CONTROL OF A FOWL CHOLERA OUTBREAK AMONG COOTS IN VIRGINIA

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ABSTRACT

In February, 1975, an outbreak of fowl cholera caused the death of 18,000 wild waterfowl, primarily American coots (Fulica americana)*, at Back Bay, Virginia. To arrest the epornitic, coots were treated with aerial application of a wetting agent, rendered flightless, collected from the water, and humanely destroyed. Over 6,000 coots were depopulated. Pertinent field observations are described for this control endeavor.*

Fowl cholera is an infectious avian disease caused by the bacterium, *Pasteurella multocida.* Although the disease is primarily a problem in domestic flocks (Heddleston 1972), numerous wild birds are susceptible, and outbreaks of fowl cholera are not uncommon among wild waterfowl, especially in the western Unites States (Rosen 1971).

This disease first appeared in wild waterfowl of the Atlantic Flyway in 1964, when Gershman et al. reported on an outbreak in eider ducks (*Somateria mollissima*) nesting off the coast of Maine. Subsequently, Reed and Cousineau (1967) reported epidemics in nesting eiders on islands in the St. Lawrence River. Two additional outbreaks occurred in the Chesapeake Bay and Everglades National Park respectively (Locke et al. 1971, Klukas and Locke 1970). The former involved various species of sea ducks, and the latter occurred principally among coots.

Control efforts during eruptions of cholera in wild waterfowl have been directed largely toward rapid collection and disposal of contaminated carcasses in hope of limiting disease transmission (Rosen 1971). Occasionally, these efforts have been augmented by drainage of impoundments, scavenger control, and/or harassment of healthy birds attempting to use an infected area.

On February 2, 1975, mortality commenced among coots on Back Bay, Virginia. The biologist aide in charge of the state's waterfowl management areas on Back Bay quickly surmised that the mortality was greater than normally expected following the hunting season. Subsequently, officials of the Virginia Commission of Game and Inland Fisheries and the manager of the nearby Back Bay National Wildlife Refuge were notified, and fresh carcasses were collected and forwarded to the Patuxent Wildlife Research Center (Fish and Wildlife Service, U.S. Department of the Interior) for examination. Arrangements were made also for the daily pickup and disposal of carcasses, and local individuals were hired temporarily to aid state and federal personnel.

Following a diagnosis of fowl cholera by the laboratory, pickup operations were intensified, and a float plane and helicopter were obtained to aid collection crews in locating dead coots and to conduct surveillance on waterfowl using the bay. Efforts also were directed toward harassment of gulls attempting to feed on contaminated carcasses, since gulls were known to spread the disease (Rosen 1971). In addition, sanitation procedures were installed as a precaution against spread of the disease from infected coots to other wild waterfowl and to prevent spread to isolated domestic and semi-domestic bird flocks in the vicinity. Collection crews were outfitted with rubber rain suits, rubber boots, and gloves, and contaminated carcasses were placed in double strength plastic bags. At the conclusion of daily pickup activity, carcasses were transported to disposal pits and buried following burning with fuel oil. Protective clothing, boats, and equipment were thoroughly cleansed with bactericidal disinfectant.

In spite of the control measures inaugurated, the epornitic enlarged. Within a week, coot losses exceeded 1,000 birds daily and more than one raft (flock) became involved. Some gadwall and wigeon feeding among coots also became infected.

Air surveillance revealed other coot rafts and flocks of ducks, geese, and swans on Back Bay which were in close proximity to the die-off area, and concern mounted that these groups of waterfowl were in immediate danger. An even greater threat was the possibility that during the rapidly approaching spring migration, additional thousands of wild waterfowl moving through Back Bay and into the Chesapeake Bay would become exposed, igniting outbreaks throughout the region. Of special concern were the large numbers of canvasbacks (*Aythya valisineria*) and redheads (*A. americana*) in the Chesapeake Bay.

Considering these problems, other control measures used in previous outbreaks of fowl cholera in wild waterfowl were considered. However, elimination of gulls was not possible due to the numbers involved; drainage of the bay was not feasible; and harassment of coots and other waterfowl on the bay could have initiated interchange among diseased and healthy birds. Thus, a previously untested control measure became necessary. This paper describes the steps taken to halt the outbreak by the depopulation of infected coot rafts.

