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DISPERSAL OF SEAGULLS IN AN AIRDROME ENVIRONMENT

John F. Stout, et al

Andrews University

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June 1975

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June 1975

Final Report for Period 31 December 1972 - 31 January 1975

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Air Force Systems Command
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Glaucous-winged Gulls (Larus glaucescens) provide an acute bird/aircraft hazard at Shemya Air Force Base, Shemya Island, Alaska. The problem was evaluated by making survey counts of aggregations of gulls on the island. At Ellington Air Force Base, TX, Ring-billed Gulls (Larus delawarensis) often aggregate in large groups on or near the active runways and are hazardous to aircraft. A sanitary landfill located close to the base was found to attract gulls to the area. Recorded gull calls played to aggregations of Glaucous-winged Gulls at Shemya

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AFB showed that the Distress call resulted in fewer birds remaining following playback than any other call. Distress calls played back to aggregations of Ring-billed Gulls near Ellington AFB were also effective in dispersal. A preliminary experiment with taxidermy mounted model gulls at Shemya AFB indicated that gull models might be effective in the permanent dispersal of gulls from critical areas. Further work with models at Ellington AFB showed that model gulls placed on their sides or models mounted with outstretched wings were effective in the dispersal of gulls from areas of aggregation. Further studies completed at Whidbey Island NAS, Oak Harbor, Washington proved effective when using artificial models made from fiberglass. The effectiveness of sound and artificial model gulls was evaluated in a breeding colony and a non-breading colony. A number of bird species other than those specifically studied should be considered small-potential hazards to aircraft at the bases.

PREFACE

This study was supported by the Aeronautical Systems Division (ASD), Air Force Systems Command, United States Air Force, Wright-Patterson Air Force Base, Ohio, Contract No. F29601-73-C-0063, and AFOSR contract F44620-67-C-0063, and was monitored by the Air Force Weapons Laboratory, Air Force Systems Command, United States Air Force, Kirtland Air Force Base, New Mexico. We want to especially thank Capt. Huey, Base Operations, Shemya Air Force Base, and Lt. Col. Newsom, Chief of Safety, Ellington Air Force Base for their cooperation during our work at the bases.

Inclusive dates of research were 31 December 1972 through 31 January 1975. The report was submitted 24 March 1975 by the Principal Investigator, Dr. John F. Stout, Andrews University, Berrien Springs, Michigan.

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SECTION I

INTRODUCTION

Collisions of birds with aircraft during recent years have been costly in terms of human life and damage sustained by aircraft. United States commercial air-carriers reported 2,196 bird strikes from April 1961 through June 1967. Several of these incidents resulted in human fatalities (Ref. 1). The US Air Force reported 1,192 strikes to their aircraft in 1968 alone and one Air Force pilot was fatally injured (Ref. 1). The cost to the USAF for repairs and replacement of damaged aircraft due to bird strikes has exceeded ten million dollars annually in recent years (Ref. 2). The Air Force is presently involved in a program to reduce bird/aircraft strike hazards at bases where the problem is particularly acute.

Species of gulls are among the most common problem birds (Ref. 3; Ref. 4). Airports are often situated in coastal lowlands and such areas provide ideal feeding environments for gulls and other shorebirds. Certain inland regions also attract large numbers of gulls.

Gull populations have been monitored for a number of years at several locations in the United States and are on the increase (Ref. 5; Ref. 6; Ref. 7 and Ref. 8). Rising numbers of gulls are reflective of increased numbers of artificial food sources including solid waste disposal sites, sewage outlets and commercial fisheries. In a report issued by the United States Environmental Protection Agency, Davidson et al.(Ref. 1) found as many as fourteen disposal sites contributing to bird hazard problems experienced by three San Francisco airports.

Methods to discourage gulls from aggregating at airports have received much attention. Bird-scaring techniques have been used at a number of places with encouraging results. These methods have involved the use of visual and/or auditory stimuli. Bremond, Gramet, Brough, and Wright (Ref. 9) and Saul (Ref. 4) have reviewed these techniques.

Wooten, Sobieralske, and Beason (Ref. 10) evaluated the gull strike hazard problem at Shemya Air Force Base, Alaska. They concluded that the Glaucous-winged Gull (Larus glaucescens) presents a serious hazard to aircraft at Shemya. A strike at this base in 1970 resulted in thousands of dollars of damage to an aircraft and severely jeopardized its mission. A number of other strikes of a minor nature have also occurred.

A preliminary evaluation of the bird/aircraft hazard at Ellington Air Force Base, Texas was conducted by Boulter et al. (Ref. 11). They reported that huge flocks of Ring-billed Gulls (Larus delawarensis) regularly visit the sanitary landfill operated by the City of Pasadena, located two miles northwest of Ellington AFB. At times groups of gulls are also attracted to the airfield for less obvious reasons, creating a serious hazard to aircraft.

