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BLACKBIRD CONTROL ON TWO ARMY INSTALLATIONS FORT CAMPBELL, KENT--ETC(U)
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FINAL ENVIRONMENTAL IMPACT STATEMENT.

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BLACKBIRD CONTROL ON TWO ARMY INSTALLATIONS

FORT CAMPBELL, KENTUCKY,
MILAN, TENNESSEE AAP

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DEPARTMENT OF THE ARMY

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SUMMARY

BLACKBIRD CONTROL ON ARMY INSTALLATIONS

( ) Draft (X) Final Environmental Statement

Office of the Chief of Engineers
Directorate for Facilities Engineering
ATTN: DAEN-FEB Mr. Harold G. Russell, Jr.
Washington, DC 20314
Phone: 203-693-6999

Responsible Office: Headquarters, Department of the Army

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of the Action: It is proposed to significantly reduce blackbird populations that have established winter roosts at Fort Campbell, Kentucky, and Milan Army Ammunition Plant (AAP), Tennessee. Blackbirds from these roosts have caused significant agricultural damage in Christian and Trigg counties, Kentucky, and Montgomery, Stewart, Gibson, and Carroll counties, Tennessee. Additionally, these blackbird roosts have been linked with histoplasmosis-positive soil samples; tree mortality; and offensive odor, noise, and unsanitary conditions at the military installations. At Fort Campbell, vast flocks of these birds cross the airfield twice daily, interfering with aircraft operations. This action is planned to be accomplished by treating the Fort Campbell and Milan AAP roosts with Compound PA-14, Avian Stressing Agent, a biodegradable wetting agent.

   The operations will be conducted in cooperation with the U. S. Department of the Interior, which is also advising local communities on blackbird control measures.

3. Summary of Impacts

   a. Environmental Impacts: The proposed action will locally reduce the population of grackles, cowbirds, starlings and redwinged blackbirds. Based upon U. S. Department of the Interior analysis of blackbird populations, this local population reduction will not adversely affect the national population. The effect of the chemical application on surface and ground water, fish, nontarget birds and wildlife, plants and humans has been considered. Under present and anticipated conditions, no adverse impact is expected. It is expected that the action will reduce agricultural damage, feedgrain losses and the potential health hazard caused by histoplasmosis. This action will also allow the Army to better discharge its responsibility toward communities in the vicinity of the project areas.

b. Adverse Environmental Effects: Consideration has been given to the possibility of an increase of soil insect populations associated with a reduction in the blackbird population. If this were to occur, it would be very local. Since the program would not affect the national blackbird population during the season when insects are a food source (blackbird food during the roosting season is principally grain), the nationwide impact should be insignificant.

If the control operation is highly successful, and if there is a concentration of bird carcasses, disposal will be a problem. Under these circumstances, effort will be required at Fort Campbell to remove the carcasses to the landfill. At Milan AAP, the carcasses will be left to decay.

Under an unlikely combination of circumstances, small droplets of PA-14 could be carried some distance from the application site. The effect of these droplets on the environment is probably negligible under the meteorological conditions planned for the proposed application requirements.

4. Alternatives: In addition to the selected control method, the following significant alternatives have been considered:

a. Trapping: Trapping would meet control objectives in an environmentally acceptable manner, but the difficulty of constructing traps of sufficient size and of disposing of the trapped birds makes this alternative impractical.

b. Biosonics: Use of alarm/distress calls coupled with harmless explosions can be used to move blackbird roosts, but roost movement will not reduce overall local economic losses and depredations caused by the birds.

c. Habitat Alteration: Thinning out of trees in the roost sites will also cause roost movement. It will again not reduce economic losses and depredations caused by the birds. Thinning of potential roost sites is occurring at Fort Campbell.

d. Chemicals: Starlicide in bait form is used in feed lots to reduce blackbird populations that consume animal feed. Consideration has been given to establishing feeding stations near the roost sites and then adding the toxicant, but additional research would be required before this alternative could be feasibly employed.

e. Other Alternatives: Several other control techniques and chemicals have been considered and are further discussed in the statement. Because of their limited usefulness due to environmental or practical considerations, they do not warrant listing here.

5. Federal, state, and local agencies from which

a. Comments were requested on the draft statement:

Council on Environmental Quality

Department of Defense

Department of the Air Force

U.S. Environmental Protection Agency
Region IV, Environmental Protection Agency

Department of Agriculture
Soil Conservation Service
Forest Service
Agricultural Research Service

Department of Interior
Fish & Wildlife Service
Bureau of Land Management
Bureau of Outdoor Recreation

Department of Commerce
Federal Aviation Administration
Southern Region, Federal Aviation Administration

Department of Health Education and Welfare
Region, IV, Department of Health, Education, and Welfare
U.S. Public Health Service

State Clearinghouse, Kentucky

State Clearinghouse, Tennessee

Lower Cumberland Cooperative Improvement Council

Sierra Club

National Audubon Society

Defenders of Wildlife

Humane Society of the U.S.

American Humane Association

Friends of the Earth

Committee for Humane Legislation

National Wildlife Federation

Wilderness Society

The Wildlife Society

World Wildlife Fund, Inc.

Environmental Defense Fund

National Wildlife Management Institute

American Farm Bureau Federation

American Forestry Association

Flight Safety Foundation, Inc.

National Agricultural Institute

National Association of State Department of Agriculture

National Tuberculosis and Respiratory Disease Association

International Association of Game, Fish, and Conservation Commission

Natural Resources Defense Council

b. Comments were received for the final statement:

U.S. Environmental Protection Agency

Agricultural Research Service

Department of Commerce

Southern Region, Federal Aviation Administration

Region IV, Department of Health, Education, and Welfare

Humane Society of the U.S.

American Humane Association

Environmental Defense Fund

Flight Safety Foundation, Inc.

National Tuberculosis and Respiratory Disease Association

International Association of Game, Fish, and Conservation Commission

c. Comments were also received from:

Cadiz, Trigg County Chamber of Commerce

Environmental Protection and Improvement Commission of Hopkinsville

Farm Bureau of Christian County

Fund for Animals, Inc.

Hopkinsville, Christian County Chamber of Commerce

International Fund for Animal Welfare, Inc.

Kentucky Department of Agriculture, Diagnostic Laboratory

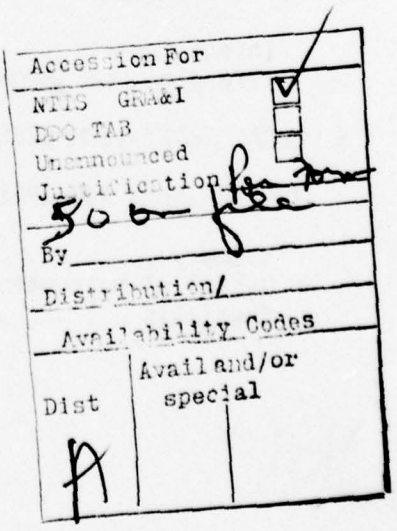
University of Kentucky, Cooperative Extension Service

University of Kentucky, College of Medicine

Society of Animal Rights, Inc.

6. Date: This draft statement was made available to the Council on Environmental Quality on 24 December 1974.

7. Date: This final statement was made available to the Council on Environmental Quality on 28 January 1975.



CONTENTS

FIGURES

TABLES

1. PROJECT DESCRIPTION

Purpose of the Action

Purpose of the proposed project is to significantly reduce large populations of blackbirds roosting during the winter at the Fort Campbell, Kentucky Military Reservation and the Milan, Tennessee Army Ammunition Plant (See Figures 1 and 2).

Species compositions of these populations are estimated to be from 50 to 75 percent common grackles (Quiscalus quiscula), from 10 to 25 percent each of starlings (Sturnus vulgaris) and redwinged blackbirds (Agelaius phoeniceus), and lesser numbers of brown-headed cowbirds (Molothrus ater) (See Appendix 1). Total populations at Fort Campbell are estimated to be approximately 4-5 million birds as of mid-January 1975. The Milan AAP roost was estimated to contain approximately 7-8 million birds during the same time period.

This proposed action would attempt to alleviate the subject economic losses sustained by area farmers and prevent damage and losses to timber on both bases. In addition, it would attempt to eliminate the obnoxious odors which have in the past and may in the future cause problems to working conditions at Milan. At Fort Campbell, the birds have presented hazards to aviation safety. Potential problems in production of agricultural and timber products, as well as the potential for increasing health problems for animals and humans, indicate that some positive action must be taken. Figures 3, 4, 5 and 6 illustrate roost areas to be treated at Fort Campbell and Milan AAP.

FIGURE 1. Blackbirds in "staging" tree near Fort Campbell roost in late afternoon. Groups of thousands of birds congregate in these trees before settling into the roost at dusk. These trees are in the right center of Fig. 3. View to the north.

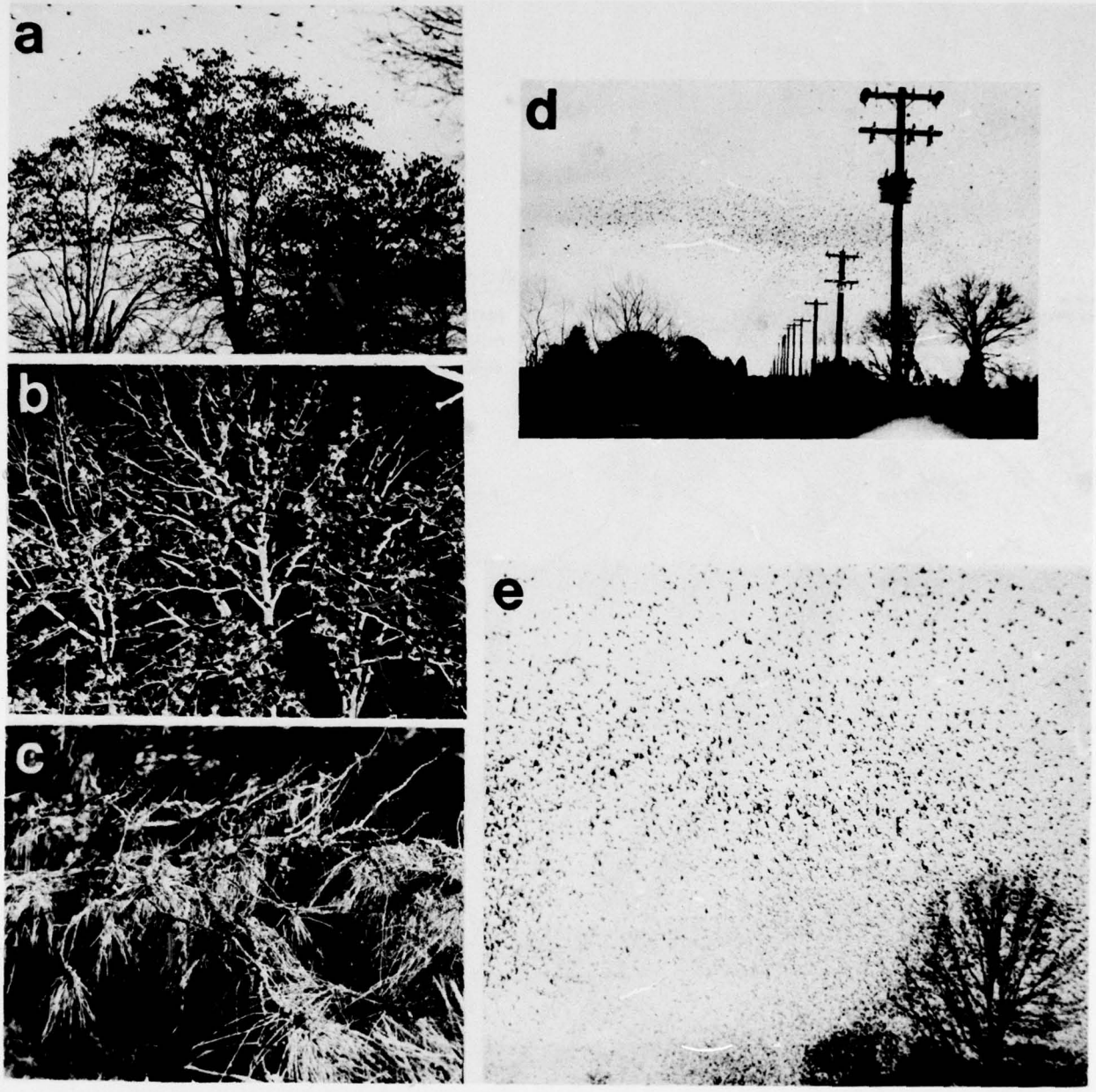


FIGURE 2. Magnitude of the bird populations in question. All except c taken 10 January, 1975 at the Milan roost. 2a. Staging trees with groups ready to roost. 2b. Taken after birds were well settled on leafless branches of small hardwoods. 2c. Branches of lower story in loblolly pines at the Ft. Campbell roost covered with bird droppings. These leaves will usually die. 2d. Small flight of incoming birds. 2e. Major part of the Milan flock as they flush from the roost when frightened before full darkness.

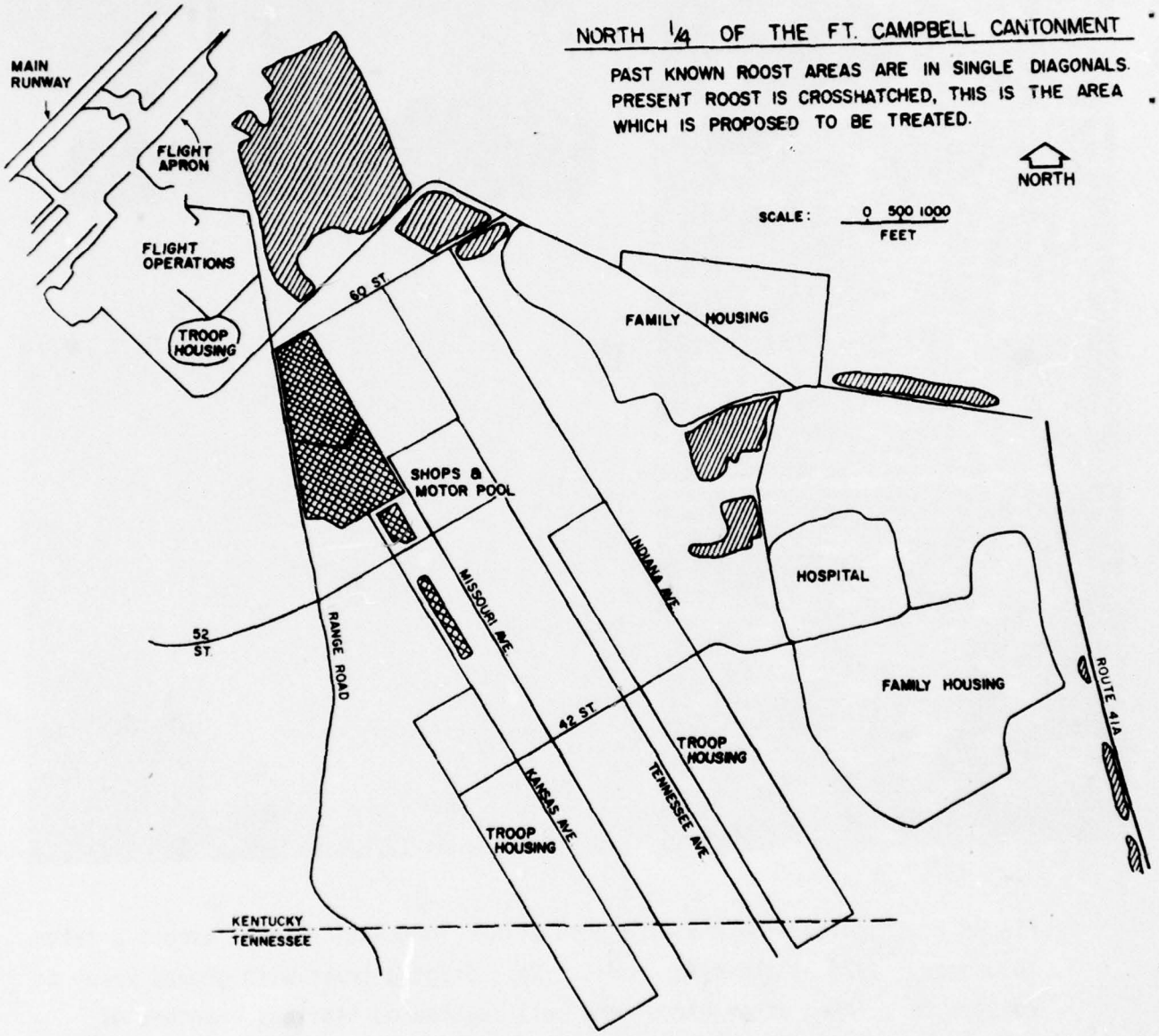

NORTH 1/4 OF THE FT. CAMPBELL CANTONMENT
PAST KNOWN ROOST AREAS ARE IN SINGLE DIAGONALS.
PRESENT ROOST IS CROSSHATCHED, THIS IS THE AREA
WHICH IS PROPOSED TO BE TREATED.
NORTH
SCALE: 0 500 1000
FEET
MAIN RUNWAY
FLIGHT APRON
FLIGHT OPERATIONS
TROOP HOUSING
60 ST
FAMILY HOUSING
SHOPS & MOTOR POOL
MISSOURI AVE.
INDIANA AVE
HOSPITAL
52 ST
RANGE ROAD
42 ST
FAMILY HOUSING
ROUTE 41A
TROOP HOUSING
KANSAS AVE
TENNESSEE AVE
TROOP HOUSING
KENTUCKY
TENNESSEE

FIGURE 3

FIGURE 4. Roost area at Fort Campbell which is in use in December, 1974. The loblolly pine plantings across the foreground are planned to be treated with PA-14. Shop buildings and motor pool areas in background. View is to the southeast.

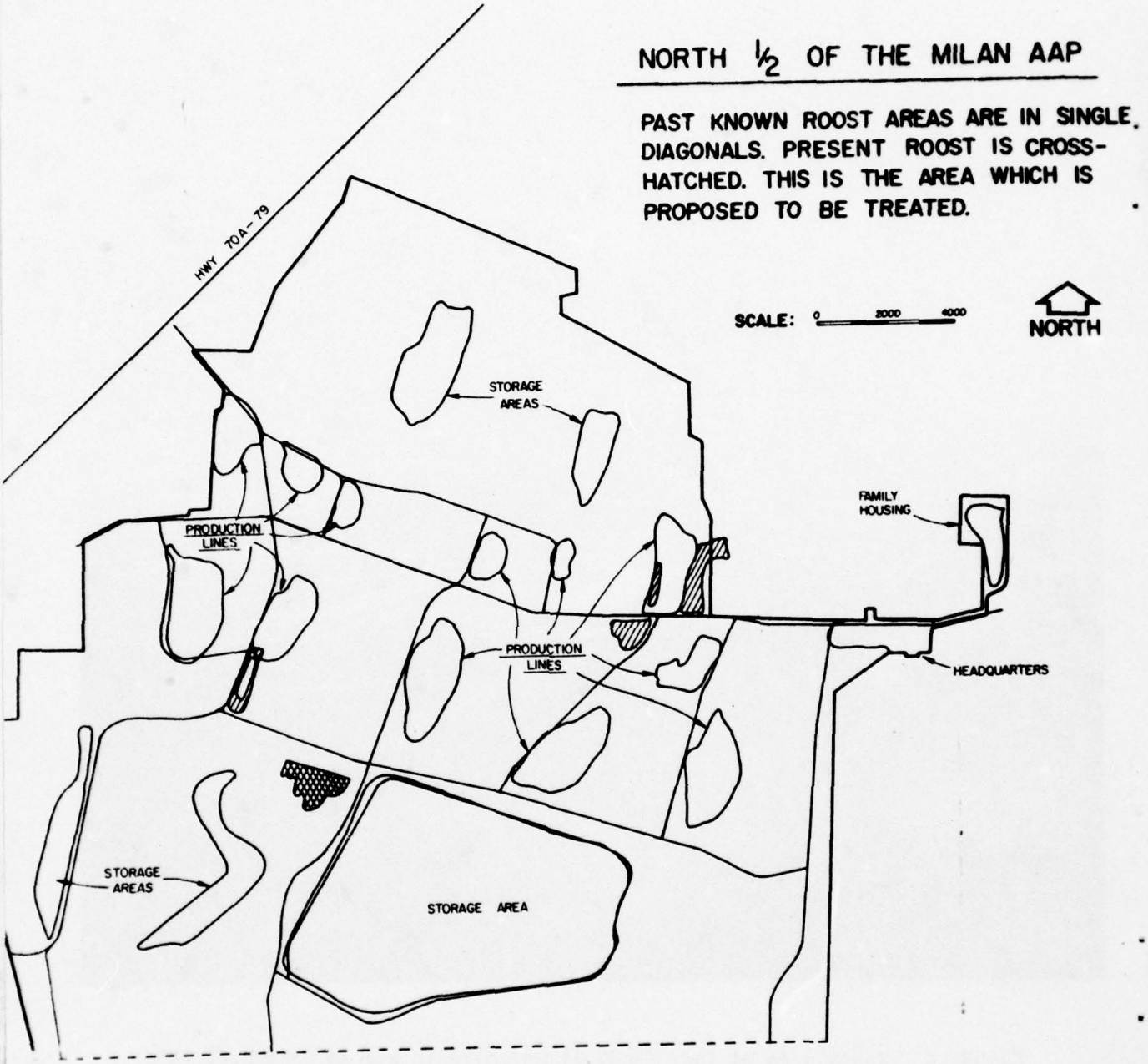

NORTH 1/2 OF THE MILAN AAP
PAST KNOWN ROOST AREAS ARE IN SINGLE DIAGONALS. PRESENT ROOST IS CROSS-HATCHED. THIS IS THE AREA WHICH IS PROPOSED TO BE TREATED.
SCALE: 0 2000 4000
NORTH
HWY 70A-79
STORAGE AREAS
FAMILY HOUSING
PRODUCTION LINES
PRODUCTION LINES
HEADQUARTERS
STORAGE AREAS
STORAGE AREA

FIGURE 5

FIGURE 6. Roost area at Milan AAP which is in use in December 1974. The irregular forested area beyond the stacked hay is the area planned to be treated with PA-14. A production line is in the background. View is to the north.

Economic Losses

The exact economic loss caused by the large roosts of blackbirds at Fort Campbell and Milan Army Ammunition Plant is difficult to estimate accurately. Economic losses can occur in several forms: consumption of planted seeds and sprouts, especially wheat; consumption of mature grain in the fields awaiting harvest; consumption and contamination of grain and prepared feed supplements in feed lots; transmittal of animal and plant diseases, and spread of disease to human populations.

Baseline data for agriculture is not presently available in a format which would be of value in this study. If yield and productivity data for each field and feed lot were available, expected yields could then be reconstructed, and reported losses to birds could be verified. Since this is not possible, the reported agricultural losses are shown on maps and tables in Appendix 2.

Calculated grain losses based on analysis of gizzards and crops of birds collected at the roosts are presented here. The birds were collected in mid-December 1974 and mid-January 1975. (See Appendix 1) Sample sizes were not large in comparison to the magnitude of these populations, so great accuracy in projecting food preferences for several months is not possible. Data, however, are felt to be better than any others available in these cases. Agricultural products were found to make up a significant percentage of the birds' diet in both samples.

The bird population at Fort Campbell was estimated to be between 4 and 5 million. The species distribution of both samples and observations is as follows:

Species	December	January
Common Grackle	45%	60%
Starling	18%	31%
Redwinged Blackbird	25%	6%
Cowbird	12%	2%

If a 4 million population is assumed, the breakdown is as follows:

Species	December	January
Common Grackle	1,800,000	2,400,000
Starling	720,000	1,240,000
Redwinged Blackbird	1,000,000	240,000
Cowbird	480,000	80,000

The bird population at Milan Army Ammunition Plant is estimated to be between 7 and 9 million birds. Species composition for the December and January samplings is listed below:

Species	December	January
Common Grackle	74%	74%
Starling	3%	7%
Redwinged Blackbird	23%	14%
Cowbird	-	4%

If a population of 7 million is assumed, the appropriate populations are as follows:

Species	December	January
Common Grackle	5,180,000	5,180,000
Starling	210,000	490,000
Redwinged Blackbird	1,610,000	980,000
Cowbird	-	280,000

Estimated food consumption per bird per day by species during the winter season is estimated to be:

Species	Food Consumption
Common Grackle	.8 oz/day
Starling	.6 oz/day
Redwinged Blackbird	.5 oz/day
Cowbird	.4 oz/day

Food requirements of the birds were approximated as representing 20 percent of body weight per bird per day, and calculations above are based upon this estimate. A more exact calculation is possible, based upon the formula $E = 140W^{.75}$, where E equals the basic metabolic requirement of the animal; 140 is a constant, approximating a wide variety of small animals; and W is the weight of the animal.[1] In a study, Brenner found that this formula adequately represented the needs of his captive birds during the summer months.[2] These metabolic needs increased by about

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[1] Maynard, L. A. and J. K. Lossli, 1969, *Animal Nutrition*, (McGraw-Hill New York,, 6th ed.) pp 418-421.

[2] Brenner, F. J., 1966, "Energy and Nutrient Requirements of the Redwinged Blackbird", Wilson Bulletin 78:111-120.

Modifying the formula to represent this adjustment, one arrives at a final equation of $E_w = 210W^{.75}$, where E_w is the basal metabolic energy requirement for the winter season. A grackle having a weight of approximately 120 g (about 4.2 oz.) would then need about 76 Kcal per day for basal requirements. We must assume that an active, foraging bird will consume more, but lacking a good method for quantifying this added factor, a basal rate is used in calculations.

Utilizing a standard figure of about 3.4 Kcal digestible energy per gram of corn, this grackle would need a minimum of about 23 g. (actually 22.35 g.) of corn, or equivalent, per day. This is about .78 oz., or insignificantly different from the 0.8 oz. suggested above as being necessary. Calculations for the other species are felt to be similarly adequate.

Agricultural products consumed by the birds at Fort Campbell for the two samples collected are shown below. The diet varies and apparently depends upon what is available.

Common Grackle	December	January
Corn	96%	97%
Wheat	-	-
Sprouted Wheat	-	-
Sorghum	-	-

Starling	December	January
Corn	4%	3%
Wheat	-	-
Sprouted Wheat	-	30%
Sorghum	-	-
Soybeans	-	-

Redwinged Blackbird	December	January
Corn	48%	7%
Wheat	7%	-
Sprouted Wheat	-	8%
Sorghum	-	-

Cowbird	December	January
Corn	73%	-
Wheat	19%	-
Sprouted Wheat	-	20%
Sorghum	-	14%

The amount of feeding done in fields and feedlots when the birds consume commercial grain can, at best, be estimated. This analysis will assume that 25 percent of the food consumed by the bird is commercial grain. Loss for the Fort Campbell area for both the December and the January population estimates is shown below:

Grain	December	January
Corn	28,589 lb/day	28,800 lb/day
Wheat	1,094 lb/day	-
Sprouted Wheat	-	3,787 lb/day
Sorghum	-	70 lb/day
Total Loss	29,683 lb/day	32,657 lb/day

These conversion factors were used to convert weight into bushels for the various grains consumed by the birds.

Corn	56 lb/bushel
Wheat	60 lb/bushel
Sorghum	60 lb/bushel
Soybeans	55 lb/bushel

Consumption in the Fort Campbell area in bushels is as follows:

Grain	December	January
Corn	510.5 bu/day	514.3 bu/day
Wheat	18.2 bu/day	-
Sprouted Wheat	-	63.1 bu/day
Sorghum	-	1.2 bu/day

Value of the grain is assumed to be $2.50 per bushel for corn, $3.00 per bushel for wheat, and $1.50 per bushel for sorghum. These values are

below current market prices. At this rate, assuming an average 120-day roosting season, losses in the Fort Campbell area, based upon the two different samples, are estimated to be as follows:

	December	January
Corn @ $2.50	$153,150	$154,290
Wheat @ $3.00	6,552	-
Sprouted Wheat @ $3.00	-	22,716
Sorghum @ $1.50	-	216
Total Loss	$159,702	$177,222

Agricultural products consumed by the blackbirds at Milan Army Ammunition Plant for the two samples are shown below.

Common Grackle	December	January
Corn	95%	97%
Wheat	-	-
Sprouted Wheat	-	-
Sorghum	3%	-

Starling	December	January
Corn	1%	1%
Wheat	61%	-
Sprouted Wheat	-	34%
Sorghum	2%	-
Soybeans	3%	-

Redwinged Blackbird	December	January
Corn	30%	10%
Wheat		5%
Sprouted Wheat		15%
Sorghum	18%	2%

Cowbird	December	January
Corn	-	54%
Wheat	-	-
Sprouted Wheat	-	8%
Sorghum	-	4%

It is assumed, based on estimates from Dr. Harold Balbach[1], and confirmed as being understated by Dr. Wade Kadel[2], that 25 percent of the agricultural products consumed are from commercial sources. Losses for the Milan area are shown below.

Crop	December	January
Corn	65,257 lb/day	64,563 lb/day
Wheat	1,028 lb/day	383 lb/day
Sprouted Wheat	-	2,849 lb/day
Sorghum	4,121 lb/day	223 lb/day
Soybeans	54 lb/day	-
Total	70,460 lb/day	68,018 lb/day

[1] CERL Ecologist.

[2] Diagnostic Veterinarian, State of Kentucky, Hopkinsville.

The quantity of grain consumed per day in bushels is presented below.

	December	January
Corn	1,165.3 bu/day	1,152.9 bu/day
Wheat	17.1 bu/day	6.4 bu/day
Sprouted Wheat	-	47.5 bu/day
Sorghum	68.7 bu/day	3.8 bu/day
Soybeans	1.0 bu/day	-

The value of the grain is assumed to be $2.50 per bushel of corn, $3.00 per bushel of wheat, $1.50 per bushel of sorghum and $5.00 per bushel of soybeans, all of which are below current market prices. A 120-day roost period is assumed to be about average, and the total losses based upon this estimate are presented below, based on the December and January estimates.

	December	January
Corn @ $2.50	349,590	345,870
Wheat @ $3.00	6,156	2,304
Sprouted Wheat @ $3.00	-	17,100
Sorghum @ $1.50	12,366	684
Soybeans @ $5.00	600	-
Total Loss per Season	368,712	365,958

The grain loss per day at Fort Campbell is estimated to be approximately $1,331 to $1,477, while at Milan, the losses are estimated to be between $3,050 and $3,072 per day. These are direct grain losses only; no value was assumed for the cost of fuel, fertilizer

and other planting-related costs. It should be noted that the wheat field may be thinned, if the sprout pulling is severe enough. If this occurs, undesirable weeds, such as wild onion, may grow in the field, reducing the harvest value still further.

The percentage of total diet consisting of commercial grain for the various species is estimated below for Fort Campbell and Milan AAP:

Fort Campbell	December	January
Common Grackle	24%	24%
Starling	1%	8%
Redwinged Blackbird	13%	3%
Cowbird	23%	8%

Milan	December	January
Common Grackle	24%	24%
Starling	16%	8%
Redwinged Blackbird	12%	8%
Cowbird	-	16%

The dollar loss for grain alone does not reflect the total economic loss. A dollar realized from grain production in small internally-oriented communities such as these is typically spent and re-spent two to three times in the local economy.

In addition to the grain consumption, the birds also contaminate grain with droppings to such an extent that cattle and even hogs refuse to eat it. The birds are also potential carriers of transmissible gastroenteritis and the soybean cyst nematode.

Transmissible gastroenteritis (TGE) is a disease which attacks hogs, especially young ones. If the infected hogs are less than five days of age, the disease is fatal in more then 90 percent of the cases. The disease is spread by soil that is picked up from an infected feed lot and carried to a noninfected lot. This can occur in a number of ways, most of which can be controlled; however, when the birds land in an infected lot, they may ingest infected soil or get it on their feet. When the infected bird goes to an uncontaminated lot, infected soil particles may be dislodged from the feet or left as infected droppings.

The soybean cyst nematode, is a microscopic roundworm which invades root systems of plants, especially soybeans. The worm causes lumps and interferes with nutritional absorption of the root system, which causes growth rates to be slower than normal and reduces yields.

The blackbird can ingest the encysted nematode which passes undisturbed through the bird's digestive tract.[3] When birds which have fed in contaminated fields leave droppings in uncontaminated fields, those fields may become infested.[4] When a field becomes infested, soybean yields are reduced, and plants from that field cannot be shipped. One farm has already reported not being able to ship starter plants from a field which became infected. This does not imply that the blackbirds are the only transmitting agent of this pest, but rather that they are potential carriers and exist throughout the area in very large numbers.

[3] Epps, James M., "Recovery of Soybean Cyst Nematodes from the Digestive Tracts of Blackbirds." Tennessee Farm and Home Science, progress report No. 81, January, February, March 1972, pp 2-3.

[4] Letter from Mr. Denton Fly of Green Acre Farms, Milan, Tennessee, dated 13 December 1974, alleging spread of cyst nematode by birds to previously noninfected fields.

Tests conducted by Dr. James Herbek of the West Kentucky Research and Extension Center reveal that nematode reduced soybean yields by as much as 50 percent. Christian County, Kentucky is presently not infested with nematode, although parts of western Tennessee are. Dr. Herbek estimates that a drop in yields of only 10 bushels per acre would represent a loss of $4.2 million to $5.0 million.[5]

The economic loss attributed to the blackbirds was great enough that on 4 February 1974, Kentucky Governor Wendell H. Ford declared Christian County to be in a state of emergency due to economic losses of $2 million.

While reported losses to forest areas are presently small, the implication that forest programs may need to be modified or eliminated to prevent blackbird roosting could have far-reaching, long-term impacts. Forest damage is outlined below.

For a number of years, Fort Campbell has been involved in a program of reforestation and planned timber production. Pine plantations are now at a development stage where they are particularly attractive to starlings as roosting sites. When roosts are established, considerable damage is done to the trees.

Through a combination of mechanical damage, caused by bird movement, and biochemical damage caused by accumulation of droppings, the trees suffer a period of stunted growth. This damage period lasts for three or four months after the starlings have left the roost and results in a 50 percent loss of growth for each year that the site is used as a roost. During the past five years, approximately 13 acres of 20-year-old pine

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[5] Letter from Dr. James Herbek to Harold Balbach, CERL ecologist, dated 14 January 1975.

plantations, stocked at a volume of 20 cords per acre and valued at $3.65 per cord, have died after having been used as a roost for starlings, blackbirds, grackles and cowbirds.

Twelve acres of loblolly pine at Milan AAP have been killed by the birds roosting in the pine stands during the past five years. Each year that the birds roost in a pine stand, areas having the heaviest bird concentrations die. The center of the roosts begins to take on a chlorotic appearance approximately one month after the roost is established. When the birds leave the roost in early spring, the inner portions of the roost are devoid of needles. Approximately three weeks to one month later, the outer edges of the defoliated area begin to grow new foliage. (See Figures 7 and 8).

There is no evidence to indicate that these trees were killed by any cause other than roosting blackbirds. If disease had been the cause of these trees' death, the effects would have spread to other parts of the roost or to other pine stands. These trees did not show any sign of boring activity by bark beetles until after they had been dead for 6 months, nor any cankers which would indicate some form of rust. These killed areas occur only where birds are most heavily concentrated, usually in the center of the roost. Of the 800 acres of pine at Milan AAP, no killed pine area is similar to that found in the bird roost area.

Average volume per acre of the 20-year-old pine stands is 17 cords. At a value of $4 per cord, pine valued at $816 has been killed as a result of the roosting birds from 1969 to 1973. In 1973, the blackbirds

FIGURE 7. Infrared photo of loblolly pine plantation at Milan AAP which was used as a roost over the 1971-1972 season. Areas of dead trees in the center of the stand are felt to result from the concentrated physical and chemical disturbance of the community by several million roosting blackbirds.

FIGURE 8. Examples of damage which are generally attributed to presence of the blackbird flocks. 8a. Swine dead after TGE outbreak near Trenton, TN. 8b. Ear of corn remaining after birds invaded partially harvested field near Milan, TN. 8c. Mechanical damage to loblolly pines utilized heavily as roost trees - Fort Campbell, KY. 8d. Dead loblolly pines on Milan AAP. These trees were used as a roost in the 1973-74 season. Note that while birds were observed causing the damage in 8b and 8c, the other examples cannot definitely be proven to be bird-caused at this time.

roosted in a stand which had 135 cords of pine pulpwood marked for sale at a value of $540. These trees have not been completely killed, but prospective buyers will not agree to purchase them. Thus, total monetary loss amounts to $1,356 during the past five years.

Some of the local farmers are taking steps to lessen the damage done by the birds, although some of the steps are expensive and time-consuming. A few examples of these countermeasures are:

* Change of feeding time
* Change of feeding method
* Feeding animals inside
* Shooting at the birds while animals are feeding to drive them away
* Limited use of starlicide

Public Opinion

The blackbird problem has become a controversial issue at both the regional and national levels. This section lists the public's principal points supporting and opposing the bird control program. (This has not been developed from a scientific sample, but rather is a composite of positions developed from news clippings and correspondence.)

Supporting positions include:

* Threat to economy and health;
* Threat to agriculture;
* Complaint of noise;
* Threat to health, welfare and livelihood;
* Threat to welfare of family;
* Concern for air traffic safety.

Opposing positions include:

* An environmental impact statement should have been filed earlier;
* Opposition to killing wildlife;
* Fear of upset to ecological balance;
* Suggestion of alternate, more humane disposal method;
* Hope that the program has been given comprehensive forethought;
* Fear that chemical use may cause hazard to human health;
* Fear of detrimental effects to nontarget species;
* Fear of detrimental effects to agriculture, ecosystem;
* Fear that this approach treats symptoms, not the problem's cause.

Land Use Relationship

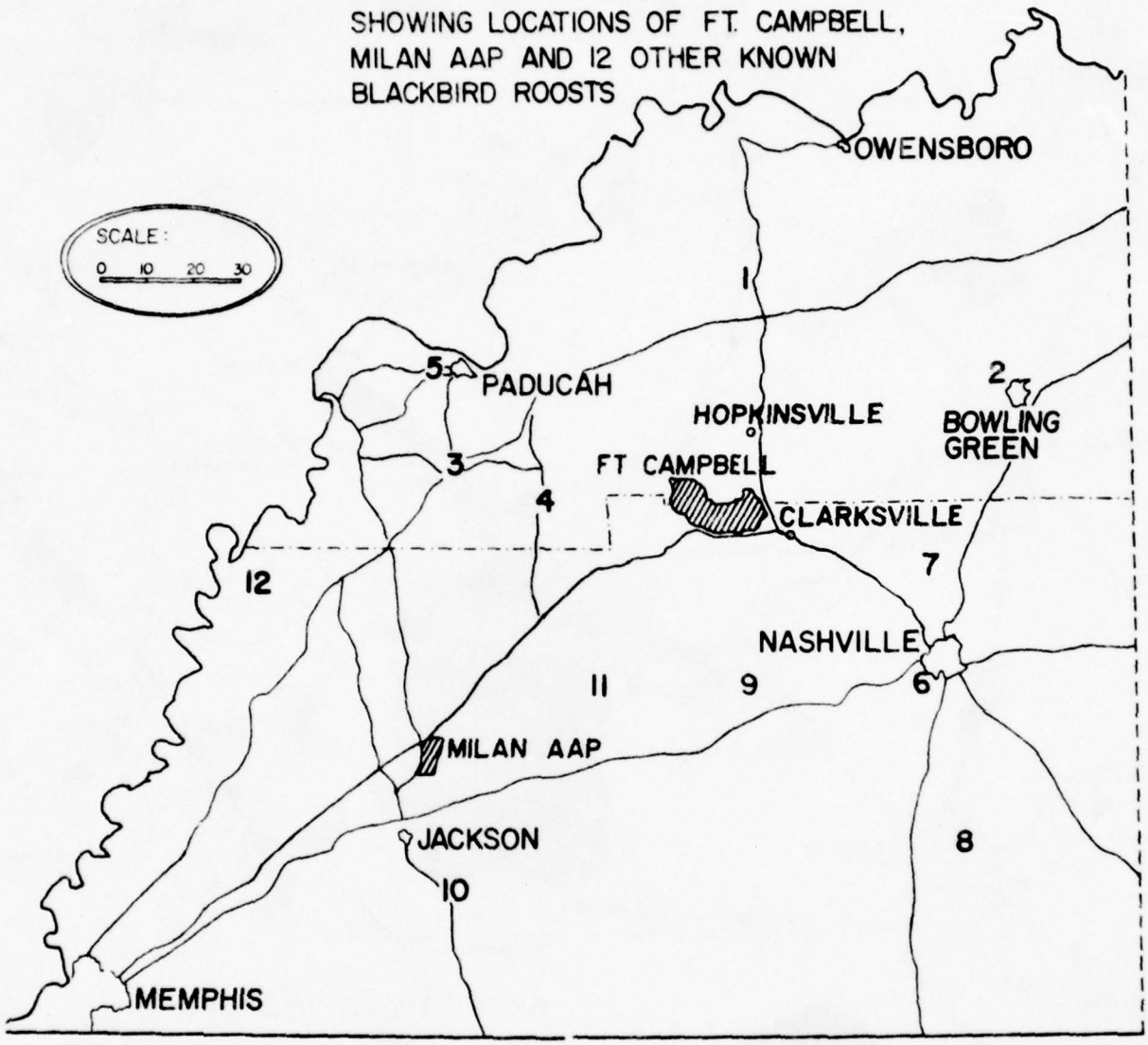
Fort Campbell possesses a diverse land mix, ranging from residential, commercial, office/institutional to open space, recreation, forestry and military training grounds. The installation is situated in a predominantly rural setting bordered by agriculture to the north and south, commercial strip development along Highway 41A to the east and recreation to the west.

Milan AAP land use ranges from industrial to forestry and agriculture (crops and grazing). Agricultural land abuts the Army Ammunition Plant to the north, south and east, while the town of Milan (population approximately 8,000) is immediately adjacent to the west (Figures 9 and 10).