This disease control program was a cooperative effort on the part of the following organizations: Division of Wildlife Refuges, Division of Wildlife Services, National Fish and Wildlife Health Laboratory, and Northeast and Southeast Regional Offices of the Fish and Wildlife Service, United States Department of the Interior (FWS, USDI); the Southeastern Cooperative Wildlife Disease Study, University of Georgia; and the Virginia Commission of Game and Inland Fisheries (VCGIF). Emergency Programs of Veterinary Services, Animal and Plant Health Inspection Service, United States Department of Agriculture; the Environmental Protection Agency (EPA); the United States Coast Guard; the United States Navy; and the Virginia Department of Agriculture and Commerce substantially aided the control effort. Although many individuals contributed greatly to this undertaking, the authors are particularly indebted to Mr. Otto V. Halstead and Mr. Edgar Leo Dozier (VCGIF) for their work in coordinating headquarters operations. This program was supported in part by the Federal Aid in Wildlife Restoration Act (50 Stat. 917).

METHODS

Study Area

Back Bay is a natural, shallow-basin, fresh water bay located within the city limits of Virginia Beach, Virginia. Comprising an area of approximately 11,000 ha, the bay is landlocked except for a southern opening into Currituck Sound at the head of the outer banks of North Carolina. Although the bay is not affected by ocean tides, water level varies as a result of wind direction (wind tides). During calm periods, water flow is minimal. Two National Wildlife Refuges (NWR) and three state-owned Waterfowl Management Areas (WMA) are located at Back Bay (Fig. 1).

Back Bay primarily supports commercial and sport fishing and sport hunting. With regard to the latter, the bay serves as a major wintering area and a migration stopover for many thousands of wild waterfowl. Principal species using the area include coots, whistling swans *(Cygnus columbianus)*, greater snow geese *(Anser caerulescens*

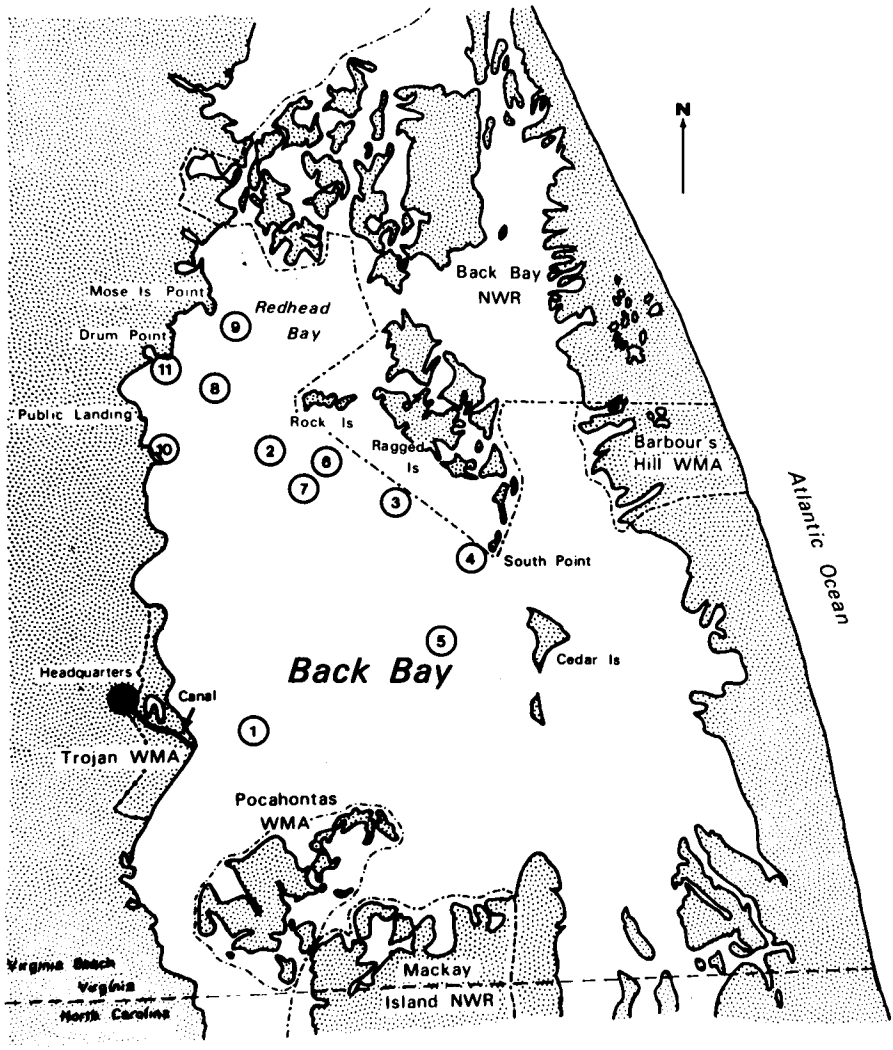

Figure 1. Portion of Back Bay, Virginia, showing locations of Back Bay and Mackay Island National Wildlife Refuges and Trojan, Pocahontas, and Barbour's Hill Waterfowl Management Areas. Numbers represent approximate locations of coot rafts treated with PA-14.

