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GULLS AND USAF AIRCRAFT HAZARDS

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Air Force Weapons Laboratory
Kirtland Air Force Base, New Mexico

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AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

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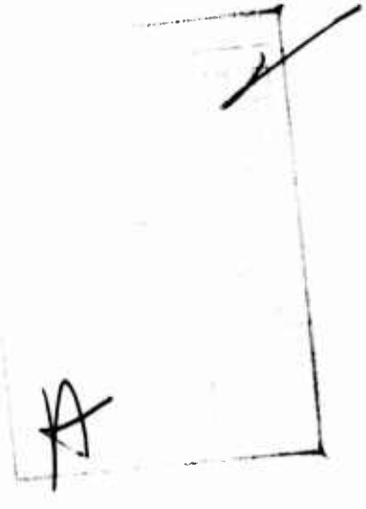

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13. ABSTRACT

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FOREWORD

This research was performed under Program Element 63723F, Project 683M3E09.

Inclusive dates of research were 1 September 1971 through 18 January 1972. The report was submitted 21 February 1973 by the Air Force Weapons Laboratory Project Officer, Captain Rutherford C. Wooten, Jr. (DEE).

The common and scientific names in this report are taken from the A.O.U. Checklist of North American Birds or the particular reference cited.

This technical report has been reviewed and is approved.

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ABSTRACT

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Gulls are often identified in bird-aircraft collisions in the United States Air Force. A study was performed to determine the impact of gulls on the air mission and to determine the effective means available to reduce the number of strikes. Review of the literature indicates that gull populations are increasing around the country. Unless positive steps are taken around the airport environment, the strike problem will increase. Control measures include habitat modifications, dispersal techniques, population control, and forecasting and avoidance.

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INTRODUCTION

1. GENERAL

The collision of airplanes with birds is a major problem at many Air Force installations. Analysis of bird strikes where the bird remains have been identified indicates that several species are major contributors to the hazard. Gulls are among those that are most often encountered.

Major factors that influence the hazard are the flying mission, the geographical location of the installation, and the ecological characteristics of the airfield and vicinity. The mission of flying organizations may dictate flying at low altitudes during certain time frames and in selective geographical locations. Either of these parameters could increase the potential for bird-aircraft collisions. The ecological characteristics of the airfield or its vicinity may increase the bird activity in the airspace required for take-offs and landings.

An analysis of where strikes occur according to type of flight can provide useful information for selecting means of reducing the strikes. Factors common to the overall problem at several Air Force bases may be elucidated and control procedures established to solve the problems. For example, the use of radar to assist pilots in avoiding migrating waterfowl may reduce strikes during enroute flights as well as during an approach. On the other hand, if bird hazards for an air base occur mostly during take-off and landing, control techniques must be employed to reduce bird activity on the airfield and in the immediate vicinity.

2. PURPOSE AND SCOPE

This study was conducted to assess the impact of gulls on the United States Air Force (USAF) bird-aircraft strike hazard and to review control procedures that may be used by Air Force installations to reduce this hazard.

Bird-aircraft strike statistics were provided by the Directorate of Aerospace Safety, Deputy Inspector General for Inspection and Safety, USAF, Norton AFB, California. Strikes were reviewed for the year 1963 to November 1971.

This strike information is based on incident reports submitted by Air Force installations in the Continental US, Alaska, and Hawaii. Information on gull control procedures is based on procedures used by other countries, a general review of the literature on bird control, and USAF experience on controlling gulls.

SECTION II

MAGNITUDE OF THE PROBLEM

The problem of the gull as a bird strike hazard in the United States Air Force has been recently emphasized. Analysis of USAF safety records as indicated in table I reveals that gull-aircraft collisions accounted for 16 to 20 percent of bird strikes involving identifiable species from 1967 to 1970. About 85 percent of these strikes occurred within the immediate vicinity (landing, take-off, touch-and-go, etc.) of the airfield as indicated in table II. Gull strikes have been notably reported around air training bases (ATC) where significant low-altitude flight occurs, at coastal air bases involving heavy transport planes (MAC), and even ocassionally in remoter areas such as Michigan, Utah, and Oklahoma. As indicated in figure 1, the problem is seasonal with a low number of strikes in December, January, and March and a high number in the Spring and Fall.

Aircraft damage due to gull strikes is substantial. Fifty-eight aircraft were damaged during 1967 to 1971. As indicated in table III, 34 percent of these were the result of engine ingestions. Two major accidents have resulted from gull strikes that occurred during take-off. A T-38 and an F-100 aircraft were destroyed. Total cost due to gull strikes has not been computed; however, it is sufficient enough for concern. Cost figures for the repair of several engines with minor damage averaged $6000 each. The cost is much greater when the engine must be completely replaced, some costing as much as $130,000 (Ref. 1). One aircraft in 1970 sustained $250,000 damage due to gull strikes during take-off (Ref. 2).

Thirty-one out of 85 bases reporting bird strikes in the Continental US, Hawaii, and Alaska had gull strikes (table I). Nine of these bases reported only gull strikes. Most of the bases with gull problems are located along coastal areas or major inland waterways (figure 2); however, several inland bases also have gull problems. Perrin AFB, Texas, has a problem due to Ring-billed Gulls (Larus delawarensis), Herring Gulls (Larus argentatus), and Franklin's Gulls (Larus pipixcan).

Table I

BIRD STRIKES CAUSING DAMAGE IN THE UNITED STATES AIR FORCE (1963-1970)*

Year	Rate of strikes per million hours: Gulls	Other birds	Unknown	Total
Total reported strikes (1963-1966)				
1963	1.1	4.7	4.9	10.7
1964	1.8	8.5	11.3	21.5
1965**	10.2	53.4	62.6	126.2
1966	2.1	11.9	31.4	45.5
Gull-strike reporting bases (1967-1970)* **				
1967	1.0	1.8	6.6	9.4
1968	1.8	1.6	6.6	9.6
1969	1.9	1.2	7.6	10.7
1970	2.4	2.1	8.6	13.2

*Source: Original data obtained from summary reports of USAF aircraft collisions with birds and USAF Accident Bulletin, Directorate of Aerospace Safety, Norton AFB, California.