In both cases, hundreds of acres have been committed to reforestation and planned timber production for more than 20 years. The roosting and feeding of an enormous blackbird population conflicts with existing

WESTERN KENTUCKY AND TENNESSEE

SHOWING LOCATIONS OF FT. CAMPBELL, MILAN AAP AND 12 OTHER KNOWN BLACKBIRD ROOSTS



1. MADISONVILLE, KY
2. BOWLING GREEN, KY
3. MAYFIELD, KY
4. MURRAY, KY
5. PADUCAH, KY
6. NASHVILLE, TN
7. GREENBRIER, TN
8. HORTON ST. PARK, TN
9. DICKSON, TN
10. HENDERSON, TN
11. CAMDEN, TN
12. REELFOOT LAKE, TN

FIGURE 9

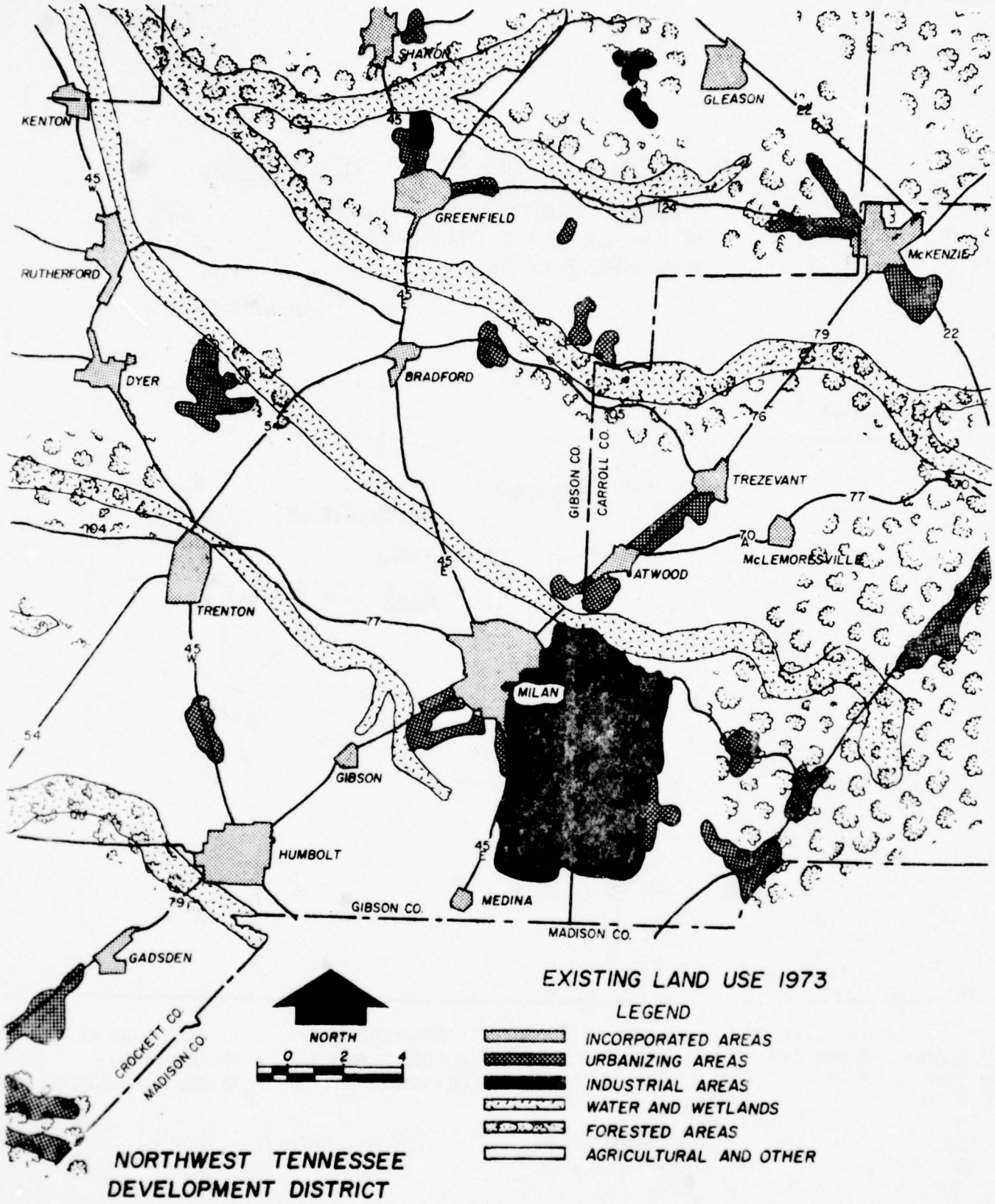

SHARON
GLEASON
KENTON
GREENFIELD
McKENZIE
RUTHERFORD
DYER
BRADFORD
GIBSON CO.
CARROLL CO.
TREZEVANT
McLEMORESVILLE
ATWOOD
TRENTON
MILAN
GIBSON
HUMBOLT
MEDINA
GIBSON CO.
MADISON CO.
GADSDEN
CROCKETT CO.
MADISON CO.
NORTH
0 2 4
EXISTING LAND USE 1973
LEGEND
INCORPORATED AREAS
URBANIZING AREAS
INDUSTRIAL AREAS
WATER AND WETLANDS
FORESTED AREAS
AGRICULTURAL AND OTHER
NORTHWEST TENNESSEE
DEVELOPMENT DISTRICT

FIGURE 10

land uses. Those uses realizing conflict are:

a. Agricultural land - birds feeding on crops (winter wheat) and livestock feed.

b. Recreational land - bird roosting generates manure which provides a rich growth medium for the dimorphic fungus, Histoplasma capsulatum. The disease histoplasmosis develops from this fungus; consequently, a Fort Campbell recreational area has been declared "off-limits."

c. Residential - interference similar to point b exists, because during dry weather, the fungus forms spores which can be airborne, exposing residents to a serious respiratory disease.

d. Forestry - roosting birds in the dense pine stands have destroyed acres of trees through an intense buildup of toxic ammonia leached into the soil from accumulated bird manure.

e. Airport - Fort Campbell airfield has been forced to cease operations 45-90 minutes twice each day to permit blackbirds to traverse runways and airspace.

The bird control program should restore the land to its full and specified uses. All roosts will require disinfection through the application of formalin before human use can be made of the areas.

Histoplasmosis. The primary public health hazard associated with starling and blackbird roosting areas is histoplasmosis in its various forms (Appendix 3). The causative organism is the fungus (Histoplasma capsulatum). It occurs naturally in soil and infects both man and animals. It is widely distributed throughout the world and can probably be found in all of the major river valleys 45^{o} latitude north and 45^{o} latitude south. In the United States, the infection is most highly

prevalent in the Mississippi River Valley and its tributary valleys, thus including the two areas of proposed action.

Major blackbird roosting sites at both Milan AAP and Fort Campbell have been shown to harbor detectable quantities of the fungus (See Figure 11).

Soil samples taken in general areas of endemicity (not necessarily the sites in question) have shown a somewhat spotty distribution of infected areas. While Histoplasma capsulatum may be isolated from one area, samples taken within a few feet may not yield any positive isolations. A question has been raised concerning the meaning of a negative soil sample. Are there no fungi, or are there simply two few to be isolated by present techniques? (See Appendix 3) It is entirely possible therefore that the fungus exists in "above-normal soil concentrations" in roosts which tests indicated to be negative.

Reaction to contraction of histoplasmosis in man ranges from undetectable symptoms to death. The former is by far the most common.

There is no direct evidence linking the blackbirds with increased cases of histoplasmosis, nor is there documentation proving an increase in histoplasmosis cases within the areas of interest.

A recent study of 147 troops at Fort Campbell (83 troops from states considered endemic for histoplasmosis, 64 from states considered not endemic for histoplasmosis) showed significant exposures to histoplasmosis in both skin tests and blood titer tests. It is evident that there is no histoplasmosis problem at Fort Campbell, Ky. This is primarily due to the distance from living areas of roosts shown to be positive for the fungus and the control (posting and patrol -

see Figure 11) provided by the Fort Campbell staff.

Conclusive evidence which would prove an existing public health problem would only demonstrate that needed action would already be too late for some individuals. In addition, lack of conclusive evidence does not reflect the existing hazard or the need for preventive action now.

From the medical hazard viewpoint, there is a distinct potential for the spread of histoplasmosis at Fort Campbell for the following reasons:

1. Fort Campbell is located in the area of highest endemicity of histoplasmosis in the United States.

2. Starling and blackbird roosts are creating enriched growth conditions in the soil on the post for Histoplasma capsulatum (See Figure 11).

3. The roost has been utilized for longer than three years, thereby increasing the concentration of Histoplasma capsulatum.

4. Even though the roost area is off limits, evidence from other epidemics shows a direct relationship with histoplasmin sensitivity.

5. No attempt to reduce the danger could be expected without disrupting the bird roosts.

At Milan AAP the threat of histoplasmosis is not as great as that at Fort Campbell due to the roosting area's more distant location from significant human populations and activities.

Run-off from Bird Droppings. The main elements of interest are nitrogen and phosphorus. Phosphates would be expected to be absorbed into the soil. Nitrogen in manure exists primarily as urea, undigested

FIGURE 11. Loblolly pine plantings at Fort Campbell contaminated by Histoplasma capsulatum. Virtually all aesthetic and recreational benefits have been lost. Note the heavy coating of bird manure over trees and ground surface. This is within the area planned to be treated with PA-14.

protein and microbial tissue. Urea is decomposed into ammonia, which is lost by volatilization or can be absorbed into the soil, and as such, probably contributes little to water pollution.

However bacterial nitrification of ammonia into nitrites and nitrates does present a problem, since they are not readily absorbed and are thus leached from the soil, can enter water supplies, and contribute to methemoglobinemia. Damage to vegetation from nitrogen burning is also a possibility.

Aesthetics

Large populations of birds are usually objectionable in the community, because they are a source of distracting noise and odors. Another common objection to large bird populations is their indiscriminate bowel movements. Bird droppings strike houses, cars, sidewalks, and on occasion, an unlucky pedestrian. In large concentrations, these strikes become objectionable to civilized man's aesthetic value of his home, community and person. Countless manhours and maintenance dollars are spent annually to clean up the mess created by these birds. In 1972, at Milan AAP, an unsuccessful attempt was made to control the odor produced by the roost then in use.

Aviation Safety

When a bird species concentrates near airfields or invades flight paths, there is a possible hazard to aviation safety. Commercial aviation reports an average of 300 bird (various species) collisions each year, while private aviation reports 500. During 1965, the U. S. Air Force reported 839 bird/aircraft collisions, resulting in damage

to windscreens, canopies, air intakes, radomes, wing panels, flaps and landing gear.[6]

At the Fort Campbell Airfield, daily Army helicopter activities have not been impacted. This is possibly due to the birds' ability to avoid slower, rotor-wing aircraft and to the delay of flight operations for 45-90 minutes twice daily (mornings and evenings) while the blackbird flock crosses runways and flight paths. These operational restrictions are in effect at the airfield during the entire roosting period.

U. S. Air Force jet and prop planes also frequent the Fort Campbell Airfield. These larger, faster, fixed-wing aircraft have reported collisions with birds.[7] When large flocks of birds are reported or observed by the airfield's air traffic controllers, advisories are issued about their position, and if known, their species, size and course of flight. This distracts controllers from their normal duties of separating aircraft.[8]

Outlaw Field, a commercial air terminal serving Hopkinsville, Kentucky and Clarksville, Tennessee, is located one-half mile east of Fort Campbell. It handles twin-engine, turbo-prop passenger aircraft operated by Ozark Airlines. In addition, this field receives traffic from small jet and propeller aircraft. Blackbird flocks from Fort Campbell roosts cross active runways, creating the same hazard discussed

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[6] U. S. Air Force, "Bird/Aircraft Collisions," Air Force Office of Scientific Research, December 1966.

[7] Major C. N. Campbell, USAF, Chief of Safety, Headquarters, 314 Tactical Airlift Wing (TAC), Little Rock Air Force Base, Jacksonville, Arkansas 72076.

[8] Mr. Clyde Cook, Manager, Outlaw Field, Clarksville, Tennessee.

above. No bird/aircraft collisions have yet been reported by Outlaw Field.[9]

The closest airport to the Milan AAP roosting area is Gibson County Airport, located six miles from the plant. Although birds are reported to cross the northern end of the airfield daily, there have been no reported bird/aircraft conflicts.[10]

Significance of bird/aircraft collisions is not fully realized until the loss of life or aircraft has occurred. Sixty-two persons were killed in the crash of an Eastern Airlines Electra at Boston's Logan Airport when the plane collided with a flock of blackbirds.[11] In another case at Peachtree-DeKalb Airport (Atlanta), a privately-owned jet ingested blackbirds into the jet intake and crashed, resulting in the death of seven persons.[12]

General. It is proposed to accomplish reduction of the bird population through aerial application of a wetting agent solution.

A newly-developed technique for reducing bird populations involves spraying the birds with an agent that reduces the surface tension of oil on the feathers. This allows the oil to be washed from the feathers, reducing their insulation and protective values. Loss of insulation causes

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[9] Captain Robert C. Monroe, USAF, Commanding Officer, Det. 1, 1878 Communications Squadron (Air Traffic Control), Campbell Army Airfield, Kentucky.

[10] Larry Browning, Manager, Gibson County Airport, Milan, Tennessee.

[11] U. S. Air Force, "Bird/Aircraft Collisions," Air Force Office of Scientific Research, December 1966.

[12] "Atlanta Constitution," 26 Feb 1973, Atlanta, Georgia.

the birds to succumb to the cold. The technique requires a liberal application of a wetting agent and water mixture during periods of low temperatures.

Operationally, this is a new technique. Careful observation of effectiveness, as well as unanticipated adverse effects on the environment, if any, will be noted. U. S. Department of the Interior personnel have assisted in planning the operation and are expected to be present at the time of application.

Aerial application during early evening after the birds have settled in the roost has proven to be best. Bird population management experiments conducted by the U. S. Department of the Interior have had varied success employing this technique. Some applications have completely failed. Other applications have resulted in an estimated 96 percent bird population reduction.

Success of the technique depends upon two critical factors: the wetting agent solution must penetrate the pine canopy of the roost in sufficient quantity, and temperatures must be low enough that a $45^{o}F$ or less chill factor will develop following application. While the wetting agent technique is believed to offer the best possibility for bird population reduction, it cannot be attempted until weather conditions meet all criteria.

The wetting agent chosen is Stressing Agent PA-14 (Tergitol 15-S-9), registered by EPA (EPA registration number 6704-73) for this proposed use (See Appendix 4). This wetting agent is nontoxic, except when consumed in large quantities, has biodegradable properties and has proven successful in some U. S. Department of the Interior experiments.

It will be applied in the following formulation and manner:

20 gallons PA-14

4 gallons ISOPropanol or ethanol

56 gallons water

80 total gallons solution per acre

Frequency of Application

Specific questions have been raised regarding the number of PA-14 applications planned for this year and future years.

Installation plans indicate that bird control will be conducted only until populations are reduced to a tolerable level. If a single PA-14 application achieves the desired results, no more applications will be made. If weather conditions required following PA-14 applications do not materialize, the operation will be repeated at Fort Campbell when weather conditions are predicted to be favorable. Lack of PA-14 at Milan AAP will preclude a second application this season.

Future applications (Fall of 1975, Winter of 1976) will depend upon roost reestablishment. If the roost is reestablished, careful environmental assessments will be made, including: impacts of previous applications; new development in bird population management techniques; the threat to health, aviation and agriculture from the roost, and location of the roost. If the assessments indicate that control is necessary and that PA-14 is the best alternative, the application will be repeated. Such applications will be made only with the full knowledge and approval of appropriate U. S. Department of the Interior personnel.

Spraying at Fort Campbell. Eighty gallons of solution per acre will be applied in two passes by helicopter. UH-1 helicopters were chosen to make the aerial application due to their adaptability, availability and application capacity. Two spray tanks, one with a 140-gallon capacity and the other with a 180-gallon capacity have been locally fabricated.

The memorandum contained in Appendix 5, dated 25 September 1974, details data concerning the application tanks, calculations and the results of static tests and tests made from the air. Details of vent time versus distance traveled, tank weight empty and charged, and the sequence in which the respective aircraft will fly the predetermined flight lines follow the memorandum.

Area occupied by the roost will increase in size to a peak in late December, remain fairly constant until mid-March, then begin to decrease when spring migration begins. The roost breaks up in early April. It is anticipated that spray operations will be conducted while the roost is at peak size.

There are aviation obstacles in the area, and an additional hazard is presented by the birds. Aircraft noise may cause birds to soar upward into the flight pattern, although this has not happened during past or recent test flights.

Because of the unique location of the roost, a variation of the previously described action is available, should the application of PA-14 be approved as outlined. (See Appendix 6). At Fort Campbell, approximately 6 percent of the roosting area is located near the pressurized water supply used for fire fighting. A pumper truck and a truck equipped with a deluge

gun nozzle are available and will be used to apply an amount of water equal to a rainfall of one-half inch to this selected roost site following aerial application of the PA-14 mixture.

A test has been made using available equipment, and it is possible and practical to apply water evenly over this particular roosting site in amounts sufficient to equal a one-half inch rainfall in a 30-minute time This will be done at a time when temperatures are predicted to be near $32^{o}F$. This temperature has been found to produce mortality of test birds within a two-hour time period, 75 percent being within the first 30 minutes. This application of PA-14 and water will be monitored closely to determine the effectiveness of such an application and the practicality of further treatments of this type. Carcasses will be collected and disposed.

Should this method prove effective, studies will be made to determine the feasibility of adding more hose connections at selected locations as close as possible to other roosting areas. Thus, a larger percentage of the roosting population can be treated in this manner when proper temperature conditions are predicted, but the necessary rainfall is not forecast. Additionally, this small area will be used to study the effects of repeated applications.

Preapplication planning, calibrating and testing with water has been accomplished. These operations have been conducted in three phases; testing and calibration of equipment; establishing ground controls, and practice aerial application runs under actual conditions. All three phases have been completed at this time.

Phase 1, that of testing and calibration, was carried out on 25 September 1974 and 21 October 1974. During these tests with water, flights were made using UH-1 helicopters at various air speeds and altitudes to determine application rate over a measured course. Following these tests, it was determined that an altitude of 150 feet above ground level (AGL) and an air speed of 80 knots would give an application rate of 40 gallons per acre with an effective width of application or swath of 40 feet. This was determined to be the most efficient application rate under flight conditions compatible with aircraft capability and for efficient application of the chemical to take full advantage of critical weather conditions.

Phase 2, that of establishing ground controls, was completed on 26 November 1974. This phase defined the area where birds are concentrated by means of ground inspection of the roost site at night after the birds had settled. Concentrations of birds were mapped using a scale of 1" = 400' (See Figure 3 - reduced map of cantonment). A system of flight lines was then plotted to place the chemical on the greatest concentrations of birds. Ground control stations have been marked on the ground to correspond to plotted flight lines. These will guide ground control personnel who will be equipped with suitable lights to serve as guides for the spray aircraft.

Phase 3, that of making practice aerial application runs under actual conditions, was conducted on 26 and 27 November 1974, using water. Two actions were completed before the test run. First, pilots flew reconnaissance runs over the roost area during both daylight

and night hours. Second, when the flight lines were plotted on the bird concentration map, the length of each line was scaled and coupled with the effective spray swath of 40 feet to determine the acreage to be treated. This was determined to be 27 acres which would be treated at the rate of 80 gallons per acre, for a total of 2,162 gallons of 25 percent PA-14 solution.

During practice aerial application runs, tanks were mounted in the aircraft and filled with water, ground control crews were positioned, and flights were made to test the functioning of the spray systems and the ground control crews. Ground control crews were radio-equipped and maneuvered by a central controller. The controller checked off each line as it was flown and the application completed and then directed the crew to their next position. Both spray systems and ground control crews functioned well. Weather forecasts will be obtained daily from Campbell Army Airfield when permission is given to proceed with the project.

Spraying at Milan AAP. Weather information from the Jackson Flight Service Station will be monitored daily by the project coordinator. The necessary predicted weather must be 45^{o}F or lower with at least 1/2 inch of rain following the spraying operation. When the weather forecast indicates favorable spraying conditions, the project coordinator will make the decision to begin the control operation.

A predetermined sequence of operations will then commence. The coordinator will contact the plant manager, who will in turn contact the flying service representative concerning the time to arrive at Gibson County Airport. The flying service requires six hours of

notice. Notification of the flying service will be made at noon preceding the spraying operation. All necessary equipment and personnel except pilots and aircraft will be supplied by the operating contractor at Milan AAP.

The solution will be applied at the rate of 80 gallons per acre in a single pass by fixed-wing aircraft. The type of aircraft used will be a Grumman AgCat having a 300-gallon capacity hopper and a flight speed of 95 mph. This aircraft will meet FAA requirements for day and night VFR flight (FAR 91.33). The pilot will hold a commercial license, an instrument license and an Agricultural Operator's Certificate.

Mr. Ken Garner, of the Division of Technical Assistance, U. S. Fish and Wildlife, will be notified of the spraying operation time.

The maintenance director will be notified to dispatch men, equipment and material to the roost and to Gibson County Airport. The maintenance director will notify the maintenance supervisors in charge of each operation.

One maintenance supervisor, one mechanic and two truck drivers will begin marking the perimeter of the roost site. Six portable generators having two lights each, will be moved into position around the roost and tested. These lights will be used to mark the general roost location for the aircraft pilots, since this area is unlit for one half mile.

One maintenance supervisor and two laborers will begin mixing the PA-14 at the Gibson County Airport in two 1,000 - 1,200 gallon tank

trucks, after transporting these items to the airport.

When the aircraft arrive at Gibson County Airport, both pilots will make a reconnaisance flight over the roost area before dark to familiarize themselves with the flight pattern. At this time, all crews will move into position around the roost, and communications between the pilots, project coordinator and ground crews will be established. After return to the airfield, ground crews will load one aircraft, which will depart immediately for the roost site. The second aircraft will remain on the ground for ten minutes and then depart for the roost site. Aircraft enroute to the roost site will fly south of Milan, and returning aircraft will fly over the city.

The spray pattern is on a north-south flight line at an altitude of about 100 feet. The spray swath will be 35 feet in width, and the operation will require 68 passes to cover the roost at the prescribed application rate. The complete spraying cycle (loading, flight to the roost, spraying the roost, return flight to the airport and landing) requires 44 minutes. Total time required for aerial application of the PA-14 is five hours, 52 minutes.

The men marking the spray swath with strobe lights will move after each pass to predetermined ground markers. These markers will be measured and placed on the ground well before the day of application. These men will be in constant communication with the pilot. Mechanics will be at the airport and the roost site to repair any mechanical failures. A back-up plane will be at the airfield should aircraft problems occur.

When aerial application begins, the plant chemist will take hourly

water samples of stream run-off from the roost site for a 24-hour period.

All personnel in the roost area will be supplied with protective rain suits, helmets, gloves, boots and face shields. A medical doctor will be on-site and a fire truck will be available in the event of a plane crash.

On the following morning at 0800 hours, men and equipment will be dispatched to pick up dead birds from the production lines and work areas and deliver dead birds to the landfill for disposal. (No birds will be picked up within the roost immediately under the trees.)

Environmental Setting[13]

Fort Campbell. Fort Campbell is located on the Kentucky-Tennessee border. One-third of the land area is in southwestern Kentucky, and two-thirds is in north-central Tennessee. The closest urban area is Clarksville, Tennessee, located eight miles south and having a population of approximately 31,000. Hopkinsville, Kentucky, located seventeen miles to the north, has a population of 21,000.

Land area of Fort Campbell is approximately 105,000 acres, located in the gently rolling Pennyroyal Plain. Greatest relief is at the edge of the plateau along the installation's southern and western edges. There are shallow solution depressions on the installation, but the karst is better developed north of the installation.

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[13] Environmental Impact Computer System: A Case Study, Construction Engineering Research Laboratory, Champaign, Illinois, May 1973, pp. 3-5.

The plain is dissected south and west of the cantonment area by creeks which give local relief of 100 feet. At the southwestern edge of the plateau, relief is between 100 and 300 feet and the slopes between 20 and 35 percent. Majority of the installation is on the Pennyroyal Plain, having slopes between 1 and 10 percent and a local relief of 20 to 80 feet.

The roost site is in the northwestern portion of the cantonment between the main portion of this area and the airfield. (See Figures 3 and 4). It is proposed that 27 acres be sprayed with the PA-14.

Installation soils are brown silt loams, relatively fertile and easily erodible when exposed. Subsoils are reddish clay loams, exposed at the surface on slopes which erode quickly by sheet wash and gullying. The installation's three major soil categories are:

a. Upland soils, consisting of the Crider Silt Loam and Pembroke Silt Loam, are found on slopes of 2 to 12 percent. Erosion hazard is slight to moderate.

b. Slope soils, consisting of Dickson Silt, Mountview Silt Loam, Cumberland Cherty Silt Loam and Boxtex Cherty Silt, have slopes of 2 to 49 percent; however, the presence of a fragipan can cause temporary perched water tables at or near the surface. Erosion hazard for these soils is severe.

c. Lowland soils, consisting of Livelside Silt Loam, Arrington Silt Loam, Newark Silt Loam and Guthrie Silt Loam, have slopes of 0 to 2 percent and tend to be wet and boggy. Surface depressions collect runoff which can lead to ponding.

Soil in the roost area is generally deep, well-drained acid-loamy.

There is one sink hole around the edge which would require sandbagging and covering with boards and plastic sheeting. This would ensure that there would be no contamination from the spraying operation to this natural drainage well. (See Appendix 7 for additional soil information.)

Fort Campbell's climate is classified as Cfa by the Koeppen system. Typical yearly data is presented in Table 1.[14]

Fort Campbell is located within the Cumberland River watershed. Multipurpose dams on the Cumberland and Tennessee rivers provide flood control and electric power. Reservoirs serve as waterways for transportation and recreation. Sizable streams are relatively rare, due to the porous nature of the limestone bedrock, which absorbs much of the normal rainfall. There is a closely knit interrelationship between the area's surface water and ground water systems.

Fort Campbell is underlain by Meramec series limestone which is well-broken by joints and solution fissures. Water drains promptly through the relatively porous rock. Depressions or sinks (usually shallow) provide direct links between surface water and ground water in the area. Numerous springs discharge from the top of the formation, with most large springs situated near minor rivers.

The region's water supply is provided by both ground and surface waters. Drilled wells in the karst areas generally produce enough water for domestic use. Shallow wells, streams and springs are principal water sources for the more dissected parts of the area. Ponds and cisterns are important water sources in the smoother uplands. The Red River and Spring Creek

[14] Telephone Conversation with CPT Albrecht, Commander Detachment 1 16th Weather Squadron, Fort Campbell, Kentucky, 17 Dec 74, Approx 1015 hrs.

provide the water supplies of Fort Campbell and Clarksville, Tennessee.

Drainage from the roost flows into the storm water drainage system, which empties into an intermittent stream. This stream traverses approximately 1,500 meters before flowing into Dry Fork Creek, a part of the Cumberland River watershed.

Dominating crops are corn, wheat, soybeans and tobacco. Small grains (millet, etc.) are grown as rotational crops. The roost area's dominant vegetation is the loblolly pine (Pinus taeda). The site had been thinned by two-thirds with the exception of the perimeter areas which are the areas of bird concentration.

TABLE 1
Yearly Climate Data - Fort Campbell

	Mean Monthly Precipitation	Wind Direction and Speed	Average Monthly Daily Maxi. Temperature	Average Monthly Daily Mini. Temperature	Number of Days at or Below 32°F
J	4.4	S-7	45	27	22
F	5.1	W-7	50	30	16
M	5.4	S-8	57	37	11
A	4.1	S-8	69	48	2
M	3.8	S-6	78	56	0
J	3.1	S-5	86	65	0
J	3.7	SW-4	89	68	0
A	3.5	S-4	88	67	0
S	2.9	S-5	82	59	0
O	1.8	N-5	72	47	2
N	3.8	S-6	57	36	12
D	4.0	S-7	47	29	20
	45.6				85

Fort Campbell is located near the western edge of the mesophytic forest region. The original forest was cut by the mid-nineteenth century, and the present forest consists of regrowth in abandoned fields. Typical tree types are oaks, hickories, sassafras, persimmon and eastern red cedar. Pines are found in areas reforested by forest management programs. Perennial grass

and weeds dominate the more recently abandoned areas approximately one-half of the total land area is used for crops or pasture.

Abandoned fields and scrub thickets provide excellent wildlife habitat throughout the region. Cultivated fields are relatively small, and brushy fence rows are common. A wide variety of common birds, mammals and fish inhabit the area. Quail and deer are hunted extensively and are considered major area resources. Squirrel, rabbit and mourning dove are also hunted. Fishing is both a popular sport and a major revenue source via tourism in the Barkley and Kentucky Lake impoundments west of the area. There is no wildlife other than birds in the roost area, largely because bird fecal material has degraded the site for terrestrial animals.

Milan AAP. Milan Army Ammunition Plant is located 1/2 mile east of Milan, Tennessee, 20 miles north of Jackson, Tennessee, and 79 miles northeast of Memphis, Tennessee. It is located in an inland extension of the Gulf-Atlantic Rolling Plain province of the Gulf-Atlantic Division.[15] It is placed in class B2C (irregular plains).

The four major soil types found at Milan AAP are Memphis, Lexington, Grenada and Calloway. These major soils are underlain with a sandstone bedrock. The land is gently rolling, having elevations ranging from 365 to 550 feet above sea level. Soil is moderately well-drained and acidic with a fragipan about 28 inches from the surface. Dominant soil types are the Loring and the Grenada soil series. (See Appendix 7.)

The 22,180 acres of the installation are composed of 36 percent woodland, 55 percent agricultural land and 9 percent roads, and buildings. The

[15] Hammond, E. H., Annals of the Association of American Geological Survey 54:11-23, 1964.

forested area is predominantly an upland hardwood forest type, with the exception of 800 acres of pine plantations. The agricultural land is used for crop production and cattle grazing. Principal crops are soybeans, cotton, corn and wheat.

More than 95 percent of the Milan AAP is located in the Obion River watershed. Runoff from Milan AAP is carried by intermittent creeks to the Rutherford Fork of the Obion River which then flows to the South Fork of the Obion River 28 miles downstream. Flow in the Rutherford Fork ranges from 1,000 cfs during the summer, to 8,800 cfs during the winter, with peaks above 26,000 cfs following an intense two-inch rainfall.

Wolf Creek carries the runoff from the northern half and the western edge of Milan AAP north to the Rutherford Fork. Runoff from the roost area under study drains west about 1.5 miles via an intermittent creek to Wolk Creek. Approximately 18 square miles of upstream drainage area contribute runoff to Wolf Creek before the bird roost runoff enters it.

The regions water supply is provided predominantly by ground water. The Milan AAP obtains its water from 11 wells located on the installation. The town of Milan obtains its water from three high pressure wells located within the town. Both the MAAP and the Milan wells are more than 200 feet deep. Rural areas obtain water from small wells, having an average depth of 80 feet.

Milan climate is primarily a Cfa climate of the Koeppen classification system. Grand daily mean temperatures range from a high of 80°F in July to a low of 40°F in January. Annual precipitation totals 53 inches, with an average of 114 days having measurable precipitation and three days having measurable snowfall. The average length of frost-free growing season is 188 days.

Wildlife is abundant at Milan AAP. The timber management program, the agricultural outleasing program and the interspersion of woodlots and field contribute to the abundant wildlife habitat. Major species of wildlife are white-tailed deer, wild turkey, rabbit, fox squirrel, quail, dove, bobcat, raccoon, opossum and hawks. There are no known rare or endangered species at Milan AAP.

Wildlife is absent from the roost site with the exception of the blackbirds, as a result of the bird fecal material accumulation.

The roost site lies in the center of the installation between two storage areas (See Figures 5 and 6). The area proposed to be sprayed with PA-14 covers 36 acres of land.

2. LAND-USE RELATIONSHIPS

This section poses a rather unique problem regarding the proposed action. Typically, the purpose of Point Two of the Council on Environmental Quality (CEQ) Guidelines calls for addressing conformity or conflict of the proposed action with other land use plans, policies and controls at the federal, state and local levels. Intent of this point is to identify the induced growth and incompatibility problems often associated with constructing dams, highways, airports and regional shopping centers.

The only perceived implications of this proposed action may be to the policies and controls embodied in the Clean Air Act Amendments of 1972, Federal Water Pollution Control Act and to applicable state solid waste management acts.

Clean Air Act

Eight-second aerial application of 130 gallons of 25 percent PA-14 solution will result in a nearly instantaneous downwind maximum PA-14 surface concentration. Concentration will be 4.6×10^{-3} grams/meter^3 at a point approximately three kilometers from the release swath. (See Appendix 8) Time-averaged over one day, this concentration is insignificant and falls beyond the context of the Clean Air Act.

Federal Water Pollution Control Act

The residual PA-14 will be deposited on the forest floor cover. Residual PA-14 from the floor could enter the surface water through run-off or enter ground water via leaching. This occurrence is not

expected; however, if PA-14 should enter the water, it will be in concentration far below standards.

Solid Waste Management Act

A problem with bird disposal could arise at Fort Campbell. The installation is located within a region of karst topography, an area of underground caverns and openings. The threat of leaching pathogens into the ground water is possible if the disposal area is not adequately surveyed for suitable sanitary landfill conditions (impermeable bottom soil).

Additional legislation applicable to the proposed project has been reviewed by means of a newly-developed computer search program, and no conflict with present laws has been found. Program outputs are displayed in Appendix 9 .

3. PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

Impact of Roost Reductions on the Blackbird Populations of Eastern North America

Based on a survey in 1969-70 by biologists of the U. S. Fish and Wildlife Service,[16] the winter roost population of blackbirds in the eastern United States consists of approximately 350 million birds. The population has the following estimated species composition: grackles - 25 percent or 90 million birds; redwings - 40 percent or 140 million birds; starlings - 20 percent or 65 million birds; and cowbirds - 15 percent or 50 million birds. Additional species are found in small numbers but are not discussed here. These estimates are only crude approximations, and no confidence limits can be given to indicate their accuracy; however, they are the best estimates available.

A crude graphic model is presented in Figure 12 to indicate the general annual cycle of the grackle population in eastern North America. The model assumes that adult grackles have an average survival rate of 52 percent and that adult females annually fledge an average of 2.76 young. These population parameters are typical for passerine species in North America.[17] The model does not pretend to precisely define the numerical response

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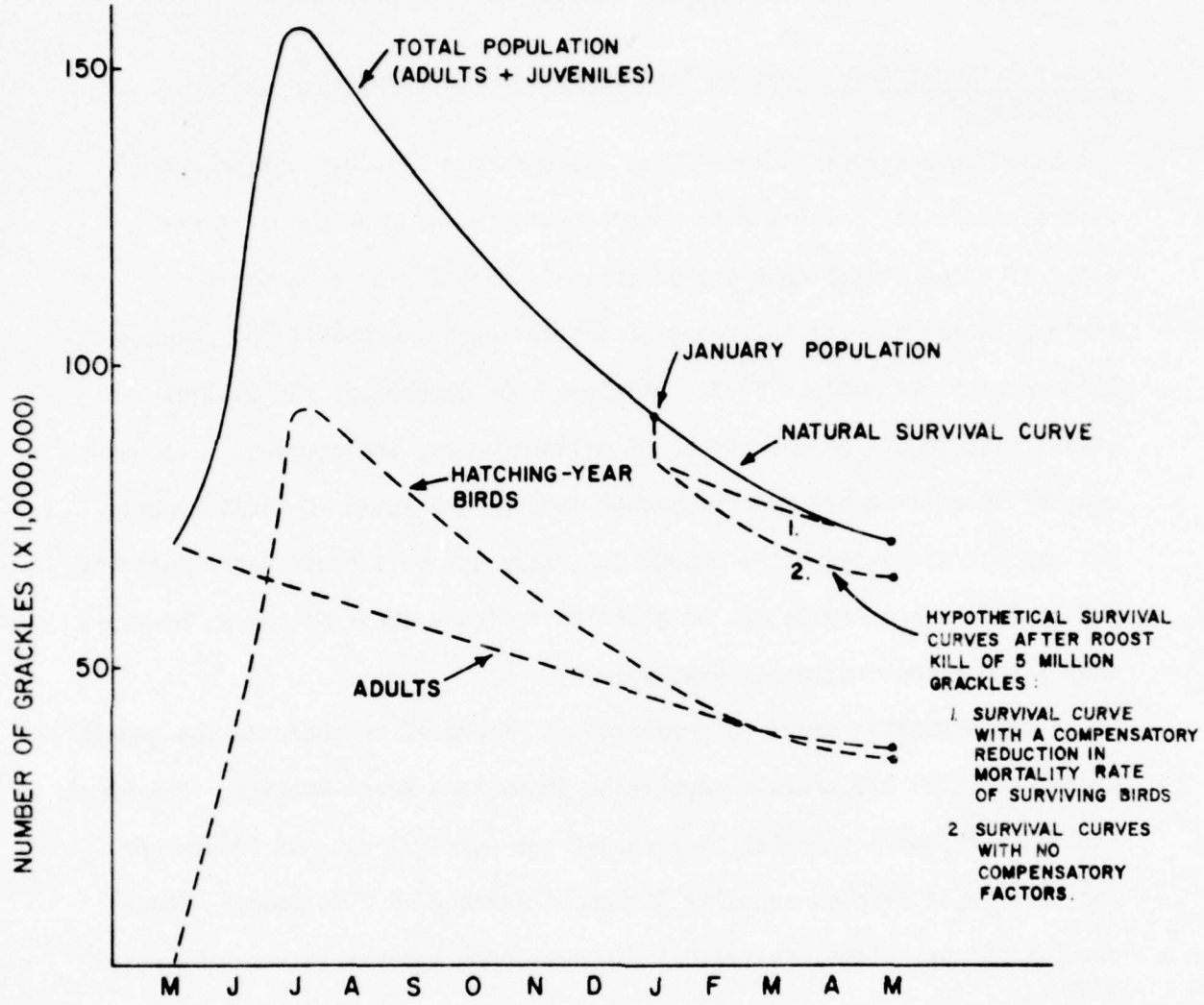
[16] Webb, J. S. and C. W. Royal, 1970, National Survey of Blackbird-Starling Roosts, proceedings Fifth Bird Control Seminar, Bowling Green State University, Sept. 15-17, 1970 p 135.

[17] Henny, C. J., "An Analysis of the Population Dynamics of Selected Avian Species," Wildlife Research Report #1, U. S. Fish and Wildlife Service, Washington, D. C., 1972 p. 99.



GRAPHIC MODEL INDICATING THE GENERAL ANNUAL CYCLE FOR GRACKLE POPULATION IN EASTERN NORTH AMERICA AND THE PROBABLE IMPACT OF A KILL OF 5 MILLION BIRDS.

FIGURE 12

of the grackle population to roost control operations. It is merely an attempt to put into proper perspective the probable immediate impact on the population of eastern North America of a roost reduction of the magnitude planned.

The model is presented only for the grackle population, since this species appears to be predominant at the Fort Campbell and Milan AAP roost sites. The impact of reduction of redwing and cowbird populations would probably be less than on the grackle population, since these two species form only a small part of the roost population.

If we assume the population of grackles in the eastern United States to be 90 million birds in January, and that the roosts at Fort Campbell and Milan AAP contain 2 million and 5 million respectively, a total reduction at these roosts in January would remove about 7.7 percent of the population. This man-caused reduction would be fairly small compared to the natural mortality occurring during the winter months as indicated in Figure 12, and ignores birds in smaller uncensused roosts and those which do not join roosts. Two hypothetical survival curves are presented to indicate the possible numerical responses of the grackle population immediately after such an event. In either case, the proposed reduction would apparently have little effect on the total grackle population of eastern North America.

The above discussion relates to the total grackle population of eastern North America. Band returns from grackles overwintering the Tennessee-Kentucky area indicate that most of these grackles breed in Ohio, Michigan, Indiana, Illinois, and Ontario. Thus, while grackles

at the Fort Campbell roost may represent only 3 percent of the total eastern population, they represent a greater percentage of the populations from the above-mentioned states. Thus, a reduction of 2 million grackles might have a greater impact on breeding populations in localized areas than is indicated in Figure 12.

Surface and Ground Water Impacts at the Proposed Sites

No ground or surface water impacts are expected as a result of the Fort Campbell or Milan AAP proposed actions (See Appendix 10).

Disposal Impacts

Disposal of dead blackbirds can be approached in three ways: pathological incineration, production of protein meal, and aerobic and anaerobic land disposal. The recommended alternative is aerobic and anaerobic land disposal.

Pathological Incineration. Assuming that the carcasses are typical dead animals and have an average moisture content in excess of 65 percent and a caloric value between 2,000 and 3,250 Btu/lb, the combustion of blackbirds would not be self-sustaining. As a result, a pathological incinerator is required.

The most inexpensive pathological incinerator available is a controlled-air incinerator. This unit will consume up to 1,000 pounds of pathological material per hour, use 7.5 million Btu/hrs of fuel and require shutdown and cool-off after 20 hours of operation for ash removal. The probable maximum kill is about 4 million blackbirds at Fort Campbell. Number of unit-hours required for incineration, if 50 percent of the birds drop outside the roosts and are not recoverable, is:

$$\frac{0.5\ (500{,}000\ \text{lb})}{1{,}000\ \text{lb/hr}} = 250\ \text{incinerator-hours}$$

Assuming 24-hr/day (20 burning), 7-day/week operation, and incineration of all collected birds within two weeks to prevent excessive putrefaction,

$$\frac{250\ \text{incinerator-hours}}{14\ \text{days} \times 20\ \text{hours/day}} = .89$$ - or one incinerator is required

If that unit can be procured (a bad assumption, given current delivery times of 14 to 16 months), and assuming it is mounted on a slab poured on grade and fired with number two fuel oil supplied from mobile tanks and electricity from mobile tactical generators at Fort Campbell, then:

Incinerator capital cost, at $114,600 = $114,600

Slab capital cost = $6,320

Fuel oil, 44,850 gallons at $0.36/gallon = $16,146

Labor, 2 men/shift at $12,000/year = $10,126

The net cost of disposal after collection in a pathological incinerator is $147,193. This method is not considered to be practical due to the capital cost, current energy situation, and the long lead times for procuring equipment.

