Conservation Medicine

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ABSTRACT: The Field Veterinary Program (FVP) of the Wildlife Conservation Society (WCS) was created in 1989 to combat the wildlife disease and health problems that increasingly complicate the process of wildlife conservation. The FVP provides veterinary services for the more than 300 WCS conservation projects located in more than 50 countries around the world. Most of these projects are in tropical regions and many have a wildlife/domestic livestock component. Wildlife health care provided by the FVP staff includes (1) identifying critical health factors; (2) monitoring health status; (3) crisis intervention; (4) developing and applying new technologies; (5) animal handling and welfare concerns; and (6) training. Additionally, the staff of the FVP give expert advice to many governmental and non-governmental agencies that are involved in setting policies directly related to wildlife health and conservation issues. In this paper, two FVP projects are presented as examples of studies that have increased our understanding of the role wildlife diseases may play in the health of livestock and human populations, as well as the role humans and livestock may play in the health of wildlife populations. Examples of the collaborative work between the FVP staff and scientists from many disciplines (e.g., acarologists, mycobacterium experts, ecologists, and biologists) are also presented.

INTRODUCTION

Conservation biology was developed primarily as a response to what has been referred to as the sixth great extinction.[1] It is estimated that 59 species of mammals and 116 species of birds have become extinct since the year 1600, representing 1.3% of known mammal species and 1.2% of known birds.[2] Unlike past extinctions, the present trends are related to human activities that have resulted in habitat fragmentation, population isolations and closer contact between wild animals, livestock, and humans. These factors may have a direct effect on species survival and may create challenges that veterinarians are particularly well suited to help address.

Conservation medicine, a subspeciality within the field of conservation biology, should be viewed as the application of medicine to augment the conservation of wildlife and ecosystems. One model for conservation medicine is the Field Veterinary

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Program of the Wildlife Conservation Society. The Field Veterinary Program was created in 1989 to combat the wildlife disease and health problems that increasingly complicate the process of wildlife conservation.[3] The Program provides veterinary services for the more than 300 Wildlife Conservation Society projects located in more than 50 countries around the world. Most of these projects are in tropical regions and many address problems stemming from wildlife–domestic livestock interactions. Wildlife health care provided by the Field Veterinary Program staff includes (1) identifying critical health factors, (2) monitoring health status, (3) crisis intervention, (4) developing and applying new technologies, (5) animal handling and welfare concerns, and (6) training.[4] Furthermore, the staff of the Field Veterinary Program give expert advice to many governmental and non-governmental agencies that are involved in setting policies directly related to wildlife health and conservation issues.

In this paper, two projects are presented as examples of studies that have increased our understanding of the role that wildlife diseases play in the health of livestock and human populations, as well as the role that humans and livestock play in the health of wildlife populations. Examples of the collaborative work between Field Veterinary Program staff and scientists from many disciplines (e.g., acarologists, mycobacterium experts, ecologists, and biologists) are also presented.

WILDLIFE–LIVESTOCK–HUMAN DISEASE INTERACTIONS

The contact between wildlife species, domestic animals, and humans has reached an unprecedented high as the human population, now approaching six billion, encroaches on wild lands. This increased contact is due in large part to an increase in habitat fragmentation, leaving isolated populations of wild animals surrounded by or in proximity to humans and their domestic animals. Fragmentation has also led to an intensified level in the hunting of wild animals as a source of bush meat. The recent interest in developing ecotourism projects in remote areas that are home to some of the most endangered species has contributed to heightened contact between wildlife and humans. Another factor in the increased contact that humans and their domestic animals have with wild life species are the common wildlife management practices of translocating and reintroducing free ranging and captive populations of animals.[5–7] One result of these varied human activities has been a greater awareness of the importance of disease interaction between domestic animals, wildlife species and humans.[8–11] It has also been acknowledged that diseases and parasites play an important role in the dynamics of wildlife populations.[12,13]

An integral part of the Field Veterinary Program is the evaluation of health concerns of free ranging wildlife species as they relate to human and domestic animal populations living in proximity to these animals. At present, the Field Veterinary Program is developing, in collaboration with World Wildlife Fund (WWF) and ECOFAC (a program funded by the European Community in Central Africa), long term health monitoring programs for lowland gorillas in Central Africa. These programs will provide baseline data on the health of two free ranging populations of lowland gorillas in areas without significant human presence. The projects will also gather data necessary for understanding the health risks to gorillas, as well as to humans

that have contact with gorillas, as ecotourism expands in this region. This is the first time that field studies of this nature will be conducted for free ranging gorillas. These studies will provide the information needed to develop preventive health management programs for these endangered animals, as well as serve as a model for future studies for other gorilla populations with potential for ecotourism development.

The two projects presented in this paper, health evaluations of guanaco (*Lama guanicoe*) in Argentina and orangutans (*Pongo pygmaeus*) in Malaysia, exemplify how the Field Veterinary Program has provided critical scientific data to help with management and conservation strategies as they relate to the increased interaction between wildlife, livestock, and humans.