atlantica), Canada geese *(Branta canadensis)*, gadwall *(Anas strepera)*, American wigeon *(A. americana)*, black ducks *(A. rubripes)*, mallards *(A. p. platyrhynchos)*, pintails *(Anas a. acuta)*, ring-necked ducks *(A. collaris)*, ruddy ducks *(Oxyura jamaicensis rubida)*, blue-winged teal *(A. discors)*, and American green-winged teal *(A. crecca carolinensis)*. Other species of waterfowl and various types of shorebirds are prevalent at times. Abundant aquatic vegetation provides a principal food source for wintering and migrant waterfowl. Numerous stationary blinds are located in open water and on state- and privately-owned marshland.

Selection of Depopulation Method

To be successful, the method chosen for the depopulation of the infected coot rafts needed to fulfill several criteria. Since time was critical, it had to have the capability of killing thousands of coots quickly. It had to be selective, since uninfected rafts were observed in relatively close proximity to infected flocks. The method needed to be thorough, since surviving birds could be expected to scatter and regroup with other rafts, possibly spreading the disease. It needed to allow for prompt collection of dead coots in order to negate gull predation. Naturally, the control method had to be humane and of minimal adverse consequences to the environment.

A number of methods were considered but eliminated because they did not meet these criteria. As examples, shooting or trapping were ruled out as being neither quick nor thorough; the use of chemical pesticides was eliminated since Back Bay supported both commercial and sport fishing; and the application of oil was unfeasible from environmental and humane standpoints.

The application of a wetting agent to the infected coot rafts was chosen as the best method under the circumstances. The ability of detergents to break down the natural, protective oils in birds' feathers was well known, and it was surmised that once applied to coots on water, they would rapidly become water laden, lose their buoyancy, and be rendered flightless. Subsequently, they could be collected easily and disposed of humanely.

Selection of Wetting Agent

Although a number of strong commercial detergents was available, PA-14 (developed by FWS, USDI; principal ingredient = Tergitol 15-S-9, Union Carbide, New York, N. Y.) was selected since it was known to be effective in breaking down the protective oils of birds and had been employed by the FWS, USDI in winter blackbird roost control programs. PA-14 also had an advantage in being biodegradable in water in several weeks; however, it was known to be toxic to fish at 3 ppm and was not approved for use in bodies of water by the EPA.

Testing of Wetting Agent PA-14

Information was non-existent on the most effective concentrations of PA-14 in wetting down coots. Crude tests therefore were conducted to quickly determine the best concentration of PA-14 for rendering coots flightless and at the same time allowing them to stay afloat but not swim off or dive extensively. The tests were undertaken also to roughly ascertain the effectiveness of applying the detergent directly to coots from overhead versus indirect application to the water first.

A limited supply of PA-14 was obtained for the tests. Warm water and alcohol were utilized to dilute the detergent into the various percentage concentrations; alcohol was necessary to render the detergent gel into a liquid. A 9.5 l capacity hand garden sprayer was used to apply the detergent.

A holding pen 4.6- x 1.5- x 1.5 m was constructed of 5.1 x 10.2 cm welded wire. One and three-tenths cm plastic netting (used in erosion control) was placed around the inside bottom 0.3 m of the pen, and a trap door was constructed in the top. The entire pen was placed in the Trojan WMA Canal near the headquarters (Fig. 1) in 0.5 to 0.6 m of water. Live coots for the trials were obtained from uninfected rafts in Back Bay by "running them down" by boat at high speed and scooping them from the air with hand nets. Boat propeller action was utilized to flush the canal area following some of the tests.

Four pen trials were undertaken and the results are summarized as follows:

Trial No. 1 (1 coot)—The bird and water surface were saturated with a coarse spray of 40% PA-14 (40 parts PA-14, 4 parts alcohol, 56 parts water). The coot was water laden in less than 1 minute, barely able to stay afloat in 2 minutes, and sank within 5 minutes.