Production of Protein Meal. Protein meal is produced by the rendering of animal parts. This concept is desirable, because it utilizes a product, (the dead blackbirds) formerly considered a waste to deteriorate or pick up and dispose of in an incinerator or sanitary landfill.

Inquiries to a rendering plant at Henderson, Kentucky, indicate that the blackbirds can indeed be processed. Tests should be run on a 5,000 lb. sample of blackbirds to determine how the rendering plant will process

the birds. Two other plants, one at Newberry, Indiana and one at Columbus, Indiana could possibly render the blackbirds. None of these companies could pick up or haul the birds.

Aerobic and Anaerobic Landfill. If the birds fall into the roost area or are spread thinly, aerobic land disposal can be acceptable.

In the roost area, droppings have been found to depths of 1 to 2 inches. Assuming an average depth of 1 inch, a density of 60 lb/ft^3, and an average kill of 1.7 blackbirds per sq ft, then the presence of the carcasses would increase the organic load on the forest floor by approximately 7 percent. Collection of birds in the roost area is probably unwarranted.

Since small birds have been observed to decompose in less than one month in warm climates, collection of dead birds outside human use areas may not be warranted. In support of EPA registration of PA-14, studies by independent testing laboratories have placed the acute oral LD_{50} of undiluted PA-14 at about 2,000 to 3,000 mg/kg. for rats and dogs. The U. S. Fish and Wildlife Service has conducted tests considering the possibility of secondary poisoning and has found a probable acute oral LD_{50} to be more than 5,000 mg/kg. in predatory birds. Studies in support of registration also established that 3-month chronic feeding of levels corresponding to about 200 mg/kg. was non-injurious to dogs (i.e., there was no weight loss and no pathology).

These extremely low toxicities indicate that no problem could be expected, even if a scavenger (or wandering pet) were to eat a considerable number of bird carcasses. A fox or domestic cat would have to eat 18

complete birds, including feathers, within one day to achieve half of the mean lethal dose. (This calculation makes the gross over-estimation that fully one-half of the PA-14 applied to a given area remains indefinitely attached to the birds.)

Aerobic disposal would allow carcasses that fall into the roost to remain, if the total kill is 1 million or fewer. Numbers will be determined by taking a count of 25 milacre (circular) plots. If an average of 14 or fewer birds per square yard are found (corresponding to fewer than 1 million within roost boundaries), it will be deemed acceptable from an aesthetic standpoint to conduct no further pickup within the roost area. Wildlife are known to scavenge carrion without ill effects and to reject material that might prove harmful. This method would not require resources to be expended for carcass collection.

Anaerobic disposal at the installation's landfill would involve collection of carcasses at the roost site to a minimum recovery of 80 percent, should the total kill be 1 million or more as determined by methods discussed above. All carcasses will be collected from all public use areas and landfilled. Since birds are organic matter which can be safely landfilled, no problems are anticipated.

Landfilling of dead birds from the blackbird control operation should have no effect on the quality of the area's ground or surface waters. The Fort Campbell landfill has a confining layer of 48 to 80 feet of red clay with abundant chert fragments. This same subsoil is used as a cover

material.[18] The landfill is located on soils classified in the Pembroke series with natural slopes from 2 to 12 percent.[19],[20] These soils are classified by the Soil Conservation Service as having only moderate limitations when used for sanitary landfills.[21] When the underlying fissured limestone is closer to the surface, as it may be under some Pembroke soils,[22] the moderate permeability of these soils renders them less than ideal for landfills. The 40 or more feet of confining clay is considered to be more than adequate to limit percolation of leachate into the water table.[23]

At Milan AAP, birds in the sparsely populated area outside the cantonment and ammunition production line zones can be left where they fall for aerobic decomposition. Birds collected from the cantonment area can be taken to the base sanitary landfill for disposal. The soil structure at Milan AAP is basically silty loam. It is generally impermeable, with the water table at an average depth of 60 feet. No problems are anticipated.

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[18] Robert Anderson, Office of the Facility Engineer, Fort Campbell, Kentucky, personal communication, 22 January, 1975.

[19] USDA Soil Conservation Service, Soil Survey Field Sheet, Montgomery County, Tennessee, Atlas Sheet No. 3, May, 1973.

[20] USDA Soil Conservation Service, Soil Descriptions and Interpretations for the Fort Campbell Reservation, Montgomery County, Tennessee, May, 1973.

[21] Ibid. Table 2, p.5, p. 229.

[22] Ibid. Description of Pembroke series, page unnumbered.

[23] Municipal Refuse Disposal, American Public Works Association, Chicago, Illinois, 1966, page 125.

Cost of executing this disposal alternative is less than incineration or recycling.

Dispersion of PA-14 in the Lower Atmosphere

Application of PA-14 will be in accordance with Instructions for the Use of PA-14 Avian Stressing Agent (reference 1, Appendix 8). The solution can be delivered by a venturi-type spreader mounted on the underside of either fixed-winged aircraft or helicopter. In the worst possible case,* 130 gallons of aqueous solution containing 25 percent PA-14 would be applied from an elevation of 50 meters in a single 600-meter long swath traversing the target area. It is instructed not to apply the material when wind speeds are in excess of 4.5 meters/second.

When such an aerial application is made, a large fraction of the solution falls directly earthward. A substantially smaller portion changes from liquid to gas by evaporation. Another fraction remains temporarily in the air as a residual mist suspension. It is the latter quantity which poses the greatest impact potential upon biotic receptors, for while it slowly settles to the earth under the influence of gravity, it is transported by winds to places outside the vicinity of the application target. Dispersion of this mist fraction is detailed in Appendix 8 and summarized here.

Quantification of the mist fraction as a function of wind speed is presented in Table 2. In the "worst case" situation, the equivalent line (600-meter) emission rate of the mist is 7.16 grams/second/meter.

TABLE 2

DEVELOPMENT OF MIST FRACTION OF PA-14
AS A FUNCTION OF WIND SPEED

Wind Speed (meters/second)	MDDS* (mm)	Mist Fraction (percent)	Mist Equivalent Emission Rate (grams/second)	Mist Equivalent Line Emission Rate (grams/second/meter)
0.50	0.125	0.57	352.7	0.59
1.00	0.184	1.28	792.0	1.32
1.50	0.225	2.03	1256.0	2.00
2.00	0.259	2.79	1726.3	2.88
2.50	0.290	3.61	2233.7	3.72
3.00	0.318	4.44	2747.3	4.58
3.50	0.343	5.26	3254.6	5.42
4.00	0.367	6.11	3780.6	6.30
4.50	0.389	6.94	4294.1	7.16

* Maximum driftable droplet size

This corresponds to a 6.94 percent mist fraction (e.g., 6.94 percent of the released volume develops into a dispersible mist).

To calculate the dispersion of the mist fraction using equation 6 (Appendix 8), a ten percent mist fraction was assumed, corresponding to a mist equivalent line (600-meter) emission rate of 10.3 grams/second/meter. Table 3 presents an evaluation summary of equation 6 for wind speeds ($\bar{u}$) of 4.5 meters/second. Assuming that the strongest advisable aqueous solution (25 percent PA-14) is applied in a swath normal to the wind direction, the maximum predicted, nearly-instantaneous downwind concentration is 4.6×10^{-3} grams/meter^3. This maximum concentration will occur approximately 3 kilometers directly downwind of the release swath.

The predicted maximum concentration was calculated by assuming an unlikely combination of coincident physical and meteorological phenomena. It is expected that real concentrations will be substantially lower than those predicted. No account was made for the drift-inhibiting terminal velocities of the mist droplets. The mist fraction will be significantly less for the lower wind speed fields likely to exist at the time of application.

TABLE 3

Data for evaluation of equation (6) for downwind solution mist and PA-14 concentration as a function of distance *

Downwind distance (km)	σ_y (meters)	σ_z (meters)	$\lvert\psi\rvert$ (meters)	$\frac{1}{2}\lvert\psi\rvert^2$ (meters^2)	$\frac{2q}{\sqrt{2\pi}\,\sigma_z\,\bar{u}}$	$\exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2\right]$	$\int_{\psi_1}^{\psi_2}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}(\psi)^2\right]d\psi$	mist concentration (grams/meter^3)	PA-14 concentration @ 25% (grams/meter^3)
0.1	8.0	4.6	37.5	703.1	0.397	* *	* * *	* *	* *
0.3	22.5	12.2	13.3	88.9	0.150	2.25×10^{-4}	* * *	3.375×10^{-5}	8.438×10^{-6}
0.5	36.0	18.5	8.3	34.72	0.099	0.026	* * *	2.574×10^{-3}	6.435×10^{-4}
0.7	49.0	24.0	6.12	18.74	0.076	0.114	* * *	8.664×10^{-3}	2.166×10^{-3}
1.0	68.0	31.5	4.41	9.73	0.058	0.284	* * *	1.647×10^{-2}	4.118×10^{-3}
3.0	190.0	65.0	1.58	1.25	0.028	0.744	0.8860	1.846×10^{-2}	4.614×10^{-3}
5.0	300.0	90.0	1.00	0.50	0.020	0.857	0.6826	1.169×10^{-2}	2.925×10^{-3}
10.0	550.0	135.0	0.55	0.15	0.014	0.934	0.4176	5.461×10^{-3}	1.365×10^{-3}
15.0	800.0	171.0	0.38	0.07	0.011	0.958	0.2960	3.119×10^{-3}	7.798×10^{-4}
25.0	1200.0	230.0	0.25	0.03	0.007	0.977	0.1974	1.35×10^{-3}	3.375×10^{-4}

* q = 10.3 grams/second/meter, $\bar{u}$ = 4.5 meters/second, and H = 50 meters

* * Negligibly small positive value ($\pm 1 \times 10^{-6}$)

* * * Virtually unity.

4. ALTERNATIVES TO THE PROPOSED ACTION

There are three basic alternatives to dealing with the blackbird infestations at Fort Campbell and Milan AAP. These are: elimination, dispersal and no action.

Reduction of the blackbird population can be obtained through several methods, but the impact of elimination of a possible 11 million blackbirds must be considered.

Elimination during autumn when the roosts are first forming would have little overall impact on the national blackbird population. Natural mortality from old age, disease and predation is estimated to be 48 percent annually. The relatively small reduction, estimated to be 7 percent of the national blackbird population, caused by completely successful control operations at Fort Campbell and Milan AAP would be completely overwhelmed by this naturally occurring mortality. There would be no effect on the population available for spring breeding nor would elimination at this time of the year provide satisfactory results. It is probable that the roosts would soon be reoccupied by other blackbird populations migrating southward later in the season. Accordingly, relief from agricultural damage, feed losses and other depredations would be only temporary.

Elimination of the birds during mid-winter when the roosts become stable would still not affect the spring breeding population. There would be some crop damage from sprout pulling and some losses in animal feeding operations. There would be potential for histoplasmosis-

contaminated soil in the roost sites, and there would be interference with aircraft landing and departure operations until the bird populations were reduced.

Elimination during the spring, just prior to roost breakup, would still probably not reduce the national blackbird population to a point where the spring breeding population would be affected. However, there would be little to gain from blackbird elimination at that time. Agricultural damage would have occurred, feed would have been lost, disease would have been transmitted, interference with aircraft operations would have occurred, and military relations with the nearby communities would have been strained.

Recently-obtained medical opinion (See Appendix 3) necessitates reevaluation of the risks and effects of histoplasmosis. It has been stated that the causative organism can be excreted in blackbird feces. Therefore, feeding as well as roosting areas must be suspect as sources of infection. Relocation of the blackbird population through biosonics, roost modification, etc. would tend to increase the number of contaminated areas and the risk of infection, while blackbird population reduction would limit potential for spreading the disease.

Dispersal of the blackbirds would only move them and the problems they cause into areas they initially bypassed as roosting sites. Their movement could be to other parts of the military installations or from government land onto private property, thus further burdening the nearby communities. Dispersal would affect neither the national blackbird

population nor the blackbird breeding population. If, by some chance a non-target bird were present, it would not be affected. No chemical load would be introduced into the environment. Dispersion would have significant adverse effects upon military-community relationships, since it would amount to either doing nothing or shifting the burden onto the civilian community.

The "no action approach" would force adaptation of lives and programs around the blackbirds. Crop losses would have to be accepted (although it has been reported that some losses could be reduced if farmers planted some crops by drilling rather than by broadcasting seed.) Animal feeding costs would continue to increase, and the risk of disease would have to be accepted. Flight operations would continue to have to be suspended when flocks of birds crossed runways and flight patterns during the roosting season. The "no action" method would effect an economic loss of time, training and funds in order to deal with the human conflicts of public health, safety and the general nuisance created by the blackbirds. Under this alternative, the only factors limiting the bird populations would be food and habitat availability, disease, predation and adverse weather conditions.

Elimination

Exposure. This control method entails the aerial application of Compound PA-14, Avian Stressing Agent. Since use of this material is covered in the description of the proposed program, it will not be repeated here.

Parasitism. Introduction of natural, population-limiting parasites presents the technical problem of dealing with four different species known as blackbirds, as well as the lack of control over the parasitic organisms. The results could be a spread of the parasite to non-target species, thus creating epidemic problems within the avian world. There is a dearth of available research in the area of man-induced population control of birds through use of parasites. This alternative is not considered usable at this time.

Virus Disease. This method entails the introduction of a virus such as Avian pox. Starlings have been frequently observed in the vicinity of chicken and turkey flocks. Research indicates that the isolated virus was found to be infectious to starlings and turkey poults, but that domestic chickens and canaries were not affected. Current research has not progressed to justify any conclusions concerning population control possibilities of this virus.[24]

Trapping. A number of articles have been written about the use of a variety of traps, including light traps, for the capture of birds. Additionally, the various trapping techniques have been discussed with representatives from the Department of the Interior. In general, traps are used only to capture a few birds. The largest catch reported in a light trap was 120,000 in a small, woodlot roost. Considering the size of the roosts at Fort Campbell and Milan AAP (20-40 acres), construction of the netting and erection of a fumigation facility would be very difficult and expensive.

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[24] Starling Control Research in California, Progress Report, 1964, p. 26.

Additionally, destruction of the trapped birds would pose a significant problem. The fumigation tent would have to be air-tight. Since there are no fumigants registered for bird control, an experimental permit would have to be obtained from the Environmental Protection Agency, as for several other chemicals considered. Killing the birds by hand would place the individuals involved in direct contact with diseased birds and their ectoparasites. While this alternative has some potential, difficulties of accomplishment have caused it to be discarded.

Predators. Man-induced predation lacks sufficient research to substantiate the action. It would be difficult to keep predators from attacking non-target species. Natural predators include such creatures as fox, weasel, feral domestic cats, owls and hawks. These animals prey on blackbirds when they find it convenient, as opposed to passing up other food sources to prey on these birds alone. In addition, the small number of predators would have little impact on the blackbird populations.

Shooting. Shooting the blackbirds would be relatively controllable with regard to protection of non-target species. This program could be promoted either through professional hunters or by promotion of blackbirds as a game species for public shooting. Shooting would be expensive as well as time-consuming. Uncontrolled shooting decreases control of non-target species protection, and shooting around housing areas, even in a controlled situation, would present undesirable safety hazards. Additionally, many crippled birds would result. The birds are edible, which in considering the present economy, might provide some individual hunters with a substitute meat source.

Dynamite. Dynamite charges placed in roosting trees could be exploded after the blackbirds had settled for the night. While this method is cost-effective, it is non-selective, cripples many birds, destroys trees and is limited to non-populated areas. The concussion of such a blast within the cantonment area would have devastating effects upon window glass.

Artillery Air-Burst. This method would require that the blackbirds be lured to a specific site within the artillery impact area. The area would be baited with grain for several days until a sizable flock of blackbirds could be established, followed by launch of a coordinated artillery air-burst attack. This method would allow a maximum of control and safety and would be cost-effective, since the operation could serve as a training function. Disadvantages include the crippling of birds and the killing of some non-target species.

Starlicide(R). (DRC 1339) (3-chloro-p-toluidine hydrochloride) is a bird toxicant which is particularly effective against starlings and blackbirds. It is commercially available from the Ralston-Purina Company in a pelletized bait form. Its registered use is limited to livestock feedlot applications.

If significant numbers of the flocks roosting at Fort Campbell and Milan AAP could be induced to feed upon the treated pellets, a population reduction could be achieved. To accomplish this, it would first be

necessary to establish feeding sites near the staging and roosting areas through the liberal application of untreated pellets. After significant numbers of birds had become accustomed to feeding on the bait at the new site, toxicants would be introduced.

Difficulties with this approach are several. Food preferences of the birds are diverse. The birds are now foraging over long distances to find the particular food they desire. Probably only that portion of the flock now feeding in livestock feeding lots could be induced to feed at the new site, and only if those food sources were shut off. Additionally, such a pre-treatment baiting program could draw non-target birds to the feeding site. However, observation of the bird species feeding on the untreated pellets will forewarn of potential kill of non-target birds. If the birds could not be induced to feed on untreated pellets, or if non-target birds were attracted to the feeding site, the toxicant would not be introduced. Since Starlicide$^{(R)}$ is not registered for this particular use, exemption or experimental permit would have to be granted by the administrator of the Environmental Protection Agency.

Starlings and other blackbirds are causing damage at feedlots and barnyards in the Fort Campbell area. Since this is a community problem, farmers experiencing significant feedlot depredations should obtain assistance from personnel of the U. S. Fish and Wildlife Service. This strategy, while probably not significantly reducing the overall roost population, has the advantage of killing the birds responsible for feedlot damage.

Contact Toxicants. The pesticide fenthion is known for its effect on birds. The pesticide, spread on the perches of the roost, is absorbed through the feet, killing the birds. Spraying this chemical directly on the birds would probably have the same result. The parathions (ethyl and methyl analogs) would also be very likely to destroy the bird roost; however, human toxicity to these materials is high, and their use would pose a threat to human populations. Use of any of these chemicals for this purpose is not presently authorized by EPA.

Reproductive Cycle Interference. Use of two materials which could affect the reproductive activity of starlings has been considered. One is stilbesterol, which has effectively interfered with the sperm-producing capabilities of the male starling. The other materials is Ornitrol(R) which carries Environmental Protection Agency registration for the management of pigeon populations. If one of these chemosterilants could be introduced into the flock's feed during the breeding season, the resultant lack of reproduction could lead to a greatly diminished bird population.

Aside from the lack of Environmental Protection Agency registration for using these materials against starlings, there are difficulties that make this method impractical. It would be necessary to get the chemosterilant into the population during the mating season. Since mating takes place several times each year, repeated application would be necessary. Additionally, the birds do not form flocks until fall, after the mating season, so that there would be no central site at which the chemosterilant could be applied (assuming that the birds can be enticed to feed

at a central site). It would also be difficult to keep the chemosterilants from being ingested by desirable birds.

Dispersal

Frightening Devices. This operation involves the use of pyrotechnics (shell crackers) and biosonics (recorded alarm calls). Shell crackers are fired into the bird flocks as they return to the roosts. The shell crackers explode harmlessly, causing the birds to be diverted from their assembly area or roosting site. Results are improved if shell crackers supplement the playing or recorded alarm calls. This technique must be continued each evening until the birds abandon the roost.

These mechanical methods were used during the winter of 1972-73 at Fort Campbell. Some roosts were moved, but results were temporary. One roost re-established itself closer to the airfield, thus increasing hazard to aircraft. These mechanical methods will not provide any relief from the depredations of the birds in farming areas. In addition, these methods create objectionable noise pollution while they are in operation. Major advantage of these methods is the lack of physical harm to the birds; however, the problems of public health and safety are merely moved to another site.

Roost Modification. One course of action that could alleviate the bird problem for inhabitants of Fort Campbell would be to modify or remove roosting areas in the cantonment area. Temperature measurements taken during the 1972-73 roosting period showed that the center of the bird roost

is slightly warmer than the adjacent open area. This led to the speculation that the birds prefer densely vegetated areas (such as a pine plantation) for their roosts so that their combined body heat can be held by the insulating foliage. If the vegetation were thinned to the point that the colder outside air could circulate through the roost, and the birds could not congregate so closely together, they would seek a more protective roost site. The following test thinning patterns are being evaluated; the third pattern has not yet been tried.

* 50 Percent Thinning. This method involved removal of alternating tree rows. This allowed some air circulation but still permitted the birds to be densely congregated. The protective canopy will probably close within a year or two, and the roost situation will probably return to normal.

* 66 and 2/3 Percent Thinning. This involved the removal of every two rows of trees, leaving the third row. This method allowed more air circulation and less bird concentration. Success of this pattern appears satisfactory, and more thinning is planned.

* 90 Percent Thinning. This would involve removal of approximately nine out of every ten trees in a landscaping pattern. This extensive thinning would ensure the rejection of the area as a roosting site. It would, however, necessitate changing the land use from reforestation and timber production to recreational.

There are 15,000 acres that have been reforested at Fort Campbell. Thinning of this extensive area to prevent the establishment of roosts would not be practical, nor would it be an acceptable forest management procedure. Additionally, the mere moving of a roost will not provide relief from the depredations committed by the birds in non-military areas.

Milan AAP has attempted to accomplish roost thinning by contract. To date, no one has responded to invitations to bid for pine stand thinning because of labor costs, and because any thinning of pines used as roosts has been completely rejected due to the histoplasmosis hazard. Furthermore, the present roost at Milan AAP is located in a forest of mixed hardwoods and eastern red-cedar which are not susceptible to regular thinning.

Avitrol(R) (4-aminopyridine). Birds ingesting this material react with distress symptoms and calls which cause nearby members of the flock to become alarmed and fly away. Most of the birds which ingest the material are killed. After repeated applications of Avitrol(R), flocks learn to avoid that location. Advantage of this control is that the flock can be moved with the sacrifice of only a few birds. However, use of this method at Fort Campbell would be self-defeating. The birds would have to be drawn into new feeding situations and, when the toxicant was introduced, the flock would learn to avoid the feeding site. Additionally, this alternative clearly causes the most pain and distress.

Alteration of Food Source. One of the birds' food sources during the winter roost is local livestock feed and winter grain crops. Agriculture is the major source of livelihood in this area, and alteration of the land usage is not practical, since fall planting is determined by climatic conditions. Alteration of feedlot operations provides a possible solution, because these provide much of the blackbirds' food. Night and early morning feeding of animals tends to reduce feed losses. Unfortunately, this procedure can only be requested of farmers and lacks control. Covered feeders may reduce feedlot losses but require a capital outlay by the farmer.

Electronic Devices. Wires are permanently installed on ledges to disrupt bird roosting by means of electrical impulses. This method is utilized on buildings and does not appear to be economically feasible for discouraging birds from roosting in trees. Advantage is that the birds are not killed; however, the problem is merely moved elsewhere.

5. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Insect Control

Blackbirds feed on insects as well as other foods. They devour large numbers of grubs and other soil insects, caterpillars and grasshoppers. Their feeding habits therefore reduce insect damage to turf and to crops at their spring/summer habitat. Reduction in the blackbird population may cause a small increase in the soil insect population. On the other hand, a reduction of the blackbird population may possibly permit other bird species access to this food source.

Effect on Non-Target Birds

Non-target bird species in a blackbird roost at the time of PA-14 application could be affected. At Fort Campbell, no non-target birds were observed during a recent field study. At Milan AAP nearly two dozen red-tailed hawks and 200 meadowlarks were observed within 1/2 mile of the roost. It is possible that the meadowlarks could be affected if they roost on the perimeter of the blackbird roost. However, red-tailed hawks are not expected to be present during application because of their migration south for winter. Non-target birds outside the treatment areas will not be affected by the spray.

6. LOCAL SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

Major short-term benefit expected from the proposed action is relief from severe local depredation of crops and feed lots. A period of greatly reduced blackbirds could result in increased survival of newly-farrowed pigs and decreased losses of feed grains. Potential hazards to aviation would be decreased to some degree.

No decrease in long-term productivity is expected. The surfactant to be applied apparently degrades rapidly (See Appendix 10), and will not be used on privately-owned lands. Separation of roost sites from the boundaries of both installations virtually precludes accidental overspray from reaching private property on which growing crops may be damaged.

A possible effect of decreased blackbird populations might be a related decreased benefit during the spring and early summer months due to consumption by the birds of potentially harmful insects. This benefit is probably real but has never been adequately quantified. The possibility that a drastic decrease in bird numbers caused by this action may leave a large area of some northern state without any summer resident birds is discounted by the U. S. Fish and Wildlife Service, whose banding records indicate specificity of return to a roost, but not specificity of choice of a single summer residence by all members of a roost. In any case, loss to the blackbird population is expected to be made up by natural reproduction within two years. Long-term effects are expected to be

negligible. If this action is carried out as proposed, major effects will be very short-term. No possible effects of this action will preclude other actions to control the severe, short-term damage caused by the roosting birds. This action is a portion of no overall plan to exterminate blackbirds. It is limited in scope to Fort Campbell and the Milan AAP, where large roosting populations of these birds are considered a safety, health and economic problem.

The extreme concern of the general public residing near these installations has caused a secondary public relations problem. It is felt that the Army is harboring destructive animals which should be controlled. In fact, lack of effective control actions to date has created some atmosphere of distrust where relations have been historically good. A potential erosion of this confidence could be a source of concern for the Army. Thus, a major long-term benefit following the proposed action might be restoration of public confidence in the Army's willingness to address a community problem, a problem which is causing a significant economic loss and has a potential for serious health hazard.

7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Summary

The blackbird reduction program requires commitments of resources which are both irretrievable and irreversible. Resources receiving consideration are:

(a) Manpower,

(b) Tax dollars,

(c) Blackbird populations,

(d) Spray chemicals, and

(e) Agricultural land.

In the cases of manpower and spray chemicals allocations, hours of activity directly associated with the project can be broken down according to personnel involved in the action. Table 4 provides information about the amounts of manpower and chemicals consumed by the proposed program, while Table 5 indicates the dollar requirements.

The total dollar figure represents an estimate of the cost associated with spraying at Milan and Fort Campbell and the bird pickup at Fort Campbell.

TABLE 4 Manpower and Chemical Allocation[25]

	Labor (man hours)	PA-14 (gal.)	Alcohol (gal.)
Milan (spraying)	230	670	144
Campbell (spraying)	180	540	108
Campbell (clean-up)	12000	0	0
Total	12410	1260	252

[25] Tom Harshbarger, Forester, Fort Campbell, Kentucky; Bill Oates, Operations Research Division, and Steve Stephenson, Forester, Milan Army Ammunition Plant, 16-17 December 1974.

TABLE 5 Dollar Allocation[26]

	Labor	Contract	Chemicals	
Milan (spraying)	$1760	$2500	$2549	
Campbell (spraying)	270	-	1912	
Campbell (clean-up)	-	-	-	
Total	$2030	$2500	$4390	= $8920

This estimate does not include expenditures for project planning, project review or impact statement preparation.

These figures are indicative of commitments which can be anticipated over the normal operating requirements of both installations.

Given the proper conditions, the proposed program could reduce the blackbird population at Milan and Fort Campbell by 10.4 million.[27] While removal of these birds does constitute an irreversible commitment of resources, the proliferation of the remaining blackbirds indicates that this resource is renewable.

Because of the impact of the bird droppings on the agricultural productivity of the roost areas, the reduction of agricultural productivity caused by the control program is deemed insignificant. Since all the contaminants (birds, droppings and PA-14 solutions) introduced to the soil are biodegradable, long-term effects on soil productivity are also negligible.

Additional resource allocations would be minimal. These would include plane and helicopter fuel, truck fuel and fuel for portable generators for lighting requirements.

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[26] Tom Harshbarger, Forester, Fort Campbell, Kentucky; Bill Oates, Operation Review Division, and Steve Stephenson, Forester, Milan Army Ammunition Plant, 16-17 December 1974.

[27] Harold Balbach, CERL Ecologist.

Detail of Manpower and Cost Calculations

Calculated manpower requirements for the spraying operations are as follows:

An estimated 10 man-hours per person is used for calculating manpower requirements for the spray preparation, application and clean-up. Payroll calculations include compensations for overhead costs and overtime. Manpower breakdown hours and costs are shown in Table 6.

TABLE 6

Milan (spraying)	Man-Hours	Payroll Dollars
2 pilots	20	.00[a]
1 operation coordinator	10	.00[b]
1 maintenance director	10 @ 14.61	147.
2 maintenance supervisors	20 @ 11.72	235.
4 truck drivers	40 @ 7.31	293.
2 mechanics	20 @ 7.58	152.
8 laborers	80 @ 6.64	532.
1 heavy equipment operator	10 @ 7.57	76.
1 doctor	10 @ 21.67	217.
1 chemist	10 @ 10.86	109.
Total	230	$1760.00
Campbell (spraying areas 1, 2 3; one application--areas 1, 2, 3 are indicated in Appendix Table 6.1 and Map Appendix Figure 6.1)*		
2 loaders	10 @ 10.50	105. [c]
8 ground personnel	80	.00[b]
2 supervisors	20	.00[b]
4 pilots	40	.00[b]
2 mixers	20 @ 8.25	165.
Total	180	$270.00

(cont.)

* Area 1 is the isolated crosshatched strip south of 52nd Street between Kansas and Missouri Avenues. Areas 2 and 3 are the crosshatched zones bounded by 52nd and 60th Streets, Range Road and Missouri Avenue, as shown in Appendix Figure 6.1.

Table 6 (cont.)

Campbell (spraying area 1; nine applications -- area 1 is indicated in Appendix Table 6.1 and Map Appendix Figure 6.1)

1 loader	18 @ 10.50	105.[c]
1 supervisor	18	.00[b]
2 pilots	32	.00[b]
4 water sprayers (firemen)	72	.00[b]
Total	140	$189.00

[a] covered by contract

[b] not receiving additional pay

[c] one supervisor not receiving additional pay

Assuming an 80 percent kill for the program at Fort Campbell, approximately 4 million birds will have to be removed. Under ideal conditions of good weather, 100 percent attendance and 100 percent participation, an engineering battalion of 750 men can complete the job in two days with a total effort of 12,000 man-hours.

Chemicals

The cost of the PA-14 was estimated to be $3.40 per gallon and the cost of the alcohol was estimated to be $.70 per gallon.[27] The total cost for chemicals is as follows:

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[27] Tom Harshbarger, Forester, Fort Campbell, Kentucky, 16 December 1974.

Milan -	PA-14	$2448	20 gal./A x 36 acre x $3.40/gal.
	Alcohol	101	4 gal./A x 36 acre x .70/gal.
Fort - Campbell (Areas 1, 2, 3; applica- (tion)	PA-14	$1836	20 gal./A x 27 acre x $3.40/gal.
	Alcohol	76	4 gal./A x 27 acre x .70/gal.
Fort - Campbell (Area 1; 9 applica- tions)	PA-14	$ 918	20 gal./A x 1.5 acre x $3.40/gal.
	Alcohol	38	4 gal./A x 1.5 acre x .70/gal.

8. OTHER INTERESTS AND CONSIDERATIONS OF FEDERAL POLICY THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

Countervailing Benefits of the Proposed Action

Community Relations. There is interface between military installations and nearby communities. The community benefits from the presence of the military installation through growth and increased trade. The installation benefits from off-post recreation and sources of housing, goods and skilled labor. Occasionally, installation-community problems develop which can normally be harmoniously solved through discussions and mutually acceptable solutions. In this case, a problem has developed for which solutions are available but action has not been made legally possible. The enormous bird roosts established at Fort Campbell, Kentucky and Milan AAP, Tennessee (See Figure 9) have generated the following complaints:

(a) County health departments report an increase in cases of histoplasmosis.

(b) County agricultural agents report increased crop losses from small grain sprout pulling, feed losses from bird feeding, and swine losses from transmissable gastroenteritis.

(c) The mayor of Hopkinsville, Kentucky has requested that the Department of the Army take action to control the blackbird population.

(d) The governor of Tennessee has requested control action against the roosting birds.

(e) The governor of Kentucky has declared a state of emergency for Christian County, due to blackbird depredations from the Fort Campbell roost.

Depredations caused by the blackbirds. These are not limited to agricultural lands and communities near the roost sites. The blackbirds and the roosts have:

(a) Been responsible for aircraft-bird collisions at the Fort Campbell airfield. Flight operations are suspended for 45-90 minutes each morning and evening when the birds cross the runway to and from the roost.

(b) Been responsible for histoplasmosis-positive soil samples at both installations. This is considered to be a health hazard.

(c) Killed 13 acres of pine plantings at Fort Campbell and 12 acres at Milan AAP.

(d) Been responsible for creating noise disturbances to nearby housing occupants.

(e) Been responsible for fouling clothing, cars and children's playgrounds.

(f) Caused many complaints about the roost stench from MAAP workers.

Various analyses of the potential effect of PA-14 on the immediate roost site environments have been made, and no problems have become evident. The material is not persistent and has biodegradable characteristics. There are no lakes, impoundments or permanent streams in or close to the application sites. An intermittent stream is located near the Milan AAP application site, but dilution from any rainfall will reduce the PA-14 concentration far below level of concern before it reaches fish-producing waters. Non-target birds continue to avoid the

roost site, as do mammals and other wildlife, so eye irritation effects of the chemical on animals will not be significant. Humans handling PA-14 will have their eyes protected from splash or falling droplets. Secondary poisoning effects are nil.

Consideration has been given to the effect on the national bird population of conducting concurrent control operations at Fort Campbell and Milan AAP during several seasons of the year (assuming total kill).

If operations were conducted in late November, there would be almost no effect upon the eastern U. S. spring breeding population. There would be slight effect on the spring breeding population if the operations were conducted during January through early February when the roost populations are almost stable. It is conceivable that a further reduction of the blackbird breeding population might occur if control operations were conducted just prior to the spring roost breakup.

Consideration has been given to the effect that applying PA-14 at different times of the year would have on local agriculture, disease, aviation safety and aesthetics. Early application would appear to provide greater protection to local agriculture, prevention of feed losses, prevention of transmissible gastroenteritis in swine, prevention of additional areas positive for histoplasmosis in roost sites, protection of aviation, and general improvement of aesthetics. However, little is known of the potential of roost reoccupation by blackbirds still moving south, or by blackbirds moving into the roost sites from roosts 30-40 miles away if application is made early. This could only be determined by a trial application made early in the roosting year and is not proposed here.

An application of PA-14 made during the period when the roosts are most stable would not protect agriculture from fall losses. Risk of histoplasmosis in roost sites would be greater, since there would be more manure. There would be greater risk of disease in swine.

Applications made in the spring would be less beneficial. All the previously cited damage would have occurred. Community relations would be strained, and as noted above, there could be slight effect on the national blackbird breeding stock population.

The United States Department of the Interior provides national leadership in the area of bird control. Field personnel of the United States Department of the Interior are working with communities and farmers in the Kentucky-Tennessee area toward solution of local blackbird problems. The Department of the Army and the Department of the Interior have cooperated in the pre-treatment phase of the Fort Campbell-Milan AAP control effort.

Consideration has been given to possible effects on the national blackbird population if other blackbird roosts in the Kentucky-Tennessee area were treated concurrently with the Fort Campbell-Milan AAP control operations. Informal reports indicate that roosts at Paducah and Bowling Green, Kentucky and Greenbrier and Pulaski, Tennessee (See Figure 9) may possibly be treated at some time.

With public opinion strongly against the presence of the birds in every area where major roosts coincide with urbanization or intensive agriculture, such widespread control programs may become common in future years. If such programs materialize, impacts on roosting and breeding

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populations will become more serious. Summer habitat may become filled with other species of native birds, and/or the roosting behavior pattern may become less prevalent. In the latter case, blackbirds would remain about as numerous in their summer range but would over-winter in dispersed, small groups, instead of large roosts. This is presently the habit of approximately one-fourth of the national population.

The conclusions are that the Fort Campbell and Milan AAP roosts should be treated with PA-14 during this season no later than mid-February and that information about treatment plans and control results must be exchanged among communities attempting blackbird population management. Applications in future years will depend upon roost reestablishment. If the roosts are reestablished, careful environmental assessments will be made, including: impacts of previous application; new developments in bird population management techniques; the threat to health, aviation and agriculture from the roosts; and location of the roosts. If the assessments indicate that control is necessary and that PA-14 is still the best alternative, the application will be repeated.

Countervailing Benefits of Alternatives

Employment of blackbird alarm/distress calls coupled with the firing of "shell crackers." The technique, applied to a roost and repeated nightly for sufficient time, will cause the birds to seek a different roosting site. The technique is particularly useful in moving a roost from a critical area, such as a family housing site. The roost and

spring breeding population will not be affected, and no chemical load will be even temporarily introduced into the environment. This technique will not reduce agricultural losses, disease potential or satisfy community relations. Its effect on aviation safety will be dependent upon the location of the new roost. While this technique may be used if a roost does develop in a critical area, it is concluded that it is not an acceptable solution to all major aspects of the problem.

Tree thinning. The thinning of pine stands opens a roost to air circulation and appears to make the roost site less attractive to birds. Thinning by both 50 percent and 66 2/3 percent has been successful at Fort Campbell. However, the birds merely move to unthinned pine stands. Even if all pine stands were thinned, there are other trees and brush which would make suitable roosting sites. Use of this technique would not affect the spring breeding population of blackbirds and would not introduce any chemical load into the environment. This technique will not reduce agricultural losses, disease potential or satisfy community relations. Its effect on aviation safety is also speculative. Even though tree thinning will not solve the blackbird problem, thinning is continuing at Fort Campbell. Attempts to contract for tree thinning at Milan AAP have not been successful. Efforts to obtain a contract are continuing.

Trapping. Consideration has been given to trapping blackbirds at the roost sites. Trapping could permit a controlled population reduction to a predetermined level by destroying only a portion of the trapped blackbirds. It would also permit release of any occasional non-target bird which might have been captured. This technique would not affect the blackbird spring breeding population, nor would it place a chemical load into the environment. If the blackbird population reduction obtained was not sufficient to reduce agricultural, economic losses to an acceptable level, additional trappings could be conducted.

While this approach is inviting, there are problems associated with trapping that are overriding. Erection of nets surrounding and covering a 20-30 acre site at night would be most impractical. If it could be accomplished, destruction of the birds would become a problem. Resources for hand destruction are not available and would subject those involved to the ectoparasites and diseases of the birds. Fumigation would require construction of a large enclosure capable of retaining the fumigant until the blackbirds were dead. Also, there is no material registered with the Environmental Protection Agency for fumigation of birds.

Starlicide. Application of the toxicant, Starlicide, near the roost sites offers little chance of blackbird roost population reduction. The blackbirds would have to alter their feeding habits, and there is the risk of drawing non-target birds into the treatment site. Use of Starlicide in feeding lots could help reduce the damage and losses suffered by feedlot operators. If all feedlot operators cooperated in this approach, bird roost populations might be noticeably reduced. Field personnel of the U. S. Department of the Interior are responsible for coordinating with the farmers for the use of Starlicide. USDI field personnel report some initial reluctance by feedlot operators to accept Starlicide because of unsubstantiated fears of secondary poisoning to swine.

Avitrol. Application of Avitrol on military property would not be productive. The blackbirds would have to be drawn into new feeding habits. Distress calls emitted by blackbirds feeding on Avitrol-treated bait would then drive the rest of the flock from the feeding site. Avitrol would have no effect on the size or location of the bird roosts. It could be used by agricultural interests for protecting crops, and guidance on its use for this purpose is available from U. S. Fish and Wildlife Service field personnel.

Other pesticides. Consideration has been given to the application of a number of pesticides to the roost. Pesticides such as parathion, EPN and fenthion would kill the birds, but toxicity is high. Additionally, none of these pesticides are registered with the Environmental Protection Agency for bird roost control.

APPENDIX 1

RESULTS OF BLACKBIRD FOOD HABITS SAMPLING -- FORT CAMPBELL, KENTUCKY AND MILAN ARMY AMMUNITION PLANT

Results presented in this report are based upon data collected on 14 December 1974 and 9 January 1975 at Fort Campbell, KY and 15 December 1974 and 10 January 1975 at Milan, TN AAP. Personal communication, land-based observations, and aerial reconnaissance determined the extent of "blackbird" roosts at both installations. Species composition and distribution were determined by sampling (shotgun) various segments of each roost site between 1715-2015 hours.

Specimens were collected, identified and weighed. Crops and/or gizzards were removed and their contents analyzed, using standard methods for food habit analysis. Food items were dried and weighed to the nearest .0001 gram. Results of crop and/or gizzard contents are presented by percent total aggregate weight for each species on each installation.

Text Figures 3 and 5 illustrate locations of roost sites utilized by blackbirds at Fort Campbell, KY and Milan AAP. Crosshatched lines designate roost areas presently utilized, and single diagonal lines indicate past roost areas.

Sampling of roost sites at Fort Campbell and Milan AAP resulted in the collection of 260 and 328 blackbirds respectively. Grackles (Quiscalus quiscula), redwinged blackbirds (Agelaius phoeniceus), starlings (Sturnus vulgaris), and brown-headed cowbirds (Molothrus ater) were the only species collected at both installations. Species compositions of both installations are indicated in Appendix Table 1.1.

Non-target species were observed only at roost sites at Milan AAP. Red-tailed hawks (Buteo jamaicensis), turkey vultures (Carthartes aura) and a cottontail rabbit (Sylvilagus floridanus) were the only non-target species observed.

Appendix Tables 1.2 and 1.3 present average weights of the four species of blackbirds sampled.