**Includes reported incidents causing no damage.

***Thirty-one reporting bases.

Table II

TYPE OF FLIGHT INVOLVING GULL STRIKES (1967-1971)

Year	Type of flight and number of strikes: Landing	Take-off	Touch and go	Enroute
1967	5	2	0	0
1968	5	8	0	1
1969	5	4	0	5
1970	3	8	3	2
1971	6	4	0	1
Total	24	26	3	9

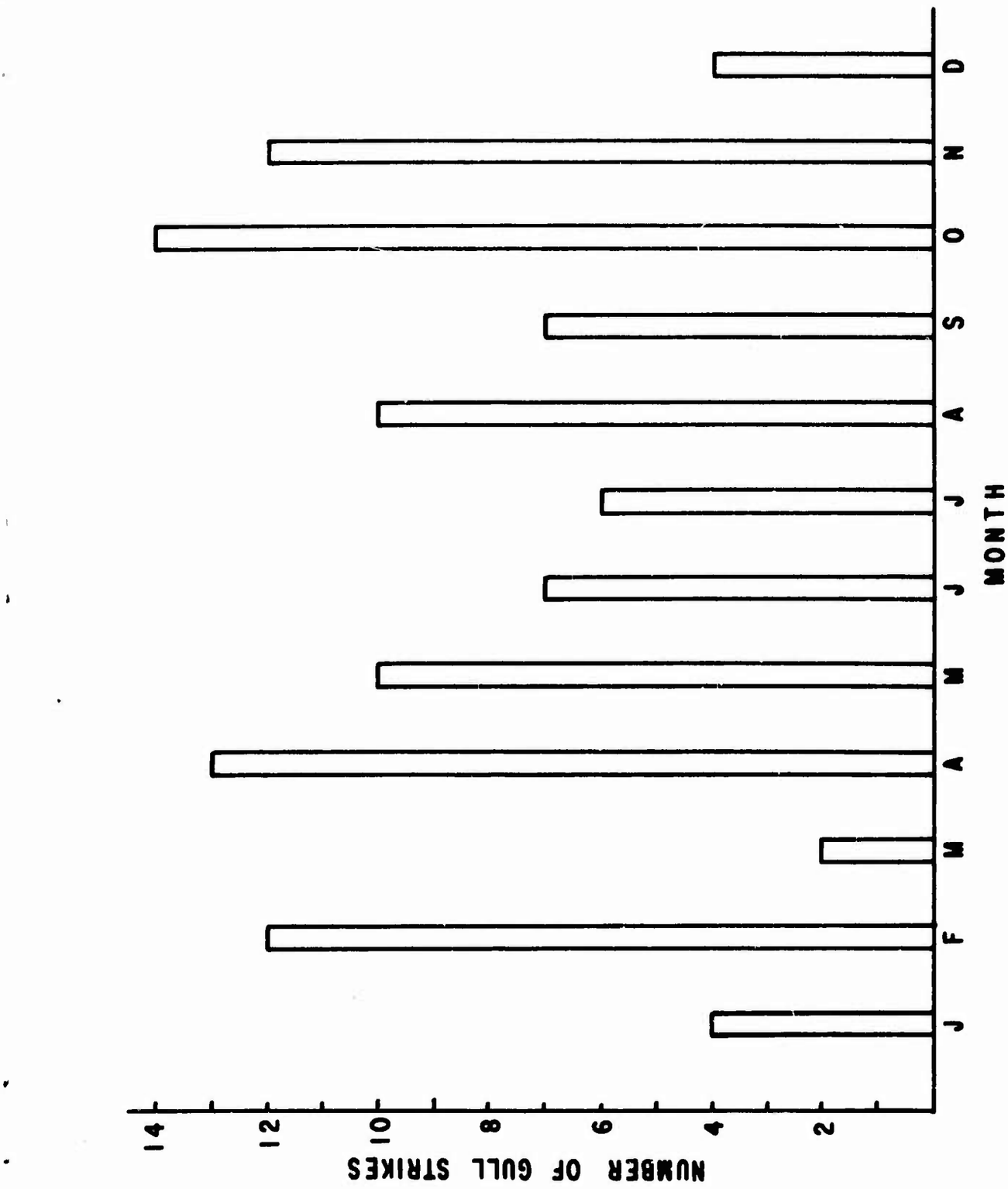

Figure 1. Total Monthly Gull Strikes (1965-1971)

Table III

AIRCRAFT DAMAGE DUE TO GULL STRIKES (1967-1971)

Year	No damage	Engine ingestions	Windscreens	Miscellaneous modes
1967	0	1	1	5
1968	0	7	0	7
1969	3	4	0	7
1970	0	6	0	10
1971	1	2	1	7
Total	4	20	2	36

Figure 2. Bases in CONUS Reporting a Gull Hazard

There are fluctuations from year to year in the severity of gull hazards at the different Air Force installations. The variation in gull activity is probably due to available food supply. Sanitary landfills and dumps are most frequently identified as gull attractants which influence this fluctuation.

The Air Force has a year-round gull problem. Some bases in the northern US are near large gull breeding colonies which cause intense spring and summer problems. Other bases are in the wintering range which increases the hazard during the nonbreeding season. The two bases which demonstrate this condition are Kincheloe AFB in the upper Michigan peninsula and Charleston AFB on the South Carolina coast. The former base has a spring-summer problem caused by large populations of Herring and Ring-Billed Gulls; the later base has a fall-winter problem caused by the same species.

Year-round problems such as the one at Shemya AFB, Alaska, can also occur. The base is located in part of the Aleutian Island Wildlife Refuge where the Glaucous-winged Gull (Larus glaucescens) breeds and overwinters.

The species of gulls responsible for a hazard have not been identified for all bases. However, from those bases that have been surveyed and from gull population studies in selected geographical areas, several species are noted. In general, Herring Gulls and Ring-billed Gulls pose the major problem for bases located on the east coast. Laughing Gulls (Larus atricilla) also pose a minor problem along the southern Atlantic coast and adjacent Gulf coast regions. A study of the gull population in the San Francisco Bay area revealed that seven species of gulls fed at dumps in the area, thereby causing a hazard to nearby civilian and military airports (Ref. 3). Four of them, the Glaucous-winged Gull, the Western Gull (Larus occidentalis), the Herring Gull, and the California Gull (Larus californicus), are relatively abundant. The Ring-billed Gulls actively feed at the dumps in large numbers. However, Thayer's Gulls (Larus thayeri) and the Glaucous Gulls (Larus hyperboreus) are present but less abundant. The combined breeding ranges of the four main species attracted to disposal sites in the San Francisco Bay area extend over most of northwestern North America. Bases located in the Great Lakes region are exposed to hazards caused by Herring and Ring-billed Gulls. Inland bases such as Perrin AFB, Texas, have hazards due to Ring-billed, Herring, and Franklin's Gulls that winter in that area on Lake Texoma (Ref. 4). The Prairie Gull or Franklin's Gull poses a considerable hazard to flying at Hill AFB, Utah, and Vance AFB, Oklahoma. Because of their large numbers and extensive geographical range,

Herring and Ring-billed gulls appear to be the number one contributor to the gull-aircraft strike hazard.