Trial No. 2 (2 coots)—The coots were placed in the pen within 10 minutes of the original application and with no further spray. Both birds were water laden and flightless in approximately 2 minutes and sank within 10 minutes. The area was flushed out. Semi-domestic mallards were observed swimming in the area within 2 hours with no visible effects.

Trial No. 3 (2 coots)—The birds were treated with a fine spray of 10% PA-14 (10 parts PA-14, 4 parts alcohol, 86 parts water) delivered by a 15-second pass across the top of the pen. Both birds were water laden and flightless within 5 minutes, but the coots were capable of rapid swimming and diving. The area was flushed out. Coots were placed in the pen with no visible effects.

Trial No. 4 (6 coots)—The birds were treated with a fine spray of 25% PA-14 (25 parts PA-14, 4 parts alcohol, 71 parts water) and they were water laden and flightless within 2 minutes. The birds were kept overnight in the enclosure and by the next morning, 5 had died and 1 survived. All dead coots were floating on the surface.

In addition to the pen trials, three coots sprayed with 25% PA-14 were placed in the canal and sought by two boat crews using hand held crab nets. Although some swimming and diving occurred, all three birds were captured with relative ease.

From these results, a 25% concentration of PA-14 was selected as the best for rendering coots flightless yet allowing them to retain enough buoyancy to be recovered. This concentration also appeared to allow for the least amount of swimming and diving by treated coots. Both the overhead delivery and the application of PA-14 to the water surface appeared to be effective.

Approval of Control Method

An environmental assessment was prepared and submitted by the FWS, USDI to the EPA. Subsequently, permission was granted for the application of up to 757 l of PA-14 into the waters of Back Bay as part of the coot depopulation program, with the understanding that detergent operations were to be undertaken under the direct supervision of FWS personnel. Any adverse environmental effects, such as fish kills, were to be recorded. PA-14 for the control program was obtained from the FWS, USDI.

Selection of PA-14 Application Method

Both the overhead application of PA-14 to coot rafts by aircraft and the application of detergent directly to the water from boats were considered. Use of the latter method was abandoned, however, since problems were envisioned regarding transport and delivery of large amounts of detergent to an area and the maneuvering of coot rafts into the "soap slicks."

Both fixed- and rotor-wing aircraft were considered as delivery systems, but field observations disclosed that the float plane could fly closely over the top of a raft without disruptive effects, while the helicopter, hovering or moving above a coot raft, caused immediate dispersal. Thus, a fixed-wing Cessna Agwagon used for crop dusting and spraying was obtained for PA-14 application.

The application rate of the plane was checked by applying water onto a field adjacent to the headquarters. Cardboard squares were placed on the ground to roughly determine the coverage that could be expected when maximum flow was released through the plane's wing-mounted spray boom. Card coverage resulting from the test flights undertaken at approximately 15 m altitude and at an air speed of 160.9 km/hr indicated that sufficient material would reach the coot rafts.

Pick-up and Disposal Preparations

Due to the shallowness of the bay and the dense, submerged, aquatic vegetation, small shallow-drafted boats (mostly 4.9 m john boats) were equipped for retrieval of coots. Boat crews were supplied with hand held crab nets and a 113.6 l capacity, plastic garbage can. Two- or 3-man crews were assigned to each boat. A large, shallow-drafted barge was outfitted with carbon dioxide chambers (fire extinguishers) for suffocation of coots collected from the water. The barge served also as the storage facility for spare equipment. To facilitate coordination of various stages in the depopulation program, the Agwagon, helicopter, barge, and most pick-up boats were radio equipped. One boat was designated as a control vessel for the pick-up operations.

In anticipation of large numbers of dead coots, a new pit was dug in the sand on the Barbour's Hill WMA (Fig. 1). Due to the high water table, the pit depth was limited to 1.5 to 2.0 m. Old iron gratings were placed on cinder blocks in the bottom to assist burning. A supply of fuel oil was stored nearby, and drip torches were obtained to ignite the fuel oil.

Coot Depopulation Procedures

The helicopter was designated for use in locating rafts to be treated, for "herding" coots into tight configurations—thereby facilitating detergent application—and as an observation center for coordinating both spraying and pick-up operations. Consolidation of coot rafts, similar to that resulting from gull predation activity, was accomplished by the helicopter slowly moving up to and hovering alongside of a loosely knit raft.