Food habits of the blackbirds at both installations are presented in Appendix Tables 1.4 - 1.11.

Table 1.1

SPECIES COMPOSITION OF BLACKBIRDS

FORT CAMPBELL, KY			MILAN, TN AAP		
	Total No.	% Composition		Total No.	% Composition
Grackles	138	53.1	Grackles	244	74.4
Starlings	66	25.4	Starlings	19	5.8
Redwinged blackbirds	39	15.0	Redwinged blackbirds	57	17.4
Cowbirds	17	6.5	Cowbirds	8	2.4

Table 1.2

AVERAGE WEIGHTS OF SAMPLED BLACKBIRD SPECIES

FORT CAMPBELL, KY

	Total Number	Total Weight in Grams	Average Weight in Grams
Grackles	138	16348.7	118.5
Starlings	66	5724.0	86.7
Redwings (M)[a]	22	1695.6	77.1
Redwings (F + I)[b]	17	1149.8	67.6
Cowbirds (M)	10	556.0	55.6
Cowbirds (F + I)	7	304.8	43.5

[a]Symbols: M = males

[b]Symbols: F + I = females + immatures

Table 1.3

AVERAGE WEIGHTS OF SAMPLED BLACKBIRD SPECIES

MILAN, TN AAP

	Total Number	Total Weight in Grams	Average Weight in Grams
Grackles	244	28770.0	117.9
Starlings	19	1631.8	85.9
Redwings (M)[a]	28	2147.7	76.7
Redwings (F + I)[b]	29	1920.4	66.2
Cowbirds (M)	7	398.8	57.0
Cowbirds (F + I)	1	45.3	45.3

[a]Symbols: M = males

[b]Symbols: F + I = females + immatures

Table 1.4

FORT CAMPBELL, KY

Principal Foods of 138 Grackles
Collected 14 December 1974 and 9 January 1975
(Based on 13 Crops and 136 Gizzards)

Food Item	14 Dec Sample Tot Wt	14 Dec Sample Agg %	9 Jan Sample Tot Wt	9 Jan Sample Agg %	Agg Total Tot Wt	Agg Total Agg %
Corn	47.1660	96.14	71.7829	96.74	118.9489	96.50
Native Seeds	1.1850	2.41	1.2129	1.63	2.3979	1.95
Animal	0.4437	0.90	0.6479	0.87	1.0916	0.89
Miscellaneous Plants	0.2604	0.53	0.5520	0.74	0.8124	0.66
TOTAL SUMMATION	49.0551	99.98	74.1957	99.98	123.2508	100.00

Table 1.5

FORT CAMPBELL, KY

Principal Foods of 63 Starlings
Collected 14 December 1974 and 9 January 1975
(Based on 63 Gizzards)

	14 Dec Sample		9 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	0.2546	4.44	0.8231	3.16	1.0777	3.39
Native Seeds	2.3616	41.20	4.4709	17.18	6.8325	21.52
Animal	0.5921	10.33	4.4777	17.21	5.0698	15.97
Miscellaneous Plants	2.5231	44.02	15.8313	60.83	18.3544	57.80
Wheat	--	--	0.4189	1.61	0.4189	1.32
TOTAL SUMMATION	5.7314	99.99	26.0219	99.99	31.7533	100.00

Table 1.7

FORT CAMPBELL, KY

Principal Foods of 16 Cowbirds
Collected 14 December 1974 and 9 January 1975
(Based on 16 Crops)

	14 Dec Sample		9 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	1.3870	73.32	--	--	1.3870	64.44
Native Seeds	0.1200	6.34	0.0371	14.22	0.1571	7.30
Miscellaneous Plants	0.0215	1.13	0.1062	40.71	0.1277	5.93
Wheat	0.3630	19.19	--	--	0.3630	16.86
Millet	--	--	0.0796	30.51	0.0796	3.70
Sorghum	--	--	0.0380	14.56	0.0380	1.77
TOTAL SUMMATION	1.8915	99.98	0.2609	100.00	2.1524	100.00

Table 1.8

MILAN AAP

Principal Foods of 241 Grackles
Collected 15 December 1974 and 10 January 1975
(Based on 33 Crops and 241 Gizzards)

	15 Dec Sample		10 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	51.2400	94.85	10.8000	97.51	62.0400	95.31
Native Seeds	0.3897	0.72	0.1958	1.77	0.5855	0.90
Animal	0.2982	0.55	0.0804	0.73	0.3786	0.58
Miscellaneous Plants	0.5886	1.08	--	--	0.5886	0.90
Sorghum	1.5025	2.78	--	--	1.5025	2.31
TOTAL SUMMATION	54.0190	99.98	11.0762	100.01	65.0952	100.00

Table 1.9

MILAN AAP

Principal Foods of 19 Starlings
Collected 15 December 1974 and 10 January 1975
(Based on 1 Crop and 19 Gizzards)

	15 Dec Sample		10 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	0.0283	0.68	0.0164	1.30	0.0447	0.83
Animal	0.0894	2.15	0.3511	27.76	0.4405	8.14
Miscellaneous Plants	1.2724	30.69	0.8667	68.52	2.1391	39.54
Wheat	2.5442	61.37	--	--	2.5442	47.03
Millet	--	--	0.0306	2.42	0.0306	0.57
Sorghum	0.0957	2.30	--	--	0.0957	1.77
Cultivated Beans	0.1152	2.77	--	--	0.1152	2.13
TOTAL SUMMATION	4.1452	99.96	1.2648	100.00	5.4100	100.01

Table 1.10

MILAN AAP

Principal Foods of 45 Redwinged Blackbirds
Collected 15 December 1974 and 10 January 1975
(Based on 45 Crops)

	15 Dec Sample		10 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	3.9349	30.44	0.4687	9.99	4.4036	24.30
Native Seeds	4.7030	36.39	2.3267	49.59	7.0297	39.31
Animal	0.1959	1.51	0.0584	1.25	0.2543	1.44
Miscellaneous Plants	1.6571	12.82	1.4978	31.92	3.1549	17.91
Wheat	--	--	0.2309	4.92	0.2309	1.31
Millet	0.0915	0.71	0.0267	0.57	0.1182	0.67
Sorghum	2.3402	18.10	0.0829	1.77	2.4231	13.76
TOTAL SUMMATION	12.9226	99.97	4.6921	100.01	17.6147	98.70

Table 1.11

MILAN AAP

Principal Foods of 8 Cowbirds
Collected 10 January 1975
(Based on 8 Crops)

	15 Dec Sample		10 Jan Sample		Agg Total	
	Tot Wt	Agg %	Tot Wt	Agg %	Tot Wt	Agg %
Corn	--	--	1.3548	53.58	1.3548	53.58
Native Seeds	--	--	0.0831	3.29	0.0831	3.29
Miscellaneous Plants	--	--	0.4233	16.74	0.4233	16.74
Millet	--	--	0.5730	22.66	0.5730	22.66
Sorghum	--	--	0.0942	3.73	0.0942	3.73
TOTAL SUMMATION	--	--	2.5284	100.00	2.5284	100.00

NOTE: No birds of this species were taken on 15 December 1974.

APPENDIX 2

DOCUMENTATION OF AGRICULTURAL LOSSES

Rural residents of the areas around Fort Campbell and the Milan AAP have consistently claimed agricultural damages during the six winters that these roosts have maintained major populations of blackbirds. Estimates of the importance of these losses have varied by several orders of magnitude. In an attempt to obtain uniform, if not completely unbiased, reports of this damage, requests were made in both the Hopkinsville, Kentucky and Milan, Tennessee areas for reports of specific damage. These requests were made over local, low-power radio stations, and reports were compiled in Hopkinsville by the Diagnostic Laboratory of the Kentucky Department of Agriculture, and in Trenton, Tennessee by the Gibson Agricultural Extension Service.

Two hundred reports were made to the Hopkinsville center during two working days following the radio announcements. Geographic locations of farms reporting damage are shown in Appendix Figure 2.1. Types of damage are further classified in Appendix Table 2.1, which includes some approximation of dollar loss. It is worth noting that this map clearly shows some tendency for the damage to be centered near the Fort Campbell roost, even though the radio broadcast may be assumed to have been equally audible in all directions from Hopkinsville. Since some farms reported two more types of losses, the number of persons reporting damage was somewhat less than the number of reports enumerated.

A similar program undertaken at the same time in Gibson County, Tennessee recorded calls of complaint from 462 persons between 1400 hours

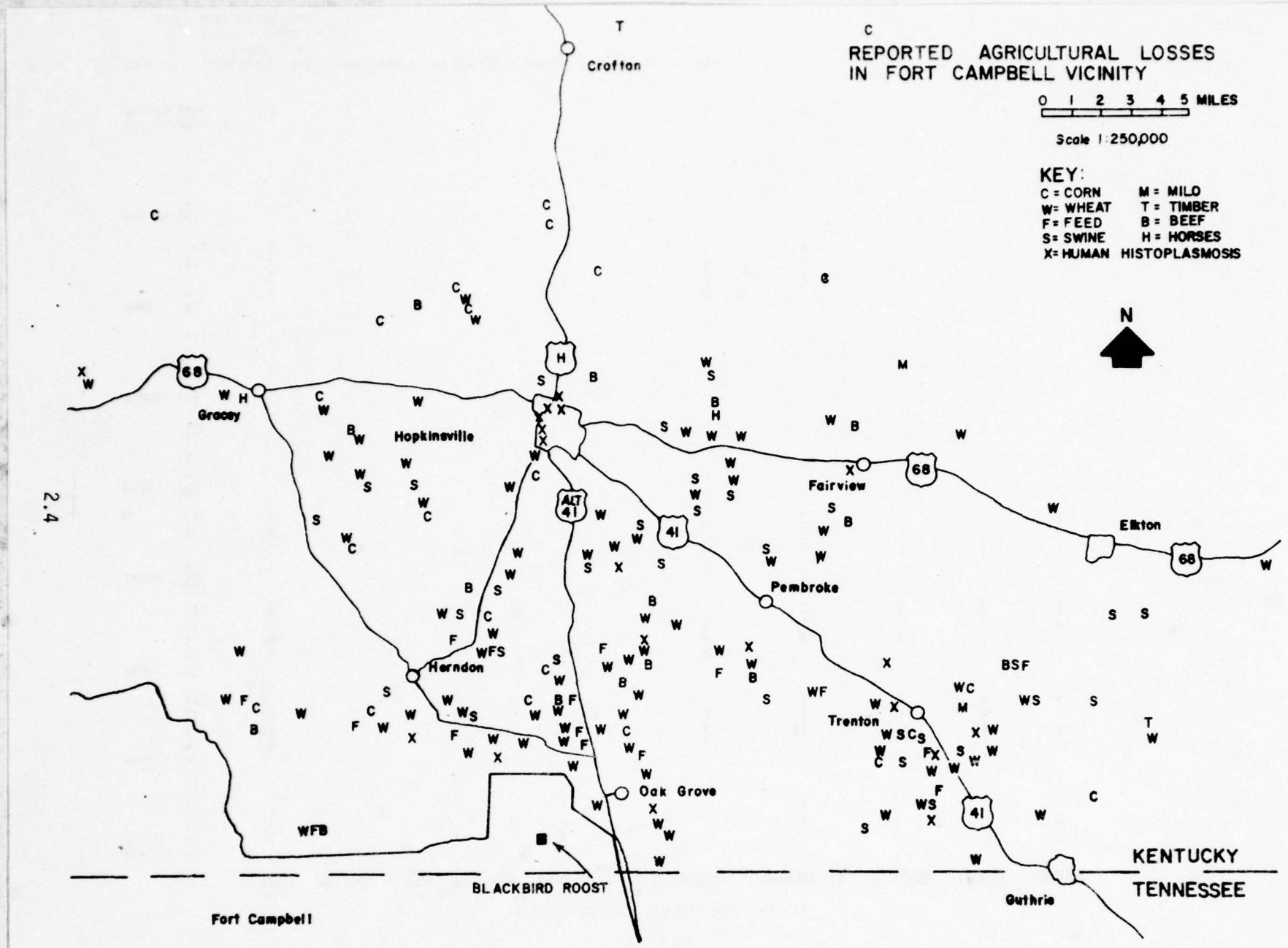
14 January and 1200 hours on 16 January. Of these, 94 farmers were able to reasonably place accurate dollar losses on damage they considered to be "major." Locations of their farming operations are shown in Appendix Figure 2.2. A verbal description about the nature of the loss is included in Appendix Table 2.2, where the numbered statements correspond to the numbered locations on the map. Some persons reported losses at more than one location, but each number represents one location rather than one type of loss. The sites show about the same tendency to cluster near the roost as do the reports from the Fort Campbell vicinity.

Table 2.1

CROP AND ANIMAL LOSSES -- FORT CAMPBELL

		TOTAL	CROFTON	ELKTON	FAIRVIEW	GRACEY	GUTHRIE	HERNDON	HOPKINSVILLE	OAKGROVE	PEMBROKE	TRENTON
Corn	(C)											
	*	5	2			1	2					
	I	7							5			2
	II	7				1		2	4			
	III	1	1									
Wheat	(W)											
	*	6				1	3	2				
	I	28		1	1			5	11	3	3	4
	II	19		1		1		3	4	4	3	2
	III	31							8	9	8	6
Feed	(F)											
	*	6	1			3		2				
	I	20						4	8	6	2	
	II	9						1	4		2	2
	III	9							3	1	2	3
Swine	(S)											
	*	1						1				
	I	5							2	1	1	1
	II	10				1			3	1		5
	III	5							3			2
Milo	(M)											
	*											
	I											
	II											
	III	1		1								
Timber	(T)											
	*											
	I	1	1									
	II											
	III	1							1			
Beef	(B)											
	*	2						2				
	I	5						1	2	1		1
	II	2						1	1			
	III	4							2			2
Horses	(H)											
	*											
	I											
	II	1							1			
	III											
Histoplasmosis People Sick		14		1				1	6			6

Key: * = Individuals interviewed could not estimate damage in a dollar figure.
I = 0 - $1000 loss
II = $1001 - $5000 loss
III = over $5000 loss



2.4

APPENDIX FIGURE 2.1

TABLE 2.2

BLACKBIRDS

1. Contaminated feed, destroyed 6 acres of corn; 25% of feed lost.
2. Replanted 22 acres of corn 3 times.
3. Destroyed several acres of soybeans.
4. Ate 7 acres milo (yield from entire crop was only 50 bushels); destroyed 18 acres of corn, sorghum and wheat planted to silage.
5. Completely ruined 15 acres of corn.
6. Ruined 7 acres of corn; shoots at the birds while animals (hogs and horses) eat.
7. Has 350-400 hogs that are sick with a virus caused by blackbirds; hogs have lost weight; 25% of feed lost or damaged.
8. 3 1/2 acres of corn (first planting) eaten by birds; after second planting, most of the crop was destroyed.
9. 200 head of cattle on feed have severe scours caused by blackbirds; scours greatly reduce the rate of gain; birds consumed and contaminated 25% of feed.
10. 25 small pigs and 5 large hogs died; birds damaged 50% of 30 acres of wheat and 100 bushels of corn.
11. Birds have eaten about $100 worth of corn each year for the past 2 or 3 years.
12. Lost 50% of 15 acres, corn crop; destroyed 5 of 10 acres of wheat.
13. 200-300 hogs have had diseases which veterinarian says is caused by the birds; disease greatly reduced rate of gain; 25% of feed was consumed and contaminated; cost was between $2000 and $3000 for feed loss and medicine.

14. Lost 160 baby pigs; best hogs lost around $500 due to disease; at least $500 damage to corn.
15. 5 calves died which veterinarian has attributed to bird-carried disease; birds destroyed corn left in field, at 1/2 of 8 acres; has to enclose animals inside to feed.
16. Had 48 sows and has had to sell all but 3 or 4 because of disease from birds; in 1974, lost about 200 pigs; ate much corn.
17. Birds are eating corn in barn and are pulling up wheat from a 10-acre field; 20% of corn in crib has been destroyed.
18. Uses approximately 500 lbs. of cattle feed per day; birds get into feed and mess it up; cattle now have disease; estimated losses are $5 per day.
19. Birds swarm his and his neighbors' cattle; neighbor's cattle have blackleg; can no longer feed crushed corn because birds eat it and ruin what is left.
20. Birds are completely destroying 4 acres of grain sorghum.
21. 50% damage to 30 acres of milo.
22. Had 146 pigs and lost to TGE; remainder are no good; had 40 acres of milo with 100% destruction.
23. Lost 52 pigs and 100% of corn in crib; was in hog business, but now is going out of business; birds destroyed 100% of 8 acres of corn.
24. Planted 15 acres of corn 5 times, and the birds destroyed all that was planted.

25. Feeding 100 hogs, with 30% feed lot loss.

26. Feeding 300 laying hens, with 35% feed loss.

27. Corn, wheat, hog losses valued at $2,500.

28. Lost 100% of pig crop, January 1974; 25% hog feed lot lost; 4 sows died from infestation.

29. 400 head of hogs, corn and supplement sustained 25% loss; 60 acres of wheat of 30/bu/acre was 20% damaged; wheat was pulled up as it sprouted.

30. 50 pigs dead, 50 more dying resulting in $200 of medicine and 50 hrs. labor; 400 cattle feeding on silage; 500 cattle on feed - supplement and are getting all grain out of silage at a 20% loss.

31. Had 65 pigs -- lost 30 to TGE, January 1975.

32. Feeds pigs for feeder pig sales (usually around 250-300 at a time); birds consume and contaminate more feed than the pigs; lost 25 pigs.

33. Lost 400 pigs to TGE, January 1, 1975; 200 pigs have scours.

34. $600 damage to feed and crops.

35. 10,000 birds or more each day are eating grain fed to cattle; estimate damage $20 to $25 per day over a 4-month period each year for the past 3 years; has some sick cattle.

36. 6 cows lost calves because of birds roosting in the barn; 3 acres of corn had to be planted 3 times, and birds destroyed all of it.

37. Birds eating hog feed (100 head on feed); estimate $36 loss per week since November 15, 1974.

38. Damaged 50% of 100 acres of wheat.

39. 100% destruction of 65 acres of corn (100 bu. per acre).

40. 100-acre wheat crop was 100% destroyed.

41. 100 acres of corn were 75% destroyed in field before harvest.

42. 50 acres of corn were 40% destroyed.

43. 25% loss of cattle feed.

44. 2 head of cattle lost in 1974, others sick; cost included 400 pounds of terramycin feed supplement.

45. 100 hogs lost.

46. 25% cattle feed loss.

47. 1,000 hogs on feed with 25% feed loss.

48. 500 hogs on feed with 20% feed loss.

49. 2,000 hogs on feed during winter months with 25% feed loss.

50. 25% of 35 acres of corn were eaten by birds in October 1974; birds are eating hogs' food.

51. 500 hogs on feed with 30% feed loss; disease cost $10/head.

52. Birds ate feed for 12 head of cattle; destroyed 6 acres of corn.

53. Can't feed hogs; birds are eating all corn in crib.

54. 14 acres of corn were replanted, with only part of 5 acres saved.

55. Feeding 30 market hogs; 15 pigs were lost, destroyed 50% of corn in ear; replanted corn for the third time.

56. Can't feed creep feed to feeder pigs; birds are also going into the barn and eating in the crib.

57. Destroyed 2 acres of corn.

58. 100% loss of 5 acres of corn.

59. $1,000 in last 3 years lost on hogs; birds are eating corn in crib.

60. Estimated damage of $1,300 to hogs, feed and crops.

61. Estimated damage of $5,000 to feed and crops.

62. $4,000 damage to feed and crops.

63. $10,000 damage to feed and crops.

64. $15,000 damage to feed and crops.

65. $800 loss to crops.

66. $500 loss to feed and crops.

67. $4,000 damage to feed and crops.

68. $800 damage to feed and crops.

69. $2,000 damage to hogs, feed and crops.

70. $500 damage to crops.

71. $1,000 damage to feed and crops.

72. $1,500 loss on hogs, medicine, feed and crops.

73. $600 damage to feed and crops.

74. $1,800 loss to feed and crops.

75. $1,500 damage to feed and crops.

76. $1,000 damage to feed and crops.

77. $1,000 damage to cattle, feed and crops.

78. $5,000 damage to hogs, cattle, crops and feed.

79. $1,500 damage to cattle, crops and feed.

80. $200 damage to cattle, crops and feed.

81. $1,000 damage to cattle crops and feed.

82. $3,500 damage to cattle, crops and feed.

83. $4,000 damage to cattle, crops and feed.

84. $1,000 damage to cattle, crops and feed.

85. $1,000 damage to cattle, crops and feed.

86. $1,000 damage to hogs, cattle and feed.

87. $800 damage to hogs, cattle, crops and feed.

88. $900 damage to hogs, cattle, crops and feed.

89. $1,500 damage to hogs, cattle, crops and feed.

90. $2,500 damage to hogs, cattle, crops and feed.

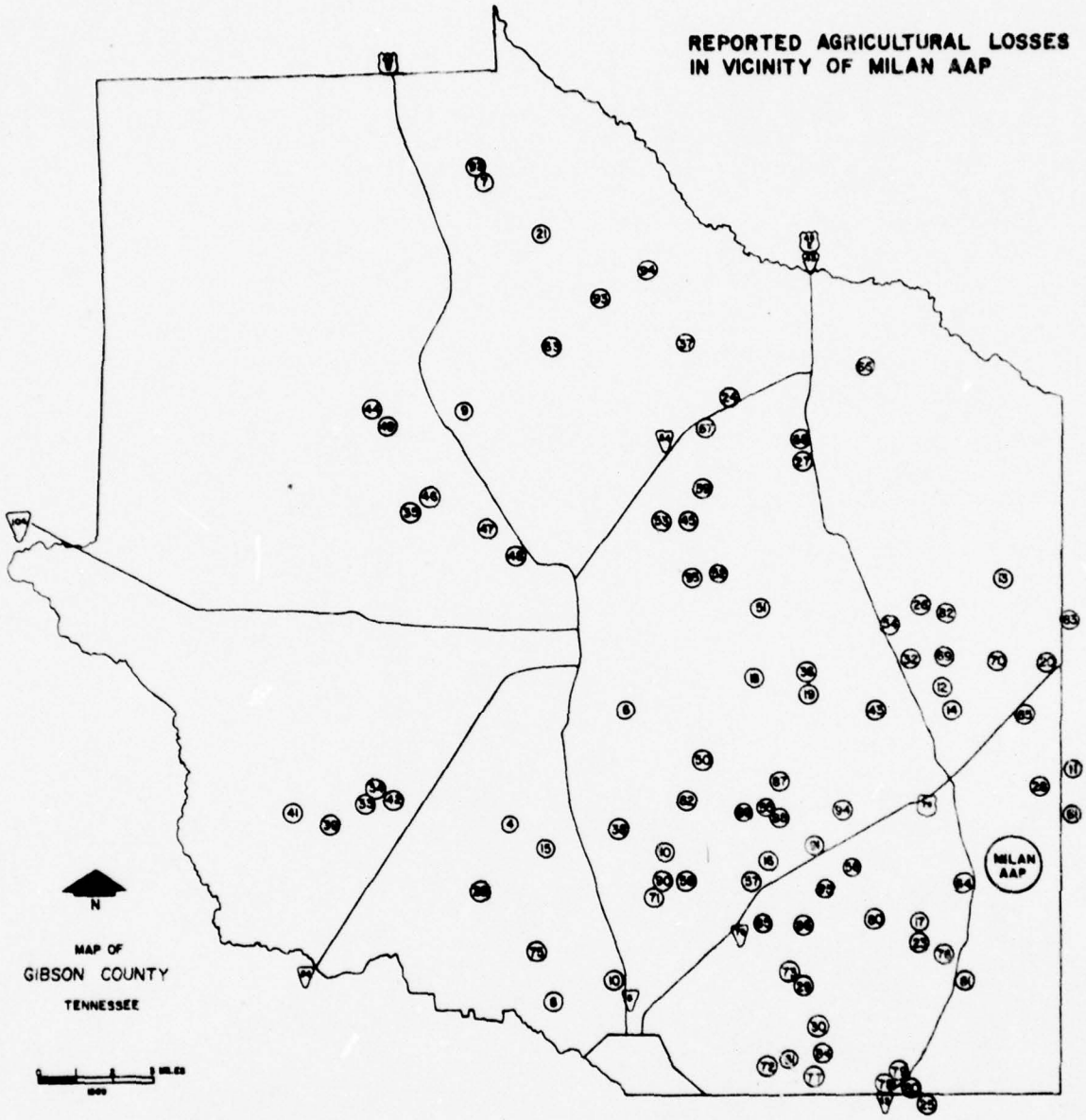
91. $1,500 damage to hogs, crops and feed.

92. 4,000 head hogs are fed during winter months with 2% death loss from birds; feed loss was 20%.

93. Destroyed 100% of 12 acres of corn.

94. Feeding 200 head of cattle 1,000 pounds of silage; half of it was consumed or contaminated in silo; 20% feed loss.

Estimates given by individuals include: Loss of pigs and grown hogs, wheat, milo, corn, crushed feed for hogs and cattle, silage for cattle, doctor bills and medicine for diseased animals.



APPENDIX FIGURE 2.2

APPENDIX 3

REPORT SUBMITTED TO CERL FROM THE
U.S. ARMY SURGEON GENERAL

The primary public health hazard associated with starling and blackbird roosting areas is histoplasmosis in its various forms. These forms of histoplasmosis include benign, acute pulmonary, chronic pulmonary, disseminated and ocular. The causative organism is the fungus (Histoplasma capsulatum). This appendix will describe:

1. The organism, its endemicity and relationship with bird excreta.
2. The forms of histoplasmosis and its extent in human populations.

Organism

Histoplasma capsulatum is a dimorphic fungus existing in mycelial or mold form in the soil and in an asexual yeast form in infected animals, including man (1).

In soil, its principal reservoir, the vegetative (mycelial) form has been isolated to a depth of 25 inches. However, it primarily inhabits only the top several inches with prevalence decreasing rapidly below 10 inches (2).

Two types of spores are produced by this phase of H. capsulatum, macroconidia and microconidia, of which only the microconidia are infective for animals (1). The infective conidiospores have been found in the top 0.3 inches of soil cover (2). Upon infection of man or other animals, the form changes to the yeast phase during which no infective

spores are formed. The occurrence of spores in nature and the lack of spores in its parasitic (infectious) phase demonstrates that the organism is saprophytic (free-living) in the soil (3) and has no requirement to infect man or animals to survive. Thus, human or animal infection may be only accidental to the life-cycle of H. capsulatum. Further, the failure to produce infective spores in an infected host explains the lack of person-to-person or animal-to-man communicability.

Surveys have shown that H. capsulatum is widely distributed throughout the world. It probably can be found in all of the major river valleys between 45^{o} latitude north and 45^{o} latitude south. In the United States the infection is most prevalent in the Mississippi River Valley and its tributary valleys. In this area, skin tests show the prevalence of infection from 70 to 90 percent, and it decreases radically from this central area (4,5).

Nonetheless, soil samples taken in these areas of endemicity have shown a somewhat spotty distribution. While it may be isolated from one area, samples taken within a few feet away have not yielded any isolations. A question has been raised concerning the meaning of a negative soil sample. Are there no fungi, or are these simply too few to be isolated by present techniques? (5) An answer has not been determined.

Much research has been done to determine the epidemiology of H. capsulatum in soil since its isolation in 1949. The soils of endemic areas are quite variable in all respects. It can grow with as little as 2 percent moisture content, with the soil types ranging from sandy loam to hard clay.

It does not survive long, however, at temperatures above 40°C (104°F) if moisture content is 2 percent or below. The soil pH can range from 5.0 to 10.2 (2).

During the past ten years, starling-blackbird roosts have been found to be important sources of histoplasmosis. It has been shown that the feces of some birds, chickens and bats have been identified as contributing to the growth of the organism. While these birds do not become infected or carry the organism due to their body temperatures, it has been suggested that the droppings may condition the soil in such a manner that H. capsulatum gains a differential advantage over the other soil micro-organisms and thus is able to grow vigorously and compete successfully. (3) Chin, et. al. (4) has shown that the longer a roosting site is used by the birds, the higher the probability of recovering the organism. This increase occurs after three years. There appears to be a significant relationship with the number and size of roosting sites and the percentage of histoplasmin reactivity. This test identifies exposure and infection with the organism.

Disease

Histoplasmosis is a systemic mycosis with the primary lesion usually in the lungs. Infection is common but clinical disease uncommon, occurring in less than 1 percent (10). While there is some disagreement with the classification of forms of this disease, the following extracted from Control of Communicable Disease in Man, 11th Ed. 1970, pg. 114 (11) is useful.

Five clinical forms are recognized:

a. Asymptomatic: Detectable only by acquired hypersensitivity to histoplasmin. Calcification of primary lung lesion may occur.

b. Acute benign respiratory: Probably common in endemic areas but easily overlooked; varies from mild respiratory illness to temporary incapacity with general malaise, weakness, fever, chest pains, dry or productive cough. Erythema multiforme may occur. Recovery is slow and spontaneous, with or without multiple, small scattered calcifications in lung, hilar lymph nodes and spleen.

c. Acute disseminated: Varying degrees of hepatosplenomegaly, with septic-type fever, prostration, typically exhibits rapid course. Often resembles miliary tuberculosis. Most frequent in infants and young children. Without therapy, usually fatal.

d. Chronic disseminated: Symptoms variable depending on organs infected. May be present as unexplained fever, anemia, patchy pneumonia, hepatitis, endocarditis, meningitis, or muscosal ulcers of mouth, larynx, stomach

or bowel. Adrenal infection common but usually asymptomatic. More common in the adult male. Cytotoxic and corticosteroid therapies predispose. Course usually subacute with variable progression over weeks up to a few years, usually having fatal outcome unless treated.

e. Chronic pulmonary: Clinically and radiologically resembles chronic pulmonary tuberculosis. More common in males over 40 years old. Disease progresses over months or years, with periods of quiescence and sometimes spontaneous cure. Death may result from respiratory insufficiency or cor pulmonale.

Numerous local epidemics and isolated cases have been demonstrated to be related to starling-blackbird roosts (3,4,7-10,12). While a majority of identified infected individuals fell into the asymptomatic and benign pulmonary classifications, some individuals did progress to the disseminated form.

In a study performed by Tosh, et. al. (7), it was shown that the distance from a starling-blackbird roost was directly related to the histoplasmin reactivity. This occurred even though the area was not disturbed by a cleaning operation or construction. He states "the findings of this investigation suggest that large blackbird roosts that contain H. capsulatum and are located in urban areas contribute significantly to the cutaneous reactivity to histoplasmin observed in children residing or attending schools near the roost. Only a few children were reported to have been on the sites of the roosts. Prevailing winds or windstorms might be sufficient to disseminate the spores of H. capsulatum throughout

the immediate vicinity of the roost. In addition, the movement of thousands or millions of birds in and out of a roost might create sufficient air currents to produce airborne dissemination of the infectious spores. Regardless of the method of spread, the fact remains that individuals residing in the vicinity of the roost are exposed to the infectious agent."

Within the past 10 years, it has been discovered that histoplasmin reactivity may be related to hemorrhagic disciform disease of the eye and chorioretinal scars (13-17). While the pathogeny of this relationship is unknown, it has been estimated that between 2.6 to 8 percent of identified histoplasmin-positive individuals have evidence of chorioretinal injury (16-17).

Conclusion

From the medical hazard viewpoint, there is a distinct potential for the spread of histoplasmosis at Fort Campbell for the following reasons:

1. Fort Campbell is located in the area of highest endemicity of H. capsulatum in the United States.

2. Starling and blackbird roosts on the post create enriched growth conditions in the soil for H. capsulatum.

3. The roost has been utilized for longer than three years, thereby increasing the concentration of H. capsulatum.

4. Even though the roost area is off limits, evidence from other epidemics shows a direct relationship with histoplasmin sensitivity.

5. No attempt to reduce the danger could be expected without disrupting the bird roosts.

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APPENDIX 4

PA-14 CHEMICAL NATURE AND PROPERTIES

PA-14 is a nonionic surfactant derived by reacting ethylene oxide with a mixture of linear secondary alcohols having 11 to 15 carbon atoms per chain.

e.g. $CH_3(CH_2)_6 - \underset{\underset{(CH_2)_5CH_3}{|}}{CH} - O - (CH_2 - CH_2O)_8 - CH_2 - CH_2OH$

The long chain alcohol (left moiety) renders this half of the molecule hydrophobic while the polyethoxylene portion is hydrophilic. The effect of adding an agent to a liquid reduces its surface tension or lowers the interfacial tension between two liquids. Some of the properties of this substance are:

Molecular weight: 596

Pour point: 13°C

Specific gravity: 1.006 (20/20°C)

Surface tension: (0.1% aqueous sol.): 29 dynes/cin

Apparent viscosity (cstk)	20°C	86
	40°C	36
	100°C	7

pH (1% aqueous solution): 6 to 8

Biodegradability

Linear secondary alcohol ethoxylates were found to be "efficiently biodegraded under a range of environmental conditions".[1] Tests were made using the Warburg Respirometer (manometric technique), River Die-Away Tests

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[1] Conway, R. A. & Gene & Waggy, American Dyestuff Reporter, Aug 1, 1966.

(surface tension and surfactants [CTAS] measured) Bioassay, BOD, Anaerobic die-away, Activated Sludge, trickling filter, lagoon-treatment and shake culture tests.

Biodegradation can occur by several mechanisms. β-oxidation of the linear alkyl chain and methyl oxidation of terminal methyl groups are important. The Polyoxyethylene chains are believed to be degraded by carboxylation and hydrolysis to split off glycol units.[2] Residual Polyoxyethelenes, while not degraded as rapidly as some compounds, are not surfactants.

Carbon-14 labeled ethoxylate chains were used in determining the rate of degradation of the PA-14 showing 10 to 21 percent degradation of the ethoxylate chain in 20 days at 27°C, and 1 to 7.5 percent degradation in 20 days at 15°C for two river waters tested.[3]

Common soil sorbents were tested and were not found to substantially remove PA-14; however, bacterial surfaces and peat or humic acid derivatives possessed high capacity to remove surfactants. This suggests that soils high in organic material might function as good sorbents.

Repeated application could saturate the absorbing capacity of the soil, but apparently PA-14 is also degraded in aqueous systems.

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[2] Osburn, O. W. & J. H. Benedit, J Arn, Oil Chemists' Soc 43, 141 (1966).

[3] Wayman, C. H., "Biodegradation of Surfactant Compounds", Bureau of Sport Fisheries and Wildlife Contract No. 14-16-0008-940.

Toxicity of PA-14

Single Oral LD_{50} in Rats:	2.38g/Kg[4]
Single Skin Penetration LD_{50} in Rabbits:	2.00 ml/leg
Primary Skin Irritation in Rabbits:	slight
Least Percent Concentration in Water Causing Significant Injury in the Rabbit's Eye:	1% serious

Toxicity to Fish (bluegill, sunfish, channel catfish, golden shiners) LC_{50} = 3.0-6.2 mg/l. (Static bioassay on young fish.[5])

Oral LD_{50} for redwinged blackbirds was found to be 550 to 600 mg/kg. No abnormal reactions were found when applying PA-14 to the feet of birds.[6] The possibility of secondary poisoning (birds of prey feeding on treated blackbirds) has been investigated. The acute oral median lethal dose was determined to be 6.3 gms/kg, and it was concluded that at a dosage rate of 20 gallons of PA-14 per acre, little or no danger of secondary poisoning of hawks would exist.

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[4] "Tergitol Surfactants," Union Carbide, New York, New York, 1970.

[5] Inglis, A. J., R. T. Mitchell and J. V. Riffle "Toxicity of Seven Surfactants to Fish in the Laboratory, 1967," Patuxent Wildlife Research Center, U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Division of Wildlife Research.

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APPENDIX 5

AFZBDPT-CM 25 September 1974

MEMORANDUM FOR: LTC MOELLERING

LTC PARSONS

COL MAHAFFEY

SUBJECT: Opn Starling

1. CPT Stonebraker was told by COL Peach, DFAE on approximately 1 September that the Command CBR Group would be required to provide the primary spray rig device for Operation Starling during 1974-1975. This mission was orally briefed to LTC Parsons.

2. The Command CBR Group had been given the back-up mission during 1973-1974, and the primary capability was provided by a civilian contractor. The back-up system that was constructed last year had several significant deficiencies, the most significant of which were approximately 11 minutes of valve open time required to vent the tank, and the relative complexity of the system.

3. A very simplified system has been designed for this year's mission; see draft charts and calculations as Inclosures 1-5 attached. Although several modifications have been made to the original design, the basic concept of the equipment has not changed.

4. On 23 September, the apparatus was filled with water on the ground and successfully vented in 30 seconds. The difference between the theoretically possible venting time of approximately 9 seconds and the actual venting time of 30 seconds was caused by one inaccurate assumption (height of fall) (assumed 4 ft, actual approx 3 ft) and by frictions and inefficiencies in the design which were known to exist but could not be calculated.

5. There is a valve device on the apparatus which will permit slower rates of venting, i.e., 40, 50, 60, 75, 105, and 120 seconds. These slower rates may be desirable depending upon the required rapidity of the spraying operation.

SUBJECT: Opn Starling

6. On 25 September, the apparatus was mounted in a UH-1 series aircraft, and initial tests were conducted from the air. The device was initially tested for airworthiness with no problems encountered. Subsequently, the device was filled with water and again airworthiness was evaluated and no problems noted.

7. The apparatus was then operated in the vicinity of Range Road and 18th Street. The venting of the apparatus occurred in 25 seconds; this difference between the ground and the air venting of the apparatus is possibly caused by a limited venturi effect achieved during aerial dispersion. The wind was at 240° and eight kts at the time of dispersion. The flight altitude was 150 ft and the speed was 80 kts. The dispersion created a swath of water 90 feet wide. On the upwind side, a strip of approximately 10 feet was minimally covered; a center strip of approximately 40 feet was heavily covered, and a downwind strip of approximately 40 feet was minimally covered. The spray was completely broken up by the rotor wash of the aircraft and appeared as a fine mist as the water hit the ground.

8. Because the water pressure decreased as the tank emptied, it is relatively difficult to perceive the point at which the tank is empty. The major portions of the water gush out for approximately 25 seconds, and the remainder dribbles out up to approximately 45 seconds.

CF: Col Peach, DFAE

5 Incl
As Stated

PETER W. STONEBRAKER
CPT, CM
Actg Chief, Comd CBR Gp

Length of Swath/Time of Swath Calculations

Airspeed Along Swath (kts)

	60	70	80	90	100
Time (min for one km)	.54	.46	.4	.36	.325
Time (sec for one km)	32	28	24	22	19

Seconds to Vent	Airspeed Along Swath (kts)				
	60	70	80	90	100
30	.94*	1.07	1.25	1.36	1.58
40	1.25	1.43	1.68	1.72	2.10
50	1.56	1.78	2.08	2.26	2.62
60	1.94	2.15	2.50	2.73	3.15
75	2.35	2.68	3.15	3.42	3.95
90	2.8	3.2	3.7	4.1	4.7
105	3.3	3.7	4.4	4.8	5.5
120	3.7	4.3	5.0	5.5	6.3

* At the above aircraft airspeeds with the above efficiencies of the apparatus (seconds to vent), the swath will be this number of kilometers in length if the valve is held open until the tank is empty or nearly empty.

FLOW RATE CALCULATIONS

1. Torricelli's Equation

$v = \sqrt{2GH}$ where v = velocity of flow
G = acceleration of gravity
H = height of fall

$G = 32\ ft/sec^2$ for water

$H = 4$ ft - Assumed from the design of the tank.

$$v = \sqrt{2 \cdot \frac{32\ ft}{sec^2} \cdot 4\ ft}$$

$$v = \sqrt{\frac{256\ ft^2}{sec^2}}$$

$v = 16$ ft/sec

2. Area of a pipe

$A = pi\ R^2$ where A = Area
pi = 3.1417
R = the inside radius of the smallest pipe, assumed = 3"

$A = 3 \cdot 3 \cdot 3$

$A = 27/144 = 1/5\ ft^2$

3. Bernoulli's Equation

$R = vA$ where R = flow rate
v = velocity of flow
A = cross sectional area of pipe

$$R = \frac{16ft}{sec} \cdot \frac{1}{5}\ ft^2$$

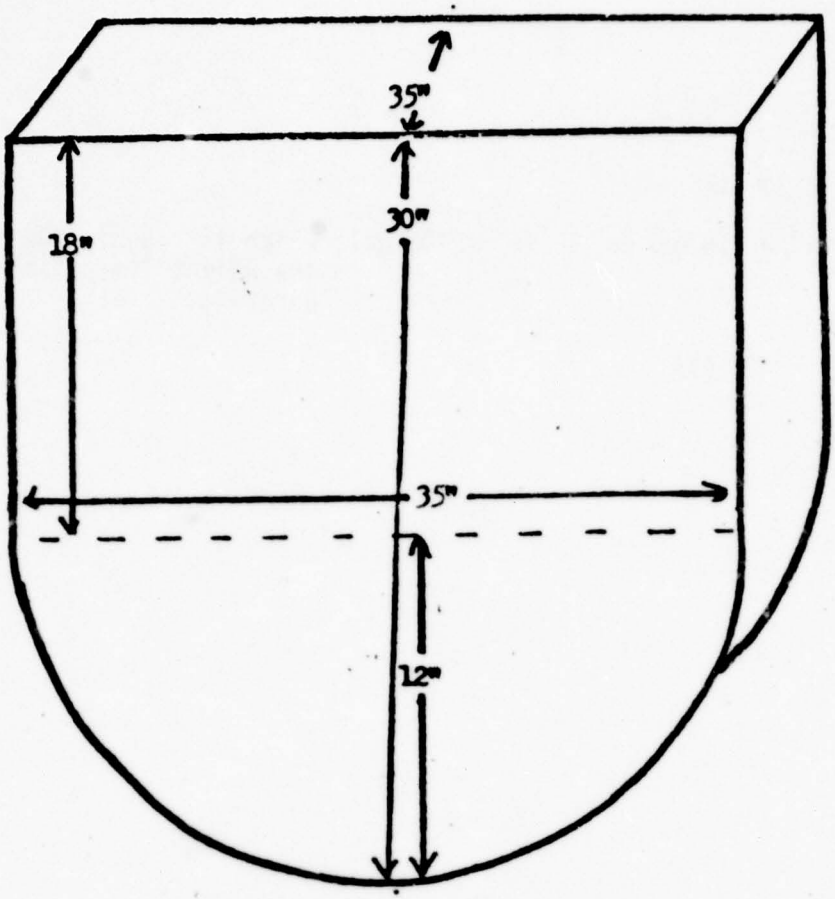
$R = \frac{3\ ft^3}{sec}$ or at 18 sec = $54\ ft^3$ (at 9 sec = $27\ ft^3$)

4. Gallons - Cubic Feet

1 gal = 231 in^3

1728 in^3 = 7.5 gal or 54 ft^3 = 405 gal, which is roughly 200 gal above the weight limitation of the aircraft.