The severity of the gull problem is probably increasing due to increasing numbers of gulls. The gull populations of the Great Lakes have grown enormously in the last decade. During a 6-year survey, 1960 to 1965 (Ref. 5), the number of Herring Gulls around Lake Huron and Lake Michigan increased from 27,000 to 43,000 breeding pairs and the Ring-billed Gulls increased from 27,000 to 99,000 breeding pairs in the same area. Studies by Drury (Ref. 6) indicate that the New England breeding population has been doubling every 12 to 15 years since the early 1900s. This increase has included new colony formations and expansion of their breeding range. In the Pacific Northwest, Veermer (Ref. 7) reported the Glaucous-winged Gull population of Mandate Island, British Columbia, to be increasing steadily because of human activities that produce larger harbors and more garbage.

SECTION III

GULL CONTROL

Gull strikes to USAF aircraft occur primarily during landing and take-off. To alleviate the local problem, gull activity within the immediate vicinity of the airfield must be curtailed. Control methods can be elaborated according to the following categories:

(1) Ecological Control. This involves habitat modifications to remove gull attractants from the airfield vicinity.

(2) Dispersal. These are techniques that are employed for temporary and permanent removal of gulls from an area by visual, mechanical, acoustical, and chemical means. Birds of prey may also be used to deter or disperse birds from the airdrome.

(3) Population Control. Gull numbers are lowered by direct elimination of segments of the population or by inhibiting reproduction.

(4) Establishing Parameters of Hazards. This involves determining when and where it is best to fly to avoid large concentrations of birds without degrading mission requirements.

1. ECOLOGICAL CONTROL

a. Eliminate Food Sources

Gulls are opportunists and scavengers; they feed on a variety of food-stuffs. Seubert (Ref. 8) has shown that the most effective way to disperse gulls from places where they are a problem is to remove the food sources that attract them. Examples were given where gull numbers dropped drastically when a food source was cut off, and increased when a new food source became available. Such negative response to the absence of food and positive response to the presence of food clearly indicates that their numbers can be manipulated by controlling the availability of food.

Dumps and sanitary landfills are often a primary food source in the airdrome. When dumps are located near an airfield, birds readily inhabit the airdrome and loaf on the runways and adjacent areas. These birds are often flushed into the path of an aircraft which is landing or taking off. In

addition, gulls periodically traversing between feeding, loafing, and roosting sites often bring themselves into the critical airspace over and adjacent to the airfield.

Sanitary landfills have had a great influence on aircraft hazards at several Air Force installations. One such situation occurred at Charleston AFB, South Carolina, in 1970. The landfill was located only 1100 feet east of the centerline of the primary runway and ran a length of 1080 feet parallel to it (figure 3). Gulls soared over and within the vicinity of the sanitary fill which often placed them directly over the airfield. Gulls departing the sanitary fill in large flocks to loaf on the runway (figure 4) caused extremely hazardous conditions for aircraft about to land or take-off. Flocks of 100 to 200 birds (mixed Herring and Ring-billed Gulls) were a common occurrence. Where the flocks were disturbed, they milled over the runway for some time before returning to the sanitary landfill to feed or loaf. Some of these birds traversed the approach to the primary runway going to and from the fill each day. Gulls frequently carried their food (bones, etc.) to the runway to continue feeding, breaking the material on the pavement to enhance ingestion, and to escape harrassment from other birds. These patterns were detected through 5 days of regular observations within the airdrome (Ref. 9). After the dump was closed, bird strikes causing damage decreased from four in 1970 to none in 1971.

The US Environmental Protection Agency issued a report in 1971 which recommended the elimination or proper maintenance of all disposal areas within the vicinity of civilian and military airports (Ref. 10). The following conclusions were drawn in another report from studies of the US Department of the Interior and the Government of Canada, as well as from discussions with wildlife experts and the Solid Waste Management Office survey.

1. Solid waste disposal sites around airports contribute to potential bird-aircraft collisions because they are attractants.

2. The majority of the land disposal sites inspected during the survey were open dumps that not only contribute to the bird-aircraft hazard, but are also sources of environmental pollution. Many of these sites were in violation of state and local regulations.

