Role of Veterinarians in Wildlife Management in the United States

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米国の野生生物保護管理における獣医師の役割
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ABSTRACT. We have presented a brief review of a selected number of wildlife disease investigations that have been carried out by the staff of the National Wildlife Health Center. Investigations into the causes of bald eagle mortality have resulted in significant legal changes to better protect the eagle. In contrast, the isolation of the new virus from the woodcock (which may be pathogenic) is currently awaiting funding to conduct experimental studies. Other investigations, such as those involving avian cholera and Newcastle disease, are designed to obtain a better understanding of the role of these diseases in the wildlife populations we are attempting to manage.

Key Words: National Wildlife Health Center, lead poisoning, wildlife diseases, wildlife pathology, wildlife management

Prior to 1975, the U.S. Fish and Wildlife Service (FWS) employed eight individuals trained in "biomedicine" to (1) investigate specific diseases of migrating birds, particularly type C botulism and parasitic infections of waterfowl, and trichomoniasis in mourning doves (Zenaida macroura) or (2) to participate as a member of a research team studying the effects of environmental pollutants upon migrating birds.

Although these individuals did provide occasional diagnostic assistance to FWS field personnel, they were primarily research scientists. Of these eight, three were parasitologists, three were microbiologists (two of whom also had veterinary degrees), one was a virologist/wildlife biologist and one a "histopathologist" (also a DVM) assigned to environmental pollutant studies. These eight individuals were widely scattered in the U.S. ; three in Maryland, three in Utah, one each in North Dakota and Colorado.

In January 1973 an epizootic of duck plaque virus (Herpesiviridae) occurred among the 100,000 mallard ducks (Anas platyrhynchos) wintering at Lake Andes National Wildlife Refuge, South Dakota, resulting in the estimated loss of 44,000 mallards. The appearance of this viral disease, which had only recently been recognized in North America, led to a unification of the FWS' wildlife disease investigations and the 1975 establishment of the National Wildlife Health Center in Madison, Wisconsin. This
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FWS Center had three missions: (1) to provide diagnostic assistance to any of the Service’s field personnel; (2) to conduct research on specific wildlife disease topics assigned to the Center by the FWS headquarters in Washington, D.C.; and (3) to provide training in wildlife disease diagnosis and disease control procedures to field personnel of FWS.

Over the next eighteen years (1975-1993), the Center grew to a total 80 employees (full and part-time), organized into four sections: (1) Resource Health Team (=field investigations section); (2) Diagnostic Services; (3) Research Section; and (4) Support Services... media preparation, photography, administration, and engineering. The Center’s total budget was $3.4 million to $3.8 million.

The Resource Health Team (RHT) consisted of a group leader (Ph.D., DVM) and five “Wildlife Disease Specialists,” of whom, three had veterinary degrees. Each Wildlife Disease Specialist was assigned to one of the North American waterfowl migratory flyways (Atlantic, Mississippi, Central, and Pacific) while the fifth served as “backup.” The assigned Specialist would be responsible for all the cases originating in his or her respective flyway by providing instructions for the shipping of specimens to the Center or going to the site to investigate the reported die-offs and initiating appropriate control procedures. When in the field, the RHT member (1) made an evaluation of the die-off; (2) conducted field necropsies and collected tissues, etc., for shipment to the Center for ancillary laboratory tests; (3) collected any appropriate environmental samples; and (4) assisted field personnel in implementing control procedures.

Carcasses submitted to the Center from die-offs were turned over to the Diagnostic Section and subsequently examined by one of the pathologists. Appropriate tissues were submitted as needed for virological, bacteriological, parasitological, histopathological and/or chemical studies. The Diagnostic Section is headed by a wildlife veterinarian and two of the three pathologists are veterinarians with advanced training in comparative pathology.

Members of the Research Section were assigned to investigate wildlife diseases of major concern to the U.S. Fish and Wildlife Service and included studies on type C botulism, avian cholera and duck plague, and avian tuberculosis in whooping cranes. Field studies originally designed to yield information on the recurrent outbreaks of type C botulism at the Sacramento National Wildlife Refuge in California’s Central Valley, led to additional work on lead poisoning of waterfowl.