27 ft^3 = 202 gal



Volume = Volume of rectangle + Volume of 1/2 cylinder.

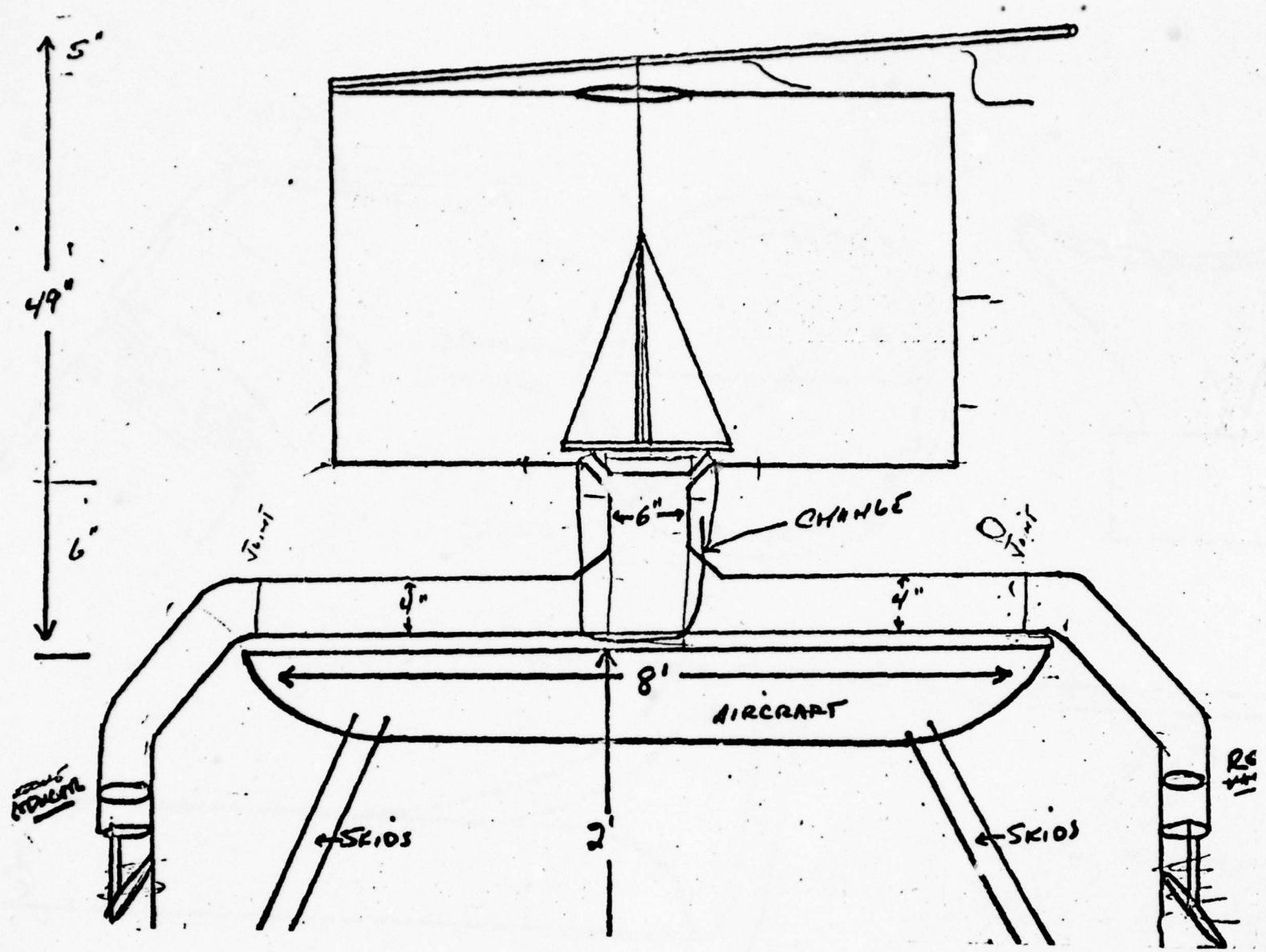
$V = lwh + \frac{pi\ r^2 h}{2}$ R = 12"; R' = 17 1/2"
Average R = 15"

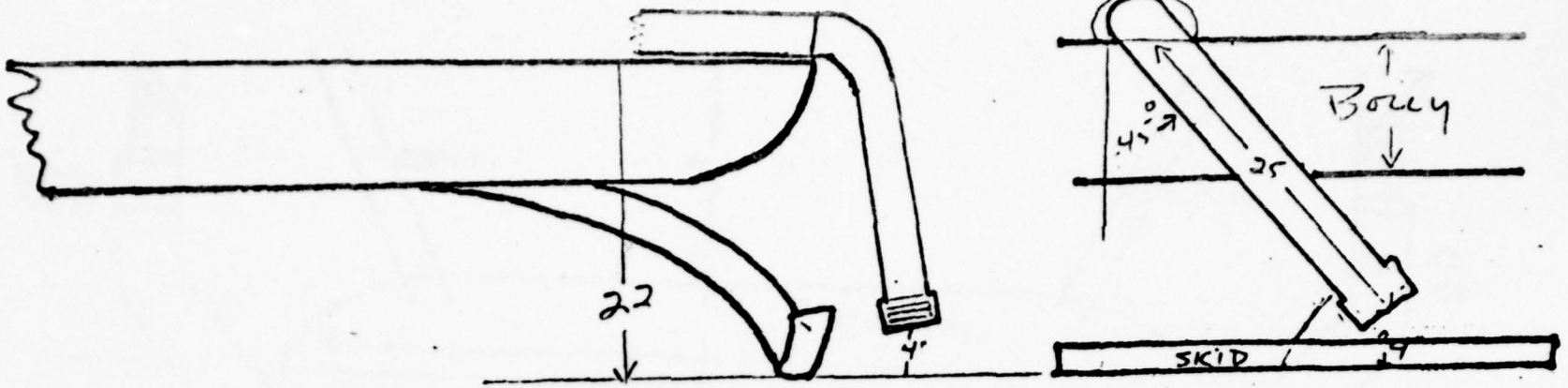
$V = 35 \cdot 35 \cdot 18 + \frac{3 \cdot 15 \cdot 15 \cdot 35}{2}$

$V = 22050 + 11811$

$V = 33861\ in^3$ or $19.5\ ft^3$

At 7.5 gal/ft^3, capacity = 146.25 gal.


5"
49"
6"
6"
CHANGE
3"
4"
8'
AIRCRAFT
SKIDS
2'
SKIDS


22
4"
BOLLY
45°
25
SKID
4"

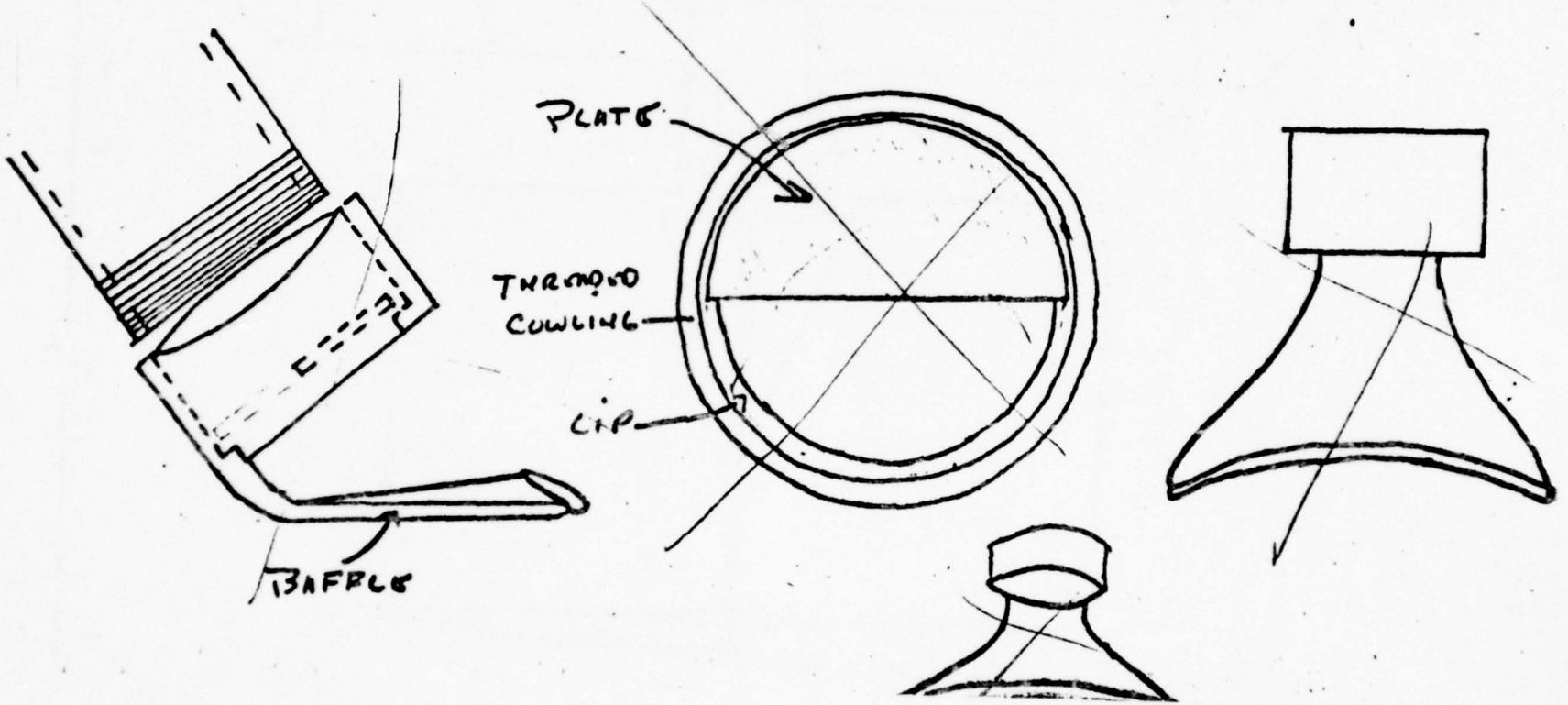


PLATE
THERMOD
COWLING
LIP
BAFFLE

APPENDIX 6

PLANNED TESTS TO DETERMINE ENVIRONMENTAL EFFECTS OF REPEATED APPLICATIONS OF PA-14

Several comments pointed out that data were not given regarding effects of repeated applications of PA-14 on the environment. This information is not available, and the Army proposes to conduct a series of tests which will develop the needed data. The tests will be conducted on a 1 1/2 acre plot located at the edge of the Fort Campbell roost area. See Map Appendix Figure 6.1. Up to nine applications will be made to this experimental acreage. Test applications will be made in accordance with the use pattern designated by EPA registration.

Should a significant kill result from carrying out this procedure, it will be repeated from one to eight additional times when suitable temperature conditions develop, either as a separate operation or in conjunction with the treatment of the entire roost area. (See Appendix Table 6.1) The number of repetitions will be dependent upon the occurence of (1) suitable temperature and flying conditions; (2) blackbirds continuing to use the site as a roost; and (3) the acceptable population level previously described, and (4) the availability of the chemical and sufficient manpower.

Careful monitoring of such a project will provide data which can be used to assess effects of repeated applications on various segments of the local environment (i.e. soil, water, loblolly pine trees, etc.). Furthermore, agencies interested in blackbird population control could be invited to send representatives to observe one or more of the opera-

tions and be briefed by Fish and Wildlife Service personnel about the techniques used.

This method will require fewer men at a given time to pick up the carcasses, should this be necessary, based upon criteria established for carcass collection. If required, it will allow the workload to be spread over a longer time period (i.e., only 120,000 carcasses would have to be picked up in one day, as opposed to 2 million if a significant kill resulted from spraying the entire roost at one time.) Overall cost of carcass recovery would not change.

Table 6.1

FORT CAMPBELL, KENTUCKY PA-14 APPLICATION SCHEDULE[1]

Application	Area Treated[2]	Acreage Treated	Gallons of PA-14	Cumulative Load of PA-14 Area One (Gallons)	Cumulative Load PA-14 Areas Two and Three (Gallons)	Cumulative Load PA-14 All Areas
1	1	1.5 Ac[3]	30	30	0	30
2	1	1.5 Ac[3]	30	60	0	60
3	1, 2, 3	27.0 Ac[4]	540	90	510	600
4	1	1.5 Ac[3]	30	120	510	630
5	1	1.5 Ac[3]	30	150	510	660
6	1	1.5 Ac[3]	30	180	510	690
7	1, 2, 3	27.0 Ac[5]	540	210	1020	1230
8	1	1.5 Ac[3]	30	240	1020	1260
9	1	1.5 Ac[3]	30	270	1020	1290
		64.5 Ac	1290	270	1020	1290

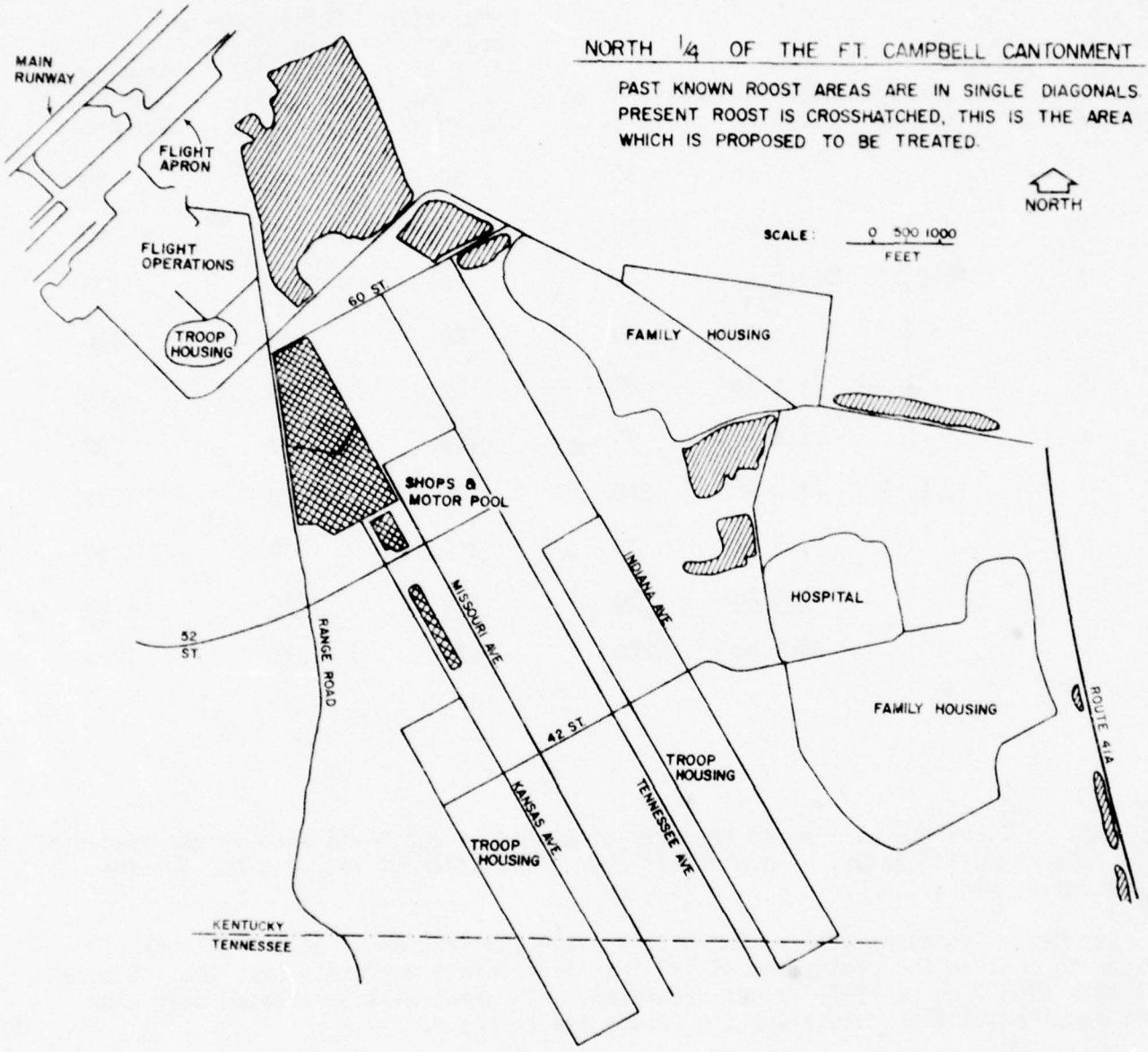
[1] All applications will be at the rate of 80 GPA of 25% PA-14 made in two passes of 40 GPA each, using rotary-wing aircraft from an altitude of 150 feet AGL on nine consecutive nights.

[2] See Map. Treatment of Area One will include application of 21,000 gallons of water to achieve the equivalent of 1/2 inch of rainfall uniformly over the 1.5 acres of this site when rainfall is not predicted. All areas will be treated only when all required weather conditions are forecasted to occur.

[3] Experimental program discussed in Appendix 6.

[4] Presently planned PA-14 application.

[5] Backup application which will be made only in event of failure of the planned program, due to unanticipated weather, etc.



APPENDIX FIGURE 6.1

APPENDIX 7

BLACKBIRD SITE SOIL DESCRIPTION

FORT CAMPBELL HUNTINGTON SERIES

General Description

Huntington silt loam soils are deep, well-drained and moderately permeable. They are alluvial soils that are found on nearly level flood plains. Materials from limestone, sandstone, siltstone and loess have influenced their development. (Non-shaded area on Map A)

The surface layer of about 12 inches is a brown to dark brown silt loam that is slightly acid.

The subsoil from 12 to 48 inches is brown to dark grayish brown silt loam that is medium acid.

Important Features

Depth to rock: Ranges from 4 to more than 6 feet

Underlying material: Alluvium

Runoff, surface: Slow

Permeability: Moderate (0.63 to 2.00 inches per hour)

Water table: 4 feet or more

Flood hazard: Subject to flooding but generally of short duration

Erosion: Slight

FORT CAMPBELL PEMBROKE SERIES

General Description

Pembroke soils are deep, well-drained, upland soils that are level to moderately sloping. These soils have formed in limestone with some influence from loess. (Shaded area on Map A)

The surface soil, having a depth of about 10 inches, is a dark-brown, silt loam. The subsoil, at a depth from about 10 to 48 inches, is a red, silty-clay loam with a dark-red, silty clay below 48 inches.

The severely eroded unit has very little topsoil left and the surface layer (approximately 8 inches) is a reddish-brown, silty-clay loam, and the subsoil is a red, silty-clay loam or silty clay.

Important Features

Depth of rock: Ranges from 6 feet or more

Underlying material: Limestone

Runoff, surface: Medium

Permeability: Moderate (.63 to 2.0 inches per hour)

Water Table: More than 6 feet below the surface

Flood hazard: None

Erosion: *Danger of erosion is slight to moderate*

MILAN AAP GRENADA SERIES

The Grenada series is a member of the fine-silty, mixed, thermic family of Glossic Fragiudalfs. These soils have silt loam A horizons, yellowish-brown heavy silt loam upper B horizons, and distinct A'2 horizons which have tongues or interfingers of gray silt loam into an underlying fragipan. (Non-shaded area Map B)

Drainage and Permeability

Moderately well-drained; runoff is medium to slow; permeability is moderate above the fragipan and is slow in the fragipan. Water is perched above the fragipans during high rainfall periods.

Use and Vegetation

Most of the acreage is used for row crops and pasture. Cotton, corn and soybeans are principal crops. A small acreage is in mixed hardwoods, including oak species, beech, hickory, elm and tulip poplar. Shortleaf and loblolly pine are found in the southern part of the range.

Depth to rock: Rock free

Flood hazard: None

MILAN AAP LORING SERIES

The Loring series is a member of the fine-silty, mixed, thermic family of Typic Fragiudalfa. Typically these soils have brown silt loam A horizons, brown silt loam B horizons and a fragipan beginning about 2-1/2 feet below the surface. (Shaded area Map B)

Drainage and Permeability

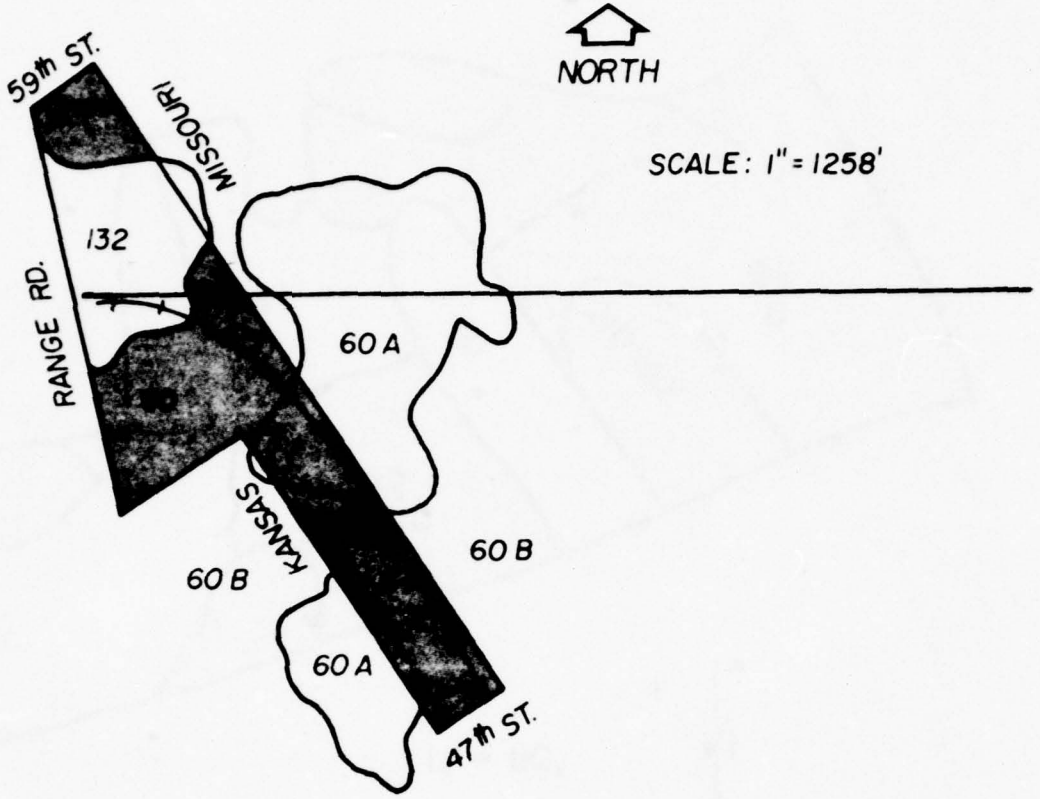
Moderately well-drained; moderate permeability above the fragipan and moderately slow permeability in the fragipan.

Use and Vegetation

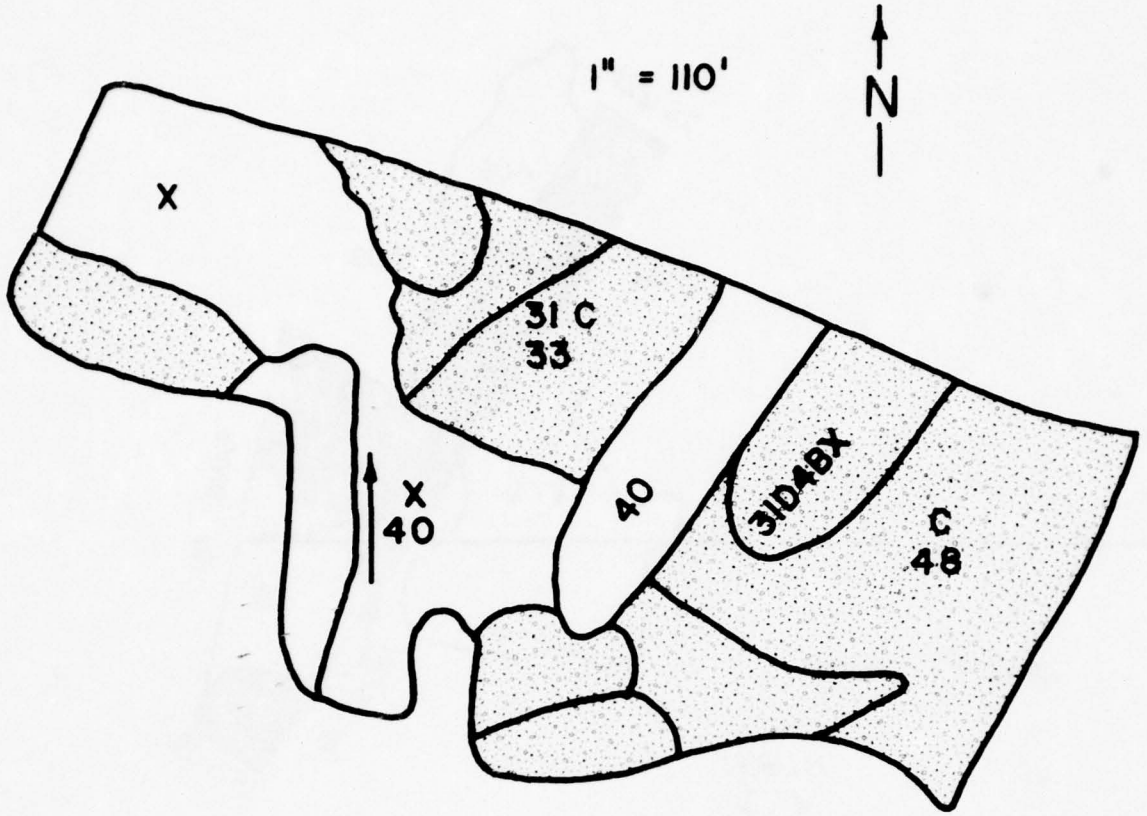
Most areas are cleared. Main uses are for growing cotton, small grains, soybeans, hay and pasture. Wooded areas are in oaks, hickory, elm, maple, tulip poplar and locust.

Depth to rock: Greater than 60 inches

Flood hazard: None



FT. CAMPBELL (MAP A)



MILAN AAP (MAP B)

APPENDIX 8

PREDICTED ATMOSPHERIC DISPERSION OF LOW-VOLUME, AERIALLY-APPLIED, LIQUID-PHASE AVIAN SURFACTANT PA-14

Introduction

This appendix includes a statement of the chief objectives of the investigation and a brief discussion of the approach taken to produce the findings on dispersion. Findings of the investigation should have general application in most situations where a surfactant similar to PA-14 is aerially dispersed.

Objectives

Chief objectives of the investigation were: to ascertain the lower atmospheric dispersion parameters of liquid phase, nonionic surfactant PA-14 released by low-volume, downward-oriented venturi spreaders from aircraft flying at above-ground heights ranging upward to 50 meters; and to determine the spatial parameters of downwind surface concentration of the dispersing aerosol.

Approach

The investigation was comprised of two major phases: determination of the dispersion characteristics of the liquid phase aerosol PA-14 and assessment of the spatial parameters of downwind surface concentrations of aerosol.

It is to be emphasized that such a dispersion problem carries with it a large number of quantitatively unknown variables. For example, the physical behavior of a mist extruded into a turbulent air field beneath a flying aircraft is not precisely known. Hence, in the course of the investigation, numerous assumptions were necessary in order to circumvent such obstacles. In all such cases, assumptions were contrived to result in overestimates (i.e., to provide for the worst possible case) of downwind surface concentrations.

It was noted that when an aerial application is made, only a fraction of the solution falls immediately earthward. A portion of the solution changes phase from liquid to gas by evaporation, and another portion remains temporarily in the air as a residual mist. It is the latter quantity that is presumed to potentially render the greatest impact upon ultimate receptors, for while it slowly settles to the earth under the influence of gravity, it is transported by winds to places outside the vicinity of the application target. It is the dispersion of this mist upon which the study focused.

Findings 1: Creation of Mist Fraction

Application of PA-14 will be effected in accordance with Instructions for the Use of PA-14 Avian Stressing Agent.[1] In keeping with the "worst-case"* viewpoint, it was assumed that the solution would be applied by a venturi-type spreader fixed to an aircraft flying at an altitude of 50 meters. It was assumed that 130 gallons with 25 percent actual agent would be delivered in a single, 600-meter long pass over the target area.

* Maximum allowable solution applied under the worst meterological conditions by maximum allowable application techniques.

Initial step taken in the investigation was to determine the maximum driftable droplet size (MDDS) of airborne PA-14. This parameter was employed to ascertain the mist fraction of the total volume of liquid phase aerosol introduced into the lower atmosphere. This residual mist fraction was then conceptually treated as having been nearly instantaneously released along a finite line source into the atmosphere. Quantitative mist fraction parameters provided input into the standard atmospheric dispersion equations developed by Turner for the United States Environmental Protection Agency.[2] These equations were solved to ascertain the spatial parameters of maximum downwind concentration of aerosol.

Quantitative parameterization of the residual dispersible mist proceeded along the following lines. It was noted that Hardy and his colleagues reported observations of droplet sizes within the ranges of those associated with "excessive rain" when surfactant solutions were aerially applied in low volume.[3] It was subsequently assumed that, both because of the method of application and the fact that water comprises the bulk of even the strongest advisable PA-14 solution, the dynamics of droplet formation in the precipitating solution could be satisfactorily approximated by the dynamics of water droplet formation. Cognizance was taken of the work of Best, who derived the following empirical relationship between the droplet size distribution and the precipitation intensity p (mm hr^{-1}):

$$1 - F = \exp\left[-(x/a)^n\right] \qquad (1)$$

where

$$a = \alpha p \beta, \tag{2}$$

and F is the fraction of liquid composed of drops of diameter less than x; and α, β and n are empirically derived numerical constants.[4] Equation (1) was solved using information furnished by Laws and Parsons for characterizing droplet size distributions in the United States. They have noted that if w is the volume of liquid in a unit volume of space,

$$w = cp^f \tag{3}$$

where c and f are empirical numerical constants unique to a particular mesoclimatological region. [5]

Prior to solving equation (1), a definition was made of the maximum driftable, droplet size (MDDS). This operational definition was made solely for the purpose of computation in this investigation. It was recognized that application of PA-14 would advisedly not take place when wind speeds were greater than 4.5 meters/second (about 10 miles/hour).

Discounting drag forces, and shear stress and turbulence effects for simplification, and assuming that a droplet falls in linear response to the resultant simultaneously applied forces of wind and gravity, a droplet falling from 50 meters will strike at a spot on the earth 50 meters downwind of a point on the surface directly beneath its release point. By equating wind speed and a generalized expression for droplet terminal velocity, which was presumed to be instantaneously attained upon extrusion into the atmosphere, it was found that for a droplet of density

1.006 g/cm^3, the required diameter to follow the above criteria is 0.389 mm. The size actually exceeds the upper limit of the droplet size range associated with a "mist", as defined by Brooks.[6]

However, in keeping with the "worst-case" viewpoint of the investigation, the maximum driftable droplet size was taken to be 0.40 mm diameter, because, based on the maximum advisable solution application conditions, a particle less than this size will drift downwind from the "target" a greater distance than the distance above the target from which it was released. This threshold size is the MDDS.

Equation (1) was solved to ascertain the fraction of the liquid composed of droplets less than or equal to the MDDS.[7] It was found that 7.39 percent of the total volume of the aerially applied solution would develop into a polydisperse mist (Table 2), and that of this mist, nearly all droplets would have a diameter greater than 0.01 mm. For subsequent computation in the investigation, the mist fraction of the released volume of solution was elevated to 10 percent.

Findings 2: Dispersion of Mist Fraction

As noted above, approximately 10 percent of the released solution will remain in the air as a dispersible residual mist. Assuming an upper-limit case where 130 gallons of solution are released, the mist fraction would be 13 gallons. In determining the spatial parameters of dispersion of the mist, it was assumed that application would take place during a winter night in a "worst-case" wind field of 4.5 meters/second, and that the solution would be released from a distance not

greater than 50 meters above the surface. It was noted that application would take place in a stable, probably inverted atmosphere, in which the typical mixing depth, as reported by Holzworth, would be approximately 500 meters.[8] Accordingly, it was assumed that there would be no vertical-upward forces acting on the mist.

The equations used to calculate dispersion estimates were those developed by Turner, referenced earlier. They are based upon the assumptions that the plume spread has a Gaussian distribution in both the horizontal and vertical planes, with standard deviations of plume concentration distribution in the horizontal and vertical of σy and σz, respectively; the mean wind speed affecting the plume is $\bar{u}$; the uniform emission rate of pollutants is Q; and total reflection of the plume takes place at the earth's surface. Neglecting diffusion in the direction of the plume travel, the concentration X (grams/meter^3) is:

$$X(X,Y,Z;H) = \frac{Q}{2\pi\,\sigma_Y\,\sigma_Z\,\bar{u}} \exp\left[-\frac{1}{2}\left(\frac{Y}{\sigma_Y}\right)^2\right]\left(\exp\left[-\frac{1}{2}\left(\frac{Z-H}{\sigma_Z}\right)^2\right]\right.$$

$$\left. + \exp\left[-\frac{1}{2}\left(\frac{Z+H}{\sigma_Z}\right)^2\right]\right) \qquad (4)$$

When the concentration is to be calculated along the plume centerline (Y = 0), simplification of equation (4) yields:

$$X_{(X,0,0;H)} = \frac{Q}{\pi\sigma_Y\,\sigma_Z\,\bar{u}} \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_Z}\right)^2\right] \qquad (5)$$

To estimate aerosol concentrations downwind of a finite line source which is oriented normal to the wind direction, equation (5) becomes:

$$\chi_{(X,0,0;H)} = \frac{2q}{\sqrt{2\pi}\,\sigma_z\,u} \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2\right] \int_{\Psi_1}^{\Psi_2} \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{1}{2}(\Psi)^2\right] d\Psi \quad (6)$$

in which $\Psi_1 = \frac{y_1}{\sigma_y}$ and $\Psi_2 = \frac{y_2}{\sigma_y}$. The x-axis is defined as traversing the direction of the mean wind and passing through the receptor of interest, and q is the source strength per unit distance with dimensions of $MT^{-1}L^{-1}$.

Summary of Findings

Numerous assumptions were made in the investigation, with the objective of overestimating the predicted downwind surface concentrations of aerially applied PA-14. It will be recalled that the worst case equivalent emission rates shown in Table 3 are based on the dispersion of 10 percent mist fraction of the total (130 gallons) applied solution, and that this fraction is based on the maximum driftable droplet size (MDDS), which was calculated by equating wind speed with droplet terminal velocity.

At a maximum aqueous solution release of 25 percent PA-14, the maximum predicted, nearly instantaneous downwind concentration of agent is 4.6×10^{-3} grams/meter^3. This maximum concentration is predicted to occur approximately 3 kilometers downwind of the release swath.

Since the mist fraction is based directly on the MDDS, it is expected that when application takes place in lower-speed wind fields, the MDDS will decrease, resulting in a decreased dispersible mist fraction and lesser maximum downwind surface concentration of aerosol.

It is noteworthy that no provisions in dispersion computations have been made to account for the terminal velocities of the mist droplets. Detailed calculations by Monin show that a polydispersed aerosol tends to be deposited selectively along the wind direction, the heaviest particles reaching the ground first.[9] This favors a reduction in the maximum total concentration in the air as the aerosol drifts windward, and points to lesser surface concentrations than have been predicted here for areas distant from the target vicinity.

It is additionally to be noted that concentration values in Table 3 are nearly instantaneous values, since they are based on an eight-second aerosol release time and not a continuous, long-term emission. Hence, if the single-application mist emission impact on downwind air quality is time-averaged over a 24-hour period, the concentration figures presented in Table 3 would be several orders of magnitude lower.

There is a proportional decrease in downwind mist dispersion distance with decreasing height of application. This can be conceptually verified by examining equation (4). This equation also suggests that downwind aerosol surface concentrations can be achieved by extruding the solution downward with applied force, rather than by spreading it and allowing it to free-fall to the target. This application method is a second way to reduce the effective release height of the mist fraction and at the same time to assure maximum dousing of the target.

As pointed out by the data in Table 3, the point of maximum concentration of aerosol will be about 3 kilometers downwind of the release swath when the solution is applied under maximum wind field

conditions. In practice, the surfactant solution may be applied when the lower atmosphere is more calm. Hence, it would be reasonable to expect a substantially lesser extent of mist dispersion, with maximum surface concentrations being realized in much closer proximity to the release area. Under all circumstances, however, it would be prudent to forewarn potential human receptors in the areas in and downwind of the application site.

REFERENCES

1. *Instructions for Use of PA-14 Avian Stressing Agent*, Patuxent Wildlife Research Center, Laurel, Maryland, 1974.

2. Turner, D. Bruce, *Workbook of Atmospheric Dispersion Estimates*, Office of Air Programs, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, Revised Edition, 1970.

3. Hardy, J. W., P. W. Tefebure, A. R. Stickley, Jr., and R. E. Matteson, "Effects of Low-Volume, Aerially-Applied Surfactant Solutions on Roosting Blackbirds and Starlings, January-April 1970," Patuxent Wildlife Research Center, Gainesville, Florida, March 1971.

4. Best, A. C., "The Size Distribution of Raindrops", Quarterly Journal of the Royal Meterological Society, Vol. 76, 1950, pp 16 ff.

5. Laws, J. O. and D. A. Parsons, "The Relation of Raindrop Size to Intensity", Transactions of the American Geophysical Union, Vol. 24, 1943, pp 452 ff.

6. Brooks, F. A., "Drifting of Poisonous Dusts Applied by Airplanes and Land Rigs", Agricultural Engineering, Vol. 28, No. 6, 1949, pp 233-239.

7. Average values are provided by Laws and Parsons (note 5) for characterizing drop size distributions in the United States: $n = 2.29$, $\sigma = 1.25$, $\beta = 0.199$, $c = 72$, $f = 0.867$. A precipitation rate p of 1.227 mm/hr (1.76 acre-wide basis) was used in solving equation (1).

8. Holzworth, G. C., *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, Office of Air Programs, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1972.

9. Monin, A. S., "General Survey of Atmospheric Diffusion", F. N. Frenkiel, P. A. Sheppard, Eds., Advances in Geophysics, Vol. 6, 1959.

APPENDIX 9

COMPUTERIZED ENVIRONMENTAL LEGISLATIVE DATA SYSTEM

The Computerized Environmental Legislative Data System (CELDS), developed at CERL, catalogues abstracts of environmental laws and statutes by geographic scope and keyword designation. CELDS includes quantifiable and objective standards, as well as report or permit requirements of all active laws or regulations that may concern the Army.

CELDS has been accessed to review any conformity and/or conflict of the proposed actions with any state or federal laws and regulations.

All information was recorded and is displayed in one of twelve fields. The information recorded in each field was as follows:

1. Accession Number - Gives accession number assigned sequentially as the documents were recorded.

2. Title - Consists of phrases or terms that identify the primary subject area of legislation (i.e., LEGISLATIVE CODE 2, 4 - TRASH BURNING, and CONTROL OF JUNKYARDS). Information in this field comes from either the title of the legislation or, if the title does not suggest the contents, from a phrase that indicates the subject of the abstract.

3. Enactment Date - Lists date the legislation becomes effective. It may be the date certain legislation was enacted.

4. Legislative References - These identify the legislative source of all laws covered by the document abstract.

5. Major Environmental Category - Contains the primary subject area addressed by the legislation.

6. Geographical/Political Scope - Identifies the state or federal origin of the legislation.

7. Administrative Agency - Identifies the subject legislative area for the agency that administers the specified environmental laws or enforces the standards.

8. Agency Address - Contains the address of the administrative agency from Field 7.

9. Bibliographical References - Consists of the bibliographical citation for the source from which the legislation was extracted.

10. Abstract - Provides an indicative abstract of the legislation.

11. Environmental Attributes - Consists of index terms selected from CERL's list of environmental attributes.

12. Key Words - Consists of word phrases or single word terms selected to enhance the search capabilities of the data file.

Laws related to the proposed action are:

LAW 252

FIELD 1

252

FIELD 2

PLANT AND ANIMAL LIFE AND VIRUSES DECLARED TO BE PESTS.

FIELD 3

11/25/71

FIELD 4

CODE OF FEDERAL REGULATIONS; TITLE 40: PROTECTION OF ENVIRONMENT; CHAPTER I: EPA; SUBCHAPTER E: PESTICIDE PROGRAMS; PART 162: ENFORCEMENT OF FEDERAL INSECTICIDE, FUNGICIDE AND RODENTICIDE ACT.

FIELD 5

ECOLOGY

FIELD 6

US

FIELD 7

ENVIRONMENTAL PROTECTION AGENCY
401 M ST., SW, WASHINGTON, DC 20460

FIELD 8

ENVIRONMENT REPORTER, FEDERAL REGULATIONS, 141.