3. Closing all existing disposal sites around airports will reduce the risk of bird-aircraft collisions at the airports.

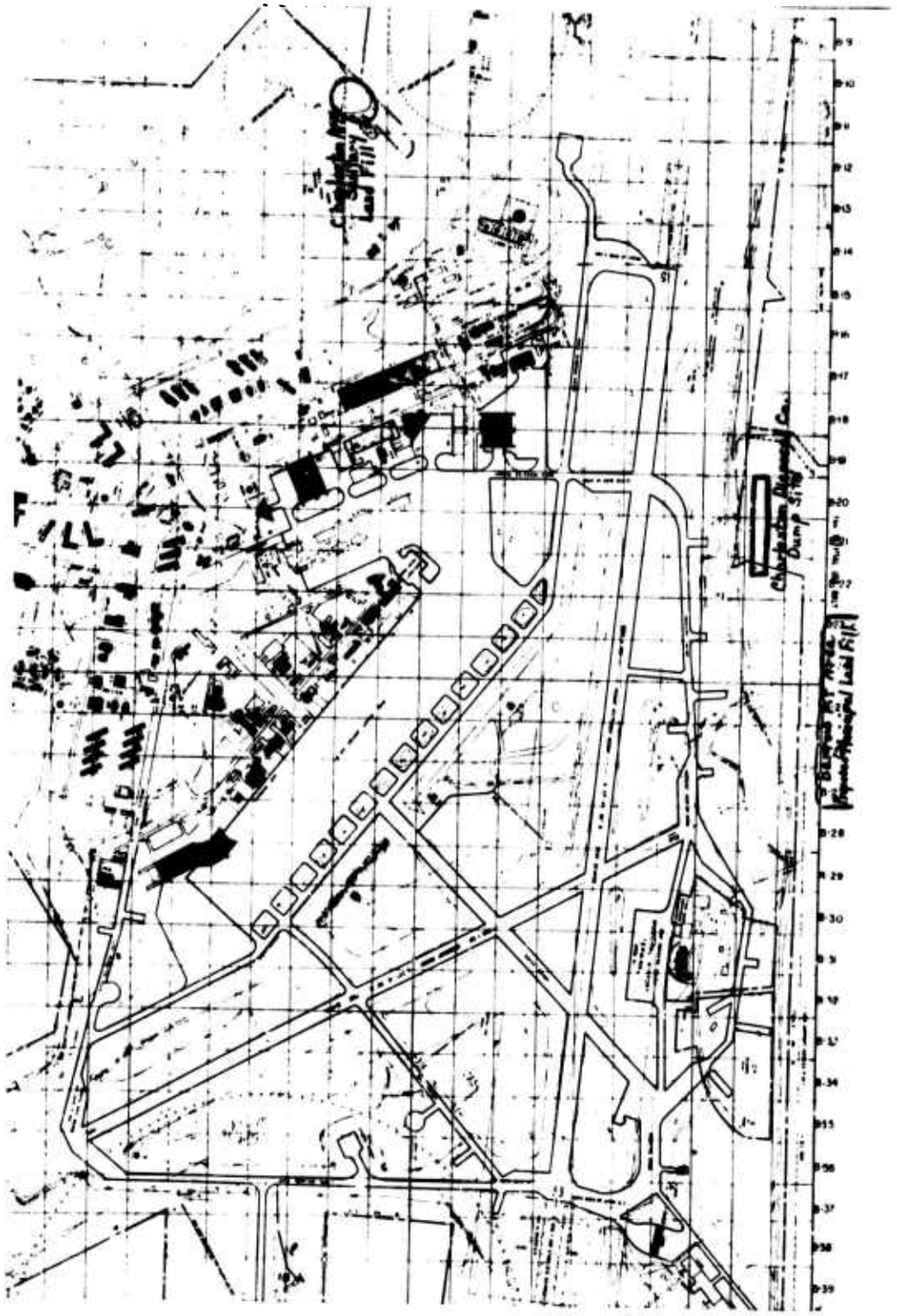

Figure 3. Survey Map of Charleston AFB

Figure 4. Gulls Loafing on the Runway at Charleston AFB

4. Although sanitary landfills are less attractive to birds than open dumps, they are not always completely free of birds. Various bird-scare devices at these sites, however, may be sufficient to keep birds away.

5. The government and a land-disposal-site owner could be liable for a bird-aircraft collision if the site is known to contribute to the bird hazard.

6. Research is needed to determine methods of operating sanitary landfills that will not attract birds (Ref. 10).

Although sanitary landfills and dumps are indicated in most instances as a primary food source attracting gulls to the airfield, there are other sources of food that influence gull activity in the vicinity of the air base. In many cases these sources must also be eliminated to reduce aircraft hazards.

Invertebrates can serve as a food source for gulls on the airfield. Earthworms are an example, especially when wet weather forces them from their burrows onto grassy areas around runways. The airports of London and Toronto are often plagued by earthworms. They attract birds to the field and in addition, constitute a skidding hazard as they move out over the runway (Ref. 11). The only effective method of control is to sweep them off the runway. The use of chemical methods for killing earthworms on federal lands is governed by Executive Order 11647, Section 3 (Ref. 12), which states:

> Heads of agencies shall take such actions as is necessary to prevent on any Federal lands under their jurisdiction, or in any Federal program of mammal or bird damage control under their jurisdiction: (2) The field use of any chemical toxicant which causes any secondary poisoning effect for the purpose of killing mammals, birds, or reptiles.

Research being done on chemical methods that can be used to kill earthworms is at this point inconclusive. The chemical that is very effective (lead arsenate) has unknown but suspected detrimental effects on the ecology. Thus far no satisfactory answer to this problem has been developed (Ref. 13).

As previously mentioned, soil invertebrates may also attract gulls to areas near the air base, thus creating a hazard to low-flying aircraft. Such is the case at Vance AFB, Oklahoma. Franklin's Gulls invade the area in large numbers during the plowing season to feed on invertebrates uncovered in the nearby fields (figure 5). This activity has caused a serious bird hazard for many years. In addition, during inclement weather gulls are attracted to the surface of the runway to loaf.

Figure 5. Gulls Feeding at an Agricultural Area

Insect populations are a food supply for some gulls. Caithness, Williams, and Bull (Ref. 14) advocate the complete elimination of the feeding base of insectivorous birds at airfields. Elimination of the insect populations should only be undertaken in situations where the ecology is well understood and not detrimentally affected. Where the relationship between the insects and the gulls can definitely be established (examination of stomach contents would be the most accurate method), a nonpersistent toxicant should be used. Wright (Ref. 15) points out that the relationships between insects and many birds are not clearly established, and the toxicity of residues of chemicals currently in use are too great to justify their indiscriminate usage. Clearly, work needs to be accomplished in the areas of bird feeding habits and in the development of effective yet nonecologically damaging control agents.

b. Eliminate Water Sources

Low areas on the airfield may fill up with water after a rain. These areas, along with any marshes or swampy areas on the field must be drained and filled in. With a food source nearby, the gulls will stay near the water, particularly if the area is flat and open. The airfield is a perfect choice for gulls because they normally loaf away from their food source and readily adapt to the regular air traffic and noise.

c. Maintenance of Vegetative Ground Cover

Vegetation plays an important role in attracting or discouraging birds from the airdrome. The merits of different heights of grass length and types of ground cover should be examined in relation to the species of bird involved in the problem. If grass grows too long, it provides cover for small mammals which attract predatory birds. It may also support large insect populations for insectivorous birds and provide shelter for ground roosting birds. If it is cut too short, it permits small birds to forage for insects and other soil-inhabiting animals. Neither of these conditions is desirable.