Procedures for depopulating each coot raft were uniform. The helicopter pilot located a raft where intense gull predation and presence of carcasses indicated sickness among coots. Once "herding" was initiated, the pick-up boats assembled 500 to 1,000 m from the drop site. As consolidation neared completion, the spray plane approached and widely circled the raft. After the helicopter moved away, the spray plane made one or two passes, depending on the relative size of the raft being treated. When coots began to lose buoyancy, the helicopter pilot advised the pick-up crews to commence operations.

RESULTS AND DISCUSSION

During the period February 2 to March 11, 1975, 18,330 dead birds exclusive of those depopulated, including 18,205 coots (99.3%), 105 ducks and geese (0.6%), and 20 of other species were collected during the fowl cholera outbreak. Mortality associated with the disease outbreak is given in Table 1.

PA-14 was applied to 11 coot rafts comprising a total surface area of approximately 1.7 ha and an estimated 6,185 coots were depopulated (Table 2). One black-backed gull was accidentally eliminated. A total of 579.3 l of PA-14 was deposited into the waters of Back Bay, an amount well within the 757 l limit imposed by the EPA in approving the environmental assessment. Fish mortality was not observed.

In the initial spraying operation (Fig. 1, Table 2), the spray boom was ineffective due to the minute size of the droplets released and resultant wind dispersion of the material prior to reaching the coot raft. Once on the water, the minute droplets were quickly diluted by choppy surface action. The Venturi spreader was utilized in subsequent treatments to concentrate more PA-14 in the drop area. This apparatus also produced larger droplets

Table 1. Known mortality associated with a fowl cholera outbreak at Back Bay, Virginia, February-March, 1975

Species	*Total Collected*
American Coot *(Fulica americana)*	18,205
Gadwall *(Anas strepera)*	76
American Wigeon *(Anas americana)*	12
Great Black-backed Gull *(Larus marinus)*	5
Whistling Swan *(Cygnus columbinaus)*	5
Greater Snow Goose *(Anser caerulescens atlantica)*	4
American Green-winged Teal *(Anas crecca carolinensis)*	4
Canada Goose *(Branta canadensis)*	3
Mallard *(Anas platyrhynchos platyrhynchos)*	2
Pied-billed Grebe *(Podilymbus podiceps)*	2
Ruddy Duck *(Oxyura jamaicensis)*	2
Boat-tailed Grackle *(Cassidix mexicanus)*	1
Common Loon *(Gavia immer immer)*	1
Fish Crow *(Corvus ossifragus)*	1
Great Blue Heron *(Ardea herodias)*	1
Herring Gull *(Larus argentatus)*	1
House Sparrow *(Passer domesticus)*	1
Lesser Scaup *(Aythya affinis)*	1
Old-squaw *(Clangula hyemalis)*	1
Snowy Egret *(Leucophoyx thula)*	1
Sparrow Hawk *(Falco sparverius)*	1

Table 2. Treatments of 11 coot rafts at Back Bay, Virginia, during February, 1975, with PA - 14.

Date	Raft no.[a]	Approx. no. coots in raft	Type spray apparatus used	% Conc. PA-14	Total liters solution applied	Total liters PA-14 applied	Approx. wind speed (km/hr)	Air temp. (C)	Area treated (ha)	Approx. no. coots recov.
2/21/75	1	400	Wing-mounted boom	25	151.4	37.9	16	4.4	0.2	0
2/22/75	2	1000	Venturi spreader	25	302.8	75.7	0	0	0.2	1000
	3	800	Venturi spreader	25	113.6	28.4	8	1.1	0.1	235
	4	800	Venturi spreader	25	113.6	28.4	8	1.1	0.1	100
2/23/75	5	2700	Venturi spreader	25	302.8	75.7	16	10.0	0.2	2500
	6	1000	Venturi spreader	20	246.0	68.1	24	10.0	0.2	850
2/24/75	7	950	Venturi spreader	25	302.8	75.7	24	7.2	0.2	800[b]
2/26/75	8	200	Venturi spreader	25	151.4	37.9	27	7.2	0.1	0
	9	600	Venturi spreader	25	151.4	37.9	27	7.2	0.1	100
2/26/75	10	500	Venturi spreader	25	302.8	75.7	27	7.2	0.2	400
	11	250	Venturi spreader	25	151.4	37.9	27	7.2	0.1	200

[a]Approximate location of raft at time of treatment given in Fig. 1.
[b]One black-backed gull was accidentally eliminated.

that were less susceptible to wind dispersion. Additional operations were begun at daybreak when waters of the bay tended to be calm.