FIELD 9

(A): EACH OF THE FOLLOWING FORMS OF PLANT AND ANIMAL LIFE AND VIRUSES IS DECLARED TO BE A PEST UNDER THE (FIRMA) ACT WHEN IT EXISTS UNDER CIRCUMSTANCES THAT MAKE IT INJURIOUS TO PLANTS, MAN, DOMESTIC ANIMALS, OTHER USEFUL VERTEBRATES, USEFUL INVERTEBRATES, OR OTHER ARTICLES OR SUBSTANCES: MAMMALS, INCLUDING BUT NOT LIMITED TO DOGS, CATS, MOLES, BATS, WILD CARNIVORES, ARMADILLOS, AND DEER; BIRDS, INCLUDING BUT NOT LIMITED TO STARLINGS, ENGLISH SPARROWS, CROWS, AND BLACKBIRDS; FISHES, INCLUDING BUT NOT LIMITED TO THE JAMLESS FISHES SUCH AS THE SEA LAMPREY, THE CARTILAGINOUS FISHES SUCH AS THE SHARKS, AND THE BONY FISHES SUCH AS THE CARP; AMPHIBIANS AND REPTILES, INCLUDING BUT NOT LIMITED TO POISONOUS SNAKES; AQUATIC AND TERRESTRIAL INVERTEBRATES, INCLUDING BUT NOT LIMITED TO SLUGS, SNAILS, AND CRAYFISH; ROOTS AND OTHER PLANT PARTS GROWING WHERE NOT WANTED; VIRUSES, OTHER THAN THOSE ON OR IN LIVING MAN OR OTHER ANIMALS.

FIELD 10

NONE

FIELD 11

PESTS
BIRDS
LARGE MAMMALS
SMALL MAMMALS
REPTILES
AMPHIBIANS

FIELD 12

PESTS

LAN 254

FIELD 1

254

FIELD 2

EMERGENCY USE OF PESTICIDES BY FEDERAL OR STATE AGENCIES.

FIELD 3

12/3/73

FIELD 4

CODE OF FEDERAL REGULATIONS; TITLE 40: PROTECTION OF ENVIRONMENT; CHAPTER I: EPA; SUBCHAPTER E: PESTICIDES PROGRAMS; PART 166: EXEMPTION OF FEDERAL AND STATE FOR USE OF PESTICIDES UNDER EMERGENCY CONDITIONS, SECTION 166.1.

FIELD 5

ECOLOGY
AIR QUALITY
HEALTH SCIENCE

FIELD 6

US

FIELD 7

ENVIRONMENTAL PROTECTION AGENCY
401 M ST., SW, WASHINGTON, DC 20460

FIELD 8

ENVIRONMENT REPORTER, FEDERAL REGULATIONS, 141.

FIELD 9

STATE OR FEDERAL AGENCIES MAY BE EXEMPTED FROM PESTICIDE USE REQUIREMENTS IF EPA DETERMINES THAT AN EMERGENCY EXISTS. AN EMERGENCY WILL BE DEEMED TO EXIST WHEN (A) A PEST OUTBREAK HAS OR IS ABOUT TO OCCUR AND NO REGISTERED PESTICIDE OR ALTERNATE METHOD OF CONTROL IS AVAILABLE TO ERADICATE OR CONTROL THE PEST, (B) SIGNIFICANT ECONOMIC OR HEALTH PROBLEMS WILL OCCUR WITHOUT THE USE OF PESTICIDE AND (C) THE TIME AVAILABLE FROM DISCOVERY OR PREDICTION OF THE PEST OUTBREAK IS INSUFFICIENT FOR REGISTRATION OF PESTICIDE. PERMITS WILL BE GRANTED FOR SPECIFIC EXEMPTION, QUARANTINE- PUBLIC HEALTH EXEMPTION, AND CRISIS EXEMPTION. APPLICATION FOR THE PERMIT MUST BE ADDRESSED TO THE ADMINISTRATOR.

FIELD 10

NONE

FIELD 11

DISEASE VECTORS
ENDANGERING COMMUNITY HEALTH
PARTICULATE BIOCIDES
GASEOUS BIOCIDES
DISEASE VECTORS
PESTICIDES
PESTICIDES AND RESIDUES

FIELD 12

PESTS
PEST CONTROL
PESTICIDES

LAW 288

FIELD 1

288

FIELD 2

REGULATIONS REGARDING MOVEMENT OF PLANT PESTS.

FIELD 3

12-24-71

FIELD 4

CODE OF FEDERAL REGULATIONS; TITLE 7: AGRICULTURE; CHAPTER III: ANIMAL AND PLANT HEALTH SERVICE; PART 330: FEDERAL PLANT PEST REGULATIONS; SECTION 330.200.

FIELD 5

ECOLOGY

FIELD 6

US

FIELD 7

ANIMAL AND PLANT HEALTH SERVICE
WASHINGTON, DC 20250

FIELD 8

SAME AS LEGISLATIVE REFERENCE.

FIELD 9

PLANT PEST REGULATION REFERS TO ANY LIVING STAGE OF MITES, INSECTS, NEMATODES, SLUGS, SNAILS, PROTOZOA, OR OTHER INVERTEBRATE ANIMALS, BACTERIA, FUNGI, OTHER PARASITIC PLANTS OR REPRODUCTIVE PARTS THEREOF, VIRUSES ETC., WHICH CAN DIRECTLY OR INDIRECTLY INJURE OR CAUSE DISEASE, OR DAMAGE IN ANY PLANTS OR PARTS.

NO PERSON SHALL KNOWINGLY MOVE ANY PLANT PEST INTO OR THROUGH THE UNITED STATES FROM ANY PLACE OUTSIDE THEREOF, OR INTERSTATE, OR KNOWINGLY ACCEPT DELIVERY OF ANY PLANT PEST SO MOVING UNLESS SUCH MOVEMENT IS AUTHORIZED UNDER PERMIT UNDER THIS PART AND IS MADE IN ACCORDANCE WITH THE CONDITIONS THEREIN AND THE PROVISIONS IN THIS PART. THE MOVEMENT OF SNAILS AND SLUGS, AS WELL AS OTHER PLANT PESTS, IS GOVERNED BY SUCH PROVISIONS. BIOLOGICAL SPECIMENS OF PLANT PESTS, IN PRESERVATIVE OR DRIED, MAY BE IMPORTED WITHOUT FURTHER RESTRICTION UNDER THIS PART, BUT SUBJECT TO INSPECTION ON ARRIVAL IN THE UNITED STATES TO CONFIRM THE NATURE OF THE MATERIAL AND FREEDOM FROM RISK OF PLANT PEST DISSEMINATION.

FIELD 10

NONE

FIELD 11

DISEASE VECTORS

FIELD 12

PESTS
TRANSPORTATION
PEST CONTROL

LAW 516

FIELD 1

516

FIELD 2

KILLING OF ANIMALS DAMAGING PROPERTY, OR PEOPLE.

FIELD 3

5-18-56

FIELD 4

KENTUCKY REVISED STATUTES, TITLE 150: FISH AND WILDLIFE RESOURCES, SECTION 105

FIELD 5

ECOLOGY

FIELD 6

KY

FIELD 7

DEPARTMENT OF FISH AND WILDLIFE RESOURCES
FRANKFORT, KENTUCKY

FIELD 8

SAME AS LEGISLATIVE REFERENCE.

FIELD 9

ANY WILD ANIMAL, FISH, OR BIRD MAY BE KILLED OR BROUGHT UNDER CONTROL IF IT IS CAUSING DAMAGE TO PEOPLE, PROPERTY, OR OTHER ANIMALS, FISH OR BIRDS, OR SPREADING DISEASES.

RESIDENT LANDOWNERS OF THE STATE MAY KILL ANY WILD ANIMAL ON THEIR LAND WHO IS CAUSING DAMAGE TO THE PROPERTY OR TO PEOPLE. THE DESTRUCTION OF AN ANIMAL MUST BE REPORTED TO THE DEPARTMENT OF FISH AND WILDLIFE RESOURCES OR THE RESIDENT CONSERVATION OFFICER FOR PROPER DISPOSITION OF THE CARCASS.

FIELD 10

NONE

FIELD 11

DISEASE VECTORS
OTHER UNDESIRABLE SPECIES
SMALL GAME HUNTING
WATERFOWL HUNTING
BIG GAME HUNTING

FIELD 12

WILDLIFE
FISH
PEST CONTROL

WHAT NEXT:

APPENDIX 10

SURFACE AND GROUND WATER IMPACTS
FORT CAMPBELL AND MAAP

FORT CAMPBELL

Surface Water

No lakes, streams or ponds intersect the roost area. Run-off from the roost area is collected by a 54-inch storm sewer and delivered to the Dry Fork Creek. No water bodies will be contaminated directly by the spray application. As a result of the March 1974 trial spray operation, no fish mortality in the streams receiving run-off was detected.

The Fort Campbell program will be divided into two parts. In the first segment, 1.5 acres of the roost area will be sprayed with PA-14 solution, followed by application of water by firetruck equivalent to 1/2 inch of rainfall. This 1.5-acre roost will be sprayed on nine consecutive nights. In the second segment of the program, 27 acres of roost area will be sprayed with PA-14 solution when predicted weather conditions indicate at least 1/2 inch of rainfall.

The "worst case" situation for the 1.5 acre roost spraying program would occur if all the applied PA-14 solution entered the water sprayed on the roost. The resultant concentration of PA-14 in the run-off would be:

Volume of water applied = $(0.5")(1\ ft/12")(1.5\ acre)(43{,}560\ \frac{ft^2}{acre})$

$= 2722\ ft^3 = 7.71 \times 10^4 \ell$

mass of PA-14 applied = (30 gal)(3.785ℓ/gal)(1.006 g/ml)(10^3ml/l)

$= 1.14 \times 10^5 g = 1.14 \times 10^8 mg$

concentration of PA-14(Cr) = mass PA-14/volume water

$= 1.14 \times 10^8 mg/(7.71 \times 10^4 + 4.54 \times 10^2)\ell$

$= 1.14 \times 10^8$ mg/$7.76 \times 10^4 \ell = 1.47 \times 10^3$ mg/ℓ

The amount of run-off from the roost area would be:

Run-off from roost (q_r) = CiA

where C = 0.25 for unimproved forested land

i = (0.5"/19 min) = (0.5"/0.317 hr)

q_r = (0.25(0.5"/0.317 hr)(1.5 acres)

= 0.591 acre-in/hr

$= 2.104 \times 10^3\ ft^3/hr$

= 0.50 cfs

Therefore, run-off from the site will have a flow of 0.60 cfs at a PA-14 concentration of 1.47×10^3 mg/ℓ. Based on the rat-rabbit toxicity studies performed by Union Carbide, an animal would have to drink his weight in PA-14 contaminated run-off in order to exceed the LD_{50}(1). It can be safely assumed that the run-off will have no impact on animal life in the area.

Maximum concentration in a stream capable of supporting fish life would occur if all run-off from the roost area would enter Dry Fork Creek. Due to a lack of flow data for Dry Fork Creek, a flow had to be estimated. During the winter, Dry Fork Creek is 15 feet wide and 2 feet deep(2). Using the Manning formula and assuming a parabolic channel, the estimated stream flow would be:

stream flow (q_s) = $\frac{1.49}{n}$ $AR^{2/3} S^{1/2}$

where n = 0.042 for winding streams with stony and weedy bed.

A = cross section area = 20.5 ft^2

R = hydraulic radius = 1.25 ft

S = slope of stream bed = 0.0124

$$q_s = \frac{1.49}{(0.042\ ft^{-1/3})} \quad (20.5\ ft^2)(1.25\ ft)^{2/3}(0.0124)^{1/2}$$

q_s = 94.3 cfs

The resulting concentration in Dry Fork Creek (Cs) would be:

$$(C_r)(q_r) = (C_s)(q_r + q_s)$$

$$C_s = \frac{(1.48 \times 10^3\ mg/l)(0.60\ cfs)}{(94.3 + 0.6)\ cfs}$$

C_s = 9.36 mg/ℓ

This concentration exceeds the LC_{50} for some fish species[3]. Fish kills will result if the "worst case" situation occurs; however, the potential for the "worst case" situation occurring is minute. A study of the biodegradation of PA-14 (Annex 1) indicates that PA-14 tends to adhere to organic and bacterial soil particles. The amount of PA-14 removed from the roost area depends upon the organic and bacterial content of the soil. PA-14 applied to the roost area will come in contact with the organic bird

droppings on the ground. It can be reasonably assumed that the PA-14 will adhere to the droppings, leaf litter and soil organic matter and that the PA-14 concentration in the run-off from the roost area and ultimately in Dry Fork Creek will be negligible.

Each application of PA-14 and water spray to the 1.5-acre roost area can be considered to be a separate, non-compounding event. Run-off rates vary directly with the rate of water application to the roost area. Since the 1/2 inch rainfall equivalent is applied over a 19-minute period, run-off from the roost area will completely enter the stream within a one-hour period (assuming some lag caused by site retention). Applications of PA-14 to the 1.5-acre roost will be separated by at least 20 hours, allowing Dry Fork Creek to return to pre-application conditions[2].

The "worst case" situation for the 27-acre roost spraying program would occur if the PA-14 solution were applied and the predicted rainfall did not occur, thus requiring a second application followed by a slow 1/2 inch rainfall. Assuming that all the applied solution enters the run-off, the resultant concentration of PA-14 in the run-off would be:

$$\text{Volume rainwater} = (0.5")(1\ \text{ft}/12")(27\ \text{acre})(43{,}560\ \text{ft}^2/\text{acre})$$
$$= 4.9 \times 10^4\ \text{ft}^3 = 1.39 \times 10^6 \text{l}$$
$$\text{mass PA-14} = (1080\ \text{gal})(3.785\text{l}/\text{gal})(1.006\ \text{g/ml})\ (10^3\ \text{ml}/\text{l})$$
$$= 4.11 \times 10^6 \text{g} = 4.1 \times 10^9\ \text{mg}$$

Concentration of PA-14 in run-off (C_r) = $\frac{\text{mass PA-14}}{\text{volume rainwater}}$

$= 4.11 \times 10^9$ mg/$(1.39 \times 10^6 + 1.64 \times 10^4)$ℓ

$= 2.91 \times 10^3$ mg/ℓ

The amount of run-off from the roost area would be:

Run-off from roost (q_r) = Cia

where C = 0.25 for unimproved forest land

i = 0.5"/12 hr

q_r = (0.25)(0.5"/12 hr)(27 acres)

= 0.28 acre in/hr

= 1.02×10^3 ft^3/hr = 0.28 cfs

at a 2.91×10^3 mg/ℓ concentration

The run-off from the roost area will be diluted by the run-off from the cantonment area. The resulting concentration in the combined run-off would be:

run-off from cantonment (q_c) = Cia

= (0.40)(0.5"/12 hr)(0.8 sq mi)(640 sq mi)

= 8.53 acre in/hr

= 3.10×10^4 ft^2/hr - 8.60 cfs

Concentration of combined run-off (C_t)

$$= \frac{q_r C_r}{(q_c + q_r)}$$

$$= \frac{(0.28 \text{ cfs})(2.96 \times 10^3) \text{ mg/ℓ})}{(8.60 + 0.28) \text{ cfs}}$$

= 93.3 mg/ℓ

Based on Union Carbide's rat-rabbit toxicity studies, an animal would have to drink more than 10 times its weight in PA-14 contaminated run-off

in order to exceed the LD_{50}(1). It can be safely assumed that the run-off will have no impact on animal life.

Dry Fork Creek is the first permanent stream capable of supporting fish. The PA-14 contaminated run-off is diluted by run-off from unimproved grounds prior to entering Dry Fork Creek and by upstream drainage. The maximum concentration occurring in Dry Fork Creek would be:

run-off from unimproved ground (q_s) = Cia

= (0.5)(0.5"/12 hr)(1.5 sq mi)(640 acre sq mi)

= 20 acre-in/hr = 7.26×10^4 ft^3/hr.

= 20.2 cfs

run-off from upstream drainage (q_u) =

(Cia) airfield + (Cia) forest

= (0.80)(0.5"/12 hr)(4.8 sq mi)(640 acre/sq mi)

+ (0.50)(0.5"/12 hr)(5.5 sq/mi(640 acres/sq mi)

= 102.4 + 73.3 = 175.7 acre-in/hr

= 6.38×10^5 ft^3/hr = 177.22 cfs

Concentration of PA-14 in Dry Fork Creek (C) = $\frac{C_T\ (q_c + q_r)}{(q_c + q_r + q_s + q_u)}$

$= \frac{(93.3\ mg/\ell)(8.60 + 0.28)cfs}{(8.60 + 0.28 + 20.20 + 177.22)}$

= 4.02 mg/ℓ

The concentration falls in the 3.0-6.2 mg/ℓ LC_{50} range for fish species[3]. Fish kills may result if this "worst case" situation occurs.

The potential for the "worst case" situation occurring is minute. A study of the biodegradation of PA-14 (Annex 1) indicates that PA-14 tends to adhere to organic and bacterial soil particles. The amount of PA-14 removed from the roost area depends upon the organic and bacterial content of the soil. PA-14 applied to the roost area will come in contact with the organic bird droppings on the ground. It can be reasonably assumed that the PA-14 will adhere to the droppings, leaf litter and soil organic matter and that the PA-14 concentration in the run-off from the roost area and ultimately Dry Fork Creek will be negligible.

Ground Water

Run-off from the roost site has the potential for coming into direct contact with the water table through a stormwater drainage located well within the roost site. The infiltration rate for the area is high, and the distance to the water table is relatively shallow as evidenced by the dug wells located in the rural areas surrounding Fort Campbell. However, contamination of the ground water by PA-14 is not considered a problem. A study of the biodegradability of PA-14 (Annex 1) indicates that it tends to adhere to organic and bacterial soil particles, but not to organic soil particles. Therefore, the amount of PA-14 which can be leached from the soil depends on the organic content of the soil. In the roost areas, the applied solution will come in contact with the organic bird droppings on the ground. The PA-14 will tend to adhere to the bird droppings and thus will be held for bacterial degradation. For this reason, contamination of ground waters in the Fort Campbell area is considered unlikely. A study of the persistence of PA-14 in the soil (Annex 2) indicated that no PA-14 was detected in the soil or the run-off seven months after application.

MILAN ARMY AMMUNITION PLANT

Surface Water

Geatest concentration of PA-14 would occur if all the applied solution were to enter the rainwater falling on the roost site. Assuming

a 1/2 inch rainfall, the concentration of the PA-14 resulting would be:

Vol. Rainwater/Acre = (1/2 in.)(1 ft/12 in.)(1 acre)(43,560 ft^2/acre)

= 1815 ft^3 = 5.14 x $10^4 \ell$

Vol. Solution/Acre = 80 gal = 3.03 x $10^2 \ell$

Mass PA-14/Acre = (20 gal)(3.785 ℓ/gal)(1.006 g/ml)(10^3 ml/ℓ)

= 7.62 x 10^4g = 7.62 x 10^7mg

$$\frac{\text{Mass PA-14}}{\text{Volume}} (q_r) = \frac{7.62 \times 10^7 \text{ mg}}{(5.14 \times 10^4 + 3.03 \times 10^2)\ell} = \frac{7.62 \times 10^7}{5.17 \times 10^4}$$

$$= 1.47 \times 10^3 \text{ mg}/\ell$$

Based on the rat-rabbit toxicity studies done by Union Carbide, animals would have to drink more than their weight in run-off containing 1.47 x 10^3 mg/ℓ of PA-14 to exceed the oral and dermal LD_{50} dose(1).

The maximum concentration of PA-14 reaching the first stream able to support fish life will occur at the junction of the drainage ditch and Wolf Creek. The run-off from the roost area will be diluted by the run-off from upstream areas. The concentration of PA-14 would be (assuming a 1/2 inch rain over a 12-hour period):

q = CiA (Rational Formula)

C_F = 0.50 for rolling forest land

i = rainfall intensity

A = area of coverage

Run-off from the roost area:

$q_r = C_F \; i \; A_r$ $\qquad$ A_r = area of roost

= (0.50)(0.5 in./12 hr)(25 acres) = 0.521 acre-in/hr =

1.89 X 10^3 ft^3/hr = .52 cfs at a concentration of 1.47 x 10^3 mg/ℓ

Run-off from the upland areas:

$q_u = C_F \; i \; A_F + C_G \; i \; A_G$

C_F = 0.50 for rolling forest land

C_G = 0.20 for flat grassland

A_F = area of forest

A_G = area of grassland

q_u = (0.50)(0.5 in./12 hr)(5.7 sq mi)(640 acres/sq mi)

+ (0.20)(0.5 in./12 hr)(12.4 sq mi)(640 acres/sq mi)

= 76 acre in./hr + 66.13 acre in./hr =

142.13 acre in./hr = 5.16 x 10^5 ft^3/hr = 143.31 cfs

Concentration at Wolf Creek ($C_t = C_r \; q_r/(q_r + q_u)$

(1.47 x 10^3 mg/ℓ) (.52 cfs/143.31 + .52) cfs = 5.31 mg/ℓ

The LC_{50} for channel catfish, bluegill and golden shiners is 3.0-6.2 mg/ℓ(3). The "worst case" concentration of 5.35 mg/ℓ falls within the LC_{50} range. Contact by fish with the "worst case" concentration may result in fish kills.

It is considered unlikely, however, that the "worst case" situation will occur. A study of the biodegradation of PA-14 (Annex 1) indicates that PA-14 tends to adhere to organic and bacterial soil particles. The amount of PA-14 removed from the roost area depends upon the organic and bacterial content of the soil. PA-14 applied to the roost area will come in contact with the organic bird droppings on the ground. It can be reasonably assumed that the PA-14 will adhere to the droppings, leaf litter and soil organic matter, and that the PA-14 concentration in the run-off from the roost area and ultimately in Dry Fork Creek will be negligible. The conclusion of this study is that the PA-14 application will have no significant impact on surface water quality with respect to animal or fish life.

Ground Water

Contamination of ground water is unlikely. As evidenced by the large volumes of run-off entering Rutherford Fork following a rain storm, the area's infiltration rate is small. The relative small volume of potentially contaminated solution infiltrating the soil must travel 60 feet before reaching the water table.

A study of the biodegradability of PA-14 (Annex 1) indicates that PA-14 adheres to organic and bacterial soil particles and not to inorganic soil particles. The amount of PA-14 remaining in solution

depends upon the organic content of the soil. The PA-14 solution applied in the roost area will come in contact with the bird droppings on the ground and will tend to be held by this organic matter for bacterial degradation. The degradation products of PA-14 which may become soluble must then percolate through 60 feet of soil before reaching the water table. It is reasonably certain that application of the wetting solution at concentrations discussed will not affect the ground water quality of the drinking water of the region. A study of the persistence of PA-14 in the soil (Annex 2) indicates that none remains in the soil or run-off seven months after application.

REFERENCES

(1) "Tergitol Surfactants," Union Carbide, New York, New York, 1970, p 19.

(2) Tom Harshbarger, Forester, Fort Campbell, Personal Communication, 22 January 1975.

(3) Inglis, Anthony, Robert T. Mitchell and James V. Riffle; *Toxicity of Seven Surfactants to Fish in the Laboratory*, 1967; U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife.

ANNEX 1

BIODEGRADATION OF SURFACTANT COMPOUNDS

by

Cooper H. Wayman*

SUMMARY**

Research has shown that aerially-applied surfactant solutions show promise for controlling roosting populations of blackbirds and starlings. Surfactants applied to the land surface may pose potential water pollution problems by run-off into surface streams or through soil infiltration to ground water. Because of the pollution potential, a research program was initiated to develop and evaluate procedures for determining and comparing the biodegradability of selected surfactants used as blackbird and starling physiological stressing agents.

Previous studies by the writer indicated that the branched-chain surfactant, alkylbenzenesulfonate (ABS), and the straight-chain surfactant, linear alkylbenzenesulfonate (LAS), both anionic types of surfactants, are not readily biodegraded under all natural environmental conditions. Thus, in this study, the investigation concentrated on Tergitol Nonionic 15-S-9*** and a sucrose ester, sucrose monolaurate (SML), which were both compared to LAS.

In addition to presenting a detailed account of the research results, this paper also sets forth some principles or guidelines which might serve instructive to those engaged in studies of biodegradation. Though surfactants are discussed in this paper, the principles developed are applicable

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** From a 456-page draft of the final report submitted by Dr. Wayman on research conducted at Colorado School of Mines under Bureau of Sport Fisheries and Wildlife Contract No. 14-16-0008-940.
*** Synonomous with PA-14.

to other systems of interest.

Major goals of the study were to: (1) attempt to develop a test method that could enable different investigators studying biodegradation to better corroborate their results (previous studies have indicated that different investigators employ different testing media [water], different types and amounts of micro-flora, and inadequate analytical procedures); (2) determine and compare the biodegradation characteristics of three types of surfactants; (3) determine if Tergitol 15-S-9 possesses environmental qualities superior to those of LAS, and if sucrose esters, possible third generation surfactants, are superior to both Tergitol and LAS; and (4) develop computer models (for both analytical and field studies) to assess the fate of surfactants as a result of biodegradation, hydrolysis, and as transport on a solid or bacterial surface in an aqueous system.

Because some readers of this paper may not be well acquainted with biodegradation phenomena, a detailed description of background data on surfactants was presented. The meaning of biodegradation has been given in terms of the range from ultimate degradation (into carbon dioxide and water) to practical biodegradation based upon quick screening tests through river-die-away testing. A thorough description of surfactant types was given in terms of their commercial formulation and electrical behavior in aqueous solution, i.e., whether they possess a positive, negative or neutral charge as a result of ionization in solution. The biodegradation characteristics of surfactants were considered on a theoretical basis in terms of energy requirements, kinetic parameters and development of rate expressions. In addition to supplying results of previous biodegradation

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studies of LAS, a detailed description of results about many other surfactants is given.

Various test procedures to evaluate biodegradation are listed. It is well known that many past studies resulted in the establishment of arbitrary conditions leading to much uncertainty in the corroboration of different investigators' results. Test variables involve the nature and types of micro-organisms, the nutrient source, toxic conditions, oxygen concentration, temperature, pH, surfactant concentration and analytical method. This report describes the advantages and disadvantages of various testing procedures: the Soap and Detergent Association (SDA) Method, the River-Die-Away method, Standard Method in the United Kingdom, the Official German Test for Anionic Surfactant Biodegradability, the Bunch-Chambers Method, the Warburg Oxygen Uptake Method, the Wayman-Yap Procedure for CO_2 Production, and the Wayman-Burt Method of Bacterial Growth.

The Wayman-Yap procedure provides a rather novel approach to assess ultimate biodegradation using compounds tagged with carbon-14. The method may be employed under aerobic and anaerobic conditions and enables determination of the amount of substrate converted to CO_2 in the gaseous phase, in solution, and upon various sorptive media.

The Wayman-Burt method is both a novel and an attractive means to evaluate biodegradation. It enables one to standardize experimental conditions and then determine the rate constant by bacterial growth studies. A readily biodegradable reference substrate, such as glucose, is utilized and contrasted to other substrates under identical conditions. The data are subject to empirical plots. The plotted data can then be employed

in a second-order computer program that was developed to calculate rate constants. These rate constants can be contrasted to determine whether the test substrate is superior, equal or inferior to the reference substrate. The method is a realistic approach to biodegradation studies, because it obviates the uncertainty discussed above.

Prior to the initiation of biodegradation studies, a number of screening tests were performed to evaluate the effects of test parameters on bacterial growth. These results could then be employed in the more definitive tests on biodegradation to optimize methodology. The effects of dissolved oxygen concentration, pH, initial bacterial concentration, substrate (surfactant) concentration, and salt concentration of BOD water were studied. The results indicated that the range of BOD salt concentration (10^{-2} to 10^{2} times the value specified in Standard Methods) has little influence on bacterial growth.

Dissolved oxygen concentrations in the range of 1.0 to 20.0 ppm do not inhibit bacterial growth unless a threshold value of less than 1.0 ppm is imposed. It is well known that the optimum range of pH for bacterial growth is 6.8 - 7.2. The only notable effect of pH on growth is an extended lag phase at higher pH. Initital cell density was studied in the range of 10^{2} to 10^{7} per ml. Initial cell density imposes no restraint on growth at concentrations greater than 10^{2} per ml to a concentration less than the maximum growth attainable. Temperature effects were evaluated between $5^{o}C$ and $30^{o}C$. At temperatures less than $15^{o}C$, bacterial growth and metabolism are lowered. The rate of biodegradation increases with increase in substrate concentration.

River-die-away tests were conducted under both aerobic and anaerobic conditions. Under aerobic conditions, all tests were standardized at:

pH = 7.1

DO = supersaturated

Temperature = $25^{o}C$

Initial seed concentration = 10^{3}-10^{4}/ml

Substrate concentration = 18-20 ppm

BOD water = standard methods concentration

The results indicated that most strains preferred sucrose ester (8 tests); some strains preferred Tergitol 15-S-9 (3 tests), whereas some strains grew equally well on both sucrose ester and 15-S-9 (4 tests). There was no single test sequence in which LAS could be metabolized as well as 15-S-9 or sucrose ester. Under anaerobic conditions, the three substrates were studied at $5^{o}C$ and $25^{o}C$. The results indicate that sucrose monolaurate is easily metabolized under anaerobic conditions at $25^{o}C$, but only slightly at $5^{o}C$. Neither Tergitol 15-S-9 nor LAS can be metabolized significantly under anaerobic conditions at either $5^{o}C$ or $25^{o}C$.

Carbon-14 studies on Tergitol 15-S-9 were limited to tagging on the ethoxylate linkage. River-die-away studies for Clear Creek water showed that the ethoxylate chain could be degraded as follows:

(1) 10 percent in 20 days at $27^{o}C$

(2) 1 percent in 20 days at $14.5^{o}C$

In South Platte River water, the amounts degraded were:

(1) 21 percent in 20 days at $27^{o}C$

(2) 7.5 percent in 20 days at $15^{o}C$

This indicates that the amount of degradation is somewhat dependent upon the bulk composition of the media. Studies were also performed on Tergitol 15-S-9 in synthetic media. Of the various seeds tested, S_o was most effective for Tergitol degradation. Tergitol could not be totally degraded in the range of 12 to 40 ppm, even in 10 days. At 5^oC, about 1 percent of the theoretical amount of the EO chain is degraded in 10 days; at 15^oC and 27^oC, the theoretical amounts are, respectively, 6 percent and 26 percent for the same time period. In activated sludge studies at 27^oC and 15^oC, the amount of metabolism of the EO chain was, respectively, approximately 50 percent and 10 percent. In anaerobic digester sludge, about 10 to 15 percent of the EO chain can be metabolized, suggesting a somewhat refractory nature under these conditions.

Carbon-14 tests were performed on SML, using synthetic media, river water and sludge systems. Experiments were also conducted for comparative purposes, using other compounds such as sucrose, glucose, untagged LAS and Tergitol 15-S-9. SML degrades very rapidly on common river water bacteria in synthetic media. However, purified mono-ester degrades more rapidly than either the di-ester or higher polymeric species.

In synthetic media, SML degrades somewhat more slowly than glucose. SML degrades somewhat more rapidly than free sucrose, suggesting that bacteria might degrade the hydrolyzed surfactant in preference to sucrose. In synthetic media, the laurate portion of SML degrades at about the same rate as lauric acid. In synthetic media, the rate of CO^2 generation (ultimate biodegradation) increases with increase in substrate concen-

tration in the range of 10 to 41.5 ppm; similar behavior would be predictable for river-die-away and sludge systems. Only meager amounts of SML are degraded at 5°C, but SML can be substantially degraded at 15°C and 25°C. It is significant to point out that Tergitol displays good EO-chain biodegradation at 27°C.

Temperature has a greater effect on the sucrose moiety than on the alkyl chain. Though the alkyl chain was not studies for Tergitol, one could predict that it would display degradation properties similar to that of the alkyl chain af SML. For purified sucrose esters in synthetic media, monolaurate, having less carbon atoms than monomyristate, displayed the higher rate of degradation. A commercial sucrose ester (Nitto Ester) displays similar degradation rates to those of monolaurate and monomyristate. The higher chained-length fatty acids (greater than 18 carbon atoms) have about 1/3 the biodegradation rate of lower fatty acids. These data indicate that the rate of biodegradation of the fatty acid portion of sucrose ester decreases with increase in chain length. Carbon-14 studies on SML in Clear Creek water indicated that approximately 40 percent of the theoretical amount of $C^{14}O_2$ was generated in 7 days at 27°C in contrast to a similar amount in 14 days at 15°C. SML degrades much faster in river water than in synthetic media. SML was degraded much faster in South Platte River water than in Clear Creek water. In activated sludge studies at 27°C, between 38 and 45 percent of the available CO^2 is generated within one day; on C^{14}UL sucrose (SML), the rate at 15°C is much slower. At 27°C, sludge studies indicated that the laurate moiety (1-C^{14}) is degraded much faster than the

sucrose portion, with decreased rates at 15°C. In comparison to carbon-14 labeled sucrose and glucose, SML degrades essentially at the same rate in activated sludge. Results of studies in anaerobic sludge systems indicate that both the sucrose and laurate portions of the SML molecule are degradable, with the laurate rate exceeding that of the sucrose portion; the rates are substantially lowered at 15°C. In anaerobic systems for SML, the rate at 15°C is about equivalent to that of Tergitol at 27°C.

In synthetic media, the amount of CO_2 generated in 4 days was 7 percent for Tergitol 15-S-9, 23 percent for LAS, and 50 percent for SML. However, the contrast to Tergitol is not a fair comparison, because it represents degradation of the most difficult portion of the molecule.

Based on carbon-14 studies, the degradatation of sucrose esters seems to take place essentially via hydrolysis of the ester linkage. These observations then suggest that the hydrolysis of the ester linkage is the first step of the degradation process. It seems quite reasonable to infer that the hydrolysis products, sucrose and fatty acid, will be degraded according to well-known metabolic pathways described in the report.

Sorption studies utilizing radio-tagged Tergitol 15-S-9, and SML were performed on soil minerals, organic surfaces, and bacterial surfaces. The sorption of sucrose monolaurate, Tergitol 15-S-9 and LAS on various inorganic, organic and bacterial surfaces permits the following conclusions:

(1) Neither Tergitol 15-S-9, LAS nor SML can be substantially removed from common soil sorbents.

(2) Sorption of these substrates is explainable on the basis of the existence of weak physical forces with heat of adsorption ranging from less than 1.0/kcal/mole to less than 10.0 kcal/mole, dependent upon surface coverage.

(3) Bacterial surfaces seem to be good sorbents for all these surfactants, indicating that bacteria-covered soil particles could serve as good sorbents.

(4) Peat or its humic acid derivatives possess a high capacity to remove these surfactants, suggesting that soils high in organic material might function as good sorbents for surfactants.

A second-order kinetics model was developed and applied to biodegradation data obtained for Tergitol 15-S-9, sucrose esters and LAS. The basis of the model is to determine the rate at which bacteria multiply on various substrate materials during the lag-growth phase just prior to die-off under controlled conditions. To assess biodegradation by direct comparison of kinetic rate constants, the tacit assumption is made that growth rate is proportional to substrate uptake and remains constant through the interval in which growth rate is measured. This assumption was verified. Reduction of data was based upon the second-order kinetics model employing the lag-growth phase as:

$X = X_0 e^{-\text{beta } t}$

Because S (substrate concentration) is small, growth becomes a pseudo first-order reaction independent of S. Beta is a measure of a number of constant S values from which k (the biodegradation constant) can be

determined. Beta is the slope of the growth rate, whereas k is the slope of S vs. beta. This approach to quantify biodegradation exemplifies a means based upon rigorous chemical reaction kinetics. The chief advantage of this method is that it removes the uncertainty of many variables noted in past studies.

A computer program was developed to generate fits to the second-order growth model. The program is designated as "Model" and was written in FORTRAN IV for a PDP (Digital Equipment Co.) with 64K core in timesharing. Total core is less than 5K, and execution time is approximately 1.5 seconds per set of data on this system. In order to solve the system of differential equations, it was necessary to approximate the integral $x(t)dt$ to arrive at an expression for x and s in linear form. Because of the complexities of bacterial growth, "Model" partakes of several different properties. The program, among other things, is capable of calculating DO, effecting double precision, and producing a wide variety of plot routines. The four different models employed in the program are:

(1) first-order exponential model;

(2) second-order model that ignores respiration ($r=0$);

(3) second-order model that includes respiration ($r\neq0$): and

(4) second-order model that includes respiration and arbitrary limiting to less than the substrate-limited level.

Fits were generated with the model by assuming values for the parameter and allowing the model to produce curves as a function of time to which the experimental data can be compared. Adjustments are made

to the values, and the process is repeated until a satisfactory distribution of the experimental data about the calculated curves is obtained.

Fits were considered for non-substrate limitation, substrate limitation (s=0) and substrate limitation (S≠0). Eighteen sets of experimental data were found to be satisfactory for subjection to a fit using program "Model." These sets consisted of sucrose ester (7), Tergitol 15-S-9 (7), and LAS (4). Any uncertainty in the method can be ascribed to variation of the parameters.

The pertinent parameters are yield constant (Y), ratio of respiration (R) to the biodegradation constant (K), beta, and the value for maximum growth (X_L). Beta, the net substrate uptake rate, is the most obvious, as it direcly reflects the availability of substrate to the bacteria. The yield constant, Y, is significant in that it gives some information with respect to the completeness of efficacy of the degradative process. The significance of R/K is with respect to substrate concentration allowable to effect maximum growth. X_L is a function of R/K, and it predicts the allowable substrate concentration at which the population just begins to die off. These four parameters provide an index of the rate of biodegradation of organic substrates. With these four parameters as computer input, one can model the growth of a culture, knowing the starting concentration of substrate (S_0) and bacteria (X_0).

After applying various fits for Tergitol 15-S-9, sucrose esters and LAS, the values for the four parameters were averaged. Results indicate that Tergitol had the highest uptake rate, largely resulting from the high limiting value. Though sucrose esters had small Y and R/K values, the

carbon-14 studies revealed their superior degradation properties. The important restraints, beta and R/K, were poorest for LAS reflecting a most refractory nature. The results are significant for two reasons:

(1) for LAS, there may be evidence of degradation when none is apparent by chemical analysis, and

(2) growth may be lacking or impaired when limited biological degradation occurs by pure chemical hydrolysis (sucrose esters).

As a final application of the research data, a computer program was devised to simulate field application. Program "Stream" models a river system with respect to a number of parameters to evaluate the degradative behavior of a surfactant with known constants of biodegradation. This model calculates pollution loads on a stream system in terms of BOD, DO, bacterial cell concentration and surfactant concentration. In addition, sorption of surfactant on organic components (peat and humic acid), clays and bacterial surfaces are employed as input data. These data are available from project research results. Thus, surfactant degradation or removal within a stream "reach" can be calculated with concomitant changes in BOD and DO.

The parameters required to evaluate the model may be conveniently divided into two classes. In the first class are those whose values will apply throughout the entire length of the stream; these are either the biodegradation constants that are fixed with respect to a given substrate or those that control the model. In the second class are parameters that vary from reach to reach.

The varying parameters are of three basic types: those that define the physical characteristics of the reach; those that govern the behavior of BOD; and those that indicate the concentrations of the required substances primarily indicative at the start of each reach and in the tributary flow. The model is applied to four tributary streams discharging into a large river that terminates in a lake, The model was evaluated for Tergitol 15-S-9, sucrose esters and LAS, using a constant set of stream parameters under two considerably different conditions:

(1) surfactant applied to a small stream at a concentration of 50 ppm with an ultimate dilution of 95:1; and

(2) surfactant applied at 30 ppm with ultimate dilution 5.2:1.

In terms of the high-dilution regimes, the differences in surfactant performance are practically negligible. This is best explainable because of the low value of X in these systems (equal to or less than 0.1 ppm). Under this condition, degradation is inconsequential. A surfactant like LAS, which may find difficulty in acclimatizing to a special bacterium, may clearly be at a disadvantage in contrast to Tergitol or sucrose ester.

In the low-dilution regime, some very significant results were observed. Tergitol 15-S-9 produced some very desirable results. Within 2.5 days, the compound did not drop below the high-dilution concentration; however, after 5 days, a surfactant concentration of only 0.025 ppm (a remnant concentration of about 1/2000 that of the high-dilution system) developed 100 miles downstream. The final concentrations of LAS produced the poorest results; in 2.4 days, it

was still at a concentration of 10 ppm, whereas, during the same period of time, Tergitol 15-S-9 and SML were about 1.5 ppm. Even after 5 days, LAS was still at 1/3 the concentration of the high-dilution system. The most exciting results were produced by sucrose ester; in only 2.3 days, it was below the concentration of the high-dilution system; and, in 5 days, SML was biodegraded to 1/2000 of the input high-dilution concentration. Thus, the order of selection of surfactants for field application would be Tergitol 15-S-9, until sucrose esters are commercially available, followed by LAS.

ANNEX 2

PERSISTENCE OF PA-14 IN SOIL

The following is a portion of a report prepared by Department of the Army, U. S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland, 21010, "Environmental Health Special Study No. 99-023-75, Acquisitions and Analysis of Environmental Samples for PA-14, Fort Campbell, Kentucky, 2-16 December 1974.

" ... Materials and Methods--Environmental Samples--Samples of soil from the treated and untreated area, samples of standing water from the treated area, and samples of pine needles from trees in the treated area were secured on a randomly selected basis and airmailed to USAEHA for analysis. Analytical Techniques---Analysis for the compound was by a spectrophotometric method modified from the procedure by Greff et. al. (1965). The Greff et. al. (1965) procedure was designed to detect nonionic surfactants in water. The USAEHA used the following modified soil extraction technique for PA-14 solutions: the soil sample was subjected to double aqueous extraction, and the extracted aqueous layer was withdrawn and treated in the same manner as outlined in the Greff et. al. (1965) procedure for water.