When dealing with a gull problem, long grass (5 to 10 inches) discourages them from using these areas for loafing. Wright (Ref. 15) states that in tests conducted in Britain by Bridgman and Brough, long grass was considered generally more effective in discouraging birds than short grass. Long grass seems to provide a habitat which gulls and most shore birds cannot abide. Their natural habitats are usually clear and flat which allows an unobstructed view in all directions. Moreover, the long grass interferes with their movements by impeding their ability to voluntarily spread their wings.

The type of vegetation or ground cover may often be an attractant for gulls. This is demonstrated by conditions occurring at Kincheloe AFB, Michigan. A survey in 1970 (Ref. 16) to determine factors influencing the gull hazard revealed that blueberries grew for approximately 2 miles on the airfield adjacent to the primary runway (figure 6). Herring and Ring-billed Gulls in large numbers fed on the blueberries when they ripened in July and August. The use of Avitrol, alarm calls, and population reduction by shooting had little, if any, effect.

After blueberry season gulls remained a problem due to sanitary landfills located near the installation. Conditions point out that several ecological factors may affect gull control at any single installation. Maximum reduction of the hazard can only occur when all factors influencing the problem are considered. Habitat alterations will not completely solve the problem. Any environment that is relatively stable, such as an airport, will attract some birds. The goal is to reduce the large risk factor involved in allowing a large population of birds to establish itself on the airfield or in the vicinity and to discourage any large periodic infusions of birds (Ref. 17).

2. DISPERSAL

Ecological control measures are the primary and most effective means of decreasing gull activity on or near the airfield. However, such control is not always feasible and habitat changes required may be outside of Air Force jurisdiction. In addition, gulls may still invade the airfield to loaf occasionally after ecological control has been initated. To cope with this variability in gull control situations, dispersal devices can play an important role. The use and classification of these techniques follow.

a. Acoustical

(1) Biosonics

One approach uses communication signals of the birds to elicit a dispersal effect. Feeding calls, sex, nesting, recognition, assembly, and alarm and distress are some of the calls studied by ornithologists. The biosonics control techniques rely on the alarm and distress call of the pest species to evoke a dispersal response (figures 7, 8). Habituation has been found to occur in many instances, probably from the lack of a reinforcement or demonstration of credibility to the bird. Research is being continued in this area and more information can be obtained on request from AFWL.