During the first 18 years (1975-1993) as a unit of FWS, the Center received diagnostic specimens from field personnel stationed throughout the United States and its territories (including Midway, American Samoa, Puerto Rico and the Virgin Islands). Field investigations were conducted in almost every state and overseas (Midway, Guam).

NWHC Since 1993

In 1993 the NWHC, as well as all other Wildlife Research Centers of the Fish and Wildlife Service (FWS), was transferred from FWS to a newly established National Biological Survey (later, renamed the National Biological Service). In 1995 U.S. Congress transferred the Center to the U.S. Geological Survey’s new Biological Resources Division. The Center’s current mission has been expanded to provide wildlife disease support to all the agencies within the U.S. Department of the Interior, which includes the U.S. National Park Service, Bureau of Land Management, Bureau of Indian Affairs, Bureau of Reclamation, as well as the FWS. Research on type C botulism, avian cholera, and duck plague continues. Current research on lead poisoning is focusing on its significance in the spectacled eider (Somateria fischeri) in Alaska, a species which has undergone a marked decline in numbers.
[1], and on the role that lead fisherman's sinkers play in causing lead poisoning in North American birds. In addition, the Center has recently become involved in the problems of poor reproduction in the herds of prong-horned antelope (Antilocapra americana) in Oregon/Nevada, the mortality of white-tailed deer (Odocoileus virginianus) in a National Park in Ohio, and the problem of salt-encrustation and salt-poisoning of waterfowl on Bureau of Land Management lands in New Mexico. Any of the U. S. Department of Interior agencies can request diagnostic support should die-offs of wildlife occur on any of the public lands managed by the agencies.

During the last two years the Center has been deeply involved in investigations to identify the causes of malformations in frogs which have been recently recognized in several states including Minnesota, Vermont, and Wisconsin, and to attempt to isolate and characterize the etiological agent responsible for fibropapillomatosis in the green sea turtle (Chelonia mydas) in Hawaii.

Increasingly the NWHC is becoming more research oriented as it is requested by other Federal and State agencies to investigate wildlife losses and to propose management techniques to overcome these losses.

We would now like to present the results of five of our investigations in order to give you a better perspective of the diversity of our work:

(1) Eagle Mortality and Lead Poisoning

Including more than 550 bald eagles that were examined at the Patuxent Wildlife Research Center, MD (1962-1975), we have now accumulated data on more than 4,300 necropsies of bald eagles (Haliaeetus leucocephalus) and golden eagles (Aquila chrysaetos) [2]. Law enforcement agents of FWS submitted bald eagles with the request to determine if the cause of death was "natural" (= infectious disease), accidental, or malicious (= shot or intentional poisoning). Severe fines and possible imprisonment could be exacted from the offender if the cause of death was found to be malicious.

At the Patuxent Wildlife Research Center bald eagle tissues were analyzed for organochlorine pesticide residues and a number of heavy metals. Since the establishment of NWHC and the subsequent transfer of the responsibility of eagle necropsies to it, a variety of infectious diseases, traumatic conditions and poisonings have been diagnosed in eagles submitted for examination. In 1970, Mulhern et al. [3], reported on the occurrence of ingested lead shot in a bald eagle from Maryland and these authors also reported on the concentration of lead found in the liver and kidney of this bald eagle. Earlier a captive Andean condor (Vultur gryphus) held at PWRC had died of lead poisoning following its ingestion of lead shot in hunter-killed game it had been fed [4], and it was suggested by the authors that perhaps bald eagles might become lead-poisoned by similarly ingesting lead pellets embedded in their prey. By 1985, lead-poisoning had been documented in more than 100 bald eagles. Responding to a Federal court order, the FWS initiated rules that led to the prohibition of the use of lead shot for the hunting of waterfowl [5]. As of 1998, a total of 374 bald eagles and 58 golden eagles have received a primary diagnosis of lead poisoning and an additional 42 (34 bald and 8 golden) have a secondary diagnosis of lead poisoning. Thirty seven had ingested lead shot in their stomach.

During the last fifteen years there has been an increasing recognition of organophosphate and carbamate pesticides as causes of eagle and other migratory bird mortality. This has required the development of diagnostic tests to characterize and identify the offending pesticides [6] and to separate these losses from bacterial intoxications [7].