An untreated soil sample was fortified with known amounts of PA-14 in order to establish recovery capabilities of the technique. The pine needles were not analyzed due to the incapability for modification of the technique for this type of sample.

RESULTS

Results of the analysis of soil and water samples are listed in

Table 2. There were no detectable amounts of PA-14 found in any of the samples analyzed. The lower limit of detectability for PA-14 using the Greff et. al. (1965) method was 2 mg/l in water. Using a 3.5 g portion of the soil sample for extraction would produce 57 ug surfactant/g soil if present. The deviation associated with these measurements was determined to be ± 1.5 mg/l in the water solution. The amount of nonionic surfactant recovered from the fortified soil sample represented 28.0 percent.

CONCLUSIONS

At the time of analysis, no detectable amounts of PA-14 were present in the soil and water samples acquired from Fort Campbell, Kentucky, utilizing the spectrophotometric method of Greff et. al. (1965).

TABLE 2

RESULTS OF ANALYSIS FOR PA-14

Sample No.	Sample Type	PA-14 Detected
1	Treated Area Soil	0
2	Treated Area Soil	0
3	Treated Area Soil	0
4	Treated Area Soil	0
5	Treated Area Soil	0
6	Treated Area Soil	0
7	Pine Needles - Treated Area	Not Analyzed
8	Pine Needles - Treated Area	Not Analyzed
9	Treated Area Water	0
10	Untreated Area Soil	0
11	Untreated Area Soil	0
1B	Repeat 1	0
1C	Repeat 1	0
11B	Fortified Untreated Area Soil	

Results of analyses of subject samples are as follows:

Sample No.	Comment	PA-14 Found
1A	soil	none
2	soil	none
3	soil	none
4	soil	none
5	soil	none
6	soil	none
7	pine needles	not analyzed
8	pine needles	not analyzed
9	ground water	none
10	soil blank	none
11	soil blank	none
1B	repeat	none
1C	repeat	none
11B	spiked blank	94 ug/g soil

Lower detection for the method with this particular surfactant is 2 mg/l in water. Using a soil sample for extraction of 3.5 g, this would be 57 ug/g soil. To get lower limits would require an extensive extraction process that would have to be developed.

The deviation associated with the measurements was determined to be ± 1.5 ppm in the water solution.

Based upon the spiked blank sample, the amount of nonionic surfactant recovered from the soil sample was 28 percent recovery.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

1421 PEACHTREE ST., N. E.
ATLANTA, GEORGIA 30309

January 20, 1975

U. S. Army Construction Engineering
Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Gentlemen:

We have reviewed the Draft Environmental Impact Statement for Blackbird Control on Army Installations and the program appears to be well planned and organized to prevent undue contamination of the environment. There are several points, however, which need clarification or need additional information. For this reason, we have assigned a rating of LO- (lack of objection) 2 (insufficient information) to the project and to the Impact Statement.

First, we note the statement on Page 22: "All roosts will require disinfection through the application of formalin before human use can be made of the roost area." We must point out that formalin is not registered for disinfection purposes; therefore, either an experimental permit must be applied for to EPA or a public health exception under Section 18 FIFRA should be sought.

We further suggest that the opening paragraph (Page 1) be revised. Appendix 1 (Page 85) discloses that the estimated species composition of the population at Fort Campbell is given as applying to the 13 million population of blackbirds roosting at both Fort Campbell and the Milan Army Ammunition Plant. (The percentage of cowbirds should be 12 instead of 17.) Percent composition of species of the blackbird population at the Milan Installation (Appendix 1, Page 85) should be given to make the first paragraph accurate. In addition, the estimated total population of birds at each installation, according to estimates stated on Pages 10 and 15, should be given, and the basis for estimating them should be explained.

Furthermore, the methodology employed in estimating percentage composition of species at Fort Campbell (Page 10) and the Milan Installation (Page 16) should be clarified. Considering the millions

of blackbirds in the roosting populations, the number of specimens collected (method unexplained) does not appear to be large enough for accurate estimation of species composition or proper analysis of food grains found in crops and gizzards as detailed in Appendix I. These birds are opportunistic feeders whose diet varies daily throughout the seasons as the availability of acceptable food items fluctuates. Therefore, a sample taken on a single day (as was done in this report) could not represent grain consumption patterns during the whole 120-day roosting period.

We also make several other observations which might be considered in the final impact statement.

The absence of predation on tons of insects which could be the result of total roost kills in Fort Campbell and at the Milan Installation could have a significant effect on the success of commercial crops in states to which the birds migrate and could require a compensating increase in the use of insecticides.

In addition, the Statement states that 50-75 percent of the grain consumed could come from open fields instead of commercially harvested grain. If the 50 percent figure is taken, then 16,000 tons of scattered and/or wasted grain is consumed during the 120-day nesting period. We suggest that if this much grain is not utilized by birds that would be killed at Fort Campbell and Milan, then it would be available for other species such as mice, rats, and voles, thus producing conditions conducive to these rodents' population expansion. Economic losses and disease hazards associated with increased rodent populations could exceed the problems presently presented by the blackbirds.

Another possibility is that if the feeding flight range of blackbirds in the other known roosts in the Kentucky-Tennessee area (as presented in Figure 7, Page 21) presently overlap, or can be extended to overlap the areas presently utilized by the Fort Campbell and Milan birds, the grain that would have been eaten by the killed birds would be available by residents of these other roosts. This additional source of food could reduce the high

winter mortality (as shown in Figure 9, Pg. 49) in these other roosts and the net result of this would be that the same areawide total amounts of grain would be consumed by blackbirds and that the number of birds still occupying the other twelve roosts in the spring would be increased.

Another, and likely, possibility would be a combination of rodent population increases plus higher survival of birds in other roosts.

We also offer these specific comments:

1. Page ii-4d should read feed lot rather than food lot.

2. Page 8, second paragraph should read "...Wendell H. Ford" rather than "...Wendell H. Fort."

3. Page 22, Paragraph b, should read "Histoplasma capsulatum rather than Histoplasmosis capulatum.

4. Page 40, fourth column in Table 1 should read average monthly daily minimum temperature rather than maximum.

5. Page 96, purpose finch should read purple finch.

We would appreciate receiving five copies of the final environmental impact statement when it is available. If we can be of further assistance in any way, please let us know.

Sincerely,

for John C. White, Deputy
Jack E. Ravan
Regional Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D.C. 20250

January 8, 1975

U.S. Army Construction
Engineering Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Gentlemen:

The Agricultural Research Service has no objection to the Draft Environmental Impact Statement concerning Blackbird Control on Army Installations.

The benefits to be derived from control of the blackbirds far exceed any potential hazards that may result from this action.

Sincerely,

H. L. Barrows
Acting Deputy
Assistant Administrator

OFFICE OF THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

January 14, 1975

U.S. Army Construction Engineering
Research Laboratory
P.O. Box 4005
Champaign, Illinois 61820

Gentlemen:

The draft environmental impact statement for "Blackbird Control on Army Installations," which accompanied your letter of December 23, 1974, has been received by the Department of Commerce for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

Successful control of the target pests is assumed following one application of PA-14. However, because of the number of variables involved, it is conceivable that the expected control may not be accomplished by the proposed plan, and a second treatment may be necessary. We suggest considering the impact of a possible second application.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHERN REGION
P. O. BOX 20636
ATLANTA, GEORGIA 30320

January 13, 1975

Mr. Henry L. T. Koren
Deputy Under Secretary of the Army
U. S. Army Construction Engineering
Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Dear Mr. Koren:

We have reviewed the Draft Environmental Statement entitled "Blackbird Control on Army Installations" prepared by the Department of the Army, with respect to potential environmental impact for which this agency has expertise.

Our review indicates there will be no significant adverse effects to the existing or planned air transportation system as a result of this project.

Sincerely,

Benny C. Frazier

BENNY C. FRAZIER
Chief, Planning and Appraisal Staff

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION IV
50 7TH STREET N.E.
ATLANTA, GEORGIA 30323

OFFICE OF THE
REGIONAL DIRECTOR

January 13, 1975

Re: 480-1-75

U. S. Army Construction
Engineering Research Laboratory
Post Office Box 4005
Champaign, Illinois 61820

Gentlemen:

Subject: Blackbird Control
Fort Campbell, Kentucky
Milan Army Ammunition
Plant, Tennessee

We have reviewed the subject draft Environmental Impact Statement. Based upon the data contained in the draft, it is our opinion that this proposed action will have only a minor impact upon the human environment with respect to the concerns of this Department.

Sincerely yours,

James E. Yarbrough
Regional Environmental Officer

MURDAUGH STUART MADDEN

Law Offices

2100 L Street, N.W.
Washington, D.C. 20037 U.S.A.
202 833-3960

January 23, 1975

Col. W. P. Gardiner
Chief, Environmental Office
Department of the Army
Office of the Chief of Engineers
Washington, D.C. 20310

Attention: DAEN-ZCE

Re: Comments of The Humane Society of the United States on Draft Environmental Impact Statement Entitled "Blackbird Control on Army Installations"

Dear Col. Gardiner:

We have reviewed the aforementioned Draft Environmental Impact Statement, along with a number of the comments and criticisms already submitted with reference thereto, and have only the following additional comments to make.

First, it would seem to be inconsistent with the philosophy of the controlling law and regulations for this operation to proceed this winter since by the Army's own estimates the chance of its being efficient and effective has been seriously impaired by the passage of time. Once again, absent some emergency, there would seem to be no justification for proceeding at a time which is admittedly not only not optimum but apparently one which offers only minimal chance of success.

Next, it is obvious that the present proposal is pure stop-gap and no more than an attempt to satisfy citizen pressure. The Army does not seriously contend that at best it will provide anything more than temporary relief, and the DEIS would appear to be fatally defective in that it has not given any in-depth consideration to the environmental impact

11-8

involved in repeated and multiple applications of this chemical agent throughout the United States.

Finally, even a quick glance at the SUMMARY shows that the Army really does not even have a definite position of its own (right or wrong) on most if not all of the serious questions which have been raised. For example,

a. it states that no adverse impact is expected under "anticipated conditions" with no analysis of the many unanticipated ones which can readily be verbalized and analyzed;

b. with reference to the possibility of an increase of soil insect populations, it states that if it were to occur it would be "very local" -- with little further analysis of this potentially serious problem; and

c. finally, it successfully eliminates any suggestion of prescience in stating that under an unlikely combination of circumstances, small droplets of PA 14 could be carried some distance from the application site, but goes on to state that the effect of these droplets on the environment is probably negligible under the meteorological conditions planned. They are frankly admitting that, given a few tough breaks, they don't know what might happen.

It is respectfully urged that the Army should abandon its present timetable and devote its energies toward seeking out adequate and long-range solutions to the problem compatible with the needs for environmental safety, since to implement its present proposal will at best constitute an exercise in futility and demonstrated inefficiency.

Very truly yours,

Murdaugh Stuart Madden
General Counsel

MSM:ch

Response to comments by Humane Society of the United States:

Response to paragraph 2:

We agree that the ideal time for control is past, but deny that the slightly decreased benefits render a February application ineffective. Statistically, the largest number of satisfactory days in any one month fall in February. Success of the control measures, themselves, is then increased by a February application, even though the benefits to the local communities are slightly decreased as opposed to a December application.

Response to paragraph 3:

The Army is definitely concerned with the question of repeated and multiple applications of PA-14 to every accessible roost in the United States, and is opposed to such programs on ecological bases. No such program is endorsed or contemplated. Further, the U.S. Fish and Wildlife Service of the Department of the Interior holds ultimate responsibility, through registration and application permit regulations, for overseeing such control programs. It is they who must approve control programs and be present when application takes place. It may be assumed that such an "eradication" campaign would not be approved by these professional wildlife biologists.

Should the Fish and Wildlife Service decide that proposed control programs have the potential for turning into "eradication" campaigns,

several courses of action could be overtaken by various governmental agencies to stop them. EPA could withdraw the registration of PA-14 as a means of avian control in a unilateral action. Similarly, the Department of the Interior could request that the registration be withdrawn immediately, and could cease to issue labels for the surfacant containers already in the hands of a potential user. This would render any further use illegal. Finally, should blackbird populations decrease in a manner which the Fish and Wildlife Service deems dangerous, the birds could be removed from the list of crop depradating birds. This would effectively protect them as songbirds rather than pests.

Response to pargaraph 4--parts a,b, & c:

Since the DEIS considered every possible type of environmental effect remotely likely, mention was made of the possibility of drift of the PA-14 to surrounding areas. The final EIS makes clear that these concentrations are minute, and possibly not even detectable. The "worst case" postulations involved in calculations of water and air pollution make assumptions that the highest winds allowable will be present and that the minimum rainfall is available to dilute the surfactant and that there is 100% immediate run-off of all PA-14 applied. The Army feels that every such calculation errs tremendously toward the conservative side, and thus the possibilities for environmental contamination are actually orders of magnitude less than stated, rather than being unknown degrees more.

The American Humane Association
P. O. Box 1266 • Denver, Colorado 80201 • 303 771 1300

AIR MAIL

January 8, 1975

U. S. Army Construction Engineering
Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Gentlemen:

As requested in a letter from William R. Wray, Brigadier General, USA received December 23, enclosed are comments concerning the Draft Environmental Impact Statement pertaining to proposed control of starlings and other blackbirds on Army controlled property.

We would appreciate it if you would keep us informed of any further developments.

Sincerely,

Rutherford T. Phillips
Executive Director

RTP:mha
Encl.
cc: William R. Wray
Jo V. Morgan, Jr., Esquire

MEMORANDUM

TO: U. S. Army Construction Engineering Research Laboratory

FROM: R. T. Phillips

RE: Draft Environmental Impact Statement pertaining to proposed control of starlings and other blackbirds on Army controlled property.

AHA Position

The American Humane Association does not concur with this proposal due to lack of data indicating the total efficacy and humaneness of compound PA-14 Avian Stressing agent.

Summary and Comments

Summary

Purpose of Action

To reduce blackbird population estimated at 13 million in winter roosting areas, located at Fort Campbell Military Reservation, KY (27 acres, 4 to 5 million birds) and Milan Army Ammunition Plant, Milan, TN, (36 acres, 7 to 10 million birds).

The army wants to reduce the bird population included in both areas by an estimated 11 million birds.

Blackbirds listed in this statement are the following: grackles, redwings, starlings and cowbirds.

Reasons for proposed reduction of blackbirds

A. Losses to local farmers

1. Birds consume standing grain crops.

2. Birds remove planted seeds and sprouts.

3. Birds consume feedlot feeds.

4. Cause damage to buildings and machinery.

B. Losses to timber in both areas

1. Causes

a. Mechanical damage

b. Biochemical damage

2. Total loss to both areas is approximately 25 acres of timber.

3. Live trees in roost areas are not suitable for cutting.

C. To eliminate odors from roost areas

D. To eliminate hazard to aviation safety; the airfield at Fort Campbell has to be closed twice daily for 45-90 minutes when birds cross over runway area.

E. To eliminate health problems to humans and animals

1. Humans-Histoplasmosis-the causative organism is the fungus (Histoplasma Capsulatum). The roost has been found to be an important source of this organism.

2. Birds carry transmissible gastroenteritis (TGE) which attacks pigs in the areas.

F. Public opinion - people do not like the indiscriminate bowel movements of the birds and the odor from the roost areas.

Proposed method of reduction

Reduction of the bird populations would be by aerial application of a wetting agent solution that reduces the surface tension of oil on the feathers. The oil is then washed off by a minimum of one-half inch of rainfall, either natural or applied by ground personnel, which reduces the feather insulation and protection. The birds then succumb to the cold.

The wetting agent solution would be applied at the rate of 80 gallons per acre and be a mixture of 20 gallons of Stressing agent PA-14 (Tergilol 15-S-9), 4 gallons isoproponal and 56 gallons of water.

The solution would be applied during the evening hours, when birds are quiet, through the use of helicopters and fixed-wing aircraft.

The critical factors in applying this solution to produce maximum kill are the following:

1. Solution must penetrate pine tree canopy in which roosts are located.

2. A need for temperatures below 45° F. Proposed application temperature is near 32° F.

3. Application of water amounting to a half inch of rainfall within 30 minutes of the spraying of PA-14.

During test procedures when these factors were followed test birds died within two hours, with a 75% death rate in the first 30 minutes. No further information was provided on the effects of PA-14 on birds.

Since the roost population is at peak size from late December to mid-March it is proposed that both the Fort Campbell and Milan roost areas be treated no later than mid-February. Also proposed is that at least one roost receive a November-early December (1975-76 roost season) treatment to evaluate the effects of blackbird damage control and roost re-occupation.

Estimated results from the total operation are from 0 to 96% kill when all variables are considered. If 11 million blackbirds are successfully exterminated it is estimated that this would represent 2% of the national blackbird population. "It is probable that the roost would be re-occupied by other blackbird populations migrating southward later in the season."(1)

Alternatives to proposed action

The following is a list of alternatives considered by the Army for the reduction of the blackbird population in the two roost areas. All alternatives were considered unacceptable for a variety of reasons.

1. Introduction of natural, population-limiting parasites
2. Introduction of a virus such as avian pox
3. Trapping
4. Man induced predation
5. Shooting
6. Dynamite
7. Artillery air-burst
8. Starlicide - bird toxicant
9. Contact toxicants
10. Reproductive cycle interference
11. Frightening devices
12. Roost modification

---

(1) Page 57, Section 4, Alternative to the Proposed Action.

13. Avitrol - birds ingesting this material react with distress symptoms and calls which causes nearby members of the flock to become alarmed and fly away

14. Alteration of food sources

15. Electronic devices

Proposed disposal of dead blackbirds

The recommended method is a combination of aerobic (on top of the ground) and anaerobic (landfill) land disposal.

The aerobic method would consist of allowing birds that fall within the roost area or unpopulated areas to decompose on the spot without removal. Birds that fall within a cantonment area could be collected and disposed of on one of the less used parachute drop areas. "A manure spreader could be used to broadcast the collected carcasses"(2) at the Milan AAP birds collected from the cantonment areas would be taken to the base sanitary landfill for disposal.

Alternative disposal methods considered but found to be unacceptable were, pathological incineration and production of protein meal.

Environmental impacts

The effect of the application of PA-14 on surface and ground water, other birds, wildlife, plants and humans was considered to have no adverse effect given present and anticipated conditions.

If everything proceeds as planned by the Army there would be a reduction in the blackbird population in the two areas of 11 million birds. This would represent 2% of the national blackbird population.

Comments

The context of the Draft Environmental Impact Statement, Blackbird Control on Army Installations indicates that the Army has selected a proposed course of action, for the extermination of 11 million blackbirds, that is expedient and requires a minimum of action, time and manpower.

---

(2) Page 52. Aerobic and anaerobic landfill.

The use of the compound PA-14 Avian Stressing agent to accomplish the blackbird population reduction is highly questionable from the information provided in the statement. Most notable is the lack of information on the effects of the compound PA-14 on birds if all the critical factors in applying this solution are not met.

Questions that come to mind are the following:

1. Is this an acceptable form of mass euthanasia?

2. If after application of PA-14 sufficient water is not applied, either naturally (rainfall) or by spraying from ground level will the birds die? If so what is the time interval?

3. Can birds fly after application of PA-14, but before water is applied?

4. If only 25 or 50 percent of the bird's body comes in contact with PA-14 and water, what will be the effects?

5. If the first application of the solution to a roost area is unsuccessful will further applications be made, and what environmental impact will these have?

The aerobic method for the disposal of the dead blackbirds is unacceptable from an esthetic viewpoint and if decomposition of carcasses is not within the proposed time period, a disease hazard to wildlife and human populations may be present.

It should be recommended that if the population reduction is permitted, bird carcasses be disposed of in a sanitary landfill.

The proposed action if carried out would only have a short-term effect as the statement indicates. Loss to the blackbird population is expected to be made up by natural reproduction within two years. Long-term effects are expected to be negligible. If this action is carried out as proposed, major effects will be very short-term.

The question that now arises is, will the Army make the Blackbird Control Program a bienniel event?

A combination of the alternatives to the proposed action would appear to be a better method for the control of the blackbird population in the two areas. These could be a combination of trapping, roost modification, reproductive cycle interference, and Starlicide.

It is felt that the proposed action and statement information is inadequate and should be opposed at this time.

Response to comments by The American Humane Association:

1. As the oil from the feathers is lost, the insulation of the feathers is lost. As the body temperature drops, vital enzyme systems fail and the bird loses consciousness. USDI personnel who have observed bird reactions to the chemical, report no evidence of fright, alarm or distress. PA-14 is registered with the Environmental Protection Agency for this purpose.

2. Experiments performed by the Division of Wildlife Research of the U. S. Department of the Interior (Caslick and Stowers, 1967; Stickley et al, 1969) for the purpose of determining the usefulness of PA-14 in avian control may be interpreted to show that many birds which were treated with surfactants but not treated with water did survive more or less indefinitely. Survival of such wild-trapped, caged birds is often problematical anyway, so some birds did die in such situations, as did some untreated controls.

3. Observations by many persons indicate that treated birds are fully capable of flight until precipitation washes the oil from their feathers.

4. The experiments referred to under point 2 (above) indicate that sublethal treatment, resulting from extremely dilute applications, serves as a temporary stressor for the bird. If body temperature drops below approximately 20°C (68°F) as a result of the treatment and

subsequent exposure, the birds cease to breathe, and death results within a few minutes. Many birds are fatally chilled at higher temperatures, with an approximate mean lethal temperature of 23°C (74°F) being suggested by the experiments. Birds generally recovered completely if they did not die within one hour.

5. Operationally, an additional application may need to be made soon after the first one. This is discussed in the final statement in Point 1.

In reference to Proposed Disposal of Dead Blackbirds:

We feel that the aerobic method is satisfactory from an aesthetic standpoint when the carcasses amount to 14 or fewer per square yard. In any case, all carcasses will be removed from housing and work areas. It is not known to what type of disease hazard to wildlife or human populations the AHA is alluding should decomposition of the carcasses not take place within the proposed time period.

In reference to the comment that major effects will be very short-term:

We agree with this statement, and our discussion in Point 6, page 70 of the DEIS established that benefits and ill effects will both be short-term.

ENVIRONMENTAL
DEFENSE
FUND

1525 18th STREET, NW, WASHINGTON, D.C. 20036/202 833-1485

January 13, 1975

Lt.C. Robert E. Flickinger
Construction Engineering Res. Lab
P.O. Box 40005
Champagne, Illinois 61820

Re: Comments on the Department of the Army's Draft Environmental Impact Statement Entitled Blackbird Control on Army Installations, December 24, 1974

Dear Sirs:

The Environmental Defense Fund (EDF) submits the following comments on the above-referenced document. EDF is a national organization composed of lawyers and scientists, employed in five offices across the nation, and a membership of over 50,000 educators, scientists, lawyers, and other citizens concerned with scientifically sound solutions to the nation's environmental problems.

Since last fall, EDF has corresponded with the Army with respect to the need for filing an environmental impact statement (EIS) concerning the proposed blackbird control program. Although the Army apparently still does not regard the proposed program as "a major federal action having a significant impact on the environment under the provisions of the National Environmental Policy Act" (39 Fed. Reg. 44257) we agree with their decision to file an EIS and submit the following comments with respect to it.

1. The draft EIS has certain major weaknesses which cast great doubt upon its over-all adequacy as an assessment of the environmental impact of the program. In the first place, the alternative selected by the Army, i.e., elimination of the blackbirds by application of a surfactant, Tergitol, is a short-term palliative measure which does not represent a permanent solution to the problem. By the Army's own admission, the proposed "control operations" at Fort Campbell and Milan AAP would not affect the spring breeding population whether the operation is conducted in autumn, mid-winter or spring and thus the proposed relief "would be only temporary." (DEIS, pp. 57-58)

11-20

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11-20

The basic cause is, of course, the roost habitat which must be altered to make the areas in question less attractive to the birds. Unless this is done, the blackbird roost will remain a problem and the program described in the DEIS will undoubtedly have to be repeated every year for several years. The draft statement, however, fails to consider the potential effects on the blackbird population of repeated annual eliminations of millions of blackbirds.

2. A second major weakness is that the DEIS ignores the fact that it is now too late in the season to carry out the proposed program with any hope of achieving the asserted objectives. Although the roosts are most stable in mid-winter,

> An application of PA-14 made during the period when the roosts are most stable would not protect agriculture from fall losses. Risk of histoplasmosis in roost sites would be greater, since there would be more manure. There would be greater risk of disease in swine.
>
> Applications made in the spring would be less beneficial. All the previously cited damage would have occurred. Community relations would be strained, and as noted above, there could be slight effect on the national blackbird breeding stock population. (DEIS, p. 79)

Thus, the conclusion on p. 80 that "the Fort Campbell and Milan AAP roosts should be treated with PA-14 during this season no later than mid-February . . . ." appears inconsistent with all of the discussion preceding and allegedly justifying it. Since the damage is already done and a problem next season will not thereby be prevented from recurring, the entire exercise and expenditure of federal funds seem unwarranted. Indeed, we believe the time and effort would be better spent between now and next winter in seeking a permanent solution to the problem by experimenting with and evaluating a combination of control measures which would alter and thereby eliminate the favorable roost habitat.

3. The draft impact statement also appears to be deficient in the following particulars:

> a. There is no discussion or evaluation of the reasons for the failure of last year's comparable program, or the possibility of failure this year. For example, there is no discussion whatever of the possibility of aircraft noise frightening the birds just prior to release of the Tergitol.

b. The statement contains no comparative data regarding the way other entities and communities have handled comparable problems and the effectiveness of alternative means to Tergitol as actually evidenced by use of these alternatives in other places.

c. The Army seems to have considered only single alternatives to Tergitol, rather than a combination of alternatives used together. (DEIS, pp. 57-69) For example, a policy of habitat thinning, dispersal through use of noise-making mechanisms, and farmer use of starlicide on feed lots, as well as drilling of seed, would, when used together, in our opinion greatly mitigate the problems without eradicating the birds.

d. The impact statement has little supporting documentation, and seems almost entirely based upon assertion. This is especially apparent in the discussion of economic costs and benefits (See DEIS, pp. 7-19) Because of the lack of documentation, the alleged benefits of the program appear speculative and overestimated, while costs are underestimated or not quantified. In addition, there are statements made which contradict the economic arguments proffered elsewhere in the DEIS. For example, at pages 9-11, an estimation of economic losses is made by extrapolation from grain found in the crops of blackbirds in late autumn. During this period of the year, the birds are undoubtedly gleaning grain from open fields which was wasted during the harvest period, yet the assumption is apparently made that 25 to 50 percent of this grain diet could result from feeding in feed lots or on recently planted soil. However, not only are these crops not planted at that time, but also the Army's own evidence of birds foraging in recently planted fields on the bases themselves showed that such foraging was not taking place. 1/ This evidence indicates that despite the unsupported assertions to the contrary, after the fields have been gleaned, by mid and late winter, the food of the birds may well be found to be far less commercially useful grains, and more weed seeds. Without more accurate economic evidence, valid cost/benefit analysis of the project cannot be made.

1/ According to the DEIS at p. 7, "A study was conducted by two biologists from the U.S. Fish and Wildlife Service in December, 1974. The study concluded that there was relatively little feeding by blackbirds on newly seeded wheat on test plots within Fort Campbell." [emphasis added]

e. The draft impact statement also greatly exaggerates the human health dangers caused by the birds, especially at Milan, where the roosts are admittedly far from human population. (DEIS, p. 24) Statements about the human health hazard are very general and tied to the peculiarities of the area only in that "Fort Campbell is located in the area of highest endemicity of histoplasmosis in the United States." (DEIS, p. 24) At the same time, the statement contains no evidence supporting the assertion of increased cases of histoplasmosis (DEIS, p. 76) not connected to the acknowledged higher natural occurrence of the disease in the area. Similarly, there is no indication of increased incidence of the various bird-borne diseases detailed at pages 95-96 of the impact statement. At most, the DEIS describes a potential health hazard which may warrant elimination over the long-term but for which the efficacy of Tergitol application has not been established. It should be noted in this connection that the impact upon human health of the disposal of the decomposing carcasses of millions of dead blackbirds, particularly upon those doing the disposal, is not adequately addressed in the DEIS. (See DEIS, pp. 46, 75)

f. The impact statement exaggerates the hazard posed by these birds to aircraft (See DEIS, pp. 27-28) Not only are there no recorded instances of serious problems to date, 1/ but the alternative solutions being used presently appear to be effective. If the roosts can be dispersed away from the airfields, the problem should be even more greatly diminished.

g. There is insufficient discussion of what will occur to non-target species as well as vegetation and drinking water supplies when the drift of Tergitol occurs, as it admittedly will, during application away from the target areas. The impact statement admits that non-target species in the roosts will be killed, and specifically mentions meadowlarks and red-tailed hawks. (DEIS, pp. 69; App. 7, p. A-1) However, there is little other discussion of possible non-target species that could be affected, such as robins, bluebirds and others that are known to congregate at winter blackbird roosts. Since the impact statement acknowledges that non-target species are present (See DEIS, pp. 47, 62, 69, 96) and could be affected by the proposed control program, a more precise study of which species are present and how

1/ Indeed, the draft impact statement establishes that "daily Army helicopter activities have not been impacted" (DEIS, p. 27) and that "aircraft noise may cause birds to soar upward into the flight pattern although this has not happened during past or recent test flights." (DEIS, p. 31) [Emphasis added]

Tergitol will affect them, should be undertaken before the program is carried out. 1/

h. We believe that the draft impact statement deals insufficiently with the ecological effect of eradication of the blackbirds at Fort Campbell and Milan AAP. In particular, the statement does not assess the potential adverse impact upon food webs if there is an increase in soil insect and weed population next spring and summer where the birds would otherwise breed. Since these birds are largely from a population which breeds in a relatively restricted area, the impact will be greater than if they dispersed throughout the nation. For example, the impact statement indicates,

> most of these grackles breed in Ohio, Michigan, Indiana, Illinois, and Ontario. Thus while grackles at the Fort Campbell roost may represent only 3 percent of the total eastern population, they represent a greater percentage of the populations from the above-mentioned states. Thus a reduction of 2,500,000 grackles might have a greater impact on breeding populations in localized areas than is indicated in Figure 9. (DEIS, pp. 48-50)

In this instance and others, the impact statement offers speculation rather than a scientific assessment of the possible ecological effects of the proposed program (See DEIS at 69-70). Such unsupported assertions about possibilities do not address potential adverse environmental effects in the manner intended by §102(2)(c) of NEPA.

i. Most significantly, there is no discussion and no data is provided with respect to industry or government testing for chronic or long-term effects of Tergitol upon wildlife. All of the information deals with acute or lethal toxicity rather than with sub-lethal toxicity with respect to such parameters as reproduction or behavior. (See, e.g. DEIS, pp. 111, 132-133). Although the statement asserts that "laboratory studies have not indicated any evidence of chronic toxicity," (DEIS, App. 7, p. A-2) no cite is given to such studies, nor are they discussed any further.

1/ It should be noted that the impact statement includes very unscientific species and population counts. (See DEIS, pp. 16, 85, 85A) Apparently the species counts were based upon shooting of a few individual birds, and it can be assumed that those doing the shooting did not shoot non-blackbirds, or at least did not report them. Further, there is no explanation as to how the total number of blackbirds was estimated, and it is well known by experts in ornithology that such mass counts are extremely difficult to make. In short, the numbers may be less and may include more non-target species than the impact statement reveals.

j. Throughout the impact statement the potential contamination of ground and surface water from Tergitol is inadequately addressed. Although the statement concludes that "No ground or surface water impacts are expected. . . ." (DEIS, p. 50), little supporting experimental or field test data is provided. In fact, in the one field experiment reported, in which residues were measured after application of Tergitol, 1/ no information is provided regarding how much was applied, by what method, or under what atmospheric conditions. It is therefore difficult to determine whether comparable results might be expected at Fort Campbell or Milan.

k. With respect to the rejection of various alternative measures which could be employed to abate the blackbird problem, we believe that the Army has overestimated its obligation to the local population to eliminate rather than disperse the blackbirds. Certainly federal taxpayers are not obliged to eliminate local wildlife nuisances across the country where they occur. This is particularly true where the local farmers seem unwilling to take upon themselves the responsibility to reduce damage done by using starlicide in their feed lots, changing to night or early morning animal feedings, or by drilling their winter planted wheat seeds. 2/ We therefore suggest that the Army's obligation at most is to disperse these large roosts into smaller numbers.

l. Consideration of the various alternatives discussed however briefly in the draft impact statement indicates that roost modification would most successfully alleviate the bird problem. (DEIS, pp. 65-66) This could be accomplished by selective thinning of the roost sites, even though such a step might "necessitate the change of the land use from reforestation and timber production to recreational." (DEIS, p. 66) The relatively small areas involved could certainly be thinned more than they have been to make the areas immediately adjacent to airfields and to bases less attractive. In addition, it may not be necessary to thin all of the large reforested area, providing that the blackbirds can be forced away from the inhabited areas. However, since "agriculture is the major source of livelihood in this area," (DEIS, p. 68) even if a significant land use change is required, the Army can preserve good community relations by taking such a step since it will best protect the local livelihood over the long term.

1/ DEIS, p. 141.

2/ See DEIS, pp. 58-59; 68; 83.

m. Finally, there is also a total lack of discussion regarding the need to monitor the program, should it take place, in order to assess its effectiveness and thereby its usefulness in comparable future situations. Nor is there any discussion of observations of normal spring and summer breeding areas to determine whether there are adverse environmental effects from the reduced number of blackbirds.

It is our firm conviction that the alternative which is better than total elimination of these birds is their dispersal through habitat modification in areas near human habitation, use of noise mechanisms to hasten that dispersal, and specific use of chemicals such as starlicide in the feed lots of farmers bothered by blackbird depredation. We believe that the method proposed of extermination, freezing to death, is inhumane and should be resorted to only if all possible alternatives regarding dispersal have been tried and failed.

Our analysis of the draft impact statement reveals that much more thought and scientific information is required before the proposed program can justifiably be carried out. The large scale elimination of any wild creatures by the Army is not a precedent which should be established lightly, without careful consideration of the overall environmental impact of the available alternatives and scientific documentation of the alternative ultimately selected.

We hope that these comments will assist the Army in the reconsideration of its proposed program.

Respectfully submitted,

Jacqueline M. Warren

Jacqueline M. Warren
Washington counsel

cc: Harold R. Russell, Jr.
JW:bw

11-26

Response to comments by Environmental Defense Fund:

Response to point 3b:

There is not a great deal of information available about the management of bird roosts. Tree thinning, if extensive enough, will result in roost movement. Tree thinning has been partially successful at Fort Campbell, but roosts have merely been moved to areas where thinning has not been accomplished. Roost selection by the blackbirds is not predictable. For example, at Milan, where pine tree thinning has not been accomplished, the roost this year is in deciduous trees.

A number of communities have had success in moving roost by means of biosonics. A similar success with biosonics was achieved at Fort Campbell in 1973. In these instances, the roost was moved away from a highly populated area. However, these roost movements did nothing to protect local agriculture from blackbird damage, and the Fort Campbell roost was re-established closer to the airfield.

Response to point 3c:

While single alternatives were discussed, there was no intent to suggest that combinations were not considered in the discussion. It is agreed that a combination of the methods suggested by EDF could assist in some aspects of the problem. In the present situation, however, the Army has no control over practices carried out by private citizens on their own farms. Instead, these citizens have consistently viewed the

situation as being one in which the Army harbors vermin which it is reluctant to control, for reasons which are inexplicable to the general public.

Dispersal alone is not likely to alleviate crop depradation or threat of spreading histoplasmosis. In the latter case, the new roost site or sites would merely become additional sources of infection for many years. Neither is it likely that the potential aviation hazard at Fort Campbell would be reduced, since there are scores of potentially attractive roost sites on both Army and private lands within a few thousand yards of the airfield. When the roost is moved, it is not really "dispersed," but tends to shift en masse to the nearest attractive alternative.

Response to point 3c:

The draft EIS did not exaggerate the human health dangers caused by the birds. The health hazard would appear obvious from the facts presented in Appendix 2 and the Public Health Hazard section of the DEIS. It is obvious to many medical professionals that a serious health hazard does exist. Numerous letters received from medical professionals and experts in the field of fungal diseases reflect great concern. In the opinion of one professional, who has studied the problem "I am convinced that the Army is sitting on a powder keg with the starling situation on base and the risks will increase as time goes on."[1]

[1]Coy D. Smith, Dr. P H, Assistant Professor, University of Kentucky College of Medicine, Lexington, Kentucky (letter to Dr. Harold Balbach, CERL ecologist), 17 January 1975.

It is true that no direct evidence is available to demonstrate that cases of histoplasmosis in the vicinities of Fort Campbell and Milan AAP were caused by blackbird roosts. However, proper health planning is more effectively performed before, not after, documentable evidence is available, i.e., it would be too late to be concerned for those persons whose health is already jeopardized and who become the documentable evidence needed to take action.

The question concerning the "potential health hazard which may warrant elimination over the longterm but for which the efficacy of Tergitol application has not been established," is addressed in "Alternatives to the Proposed Action," Section 4 of the DEIS.

Health hazards associated with disposal of the dead birds are not considered to be a serious problem if disposal is controlled, handlers are provided adequate protective clothing, and the birds are transported to a safe area where contamination of surface and ground water is not a threat. These items are addressed in the text on pp 42, 54 and 58.

Response to point 3f:

There have been no fatalities to date at Campbell Army Airfield due to bird strikes. The suspension of operations for several hours a day has been a prime preventive action. The cost to the government

resulting from this reduction in operational time has not been considered when calculating economic losses resulting from the presence of the birds, but it is substantial. If the cost accounting procedures were available to estimate frequency of disrupted schedules and added days of operation and training necessitated by shortened days available for light, this cost alone would probably be the single greatest economic factor involved.

Response to point 3g:

All tests and all experiments conducted on degradation of the surfactant PA-14 have indicated little damage to vegetation and biodegradation within a few weeks if used in the concentrations anticipated. It is admitted that an accidental spill of the undiluted compound could cause severe soil and vegetation damage, however, all transport and mixing will take place on paved airport aprons where run-off may be contained easily and not within many thousands of yards of the roosts.

The meadowlarks and red-tailed hawks were merely observed during daylight hours within a mile of the Milan roost. There is no evidence that they will be present in or near the roost after dark. They were mentioned solely for reasons of scientific completeness, and as a remote, unquantifiable possibility of presence of non-target species. In point of fact, no non-target bird species whatsoever were observed at either roost during eight man-days of observation and specimen collection.

The birds which would be lost from the summer breeding population as a result of this action, even if the action is extremely effective, are almost certainly no more than the 7 percent proportion now stated. They probably are an even smaller proportion, if the number of birds living in un-censused roosts and smaller groups is considered. It is felt that this small decrease will probably not be noticed in any one area. This question of increase in insect populations assumes, additionally, that there are no other birds capable of feeding on these insects in the summer ranges of the blackbirds. This is an obvious oversimplification.

Response to point 3i:

Due to the short time frame of the proposed action, and the biodegradability of PA-14 in the natural environment, exposure time of non-target animals to the chemical must be considered to be short, and not chronic, thereby eliminating the need for detailed chronic exposure studies.

Response to footnote 1, p 5:

Population estimates were made by two highly-trained biologists with advanced degrees, one of whom has broad previous experience in food habits of birds. The numbers utilized in the DEIS are considered to be very conservative and average 30 to 50 percent less than most numbers suggested by other trained wildlife biologists who observed the roosts in December. Specimens were collected in absolute darkness,

and were from all portions of the roosts. No specificity of sampling was remotely possible. No birds of other than the four species discussed were taken or observed on the roost after dusk.

There is obviously a possibility of considerable error when sampling such a population. A sample which met theoretical statistical adequacy in such a situation might be as many as 40,000 to 100,000 birds, a number far in excess of that which the biologists could manage. We are confident that the rank order of the species in the populations is as stated in Appendix 1, taking into consideration some shifts of birds into and out of the two roosts between December and January samplings.

Actual percentages could vary several percent each way, but both populations now consist mostly of grackles, with the percentage increasing between the December and January samplings.

Response to point j:

Reference should be made to evidence and discussion presented in DEIS Appendix 7. Since supporting field and experimental data were inadequate, accepted engineering estimates for run-off and stream flow were utilized, and calculations for potential contamination were made for the "worst case" situation.

Response to point 3k:

It is not the intention of the Army to embark upon a national blackbird erradication program. In this instance, the blackbirds have

taken refuge on Army property. From this refuge, the blackbirds are foraging over many hundred square miles and causing economic losses.

Since local agricultural interests lack authority over military property, they have requested that the Army take action. Reference is made to the following responses to the Draft Environmental Impact Statement contained in this Appendix: Hopkinsville-Christian County Chamber of Commerce, Environmental Protection and Improvement Commission, Christian County Farm Bureau, and Cadiz-Trigg County Chamber of Commerce. Under these circumstances, the Army has a clear responsibility to take action to control the birds which are roosting on its property.

Field personnel of the U.S. Department of the Interior rather than Army personnel have the responsibility of assisting communities with bird problems. They have reported some success with convincing farmers to use Starlicide in feedlots and to use covered feeders. It has recently been pointed out that crop planting by drilling is more common in the area than was indicated in the Draft Environmental Impact Statement.

Response to point 31:

Roost modification within the cantonment area and around Campbell Army Airfield was begun in the summer of 1973 and has since been continued.

Approximately 90 percent of the pine stands have been thinned to the extents in the roost modification section, During 1974, the birds initially chose to roost in hardwood trees during the early fall and later moved to unthinned pine stands and unthinned perimeters of pine stands which had been left for aesthetic purposes. Thinning will continue to force the birds to an uninhabitated area, however, it would not alleviate problems that might result if troops trained in roost site areas having the potential for becoming contaminated with H. capsulatum.

The comment is understood to propose major land use change (i.e. from reforestation and timber production to recreational, even over large acreages of the installation) as a solution to the problem. This method might move future roost sites from the installation sites to on private land. This still would not alleviate crop depradation problems.