The purpose of this study was to evaluate the use of visual and accoustical stimuli to achieve effective dispersal of gulls from aerodromes. Techniques were developed which make the standardization of such procedures and their implemention by USAF base personnel feasible. In addition to developing these techniques evaluations were made of environmental conditions influencing the gull hazard problems at the locations studied.

The various segments of this study were carried out at Shemya AFB, Alaska, Ellington AFB, Texas, Whidbey NAS, Washington and in gull breeding colonies along the coast of Washington. Whidbey NAS was used because of its close proximity to the breeding colonies and because aggregations of gulls frequented the sanitary landfill there. Experiments at the breeding colonies were carried out to test the effectiveness of our techniques on gulls highly tenacious to nesting territories. Techniques shown to be effective in the dispersal of nesting gulls would presumably be all the more effective on gulls having relatively little site tenacity (such as those loafing on aerodromes).

SECTION II

MATERIALS AND METHODS

Experiments designed to disperse aggregations of the Glaucous-winged Gull (Larus glaucescen) were made on Shemya Island, Alaska between 5 August and 22 August 1973. Shemya Island (Figure 1) is located at approximately 174° E. longitude, 53° N. latitude, near the end of the Aleutian Island Chain. The island is approximately 4.5 miles long by 2 miles wide and is oriented in a somewhat northwest-southeast position with respect to its long axis.

Similar studies were conducted on aggregations of Ring-billed Gulls (Larus delawarensis) at Ellington AFB, Texas from 1 January to 18 January 1974. The experiments made at Ellington AFB were based on the results of our work at Shemya AFB.

Further experiments were conducted on Colville Island, Flower Island and the Whidbey Naval Air Station (WNAS) Sanitary Landfill. These experiments were conducted between 0600 hrs and 1900 hrs from 15 June to 21 August 1974. Experiments in a colony using the distress call were conducted only at the end of the reproductive season so as to cause as little disturbance as possible.

1. ENVIRONMENTAL AND DISTRIBUTIONAL SURVEYS

Shemya AFB. Parts of the northwest and most of the southeast coast areas of Shemya Island consist of sandy beaches. Much of the remaining coastline is rocky with numerous tidepools containing a variety of algal and other herbacous vegetation. The natural flora has been disturbed, however, by a network of roads, buildings, and aircraft runways. Shemya Island is