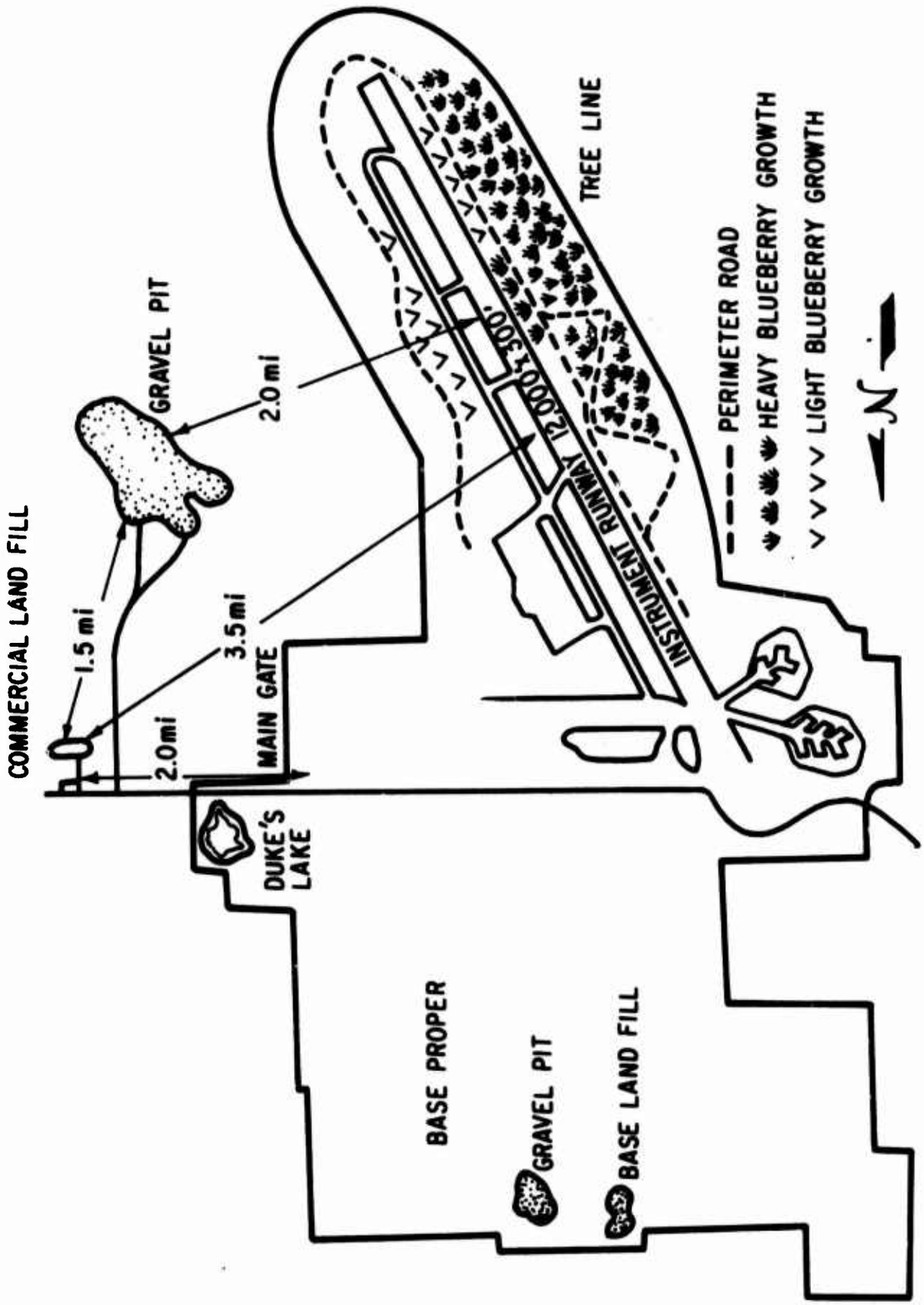

Figure 6. Survey Map of Kinchelce AFB

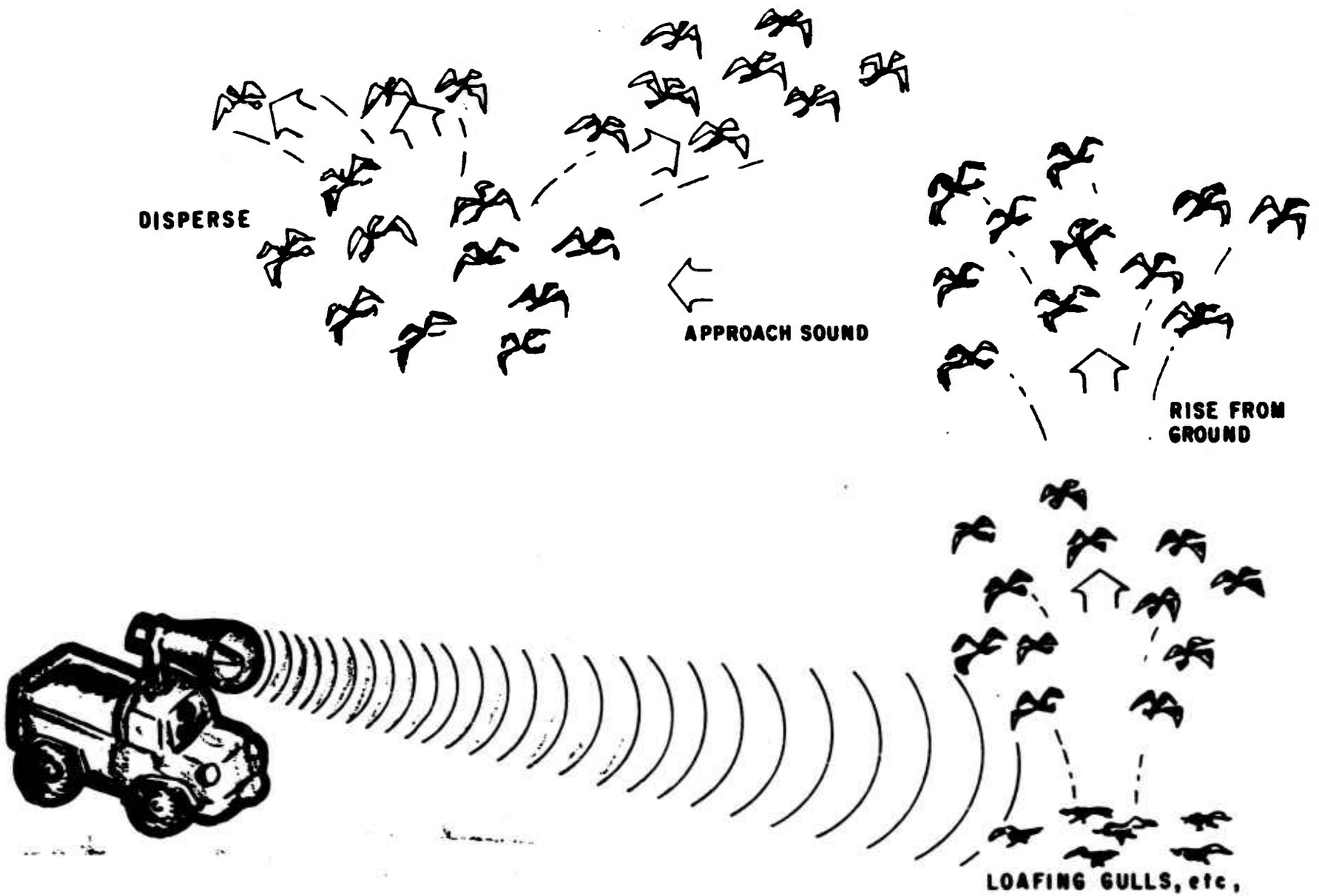

Figure 7. Gull Response to Broadcast Alarm and Distress Calls

Figure 8. Sound Equipment

The theory behind the use of alarm and distress calls is indicated in figure 7. A mobile patrol unit responds on call from the tower that gulls loafing on the airfield. The unit consists of a vehicle and sound system. The vehicle approaches within approximately 300 feet of the birds or closer when up-wind and begins to apply the sound. Short bursts of sound are directed at the birds, eliciting an escape response. Generally, if a few disperse, the entire flock may respond on the succeeding sound application. Some reinforcement may be obtained through firing shell crackers into the flock at the same time.

Generally, the best sound equipment should be used if this method is attempted. Figure 8 shows a typical sound system which is powered through the cigarette lighter on a truck.

(2) Bioacoustics

Most other acoustical and some visual techniques fall into this category. They rely predominantly on a startle response to achieve a dispersal effect. Used in conjunction with other techniques, they may be very effective. For most animals and birds, habituation soon occurs with loud noises; when gull control requires prolonged treatment, this technique will soon become ineffective.

(3) Shell Crackers

There are standard 12-gage shotgun shells available which have a pyrotechnic device substituted for the shot. They are particularly effective when used in conjunction with the alarm or distress call. The shell cracker has its limitations and may be ignored in time by birds when used as a sole method. The range of effectiveness varies (according to the brand purchased) from 100 to 200 yards.

(4) Carbide Cannons or Acetylene Exploders

These are devices which simulate the sound of a shotgun discharge. They can be set to operate in a timed sequence which can vary from seconds to minutes. Major success has been with species which are regularly hunted and have therefore learned to fear the sound of a shotgun. When the exploders are used as the sole repellent technique or when they are operated improperly, they are not at all effective. Exploders have a place in the control program when their operation is stringently regulated. Their operation must be checked

Avitrol, like other bird control techniques, has limitations. The product must be used in strict compliance with the instructions. Shortcuts in application will yield poor results. Birds can become conditioned to Avitrol just as they can to other scare techniques. Varying the size and shape of the bait may be one way of temporarily overcoming this. If the gull has eaten before he took the treated bait, it may be 5 to 15 minutes before the treatment takes affect. It should be noted that this chemical is water soluble. To lessen the possibility of poisoning other animals, any unused bait should be collected at the end of the day and destroyed. The bodies of dead birds should also be collected and disposed of properly.

d. Visual

There is evidence that by posturing dead birds in a particular fashion a high degree of bird control can be obtained. Saul (Ref. 19) found at Aukland International Airport that dead gulls preserved with Formalin and nailed on boards were effective in eliminating lounging flocks of Black-backed Gulls (Larus dominicanus) and Red-billed Gulls (Larus novaehollandiae scopulinus). A few of these corpses produced immediate and long-lasting results. The effect lasts for as long as the corpse is intact (about 3 months). Caithness et al. Ref. 14) also found that Black-backed Gulls could be discouraged from roosting on grass adjacent to the runway by placing carcasses with wings outstretched on these areas. However, polystyrene models proved equally effective and has the advantage of being more durable. Research is still required to determine the optimum position and mechanical method.

