVAs, *in situ* management, conservation-oriented research (surveys, taxonomy, etc.), captive breeding, genome banking.

CAMPs are developed as collaborative efforts of the Captive Breeding Specialist Group and the other Specialist Groups of the SSC and ICBP, wildlife agencies, and the Regional Captive Programs.

A CAMP provides:

(1) a resource for the development of IUCN/SSC and ICBP Action Plans;

(2) a strategic guide for intensive conservation action;

(3) the first step in the Global Captive Action Plan (GCAP) process.

A CAMP considers multiple taxa.

GCAP A Global Captive Action Plan (GCAP) also considers a broad group of taxa and:

(1) recommends:
  - (a) which taxa in captivity should remain there;
  - (b) which taxa in captivity need not be maintained there for conservation reasons;
  - (c) which taxa not yet in captivity should be there to assist conservation efforts.

(2) proposes a level of captive breeding program in terms of genetic and demographic objectives which translates into recommendations about global captive target populations;

(3) suggests how responsibilities for captive programs might be distributed among the Regional Programs; i.e., this function translates into recommendations for regional captive target populations.

(4) identifies priorities for technology transfer to and for financial and other support for *in situ* conservation.

GCAPS are developed by a Working Group which consists of representatives of the Regional Programs, especially the Chairs and selected members of the Taxon Advisory Groups (TAGs), with advice and facilitation from the IUCN/SSC Captive Breeding Specialist Group (CBSG). The GCAP Working Group will also normally include representatives of the range-country wildlife community and scientists who can resolve problems of systematics. A CAMP can provide a first step of the GCAP process. The GCAP is developed further in an interactive and iterative process involving the Regional Programs and their own Regional Strategic Collection

Plans (RSCPs). The GCAP is a dynamic process and mechanism that enables the Regional Programs to coordinate development of their RSCPs in response to the conservation needs of taxa (as identified initially by the CAMP) but also to the circumstances and interests of the regions. Hence the GCAP is a facilitation and forum for the regional programs to integrate themselves into the best global conservation effort possible.

A GCAP considers multiple taxa.

RSCP A Regional Strategic Collection Plan (RSCP) is a set of recommendations developed by a Regional Taxon Advisory Group (TAG) on the taxa in a defined broad group for which Regional Captive Propagation Programs (RCPP) should be developed. A Regional TAG will consider the recommendations of the CAMP and initial GCAP as one factor in preparing the first drafts of the RSCP. However, the RSCP also considers other factors such as the realities of Regional space and resources in the Region as well as other interests the Region may have in maintaining taxa. As stated above, the GCAPs and RSCPs are interactively and iteratively developed in an effort to maximize effectiveness in using captive space and resources for taxa in need of captive programs for their conservation. An extension of the RSCP for defined broad groups of taxa is an overall strategic collection plan for all organisms to be maintained by institutions participating in the Regional Program. The Australasian Region has already embarked ont his kind of overall strategic collection plan.

An RSCP considers multiple taxa.

ICP An Institutional Collection Plan is a strategic design for the taxa that a particular zoo, aquarium, or other captive facility will maintain and propagate. Ideally, an ICP will develop its collection to contribute as much as possible to RSCPs and ultimately GCAPs.

TAG A Taxon Advisory Group is a committee formed within the organized Regions of the zoo/aquarium world and which consists of zoo professionals and other experts. A primary function of a TAG is to formulate and implement Regional Strategic Collection Plans and by extension development of the GCAP. TAGs also recommend priorities for establishment of studbooks, development of Regional Captive Propagation program, and research priorities.

A TAG considers multiple taxa.

RCPP A Regional Captive Propagation Program (RCPP) is one of the organized collaborative programs within a Region to breed and manage a designated, usually threatened, taxon. Examples include an AAZPA SSP in North America, an EEP in Europe, a JMSP in the U.K., an ASMP in Australasia, an SSCJ in Japan, an IESBP in India, and an APP in Sub-Saharan Africa. Other Regions are initiating similar programs. RCPPs develop Regional Masterplans for propagation and management of the taxon.

An RCPP normally considers a single taxon (e.g., a species).

GASP A Global Animal Survival Plan (GASP) is a program for management and propagation of a single taxon at the international level. A GASP provides the facilitating framework for the Regional Captive Propagation Programs.

(1) to adopt global goals, in part by considering CAMP and GCAP recommendations;
(2) to divide responsibility, e.g., especially target population sizes, for achieving the global goals among the Regional Programs;
(3) to arrange interactions, especially animal or germplasm exchanges, among the Regional Breeding Programs toward achieving global and regional goals.

Analogous to the RCPP, a GASP develops a global masterplan to guide propagation and management of the taxon at the international level.

A GASP normally considers a single taxon.

PHVA A Population and Habitat Viability Analysis (PHVA) is an intensive analysis of a particular taxon or one of its populations. PHVAs use computer models:

(1) to explore extinction processes that operate on small and often fragmented populations of threatened taxa;
(2) to examine the probable consequences for the viability of the population of various management actions or inactions.

The models incorporate information on distributional, demographic, and genetic characteristics of the population and on conditions in the environment to simulate probable fates (especially probability of extinction and loss of genetic variation) under these circumstances. PHVAs use models to evaluate a range of scenarios for the populations under a variety of management (or nonmanagement) regimens. As a result of the different scenarios modeled, it is possible to recommend management actions that maximize the probability of survival or recovery of the population. The management actions may include: establishment, enlargement, or more management of protected areas; poaching control, reintroduction or translocation; sustainable use programs; education efforts and captive breeding.

A PHVA normally considers one taxon at a time.