Health Evaluation of Free Ranging Guanaco (Lama guanicoe)

Guanaco, a non-domesticated New World camelid related to the lama (*L. glama*), are listed on CITES Appendix II and limited to Argentina, Chile, Peru, Bolivia, and Paraguay.[14] The largest populations are currently found in dry grasslands and scrub forest of Southern Argentina. The threats to the survival of this species include heavy utilization of land for sheep ranching, indiscriminate hunting to supply meat for sheepdogs and humans, and harvesting of skin and wool. In the Patagonia region of Argentina ranchers have for decades blamed free ranging guanaco for carrying and transmitting infectious diseases that are harmful to their domestic livestock. (This has provided yet another justification for the hunting of guanaco.) To investigate the validity of the ranchers' claims, the Field Veterinary Program initiated a study in 1995 to evaluate the health status of free ranging guanaco, and to compare these findings with domestic sheep in the same region.[15]

Serologic, hematologic, serum chemistry, vitamin and mineral levels, and fecal parasite counts of guanaco were performed.[15] These data have provided the first baseline health information on guanaco in this region, which is vital for the implementation of appropriate management and conservation strategies.[4]

A panel of 11 infectious agents, common causes of disease in domestic livestock and previously detected in new world camelids,[16,17] were tested by serologic analysis in guanaco ($n = 20$) and sheep ($n = 20$). The guanaco were seronegative for all 11 infectious agents. However, the sheep were seropositive for four (bovine respiratory syncytial virus, Johne's disease, leptospirosis, and parainfluenza-3) of these 11 agents. These results were contrary to common local opinion that the guanaco serve as the source of diseases for sheep. The conclusions from this study were that populations of free ranging guanaco can be relatively disease free and, at the same time, susceptible to common diseases of domestic livestock. These results were provided to local government authorities as objective data to support conservation policies for guanacos.

The findings from this study were televised on CNN™ in both the USA and Argentina, which helped garner public support for guanaco conservation. This study is a prime example of how a wildlife health investigation and appropriate media involvement can help in the conservation of a species, as well as provide important data on livestock and wildlife disease interactions.

Health Evaluation of Orangutans

The single species *Pongo pygmaeus* contains two subspecies, *P.p. abelii,* of Sumatra and *P.p. pygmaeus,* of Borneo, both of which are listed in Appendix I of CITES.[18] The current status of orangutans in the wild is an excellent example of the effects that habitat destruction and forest fragmentation can have on a wildlife species, as well as the health issues associated with rehabilitation and translocation programs of a primate species.

Two complementary conservation efforts were carried out during 1997 and 1998 by members of the Field Veterinary Program staff and state wildlife authorities in Sabah, Malaysia: (1) rehabilitation of infant orangutans with reintroduction to the

TABLE 1. Viruses and bacterial antibody titers and microfilaria in 34 free ranging orangutans (*Pongo pygmaeus*)in Malaysia

Virus	+	%	Virus	+	%	Leptospirosis (serovars)	+	%	Leptospirosis (serovars)	+	%
SRV	0	0	SA-11	10	30	pomono	0	0	tarassovi	0	0
SIV	0	0	EBV-VCA	34	100	hardjo	2	6	australis	4	12
STLV	0	0	SIM, V-Z	0	0	icter/ cop	4	12	pyrogenes	2	6
MMR	0	0	Cox B1-5 (4+)	1[a]	3[a]	grippo	30	8	bratislava	16	47
RSV	1[a]	3[a]	Hepatitis A,C,E	[b]	[b]	canicola	0	0	sejroe	2	6
EMC	0	0	CHIMP-CMV	0	0	ballum	9	27	javanica	0	0
MPV	0	0	Polio	0	0	wolffi	3	9	szwajizak	1	3
VZV	0	0	B-VIRUS	0	0	automnalis	25	73	saxkoebing	1	3
Filo	0	0	HSV 1	0	0	bataviae	0	0			
Flavivirus	[b]	[b]	Hepatitis B,D	[b]	[b]				OTHER		
Alpha-virus (Arbo)	[b]	[b]	Adenovirus	3	9				Microfilaria	0	0
Flu-A&B	0	0	Para Flu 1,2,3	0	0						

[a]Positives not significant-possible cross reaction/nonspecific.
[b]Possible positives and/or further analysis in progress.