The results of the necropsies of bald eagles, the national emblem of the United States, have been extremely useful in a variety of ways:
(1) There has been the development of a base of knowledge about diseases and injuries of eagles, and this information has lead to changes in lessening the likelihood of injuries; demonstrations that deaths were caused by electrocution has led to changes in design and construction of power lines; knowledge of injuries caused by steel traps has led to changes in trapping procedures; (2) Necropsy data has strengthened law enforcement, resulting in stronger cases for prosecution and conviction; (3) The demonstration that a number of organochlorine pesticides and their metabolites were adversely affecting eagle reproduction played a major role in banning the use of those pesticides in the U.S.; (4) The opportunistic emergence of two previously unsuspected poisoning problems has, in one case, led to the prohibition of the use of lead shotgun pellets for the hunting of waterfowl. The second, poisoning caused by organophosphate or carbonate pesticides, has led to increased Federal regulation of the use of carbofuran.

In spite of the prohibition against the use of lead shotgun pellets for the hunting of waterfowl in the United States, lead poisoning continues to be a cause of illness and mortality in bald eagles. The presence of lead shotgun pellets and lead bullet fragments in carrion has been an ongoing detriment to the reintroduction of California condors (Gymnogyps californianus) into its former habitat in Southern California, and the comparative lack of hunter-killed carrion has favored the release of these condors in Grand Canyon National Park, Arizona.

(2) Avian cholera

Avian cholera (Pasteurella multocida, serotype 1) had been recognized as a cause of mortality among North American waterfowl since 1944. Each year the disease usually reappears among waterfowl wintering in the Central Valley of California and in both the High Plains of the Central U.S. and/or in the Coastal Plains of Texas. During spring migration it often reappears among waterfowl resting in the Rainwater Basin of Nebraska. The numbers of birds that die vary considerably, for example in Nebraska, losses ranged from a low of 106 birds in 1978 to an estimated high of 80,000 birds, primarily white-fronted geese (Anser albifrons) in 1980 (30,677 dead waterfowl actually picked up) [8]. For many years there have been questions as to the possible source of the Pasteurella multocida, as the infection is usually peracute to acute with little evidence of survivors. One of our Center's studies is seeking evidence for the persistence of Pasteurella multocida in the habitat. Observations that epizootics often followed the appearance of snow geese (Chen caerulescens) on the wintering grounds have also focused our attention on this species as a possible source or carrier.

In joint studies with Russian biologists on Wrangel Island and with Canadian biologists on Banks Island, Center researchers are studying two populations of snow geese which winter in California's Central Valley, a "hot bed" of avian cholera. In July 1994, an isolation of a pathogenic serotype 1 Pasteurella multocida was made from a pharyngeal swab taken from an apparently healthy adult lesser snow goose on Bank's Island [9] - the first isolation from an apparently healthy wild snow goose and although avian cholera has not yet been reported from snow geese nesting on Wrangel Island, antibodies were found in 4.8% of the females and in 2.1% of the males tested in 1995 [10].

(3) Southern Sea Otter (Enhydra lutris nereis)

The southern sea otter is a highly protected subspecies whose range is limited to the Central Coast of California. Prior to the 1990's, the California Department of Fish and Game studied southern sea otter mortality and had identified several types of traumatic mortality, but a large percentage (56%)

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had died of unknown causes. In the 1990's, a cooperative five-year study of the causes of mortality was undertaken at NWHC in an attempt to investigate the large percentage of unknown causes. Approximately 50 sea otter carcasses per year were subjected to intensive necropsy with subsequent histopathological examination of tissues and a variety of ancillary laboratory techniques to assist in diagnosis.

Analysis of these data are still in progress, but laboratory studies have shown that various parasitic, bacteriological and fungal diseases have caused a large proportion of the deaths (38.5%) : 20% died from traumatic injuries, another 10% were emaciated but no specific cause for their condition could be identified. Miscellaneous conditions such as neoplasia, urinary or gastrointestinal obstructions, were responsible for 18% of the deaths and in 18.5% no cause of death could be established [11].

Studies are now being proposed to obtain a better understanding of the possible effects that various environmental pollutants may be having on the California sea otter population. A recent paper reported butyltin residues in dead sea otters involved in our study [12]. Butyltin compounds are of concern because of their potential ability to cause immunosuppression.