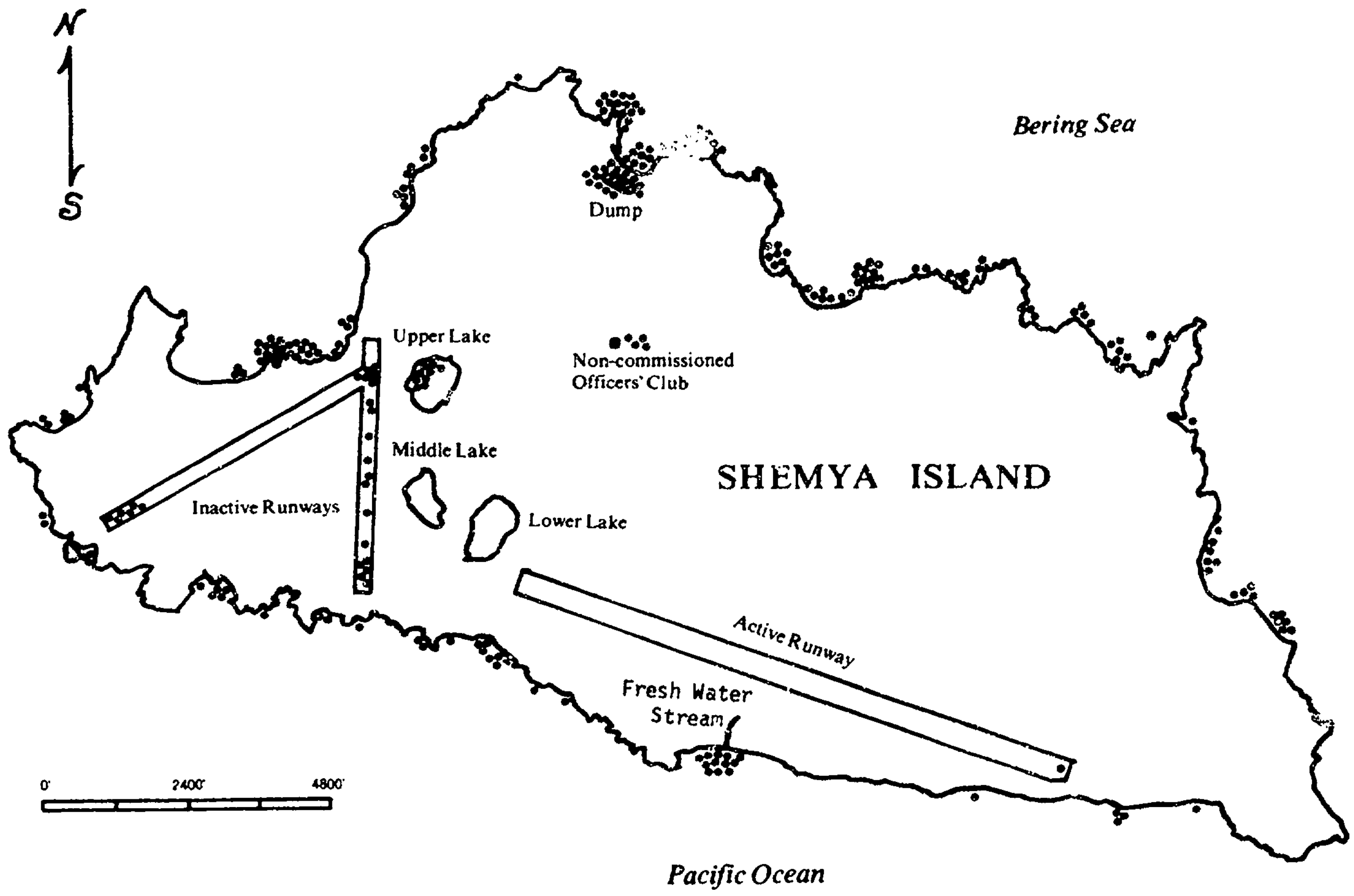

Figure 1 Map of Shemya Island showing features discussed in this paper. The dots (·) indicate areas where aggregations of the Glaucous-winged Gull (*Larus glaucescens*) were found during 14 surveys of the island. The number of dots concentrated in any particular area indicate the number of surveys in which birds were observed in that area.

administered by the Alaska Air Command as a remote Air Force Base. The island is also part of the Aleutian National Wildlife Refuge.

Daily weather reports were provided to us by the Air Force weather station located on the island. Tidal variations were calculated from tide tables issued by the United States Department of Commerce (Ref. 17). These data were compared with gull distribution patterns to determine the effects of climatic and tidal factors on the birds.

Distribution patterns were determined by driving a pickup truck around the island and counting the adult and immature birds seen in individual aggregations. Solitary birds and small numbers of birds spread out over large areas were infrequent and not usually counted except when they were found on the runways. The general behavior of birds in each aggregation was noted. Exact locations of the aggregation were extablished by the use of a crash grid map of the island. The date and time at which each count was made were also tabulated. Fourteen such surveys of the entire island were made over a period of 15 days. Each survey took approximately one to two hours to complete.

Ellington AFB. The Pasadena Sanitary Landfill, located two miles northwest of the Ellington AFB airfield, has been recognized as a major gull attractant (Ref. 11). Further observations were made by us at the landfill to determine more fully the behavior patterns of Ring-billed Gulls (*Larus delawarensis*). The time of arrival and departure of the gulls was noted and also the direction they usually traveled. The evening feeding and roosting habitat was determined by using a helicopter to follow groups of gulls leaving the landfill.

The sanitary landfill was frequented by gulls on an almost daily basis. It was therefore, a convenient location to experiment with different techniques in dispersing gulls. The landfill at Whidbey Naval Air Station afforded an excellent place for futher gull dispersal work in testing the imitation fiberglass gull models.

2. EXPERIMENTS USING SOUND STIMULI

Experimental work involved the playback of five recorded calls of the Glaucous-winged Gull at Shemya AFB: Choke, Trumpet, Alarm, Mew, and Distress. Distress call recordings were made by Erwin W. Pearson of the Denver Wildlife Research Center. We recorded the other calls in a breeding colony in Washington. Calls were played back from a Uher 4400 Report Stereo tape recorder through a Bell P.A. Transistor Mobile 30 amplifier and an Electro-Voice P.A. 30A speaker. The speaker was aimed at the birds through the open window of a pickup truck parked 30 to 200 meters from each aggregation. Calls were played for approximately 15 seconds. Sound levels for the five recorded calls were measured with a Pulsar Model 40 sound level meter placed 10 meters from the loud speaker. They were as follows: Choke, 90-95 dB; Trumpet, 110-115 dB; Alarm, 85-90 dB; Mew, 105-107 dB; Distress, 105-107 dB.

The date, time, location, and number of gulls in each aggregation were determined before calls were played back. Calls were played back to birds loafing on two abandoned runways at the west end of the island and to aggregations of birds loafing and feeding along the shore. The number of birds remaining after the 15 second playback was recorded to compare the relative effectiveness of the five calls. The number of times any birds returned before 2 minutes after cessation of the playback was also recorded.