The employment of bird carcasses or models in conjunction with bio-sonics, habitat manipulation, etc. should enhance the effectiveness of a total gull control program. Although this technique has not been used against the Herring and Ring-billed Gulls in the US, it is expected that they would also respond.

Model aircraft altered to resemble the characteristic shape of a hawk have been used to scare birds from the airdrome (Ref. 20). This technique needs to be improved to provide better control and greater range of the model. Once these problems are solved, the model may be used to carry a hawk silhouette overhead. Increased control would make the use of this technique safer for air traffic and enable the operator to realistically simulate the behavior of the hawk.

periodically, and when used against gulls they must be frequently relocated to ensure effectiveness.

Other noise makers have been tried to evict gulls and other birds from the airfield. Banging trash-can lids, yelling, hand clappers, and even fireworks are among those recorded in the literature, but these things are not considered effective.

c. Chemical

These chemicals produce varying periods of incoordination, narcosis, and disturbing vocalizations emphasized by periods of near normalcy. Avitrol 200 concentrate, a chemical produced by the Avitrol Corporation Co., elicits this type of abnormal behavior when ingested by birds. The primary constituent of Avitrol is 4-aminopyridine, a white, water-soluble, highly basic solid. While Avitrol is a very toxic material whose mode of action does not rely on mass population reduction to achieve control. The concentrate has flock alarming properties. Its effectiveness depends upon ingestion of Avitrol by a few members of the target species in a flock. Since acceptance of the bait is critical, good technique in prebaiting is essential. An Avitrol brochure describes the bait preparation as follows (Ref. 18). The treated bait is mixed in a ratio of 1 to 10 with the untreated bait. The prebaited areas are then treated with the prepared bait. Initially, baiting would probably have to be done every day. After the first few days baiting twice a week would probably suffice.

While a few birds will die, it is only a small percentage of the population. A flock of at least 5000 requires a treatment of about 264 pieces of bread (24 treated). Thus, no more than 24 birds should be affected. This would be less than 1/2 of 1 percent of the population. When dealing with smaller flocks, one-half of the prescribed amount at the baiting locations should suffice. Since all situations are different, a licensed pest control operator or an official from the Federal or State Wildlife Service should be consulted.

Because gulls are protected by law, Avitrol can be used only when the proper state and federal permits have been obtained. Because Avitrol is a toxicant, it should only be handled by trained personnel.

Avitrol has been used at some Air Force bases in the US for gull control with good results. Results and circumstances surrounding the use of Avitrol are described in table IV.

Table IV

EVALUATION OF THE USE OF AVITROL 200 AT USAF BASES*

AF base	Birds species affected	Success of application	Effective length of application	Remarks
Patrick AFB, FL	Gulls (Ring-billed, Herring, Laughing)	Entire year, very good	1 month or more each application	This control method was so effective that use of shell-cracker scaring was discontinued; garbage landfill source of gulls, as well as coastal waters.
Kirtland AFB, NM	Crows, starlings, ravens, English Sparrows	Very good		Only species which returned were sparrows.
MacDill AFB, FL	Gulls (Herring, Laughing)	90-95 % effective on gulls	2 months	Effectiveness is greater with large flocks; this was a detailed study.
Lockbourne AFB, OH	Starlings, Sparrows, Pigeons	Good results	2-3 weeks	Despite limited study, effectiveness well demonstrated.
Eglin AFB, FL	Gulls	Very effective	30 days (10 feedings)	Useful only when used in strict accordance with instructions; bait shyness may take place after 10 feedings; suggest other methods of sea gull control be used in conjunction with Avitrol to obtain maximum effectiveness (such as sound-scare devices), at best a temporary deterrent, worth its cost.
Langley AFB, VA	Gulls	Very effective	Several days	Cost of product negligible as related to results obtained, especially if it has prevented a serious aircraft accident.
Myrtle Beach AFB, SC	Gulls	Very effective	1-7 days	Effective only if little rainfall.

*Aerospace Safety Magazine, p. 19, February 1969.

Avitrol, like other bird control techniques, has limitations. The product must be used in strict compliance with the instructions. Shortcuts in application will yield poor results. Birds can become conditioned to Avitrol just as they can to other scare techniques. Varying the size and shape of the bait may be one way of temporarily overcoming this. If the gull has eaten before he took the treated bait, it may be 5 to 15 minutes before the treatment takes affect. It should be noted that this chemical is water soluble. To lessen the possibility of poisoning other animals, any unused bait should be collected at the end of the day and destroyed. The bodies of dead birds should also be collected and disposed of properly.

d. Visual

There is evidence that by posturing dead birds in a particular fashion a high degree of bird control can be obtained. Saul (Ref. 19) found at Aukland International Airport that dead gulls preserved with Formalin and nailed on boards were effective in eliminating lounging flocks of Black-backed Gulls (Larus dominicanus) and Red-billed Gulls (Larus novaehollandiae scopulinus). A few of these corpses produced immediate and long-lasting results. The effect lasts for as long as the corpse is intact (about 3 months). Caithness et al. Ref. 14) also found that Black-backed Gulls could be discouraged from roosting on grass adjacent to the runway by placing carcasses with wings outstretched on these areas. However, polystyrene models proved equally effective and has the advantage of being more durable. Research is still required to determine the optimum position and mechanical method.

The employment of bird carcasses or models in conjunction with bio-sonics, habitat manipulation, etc. should enhance the effectiveness of a total gull control program. Although this technique has not been used against the Herring and Ring-billed Gulls in the US, it is expected that they would also respond.