NOTE: SRV, simian retrovirus; SIV, simian immuno deficiency virus; STLV, simian T-cell leukemia virus; MMR, mumps, measles, rubella; EMC, encephalomyocarditis virus; VZV, varicella-zoster; SA 11, rota1 virus; EBV-VCA, Ebstein-Barr virus; Cox B 1–5, coxsackie B; HSV 1,2,3, Herpes simplex; CHIMPCMV, cytomegalo virus; B virus, Parvo virus; MPV, monkey pox; Filo, ebola like; Flavi, including Dengue and Chikungunya; ictero, icterohemorrhagiae; cop, copenhageni.

wild and (2) the translocation of stranded wild adult orangutans from areas of habitat destruction to protected forest areas.[19] During the translocation of 56 wild orangutans, a health evaluation of these animals was conducted.[20] In addition to gathering baseline health information (e.g., hematology, serum chemistry, and toxicology evaluation) of these free ranging primates, the prevalence of various infectious disease agents was determined (TABLE 1).[20–22] The presence of many of these pathogens, all of which have the potential to affect wildlife population dynamics, as well as local human and livestock populations, is important in developing management and conservation strategies for this species.

The prevalence of potentially active mycobacterial infections, based on serum Ag85 levels, was low in the free ranging population.[21] This finding is in stark contrast to the high prevalence of mycobacterium tuberculosis in semicaptive orangutans. The high prevalence in the semicaptive population is believed to be the direct result of contact with infectious humans.[21] It has been found that confiscated, captive orangutans that were intended for reintroduction to the wild have also been exposed to human influenza and hepatitis viruses and gastrointestinal parasites (W. Karesh and A. Kilbourn, unpublished data).

These studies, in addition to a similar study conducted in 1998,[23] have been crucial to our understanding of the role of diseases in population dynamics of captive and free ranging orangutans. In addition, these data highlighted the risks inherent in certain conservation efforts: introducing human disease agents during the course of reintroducing confiscated animals to the wild, and spreading disease agents among wild translocated animals. Public and official education has also been accomplished using results from these studies, which may help to slow the current illegal pet trade in orangutans, as well as contribute to conservation management decisions.

COLLABORATIVE PROJECTS

The majority of the Wildlife Conservation Society's Field Veterinary projects are conducted in Asia, Latin America, and Africa. We provide veterinary services throughout the world and thus have an opportunity to collect tissue samples and parasites from a variety of wildlife species. The Field Veterinary Program has been instrumental in many projects with conservation and public health components through collaborative efforts with scientists with diverse research interests. The following are a few examples of past collaborative projects in which the FVP staff have participated.

Ticks and Tick-borne Diseases

Over the years, the Field Veterinary Program has collaborated with an acarologist with a strong interest in the issue of host–parasite coextinction. Through this collaborative work new hosts and parasite ranges have been established for a number of tick species.[24–26] These findings are significant in regard to the epidemiology of tick borne diseases, as well as tick ecology.

Zoonotic Diseases

The FVP staff collaborates extensively with human disease researchers and clinicians that have an interest in infectious diseases of public health significance. During the health evaluation of orangutans in Malaysia, a mycobacterial disease expert was instrumental in determining the prevalence of mycobacterial infections in these orangutans using the serum antigen (Ag85) assay.[21] The possible role of wild primate populations as sentinels for emerging infectious diseases is presented in a paper[10] by Wolfe *et al.,* and demonstrates how the Field Veterinary Program has contributed to the understanding of this increasingly important area of public health.

Biologists and Field Ecologists

Many of the FVP projects are part of ongoing ecological studies of a variety of species being conducted by field biologists. Examples of these studies include the health evaluations of free ranging duikers (*Cephalophus* spp.) in Zaire and macaws (*Ara* spp.) in Peru.[27,28] Findings from both of these health evaluations show how a veterinary component in conjunction with an ecologic study provides necessary information for making sound conservation and wildlife management decisions. Exposure to disease agents in the duikers has shed light on the potential these diseases may exert on wildlife population dynamics, as well as on local peoples by direct (e.g., bush meat) and indirect (e.g., risks to their livestock) effects. The health evaluation of macaws in Peru provided information on the difference in exposure to infectious agents between free ranging and hand reared macaws at an ecotourism lodge. The results from this study revealed the potentially negative impacts of attempting to artificially increase reproductive output of a population, as well as highlighting some of the limitations of ecotourism as a conservation strategy. If health considerations are not taken into account at the inception of a project, these approaches can actually threaten wild populations.

CONCLUSIONS

The importance of wild life diseases in both domestic species and humans is becoming more apparent as the human population approaches six billion. Furthermore, the spread of disease to endangered wildlife species from contact with humans and domestic animals increases as humans and their domestic animals encroach on the land available for these species. One role of the Field Veterinary Program of the Wildlife Conservation Society is to investigate the health status of these wildlife populations and assess the potential of zoonotic and domestic–wildlife diseases from these populations. The two projects described in this paper exemplify this role. These investigations allow the staff of the Field Veterinary Program to give expert advice to many government and non-government agencies that are involved in setting policies directly related to wildlife health, livestock and human population management, and conservation issues. Collaborative efforts between staff of the FVP and scientists from a variety of disciplines will continue to expand our role in the field of conservation medicine and provide the sound scientific studies necessary for appropriate conservation and public health planning.

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