Response to point 3m:

Monitoring of the program is the responsibility of the U. S. Department of the Interior, although Fort Campbell personnel did assist USDI with post-spray observation last year. This responsibility is stated in the EPA registration requirements contained in PA-14 label use instructions. In addition, USDI has primary responsibility for observations of breeding areas. The operation can only be carried out with their knowledge and under their guidance; therefore, it was felt that they would take proper steps to collect follow-up data necessary to their nationwide management of bird populations.

FLIGHT SAFETY FOUNDATION, INC.

21 January 1975

Dr. Harold Balbach
Environmental Systems Branch
U.S. Corps of Engineers
Construction Engineer Research Lab.
P.O. Box 4005
Champaign, Ill. 61820

Dear Dr. Balbach:

At this point in time we do not have the expertise to make a judgment concerning appropriate action to reduce the bird population at Fort Campbell.

We read your first draft of the EIS and can understand the so-called horns of a dilemma you seemingly "rest" on. On one side you have officials at Fort Campbell who do not regard the roost of over five million blackbirds as a threat to air safety (and with the the Audubon Society decrying the suggested means of "freezing-out" the birds) and on the other side a faction anxious to eliminate the birds. The answer to that problem would seem to lie somewhere in between, but where that would be, we do not know.

We appreciate the problem but are in no position at this time to make any suggestions or even judgments.

Sincerely,

D. N. AHNSTROM
Vice President Publications
& Referrals

cc: Mr. Harold Russell
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H.G. Russell | OFFICE SYMBOL CERL | TELEPHONE NO. 217-352-6402 | # PAGES 1 | PRECEDENCE

AMERICAN LUNG ASSOCIATION

January 17, 1975

William R. Wray
Brigadier General, USA
Director of Facilities Engineering
Department of the Army
Office of the Chief of Engineers
Washington, D.C. 20314

Dear General Wray:

The American Lung Association (formerly the National Tuberculosis & Respiratory Disease Association), through its medical arm, the American Thoracic Society has reviewed the Draft Environmental Impact Statement (Blackbird Control on Army Installations). The statement is factual with regard to histoplasmosis. In addition, our experts state that while evidence is only suggestive, it appears that, blackbird, starlings, etc., although unable to carry histoplasmosis internally, may harbor this fungi in their feathers known to moult during the roosting period, thereby recurrently seeding the ground coverage.

Secondly, there is substantial evidence indicating that cryptococcus can be grown from pigeon droppings. Again, slight evidence does exist indicating that cryptococcus will pass through blackbirds, starlings, etc. and will grow in the droppings of these birds. Cryptococcus is a proven cause of human disease. As far as our organization knows, no detailed work on the relationship between cryptococcus and starling roosts has been undertaken.

Finally, it is well known that pigeon droppings can cause "intrincic allergic alveolitis" in people working in close proximity to the droppings...commonly pigeon breeders. Although no substantial evidence exists, one can surmise that a similar problem may arise if an individual was re-currently and frequently exposed to other bird droppings.

The American Lung Association feels that it should limit its comments on the Environmental Impact Statement to only medical entities. If you have any further questions, please do not hesitate to write.

Sincerely yours,

Gerald R. Rice
Managing Director

mas
cc - Dr. Green, Dr. Sharbaro

11-36

International Association
of
Game, Fish and Conservation Commissioners

(ORGANIZED JULY 20, 1902)

January 22, 1975

U.S. Army Construction Engineering
Research Laboratory
P.O. Box 4005
Champaign, Illinois 61820

Dear Sir:

We have reviewed the Environmental Impact Statement prepared under the title "Blackbird Control on Army Installation," dated December 1974. This statement covers proposed reduction of blackbird populations at Fort Campbell, Kentucky and Milan Army Ammunition Plant, Tennessee.

In our opinion the statement is a comprehensive and competent discussion of the problems implicit in the kind of operation proposed. The need for the control program is well documented, and the various alternatives are discussed in a professional manner.

It is recognized that projects of this sort are inevitably controversial. The responsible organization, having determined the need for the control program, is obligated to find the most humane and efficient method available. In our opinion this has been done in the case of the proposed control operation.

Sincerely yours,

John S. Gottschalk
Executive Vice-President

11-37

Phone 522-8224

Cadiz, Trigg County
Chamber of Commerce

AN ALL KENTUCKY CITY

Chappell R. Wilson, Pres.
W. Cleland White, III, V. Pres.
Virginia Alexander, Sec.
John T. Edwards, Treas.

Directors:
Billy Burke
Boyd Champion
Elmer Cossey
William E. Fuller
William G. Lawrence
Ned B. Southwick
M. Roger Thomas
Cleland White, III
Chappell R. Wilson

P.O. Box 647
Cadiz, Kentucky 42211

January 15, 1975

Honorable Howard H. Calloway
Secretary of Army
Department of Army
Pentagon
Washington, D. C. 20310

Dear Secretary Calloway:

The Cadiz-Trigg County Chamber of Commerce is becoming increasingly concerned about the problems caused by the roosting of millions of starlings on the Fort Campbell, Kentucky, military reservation which is partially located in Trigg County, Kentucky. The Chamber has for some time been quite concerned about the economic losses suffered by Trigg County farmers and the health hazards created by the starlings feeding in and flying over our county. Even though we are concerned about these problems we have yet to find an effective way to either reduce or eliminate the source of the problems. Being an agriculture county, we certainly cannot cut off the starlings' food supply nor can we prevent the starlings from flying over our residential areas.

Our Chamber of Commerce is even more concerned that plans which have been formulated to reduce these problems through the eradication of the starlings in their roost areas might be cancelled on the basis of ecological priorities. The members of our Chamber who are affected in their daily lives by the presence of the starling menace find it hard to give the starlings and their newly found ecological status a higher priority than the priority of man's food supply and health.

Because of the tremendous number of starlings that spread out and feed over the large argicultural areas of our county, their eradication on private property is totally impossible. In our opinion, their eradication must come in their roost areas at Fort Campbell, Kentucky, where their numbers are concentrated. To deny the starlings access to the roost areas

rather than their eradication would cause Trigg County farmers further economic losses, increased health hazards, and the loss of the opportunity to eradicate the starlings in such numbers to justify the costs.

Now that time, weather, temperature, and location are all extremely important if eradication of starlings in Trigg County is to be successful, we strongly urge you to direct those units and agencies primarily responsible for carrying out the eradication plans to proceed with all possible haste so that the eradication can take place within the 1975 time frame.

Sincerely,

Chappell R. Wilson
President

CRW:lbm

cc: Construction Engineering Research Laboratory
Department of the Army
P. O. Box 4005
Champaign, Illinois 61820

EPIC - 101 North Main Street - Hopkinsville, Kentucky 42240 - Phone 886-3303

January 14, 1975

Mr. Harold G. Russell Jr.
Directorate for Facilities Engineering
Office of Chief of Engineers
Washington D.C.

Dear Mr. Russell:

The 10 members of the Environmental Protection and Improvement Commission feel deep concern and great alarm over the disease bearing and destructive starling population of our county. As a group concerned about the environment we understand the reluctance of many to engage in a wholesale destruction of these birds especially when considering the cruel aspects of the method employed.

However, as environmentalists we also know that the starlings are in no danger of extinction, are not native to our country and other methods to remove the birds have proved futile.

Living in Christian County and observing the problem firsthand we can say with firm conviction that the dangers of histoplasmosis, and the destruction of livestock and needed crops are much more cruel, dangerous and destructive than the above reasons for reluctance.

We strongly request that the decision on this necessary program not be delayed past the necessary temperature conditions for eradication. It is vital that the program be carried out with the utmost speed for the health, safety, and economy of our community.

Yours truly,

Rebecca W Williams

(Mrs.) Rebecca Williams
Chairman

"To advance the science and art of Agriculture and Home Economics"

CHRISTIAN COUNTY FARM BUREAU

INCORPORATED

P. O. Box 683 HOPKINSVILLE, KY. 42240 Phone 886-3434

January 14, 1975

Mr. Harold G. Russell, Jr.
Office of the Chief of Engineers
Directorate for Facilities Engineering
Washington, D. C. 20314

Dear Mr. Russell:

The Board of Directors joins me in endorsement of the proposed action stated in the Draft Environmental Impact Statement of December, 1974. Our county and the adjoining counties have suffered significant economic losses due to the large bird roost located at Ft. Campbell, Kentucky. If the proposed action in the Environmental Impact Statement is completed, we expect to receive relief from the expected continued economic losses. We hasten to remind you that the excessive blackbird population is also detrimental to the health of our citizens in this area.

Our interpretation of the Impact Statement indicates that the use of tergitol is the proper action to take at this time. We do encourage you to forward our request for research to determine more effective methods of controlling the growing blackbird population throughout the southeast region of the United States. We do not believe that simply moving the birds from one region to another region is the ultimate answer to our problem.

We appreciate all the time, effort and expense that has been expended by the Department of Defense to prepare the Impact Statement. Please be assured that we believe that this was a proper use of tax funds. At this point we are optimistic concerning the application of tergitol sometime in February, and we hope that the application of the surfactant will be successful.

Sincerely,

Wilbur Ray

Wilbur Ray
President, Christian County Farm Bureau

11-41

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►US ARMY CONSTRUCTION ENGINEERING RESEARCH LABORATORY
PO BOX 4005
CHAMPAIGN IL 61820

THE FUND FOR ANIMALS INCORPORATED, A 63,000 MEMBER NATIONAL CONSERVATION ORGANIZATION, HAS THOROUGHLY REVIEWED THE ENVIRONMENTAL IMPACT STATEMENT ON BLACKBIRD CONTROL ON ARMY INSTALLATIONS AND AFTER CONSULTING WITH NATURALISTS AND BIOLOGISTS IT IS OUR BELIEF THAT YOUR REPORT LACKS CONCLUSIVE DATA WITH REGARDS TO THE IMPACT ON HUMAN, WILDLIFE, FISH AND PLANT LIFE. THE REPORT MAKES MENTION OF POSSIBLE ADVERSE EFFECTS, BUT FLAGRANTLY OVERLOOKS THE INTENSITY OF THESE POSSIBLE EFFECTS
THE REPORT DEALS ALMOST EXCLUSIVELY WITH REASONS FOR USING THE PA-14 FOR EXTERMINATING THE BLACKBIRDS, BUT DEALS LITTLE WITH PRESENT ALTERNATIVES, AND LACKS ANY DISCUSSION OF FUTURE ALTERNATIVES.
WE FEEL THE PLANNED ACTION OF DESTROYING 13 MILLION BLACKBIRDS WOULD RESULT IN MORE OF A PROBLEM THAN A SOLUTION.
THE ELIMINATION OF THIS LARGE NUMBER OF BIRDS WOULD MOST DEFINITELY RESULT IN THE PROLIFERATION OF INSECTS WHICH WOULD IN TURN LEAD TO THE USE OF PESTICIDES ADDING TO ENVIRONMENTAL DECAY
AMOND OTHER THINGS, THE REPORT FAILS TO MENTION THE IMPACT OF KILLING NON TARGET BIRDS SUCH AS MIGRATING BIRDS WHOSE FLYWAY MAY INCLUDE THE AREA WHERE THE SPRAYING IS TO TAKE PLACE, PLUS THE KILLING OF "SCOUTS" FOR MIGRATORY BIRDS WHICH WOULD AFFECT ENTIRE FLOCKS OF VARIOUS SPECIES
IN CONCLUSION, WE WISH TO MAKE IT ABSOLUTELY CLEAR THAT THE METHOD OF DESTROYING 13 MILLION ANIMALS BY THE PROCESS OF CAUSING DEATH DUE TO FREEZING IS BY NO MEANS A CIVIL, HUMANE METHOD. WE ARE UNAUTHORAB LY OPPOSED TO THIS CRUEL METHOD OF DESTRUCTION
WE WOULD ALSO MENTION THAT THROUGH READING YOUR REPORT WE FOUND THAT THE US ARMY HAS DISPLAYED ITS INFINITE CAPACITY TO RATIONALIZE THIS ACT OF CRUELTY.
S E ROWLAND OHIO COORDINATOR THE FUND FOR ANIMALS INC 12810 SOUTH DIXIE HWY BOWLING GREEN OHIO 43402

1242 EST

MGMSGFA SGF

11-42

Response to comments by Fund for Animals, Inc.:

In consideration of the problems caused by the blackbird roosts at Fort Campbell and Milan AAP, alternatives were discussed on pages 57-68 of the Draft Environmental Impact Statement. Of the various alternatives which would resolve problems caused by the blackbird roosts, use of Compound PA-14 appeared to offer the most humane and environmentally sound approach.

As long as the Army continues to be faced with the problem of the bird roosts at Fort Campbell and Milan AAP, it will continue to follow new developments in the area of bird population management. Our interest in the problem is well known by the U. S. Department of the Interior, and we have been kept aware of developments in their research efforts. Should a new alternative become available, it will be carefully addressed, as will any future application of Compound PA-14.

As noted in the DEIS, the blackbirds are currently feeding on vegetative matter. It is not until late spring that the food preferences switch to animal protein. As noted in Figure 12 and the discussions in Section 3, reduction of the bird population at Fort Campbell and at Milan AAP will have little effect upon the spring breeding population and thus on the blackbirds during the time of the year that they feed on insects. This conclusion has been given by bird research personnel of the U. S. Department of the Interior.

Repeated observations of the roost by qualified biologists indicate that non-target species are not present. Accordingly, non-target migrating birds will not be affected by the proposed action.

Application of Compound PA-14 is not considered by physiologists to be a cruel means of death. Application of the detergent, followed by wetting, causes oil to be removed from the blackbirds, and body insulation is lost. With low temperatures, body temperature drops, and vital enzyme systems fail to function, causing loss of consciousness. This occurs at a body temperature of 70°-74°. Observations made by U. S. Department of the Interior personnel indicate that treated blackbirds show no evidence of pain, alarm or distress.

January 10, 1975

Mr. Harold G. Russell, Jr.
Directorate for Facilities Engineers
Office of Chief of Engineers
DAEN - FEB
Washington, D. C. 20314

Dear Mr. Russell:

The Hopkinsville-Christian County Chamber of Commerce is in full support of the Draft Environmental Impact Statement (Blackbird Control on Army Installations).

We would like to be recorded as having extremely strong feelings about the urgent need to diminish the blackbird roost at Fort Campbell, Kentucky. As the Environmental Impact Statement points out, we have been adversely affected in the realm of human health and economic losses to grain and livestock farmers.

We would appreciate you making our letter available to all parties interested in this issue.

Sincerely,

Rodney P. Dempsey

Rodney P. Dempsey
Manager

/da

11-45

HOPKINSVILLE - CHRISTIAN COUNTY CHAMBER OF COMMERCE • P. O. BOX 565 • HOPKINSVILLE, KY. 42240 • PHONE (502) 885-9096

INTERNATIONAL FUND FOR ANIMAL WELFARE INC.

FONDS INTERNATIONAL POUR LA PROTECTION DES ANIMAUX INC.

IFAW--USA: P. O. Box 9744 · Cleveland, Ohio 44140

January 16, 1975

U. S. Army Construction Engineering Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Dear Sirs:

The following constitute our comments on the Draft Environmental Impact Statement: "Blackbird Control on Army Installations" December, 1974.

Since early last December I have been in contact with Colonel Gardner, Head of the Army Environmental Office; George Cunney, Environmental Engineer, Dept. of the Army; and Bruce Hildebrand, Special Assistant for Environmental Quality, Office of the Deputy Undersecretary of the Army, concerning alternate methods for moving the large flocks of birds out of the Ft. Campbell and Milan areas. Unfortunately, I received the draft EIS only January 13th and consequently my comments are necessarily limited in both scope and detail. However, as I have told Col. Gardner and Bruce Hildebrand, the International Fund for Animal Welfare stands ready to assist the Army in their bird problem by bringing experts in bird control to the problem areas at no cost to the Army.

In our opinion the DEIS is incomplete and unsatisfactory in several respects.

1. There is no indication that past experiences with the use of wetting agents have been carefully assessed to determine the factors controlling the effectiveness of this method, in killing the target species and in sparing non-target species. For example, no mention is made of the failure of Tergitol at Moody AFB in January 1967 when used in an attempt to kill a flock of 10,000,000 Starlings and Redwing Blackbirds roosting in swamp brush.

2. Insufficient attention has been given to the long-range effects of killing many millions of insectivorous birds such as those now roosting at Ft. Campbell and Milan. If the proposed killing methods are successful there will undoubtedly be many other attempts to destroy large flocks of birds that are judged to be a nuisance to man. Two such possibilities are mentioned in the DEIS (p.80). One must remember that while the winter diets of these birds consist largely of plant material (DEIS, p. 85) the warm weather diets are largely of animal products (mostly insects) (See A. C. Martin et. al. "American Wildlife and Plants--A Guide to Wildlife Food Habits, Dover Press, N. Y. 1951). Insects do not develop resistance to bird

predation as they do to our insecticides. Unfortunately, many insectivorous birds flock in large numbers in the winter months. If man destroys these flocks he certainly destroys nature's most effective method of insect control. No calculations are presented in the DEIS to show the effect of removal of, say, 11,000,000 blackbirds on the crop lands inhabited by these birds in the summer months. Such calculations can be made from data available in the literature concerning the birds feeding habits and the crop destruction potential of their insect prey. The DEIS is incomplete without such considerations.

3. A great deal of information is presented in the DEIS on the grain losses in farms surrounding the infested areas but no clear picture is presented as to what steps, if any, the farmers have taken to protect their feed stocks.

4. The use of biosonics as an alternate method of control is dismissed out of hand with no indication that this method has been used successfully for several years in controlling bird depredations in vineyards both in this country and in Europe. (e.g. G. W. Boudreau: "Alarm Sounds and Responses of Birds and Their Application in Controlling Problem Species:, The Living Bird, Vol. VII, Cornell Laboratory of Orinthology, 1968, p. 27). The discussion of Frightening Devices (DEIS, p. 65) indicates little understanding of the use of a comprehensive bird control program based on the use of recorded alarm sounds. For example, the statement is made that the dispersal effect of shell crackers is improved slightly if combined with the use of recorded alarm sounds. Exactly, the reverse is true, namely the dispersal effect of alarm sounds is slightly improved by the use of other noises although shell crackers are unnecessary.

5. There is no supporting evidence for the statement (DEIS, p. 65) that biosonics creates objectionable noise pollution. Certainly, an ill-conceived program of general noise application such as that applied at Graceham, Md. last year results in high noise levels. However, modern methods of bird control do not depend on high noise levels but rather on the selective application of alarm sounds combined with the thinning of roosting areas. In fact, birds become inured to very loud sounds even when continuously applied if these are not part of their natural vocabulary.

6. It is impossible to make an intelligent judgment of the effectiveness of bioacoustics without the opinion of an expert in this field who has carefully examined the areas of infestation and other possible roosting places. The DEIS does not indicate such an assessment of the problem was made.

7. There is no reason to assume that the proper application of bioacoustics will result in the birds simply moving to an equally unacceptable area.

In conclusion, it seems inconceivable that the Army would attempt to freeze to death millions of insectivorous birds without first attempting to move them by the use of a comprehensive bird control program developed by recognized experts in the science of bioacoustics. The notion that when other creatures become a nuisance, man should simply kill them, is at best a poor idea that completely neglects the close interaction of all living things. If we are unwilling to tolerate large bird flocks even in rural areas we will be faced with the loss of our strongest ally in the battle against insects and the certainty of eventual defeat.

Again, let me emphasize our offer of help to the Army in developing a modern bird control program at Ft. Campbell and at Milan. If there are any questions concerning my comments, please call me at 216/871-5314. Correspondence should be addressed to my home: 28001 West Oakland Road, Bay Village, Ohio 44140.

Yours truly,

W. F. Brown, Jr.

W. F. Brown, Jr.
Director
U. S. Operations
WFB/zg

cc: Mr. Henry L. T. Koren
Deputy Undersecretary of the Army

Response to comments by International Fund for Animal Welfare, Inc.:

Response to point 1:

PA-14 is non-selective. It is recognized that non-target birds in the roost will be killed. However, repeated observations at Fort Campbell and Milan AAP by qualified observers have not identified any non-target species in the roost. Nevertheless, it must be recognized that a very few non-target birds may be present at the time of application.

The situation at Moody AFB was significantly different from those which exist at Fort Campbell and Milan AAP. First, the work done at Moody AFB was experimental. Several different PA-14 concentrations were applied, and different delivery systems were used. Second, the roost areas were not concentrated; rather, they were scattered over an 11,000-acre swamp. Those experiments did show the potential for use of PA-14 in bird control, the use of aircraft for delivery of the detergent, and that fish in the test area were not affected by the application.

Response to point 2:

This comment has either not considered or has rejected the analysis presented in the first paragraphs of Section 3, where Figure 12 indicates that control operations will not materially affect the size of the summer breeding population. The number 11 million is used in this comment, even though this represents a control success of about 100 percent,

which is unlikely to be achieved. Furthermore, even this large number of birds represents less than 3 percent of the national breeding population. It is admitted that an indefinite but greater decrease may occur in certain local summer populations.

This comment also assumes that the blackbird species discussed are the only birds capable of consuming insects in their summer range. This is obviously not the case. Many other birds, native and introduced, utilize this food source during the late spring and early summer months. Many ornithologists have suggested that more desirable birds could occupy the breeding habitat made available by a blackbird population reduction.

Response to points 4-7:

Points raised relate to the disposal of birds through use of biosonics. This has been discussed on pp 57 and 65 DEIS. There is no doubt that biosonics have been used successfully for moving roosts from critical areas and for protecting high-value crops from bird depredations.

Biosonics, including alarm calls and cracker shells were used to move a roost from a housing area at Fort Campbell in January 1973. The project was accomplished by USDI personnel having expertise in bird population management. The roost was moved after three nights.

It is estimated that there are more than 15,000 acres of potential roost sites at Fort Campbell and 8,200 acres at Milan AAP. Additionally, there is an abundance of potential roost sites outside miltary property. The mere moving of the birds from one site to another on the installation or even moving the birds away from the installations would not solve the problem of local agricultural losses.

While the Army has no responsibility for control of birds not on its property, it should not be placed in the position of pushing its problems onto its neighbors. Considering the extensive agricultural use of land in nearby counties, it is inconceivable that biosonics could be used to protect these crops. In addition, movement of the roost is dependent upon the proximity of human populations, since it spreads the potential for histoplamosis.

Noise pollution is dependent upon the presence of humans, and if biosonics are applied in a housing area, there will be noise associated with the operation. However, people usually prefer the noise associated with biosonics to that of the birds.

KENTUCKY DEPARTMENT OF AGRICULTURE

DIAGNOSTIC LABORATORY

NORTH DRIVE

HOPKINSVILLE, KENTUCKY 42240

TO: Dr. Harold Balbach

FROM: Dr. Wade L. Kadel WLK

SUBJECT: Opinion of Draft Environmental Impact Statement (EIS), Blackbird Control on Army Installations, December, 1974

DATE: January 15, 1975

Please accept my gratitude and compliments for a job well done completing the EIS in a very short period of time. The quality and quantity of work done by you and your staff in such a period of time were exemplary. We admire your attempt to present the EIS using a scientific method. On the whole I was favorably impressed with the work and remain optimistic concerning the ultimate approval of the final EIS.

There are a few points in the draft EIS that I believe should be strengthened or corrected. It is requested that you review your data concerning the items listed below and if indicated, make appropriate changes in the final EIS:

1. On page 18 the EIS states, "It has been estimated that 25-50 percent of their diet may come from commercial grain." After consulting with numerous large grain farmers, extension grain specialists, grain elevator operators and marketing experts, I believe that the 25 percent figure assessment is below a realistic estimate of the grain loss. If 96.1 percent of the grackle's diet consists of corn as stated on page 85, then the source of this corn must be determined in order to assess the true economic loss. Apparently you assumed that the major portion of the corn for the grackles originated from corn which was left in the fields after harvesting. My conversations with persons concerned with grain production indicate that this figure should be from 50-75 percent of the corn originated from sources of economic significance. A majority of the corn farmers in this region disk the fields in the fall shortly after harvesting, preparing the soil for fall wheat seeding operations. The disking procedure buries the corn kernels and prevents birds from eating this corn. We submit that the corn found in the crop of grackles came from sources of economic significance such as storage bins or feed bunks. We believe if you will review your notes you will find that the corn found in the crops of the grackles was not intact, and it, in fact, was broken as if it had been processed through a mill. On page 85a you will note that your data indicates that the crop of the starlings contained 61.4 percent wheat. We submit that this wheat was certainly of economic significance. We furthermore submit that all of this wheat should be counted as economically significant. The important point to consider is the availability of the foodstuffs. We submit that corn from feed bins and storage bins and wheat

Comment by Kentucky Department of Agriculture Diagnostic Lab.

(cont'd)

fields are the most probable sites for grain. We encourage you to change the final impact statement to include at least 50 percent of the grain loss assessment. We agree with the concept of stating the figures conservatively, but we believe that you have been overly conservative in your estimates.

2. On page 85 your data indicates that the crop or gizzards of starlings killed at Fort Campbell did not contain wheat. We doubt that this is an accurate reflection of the activity of starlings in the Fort Campbell area. We hope that the examination completed in January on the crops and gizzards of starlings killed at Fort Campbell will reveal wheat to be a major component of the starling's diet. If this is the case, then we expect to see a larger figure ascribed to the economic loss from starlings. The important point to remember is that the data collected on any single day only indicate what the diet was on that particular day. If starlings were examined in October and November, it should be expected that the crop would contain different foodstuffs than what was found in December or January. We hope that you will make this type of statement somewhere in the final text of the EIS. We are convinced that starlings eat tons of wheat seed in this region.

3. The subject of histoplasmosis was dealt with in the draft EIS, but we believe that the subject could be presented in a more forceful manner. Today I have asked Dr. Coy Smith of the Division of Community Medicine at the University of Kentucky and Dr. Amos Christie of the Vanderbilt School of Medicine to write to you concerning the occurrence of histoplasmosis in this region.

4. During our recent survey of economic losses we noted the frequent occurrence of the statement, "Due to the frequency of TGE in our swine herds, we have been forced to cease swine production." These surveys also included statements indicating the feed was frequently severely damaged by the bird droppings to the extent that animals would refuse to eat the feed. It is very difficult to ascribe an economic value to each of these points; however, both of them were mentioned so frequently that we believe that somehow these statements should be included in the final EIS. Today I will send you a map which will illustrate the extent of the economic losses suffered by our farmers. I will also send you copies of the reports sent in by over 100 farmers. A request was made for data in the Kentucky New Era newspaper on Friday, January 10 and public service announcements were made on radio on Monday and Tuesday, January 13 and 14. The data on the maps and the raw data worksheets are the result of two days telephone survey.

I will also send you photographs illustrating the birds activity around cattle feed bunks and around hog feeding operations. The photographs were taken on the farm of Henry Lilly. Mr. Lilly's problems with the birds are typical for so many other farmers in this region. Mr. Lilly discontinued his pure-bred swine operation several years ago due to the frequent occurrence of TGE. On Sunday, January 12, Mr. Lilly drove around his farm expending over 100 shotgun shells in an effort to keep the birds moving. This activity is fairly common for Mr. Lilly to do when he has the time. Mr. Lilly told me that he was unsure of the exact feed consumption of the birds, but his

Comment by Kentucky Department of Agriculture Diagnostic Lab. (cont'd)

estimate was that the birds were probably eating between 200 to 300 pounds of hog feed daily. Of course, the consumption of hog feed by birds is greatly increased during periods of snow cover. It is hoped that the maps, raw data sheets, photographs and the comments in this memorandum will be of value to you in preparing the final impact statement. Please do not hesitate to call me if you have questions concerning any of these data.

skd

UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY 40506

COOPERATIVE EXTENSION SERVICE

COLLEGE OF AGRICULTURE
RESIDENT INSTRUCTION
AGRICULTURAL EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE

EXTENSION PROGRAMS
West Kentucky Research
and Extension Center
P. O. Box 469
Princeton, KY 42445

January 14, 1975

Dr. Harold Balbach
U.S. Army Corps of Engineers
Construction Engineering Research
Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Dear Dr. Balbach:

This letter is written in reference to the existing blackbird situation which has plagued the areas and communities in Christian County, Kentucky and surrounding areas of Todd County and Trigg County. The content of this letter will focus on the crop damage being inflicted and potential damage in the area as a result of the blackbird species present in terms of plant diseases that may be spread by the birds.

I view the existing multitude of blackbirds as posing a very serious threat to the $12 million soybean crop of Christian County. There presently exists in West Kentucky (West of the Tennessee River) and most of West Tennessee a serious soybean disease problem called the soybean cyst nematode. The cyst nematode is an organism that lives in the soil and utilizes the roots of the soybean plant as a host. The result is a dramatic drop in soybean yields of over 50% in tests that we have conducted. However, the problem goes farther than this. Once a soil becomes infected, the nematode is there for good. This means growing crops other than soybeans or utilizing non-host crops in a rotation. Once established in an area, the cyst nematode readily spreads within an area by means of soil movement.

What does the above have to do with blackbirds? In my estimation, they are a principal means of spreading soybean cyst nematode. The University of Tennessee has conducted research on the feasability of blackbirds spreading the soybean cyst nematode. Through experiments they conducted of 1) force-feeding blackbirds soybean cysts, b) feeding blackbirds feed mixed with cysts, and c) feeding blackbirds feed mixed with soil containing cysts, there experiments showed that cysts, eggs, and larvae of the soybean cyst nematode can pass through the digestive tract of blackbirds and remain capable of infection soybeans. Cysts recovered from the excrement of the blackbirds 48 hours after feeding developed freely on roots of soybean plants. As further proof, some blackbirds were trapped in a known field heavily infested with soybean cyst nematode in which they were feeding. Thirteen percent of the birds trapped contained cyst nematode in their digestive tract.

What does this mean in terms of the soybean crop in Christian County? It is possible and probable that the blackbirds can spread soybean cyst nematodes to non-infested fields in Christian County (at least presently we think Christian County is not infested or it has not reached a build-up point yet). Birds feeding in infested fields move freely from field to field, some long distance, after feeding to roosting sites, and ingest the cysts which can later be spread in their feces. In Christian County alone a conservative loss of only 10 bu/acre on about 70,000 acres of soybeans (74,000 acres were produced in 1974) would mean a loss of 700,000 bushels valued at between $4.2 million to $5.0 million dollars. This would be a tremendous loss to the third largest soybean producing county in the state of Kentucky. This is why preventive measures need to be taken now so that it would not happen and cannot be allowed to happen.

In another facet, the damage incurred by the blackbirds during the planting of crops cannot be overlooked. This is particularly true of small grain plantings in the fall. The damage resulting from these blackbirds feeding on small grain fields in the field could easily reach 40% of the potential economic return of that crop. This needs to also be added to the potential economic loss resulting from fields not being planted solely because the bird problem exists.

Sincerely,

James Herbek

Dr. James Herbek
Extension Grain Crops Specialist

JH/mw

Comment by University of Kentucky, Cooperative Extension Service (cont'd)

UNIVERSITY OF KENTUCKY

LEXINGTON, KENTUCKY 40506

ALBERT B. CHANDLER
MEDICAL CENTER
COLLEGE OF MEDICINE
DEPARTMENT OF COMMUNITY MEDICINE

January 17, 1975

Dr. Harold Balbach
U.S. Army Core of Engineers
Construction Engineer Research Lab
P.O. Box 4005
Champagne, Ill. 61820

Dear Dear Balbach:

I have been working with Dr. M.L. Furcolow for the past 17 years on the sytemic mycoses. We have spent considerable time during this period studying Histoplasma capsulatum in bird roosts throughout the Central United States especially relating to human infections. I have been to Fort Campbell and have observed the situation there and the surrounding area. The overall conditions are certainly undesirable to say the least; however, I would like to comment on the health aspects in relation to histoplasmosis of which I am best acquainted.

The major roost at Ft. Campbell is fortunately not adjacent to living or working quarters of personnel which reduces the risk. One has to evaluate the hazard of the roost in regards to persons previously exposed to the fungus such as more permanent residents in the endemic area and non-sensitized persons moving in as well as young children on the base. As expected, we find persons living or working closer to roosts have higher infection rates. Also persons exposed to prevailing winds downwind from a positive roost are more apt to be infected up to a distance of 3-4 miles. The repeated exposure to small doses of the fungus that one would expect to occur to persons in the vicinity of the roost on base is more likely to be severe in young children. Judging from case reports this age group is more susceptible to severe disease from small doses than healthy adults. The non-sensitized individuals that move in from outside the endemic area are likely to experience an influenza-like illness or asymptomatic infection depending on the dose and individual resistance. However, these persons may suffer additional affects from this type of infection in later years.

We are currently collecting several cases of chronic pulmonary disease and associating them with repeated reexposure of individuals to exogenous sources of the fungus. The literature describes this type of disease to behave like tuberculosis i.e., cavitation is endogenous, reinfection. We do not disagree with this in tuberculosis and in many histoplasmosis cases. However, we do not regard a positive skin test in histoplasmosis to protect an individual from reinfection as well as we had previously believed. This condition exists on the base with the skin test positive individuals and the threat of cavitation exists in them especially after age 50.

Under the present conditions, the accumulation of droppings will begin to kill the trees and the birds will then move to adjacent areas and create more hazardous sites.

11-57

Some of the indivduals infected will experience chronic pulmonary disease later in life based upon reported cases in California, England and other parts of the world. These areas do not contain H. capsulatum but the patients have histories of visiting or once living in the endemic area of the United States.

There is considerable clinical, epidemiological, pathological and experimental evidence that histoplasmosis is the probable etiological agent for posterior uveitis in man. In one large study 89% and another 100% of patients had positive histoplasmin skin tests but were free of active histoplasmosis. This type of eye disease has not been recognized in uveitis clinics in England or Switzerland where the fungus is not found in soil.

Finally, I am presently performing experiments that show certain species of birds may play a more direct role in H. capsulatum soil reservoirs than we realized.

We find that birds are similar to what has been recently shown to be true in bats; i.e., H. capsulatum can be excreted in their feces. Obviously, they do not confine their defecating to the roost alone but throughout the area.

I am convinced that the army is setting on a powder keg with the starling situation on base and the risks will increase as time goes on. The situation can't help but go from bad to worse if something isn't done. These birds will be blamed for every case of histoplasmosis in the area whether it is justly or unjustly.

I will be glad to send to you reprints of published articles upon request to support any of the statements that I have made or that might be of interest to you.

Sincerely yours,

Coy D. Smith

Coy D. Smith, Dr. P.H.
Assistant Professor

CDS/djs

11-58

SOCIETY FOR ANIMAL RIGHTS, INC.
900 FIRST AVENUE • NEW YORK, N.Y. 10022 • (212) PLaza 2-8690

January 17, 1975

In Opposition to
DAEN-FEB

U.S. Army Construction
Engineering Research Laboratory
P. O. Box 4005
Champaign, Illinois 61820

Gentlemen:

We wish to make the following comments in opposition to the Draft Environmental Impact Statement pertaining to proposed control of starlings and other blackbirds on Army-controlled property on Fort Campbell, Kentucky and Milan Army Ammunition Plant, Tennessee.

Assuming that it is necessary to reduce the population of so-called undesirable birds at these two installations, the reduction should be carried out in a humane manner. The DEIS, of course, does not discuss whether treatment of the roosts with PA-14, Avian Stressing Agent, would cause the affected birds to suffer pain. However, a reasonable person can conclude from the description of the manner in which PA-14 operates--causing birds to "succumb to the cold" (p. 29)--that the use of this method of population reduction would cause a large proportion of the estimated 13 million birds to suffer some degree of pain and stress.

Furthermore, humane alternatives are available, although they are only briefly discussed in the DEIS. We recommend further study and possible use of either roost modification through tree thinning (discussed on pp. 65-67) or reproductive cycle interference through the use of Ornitrol (discussed pp. 64-65). The dismissal of the latter alternative as "impractical" because "repeated applications would be necessary" cannot be justified in light of the admission on p. 29 that the efficacy of PA-14 is uncertain.

11-59

U.S. Army Construction
Engineering Research Laboratory

January 17, 1975

> "Bird population management experiments conducted by the U.S. Department of the Interior have had varied success employing this technique. Some applications have completely failed. Other applications have resulted in an estimated 96 percent bird population reduction."

From the above quotation, it can be deduced that repeated applications of PA-14 might also be necessary. Therefore, the dismissal of Ornitrol as an alternative cannot be justified on the grounds of impracticality.

Furthermore, it is clear that the use of PA-14 in this proposed operation is in fact simply another experiment--but one that will inflict suffering on up to 13 million birds, as well as "unanticipated adverse effects on the environment" (p. 29).

In addition to opposing the DEIS for the reasons outlined above, we should also like to express our dissatisfaction with the way in which the DEIS was disseminated and the accelerated schedule for comments. A copy of the DEIS was requested by mail on January 6, 1975 and by telephone on January 10, 1975. The copy was not received until January 17, 1975--thus allowing less than one day for interested persons to read a 153-page document and prepare a comment. Even though we have done so, we cannot be certain that this letter of comment will be received before the deadline of January 20, 1975. Furthermore, since the comments must be sent to a P. O. Box address, our comment cannot be sent by Special Delivery, Certified Mail, Return Receipt Requested, which would ensure its delivery by the deadline, as well as provide us with a record of its receipt.

For these reasons, we are forwarding a copy of this letter to the Council on Environmental Quality protesting its decision to shorten the normal period for review and comments.

Very truly yours,

Nancy Stassinopoulos

Nancy Stassinopoulos
Legal Director

NS:lw

cc: Council on Environmental Quality

Response to comments by the Society for Animal Rights:

Response to paragraph 2:

The question of "pain and stress" is relative. During studies carried out by personnel of the Division of Wildlife Research of the U. S. Department of the Interior and reported by Caslick and Stowers in 1967 and by Stickley, Hardy, Matteson and Ingram in 1969, personal observations by research personnel were directed incidentally to this question. They report in personal communications that no obvious signs of suffering were seen. The birds did not vocalize and were not agitated. No abnormal activity was noted, and in general, treated and control birds behaved similarly, except that treated birds gradually lost consciousness.

Response to paragraph 3:

Tree thinning in existing roosts is probably capable of causing the birds to roost elsewhere, provided the Army is willing to permanently abandon silvicultural plantings of pines on these installations. The drastic thinning required allows development of rank undergrowth and instrusion of many undesirable weed tree species.

The present roost at Milan AAP within a native forest stand having Juniperus virginiana (eastern red cedar) understory. Due to the topography of this site, thinning seems to be impractical. In both cases, thousands of acres of potentially suitable roosts may be found within a few miles of the present sites. Moving the roosts would not resolve the problem of local agricultural losses in any way.

The decision that use of Ornithol or other chemosterilants was impractical was based on the need to feed these hormones to the birds during their active reproductive periods. The birds spend these periods dispersed broadly over the eastern upper Midwest, feeding on a wide variety of foods. Ensuring that baiting areas would disperse sterilants only to blackbirds and not to non-target species requires techniques unknown to the proponent agencies.

Response to paragraph 5:

Many previous applications of PA-14 were experimental and used varying concentrations of different surfactants. Success in these cases was not consistent, since the best techniques and concentrations were being determined. A previous application in March 1974 at Fort Campbell was less than 10 percent successful. This failure was judged to be due to variable weather conditions, during which the predicted quantity of rain failed to arrive, and temperatures were much higher than forecast.

A repeat application is possible if predicted weather conditions fail to assist the operation. Since available data indicate that PA-14 is virtually 100 percent biodegradable within a few months, no special precautions are felt to be necessary if one repeat application is performed. One small (1 1/2 acre) test plot will receive several repeated applications in an effort to experimentally determine exactly what effects may be associated with such continuing programs. This is explained in Appendix 6.

VANDERBILT UNIVERSITY

NASHVILLE, TENNESSEE 37232 TELEPHONE (615) 322-7311

Department of Pediatrics • School of Medicine • Direct phone 322-3377

January 16, 1975

Dr. Harold Balbach
Environmental System Branch
U.S. Army Corps of Engineers
Construction Engineer Research Lab
P.O. Box 4005
Champaign, Illinois 61820

Dear Dr. Balbach:

For some months, possibly the past several years, I have been conscious of what might be called an epidemic of histoplasmosis in the general area of Hopkinsville, Clarksville, parts of Western Tennessee--in and around Fort Campbell. This was repeatedly called to my attention by the number of telephone calls that I have had about the diagnosis and treatment of pulmonary histoplasmosis. While this is usually a relatively benign disease, it also can be disseminated and almost uniformly fatal. Also because of the protean nature of the disease spectrum it is of great concern to the physician, parent and dependent alike. The differential diagnosis involves many even more serious entities from tuberculosis to malignancy and leukemia. In any case, after a series of telephone consultations, I was officially invited to Fort Campbell in September 1974 to give a lecture about this disease. The epidemiology is interesting in many ways but there is no doubt that the disease is transmitted by bird droppings. A number of important epidemiological surveys have been conducted dating back to 1945 by the United States Public Health Service in this regard. Dr. Leo Furculow, formerly of the U.S. Public Health Service and now on the faculty at the University of Kentucky, could confirm this. A number of epidemiologists at the Communicable Disease Center in Atlanta will likewise confirm the fact that the avian species is a means of transmission of the disease. Starling roosts have been specifically implicated.

I am familiar with the extent of the bird population in that general area. It would seem axiomatic that when a well recognized problem becomes a menace or a burden to a community the community would and should do something about it. In this case, the United States Corps of Engineers would seem to be the logical agency to take its responsible place in the prevention of disease for which the community and the Armed Forces should give additional votes of confidence and credit.

If there is further information that I could contribute to the solution of this problem, I will be happy to correspond or make an on the spot survey with you.

Sincerely yours,

Amos Christie, M.D.
Professor of Pediatrics Emeritus

11-63