The remaining spraying operations generally were least successful when the raft was not completely consolidated; the birds flushed just prior to spraying; and/or pick-up operations were initiated too soon following spraying. Consolidation of rafts generally became more difficult as the depopulation operations advanced, probably due to the progressive harassment of the birds—coots surviving early treatments constituted the bulk of the rafts sprayed later. Premature flushing of several rafts (i.e., Nos. 3,4,8—Fig. 1, Table 2) ahead of the spray plane resulted in the birds moving away from the flow of dropped material. As a result, these operations were largely unsuccessful. The spray also missed coots from raft No. 6 (Fig. 1, Table 1), but the flushed birds came to rest in the thick detergent film, and many were picked up and eliminated.

Raft No. 9 (Fig. 1, Table 2) was sprayed accidentally; however, the first pass of the spray plane was largely ineffective and the pilot was diverted prior to a second attempt. Spraying operations were terminated when only several hundred stragglers remained in the infected area. These birds were spread out in small groups along the western edge of Back Bay.

Pick-up operations were initiated 10 to 20 minutes following a successful spraying. As pick-up on a raft progressed, the number of birds retrieved that had already drowned increased. In cases where treated coots reached stationary blinds or dense marsh vegetation, pick-up operations were slowly considerably.

Water-laden coots were placed in garbage cans and transported to the disposal barge. Live and dead coots were separated and placed in double strength plastic bags. The former were killed with carbon dioxide. Bags subsequently were sealed, transported to a loading dock on the Barbour's Hill WMA, transferred to a pick-up truck, and carried to the burn pit. Even though large amounts of fuel oil were utilized, complete burn usually was not achieved due to the water-laden nature of the carcasses. After the pit was covered, the surface was contoured to reduce wind erosion.

Following the elimination of infected coots, efforts were directed toward keeping healthy waterfowl from congregating in the outbreak areas. Propane exploders were placed on Rock and Ragged Islands (Fig. 1) and set at 30-minute intervals. These were supplemented by fire cracker strings attached to poles placed in the bay. Boats, including one which contained a propane exploder temporarily mounted on the bow, cruised the area flushing birds. Personnel in some boats were outfitted with shotguns, shell crackers, rockets, and other pyrotechnic devices. Both the helicopter and float plane were used for harassment, and marshland on the Back Bay NWR was burned to attract greater snow geese away from the infected area.

Other efforts were directed toward air and water surveillance of the bay for new outbreaks of disease and disinfection of equipment, laboratories, and the headquarters area. Burning of vegetation on Ragged and Rock Islands where both sick and PA-14 treated coots had been picked up was considered, but this idea was abandoned due to

inclement weather and rising water. Intensive surveillance and hazing operations continued for 10 days following coot depopulation then were phased out as a waterfowl began leaving the area.

CONCLUSIONS

The depopulation of the infected coot rafts resulted in the termination of the fowl cholera epornitic. Prior to coot depopulation, waterfowl mortality averaged over 890 birds per day. Dead bird collections, exclusive of those depopulated, averaged less than 213 birds per day while spraying was in progress. Following spraying, mortality averaged less than one bird per day. Within the last three weeks of March, mortality virtually ceased, despite a large influx of migrating wild waterfowl to the infected area. Interestingly, VCGIF personnel at Back Bay noted more coots on the area during the subsequent winter than seen prior to the outbreak.

The eventual success of the disease control effort at Back Bay can be attributed to many factors, of which two are most noteworthy. First, the quick recognition by the area manager that "unusual" mortality had commenced led to an early diagnosis of a fowl cholera outbreak. Had more time elapsed, the epornitic could have become so widespread as to preclude any possibility of control. Second, the participation of personnel from various state and federal organizations gave the operations collective expertise that proved to be vital in the development and undertaking of an unprecedented wildlife disease control program. The aggressive and ultimately decisive effort realized at Back Bay would have been quite difficult, if not impossible, for personnel of any single organization.

Previous epornitics of fowl cholera have either erupted in or involved coots or other gregarious species of wild waterfowl (Klukas and Locke 1970, Rosen 1971). Although each wildlife disease problem usually is unique and must be handled accordingly when considering controls, the possibility exists that a depopulation program similar to that described herein may aid in reducing losses and preventing explosive epornitics involving these species. At the very least, the methods developed at Back Bay provide wildlife biologists with a much needed, acceptable program which can be considered in future efforts to control fowl cholera and possibly other diseases in wild waterfowl populations.

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