(4) Newcastle disease in Cormorants

The most virulent strains of this virus are considered exotic to the U. S. and a serious threat to the U.S. poultry industry. Outbreaks of velogenic Newcastle are controlled by the eradication of infected flocks of domestic poultry. Newcastle disease was first confirmed in wild juvenile double-crested cormorants (Phalacrocorax auritus) in Western Canada in 1990 and then appeared again in Canada and in the upper Midwestern U.S. in 1992. Associated with the U.S. outbreak, the NWHC investigated losses of cormorants at 29 sites in Minnesota, Nebraska, and South Dakota and in Lakes Michigan, Superior, and Huron. Necropsies were performed during field investigations carried out by members of the Center's RHT and 88 double-crested cormorants were examined at the NWHC. Samples of 21 organs from each bird were examined histopathologically: virus isolations were attempted on 526 tissues (brain, liver, spleen, intestine, trachea and lung) from 93 cormorants; bacteriological studies were conducted on liver and intestinal samples; heart blood from 24 cormorants was tested for botulism. Microscopic lesions in the brain and spinal cord were present in all cormorants from which Newcastle disease virus was isolated and these consisted of Purkinje cell necrosis, extensive gliosis, and vasculitis in the cerebellum and gliosis and vasculitis in the spinal cords [13]. The 1992 cormorant isolate was characterized by embryo death time as velogenic and subsequently shown by USDA transmission studies to be pathogenic to domestic poultry. Subsequent isolates from double-crested cormorants in California, Oregon, and Utah have been classified as mesogenic although the California epornitics have been associated with heavy nestling mortality.

(5) American Woodcock (Scolopax minor)

In the winter of 1989–90 an estimated 1,000 dead American Woodcocks were found in Cape May, New Jersey and Cape Charles, Virginia during a period of record cold weather. Most of the carcasses submitted to NWHC for necropsy were emaciated. A new reovirus, later characterized as an orthoreovirus was isolated from several tissues of the dead woodcocks. Subsequent attempts to demonstrate this virus in 305 apparently healthy woodcocks collected on both the breeding and the wintering grounds were unsuccessful [14]. In 1994 there were two other die-offs of woodcocks under very similar conditions and reovirus isolates identical to the 1989–90 isolant were found. This reovirus is the
first virus of any group ever isolated from the American Woodcock, a fairly important game bird in the Eastern United States. The pathogenic significance of this reovirus, and the original source of this virus are still unknown as no experimental studies have been conducted.

要 約
1970年発表以来、野生動物保護管理において野生生物穀医師が果たすべき役割に対する認識が、国や州のレベルで高まってきた。その役割には、疾病の診断や制御、医学病理、絶滅危惧種の増殖と臨床ケア、野生動物の移植（translocation）がある。渡り鳥や絶滅危惧種の管理、および数種の海洋哺乳類の主要担当機関である米国内務省魚類・野生生物局（FWS）は、1975年に米国野生生物保健研究センター（NWRC）を設立した。このセンターでは、FWSの野生調査員による診断補助、特定の野生生物疾病に関する研究、FWS野生調査員に対する野生生物疾病の診断と制御の教育を行っている。診断に関しては、家禽コレラ（avian cholera）、C型ボツリヌス中毒、水鳥の鉛中毒の鑑別、ウ類のニューカッセル病、鉛中毒の鑑別、殺虫剤中毒、ハクトウシとイヌワシの死因、ラッコやオオカミ、キットギヌ、アメリカシロツメの死因に関する調査を行っている。メリーランド州ローレルのバチューシェント野生生物研究センターでは、野生生物穀医師が渡り鳥に対する環境汚染の影響を測る研究の病理学的サポートを行っている。一方、飼育下にある絶滅危惧種の臨床的ケアを担当するものもいる。我々は、米国野生生物保健研究センターの歴史と組織の状況、FWSの一部であった当時の業務（これには特定の伝染病の調査など、現在の業務も含まれる）、米国地域調査局の生物資源部門に属する研究センターとして新たに加わった業務について論じる。

キーワード：米国野生生物保健研究センター、鉛中毒、野生動物の疾病、野生動物の病理学、野生動物の保護管理

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