Model aircraft altered to resemble the characteristic shape of a hawk have been used to scare birds from the airdrome (Ref. 20). This technique needs to be improved to provide better control and greater range of the model. Once these problems are solved, the model may be used to carry a hawk silhouette overhead. Increased control would make the use of this technique safer for air traffic and enable the operator to realistically simulate the behavior of the hawk.

e. Raptors

The use of falcons and goshawks may be used to disperse gulls. The Canadian Associate Committee on Bird Hazards to Aircraft has on two occasions experimented with the use of falcons for airport bird control. At Victoria International Airport, British Columbia, Mr. Frank L. Beebe was contracted to use Peregrine Falcons (Falco peregrinus) and Gyrfalcons (Falco rusticolus) to disperse gulls from the airport. The raptors are launched against a group of gulls. The raptors attack the gulls and occasionally make a kill. The falcons did succeed in dispersing the gulls from the airport area (Ref. 20).

A second experiment was conducted by Mr. George Galica at Shearwater Naval Air Station near Halifax, Nova Scotia, between 22 September and 12 November 1964. In this experiment the raptors were not allowed to attack the gulls, but flew milling patterns above the falconer within sight of the gulls. The dispersal of the gulls was affected by the presence of the predator in flight (Ref. 21). While the raptors can control the problems to a certain degree, there are problems associated with their use which must be considered.

The raptors must be housed and exercised daily, which requires facilities and handlers. Falcons have to be trained for use on military installations and to take gulls, which are not a natural prey. Raptors are ineffective during a moult, during hours of darkness, in heavy precipitation, and in a high wind. Because of the protected status of these birds, particularly the Peregrine Falcon, their use may be severely limited. Special permission is required to keep raptors in captivity. A minimum of three birds is needed and replacements would have to be obtained for any which are lost or die. Air traffic control would have to coordinate very closely with the falconers.

The Associate Committee on Bird Hazards to Aircraft did not feel that the use of falcons at Canadian airfields was feasible. The limitations imposed by the mode of action of the birds, special requirements for procurement, accommodations and handling, and the availability of alternate methods militated against the widespread use of raptors for bird control (Ref. 23).

3. POPULATION CONTROL

Population control of gulls has not been practiced extensively to reduce the bird strike hazard, being limited mostly to feasibility studies. Shooting gulls in the airdrome is the most common method employed.

Permits have been issued to kill gulls at Air Force installations with severe problems. In general, shooting gulls has been ineffective. At Kincheloe AFB, Michigan, gulls invaded the airfield day after day during the summer to feed on blueberries, although substantial numbers of gulls were killed. Seubert (Ref. 8) states that

> ". . . control measures (killing, reproductive inhibition) directed at portions of the gull population would not be effective unless food sources are altered, because gulls not affected by such control programs would continue to concentrate at places where there is food."

The unsuccessful attempt at Kincheloe to reduce the aircraft hazard by shooting gulls bears this out.

In 1965 a narcotic, alpha-chloralose, was used in a successful operation designed to destroy southern black-backed gulls breeding in the vicinity of Hawke Bay Airfield, Napcier, New Zealand (Ref. 22). Four days of prebaiting by aircraft with unpoisoned bread baits was accomplished in the area occupied by the breeding colony. Following prebaiting, the poison was applied to similar baits (200 mg/bait); these were spread over 250 acres at the ratio of one poisoned bait to four unpoisoned. Further poisoning was done following another day on which unpoisoned baits were spread. Over 85 percent of the estimated 2500 breeding gulls present were killed. The impact of the gull strike problem due to this operation was considered substantial. In a 5-month period prior to poisoning, gulls were involved in 12 incidents with aircraft; only four incidents were recorded within the following 18 months.

Seubert (Ref. 8) reported on the evaluation of another method rather than direct poisoning to reduce the very large population of Herring Gulls in the northeastern US. Gull eggs in active nests were sprayed with a mixture of oil, water, and formaldehyde to inhibit reproduction. Under the spray treatment the production of young gulls per active nest was about 0.3, while approximately 1.0 young per nest was produced on control islands. Seubert (Ref. 8) surmises that

> ...The northeastern herring gull population could be lowered by a massive program of killing, or the population's growth could be stopped by an extensive program of reproduction inhibition. However, the large number of gulls breeding in small colonies or in areas beyond the reach of a program of reproduction inhibition would,

> by their productivity and emigration, largely offset hope for a population drop resulting from such a program on the gull population wintering in the Northeast....

The long-range reduction of gull populations is beyond the jurisdiction and interest of USAF. Local measures of this type will not produce permanent success in the long run.

4. ESTABLISHING PARAMETERS OF THE HAZARD

The potential for gull strikes can be reduced by determining daily gull activity patterns near the air base. If a gull flight traverses the approach or take-off paths on the airfield during certain time frames, flying schedules should be altered to keep aircraft movements to a minimum during these times. Also, flying over areas where gulls concentrate (e.g., loafing sites, feeding sites) should be avoided when possible. Often at these sites, gulls soar in large numbers using the thermals above or near the site.

Information can be obtained about gull activities from direct ground observation, radar, and from pilots flying in the area. In addition, strike reports may suggest critical time periods and locations.

SECTION IV

LEGAL ASPECTS OF GULL CONTROL

The terms of Migratory Bird Treaty Act of 3 July 1918 prohibit the trapping or killing of protected birds and the destruction of their nests and eggs. Special federal permits can be obtained when under certain conditions the birds must be moved or killed. Some states have also acted to protect additional species of birds from unnecessary depredations. The local wildlife offices must be consulted and the necessary permits obtained before any control procedures that require taking birds are initiated. The following is a list of gulls that are protected under the federal act (Ref. 23):

Black-headed Gull (Larus ridibrendess)

Black-tailed Gull (Larus crassirostris)

Bonaparte's Gull (Larus philadelphia)

California Gull (Larus californicus)

Franklin's Gull (Larus pipixcan)

Glaucous Gull (Larus hyperboreus)

Glaucous-winged Gull (Larus glaucescens)

Great Black-backed Gull (Larus marinus)

Heermann's Gull (Larus heermanni)

Herring Gull (Larus argentatus)

Iceland Gull (Larus glaucoides)

Ivory Gull (Pagophila eburnea)

Laughing Gull (Larus atricilla)

Lesser Black-backed Gull (Larus fuscus)

Little Gull (Larus minuters)

Mew Gull (Larus canus)

Ring-billed Gull (Larus delawarensis)

Ross' Gull (Rhudostethia rosea)

Sabine's Gull (Xema sabini)

Slaty-backed Gull (Larus schistisagus)

Western Gull (Larus occidentalis)

All sea gulls and terns are additionally protected by the federal treaty with Mexico, which became effective 10 March 1972.

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