A two-way analysis of variance test for unequal _n_'s was used to compare the percent birds remaining following call playbacks in the two areas. A Duncan's multiple comparison test for unequal _n_'s was used to make specific comparisons between calls. Chi-squared tests were used to compare the number of times birds returned within two minutes after playback of the various calls and to determine if environmental factors influenced the number of times birds returned. All tests were carried out at the .05 level of significance.

The Ring-billed Gull Distress call was tested for its effectiveness in dispersing gulls near Ellington, AFB at the Pasadena Sanitary landfill. This call was also obtained from Erwin W. Pearson of the Denver Wildlife Research Center. The Distress call was played back using the same equipment mentioned above.

On each experiment the speaker was directed at the gull aggregation. Sound level during playback (100-110 dB to 10 meters) remained constant in all the experiments. Time was recorded from the beginning of the sound stimuli to the moment the first bird returned. Observations were maintained for at least 30 minutes after each playback. The calls were played for no more than 15 seconds. At the end of each experiment the number of birds remaining was also noted.

The Glaucous-winged Gull Distress call was also tested for its effect on gulls in a breeding colony where these birds are more site -- tenacious and would be expected to habituate to the calls more rapidly. The Distress call was played at 5 minute intervals for 15 seconds, the total experimental time being 30 minutes. The number of birds in a prescribed area were recorded before and after each call. Time was also recorded from the moment the sound stimuli ceased to the moment the first bird returned.

3. EXPERIMENTS USING VISUAL STIMULI

Two taxidermy mounted model gulls in choking postures were placed on the mudflat along the west side of the Upper Lake on Shemya Island where gulls frequently aggregated. The response to these models by the gulls was noted.

Four types of models were constructed to test the effects of visual stimuli on gull dispersal. The first consited of a taxidermy mounted head and neck of a real gull mounted on a wooden body of approximately the normal body shape and size. Real wings were folded and attached to the wooden body. The second model type was similar to the one just described except the head, neck and wings were molded from fiberglass components, painted normal body colors of L. glaucescens, and attached to the wooden body. The third model type was a complete taxidermy mount of a dead gull. This was used in conjunction with the fourth model type which was a molded fiberglass whole mount of a dead gull.

At Ellington AFB six gull models were constructed that consisted of a taxidermy-mounted head and neck of a real gull mounted on a wooden body of approximately the normal body size. The head was mounted for each experiment in the Aggressive Upright display posture (Ref. 12). Wings were folded and attached to the wooden body on five of the models. The sixth model had the wings out-stretched as before flight. These models were placed in areas where gulls were loafing or where they were frequently observed. Time was recorded from the placing of the models, to the return of the first bird. The behaviors of the reacting gulls were carefully noted.

The following experiments were conducted at the Pasadena Sanitary landfill to determine the effectiveness of the models in different positions.

1. Model upright with wings folded
2. Model lying on its side with wings folded
3. Model upright with wings outstretched

Based on the results of the above three experiments, a fourth one was conducted to test the dispersal effectiveness over a long period of time. This was done by placing three models (upright lying on their side with wings folded) in an area that consistently had gulls loafing. Models were left in place for eight days and observations were made daily.

A control was made for the effect of human disturbance on the dispersal behavior of gulls. This was done by walking into the aggregation of gulls with no model. Time was recorded from the moment walking towards the gulls began until the moment the gulls returned. This enabled us to differentiate between effect of the model and human disturbance.

On Colville Island, a series of experiments were run to determine the difference between imitation fiberglass models and the real gull component models. In each experiment two models were placed in a territory at the same time. The reaction given to the models was similar to that given to an intruder. The models were placed whenever possible at equal distances from the eggs and chicks. Only aggressive behavior involving contact with a model was recorded as an attack. Models were placed in either the Upright posture or the Choking posture (Ref. 12). The amount of time that elapsed until attack was recorded.

Paired models were used in the following series:

Series 1. An imitation fiberglass head, neck and wings mounted on a wooden body in the Upright posture and a real head, neck and wings mounted on a wooden body in the Upright posture.

Series 2. An imitation fiberglass head, neck and wings mounted on a wooden body in the Upright posture and a real head, neck and wings mounted on a wooden body in the Choking posture.

Series 3. An imitation fiberglass head, neck and wings mounted on a wooden body in the Choking posture and a real head, neck and wings mounted on a wooden body in the Upright posture.

Series 4. An imitation fiberglass head and neck with real wings mounted on a wooden body in the Upright posture and a real head, neck and wings mounted on a wooden body in the Upright posture.

Series 5. An imitation fiberglass head, neck and wings mounted on a wooden body in the Upright posture and a real head with a fiberglass neck and wings mounted on a wooden body in the Upright posture.

The x^2 test with one degree of freedom was run for each series of experiments at the .05 significance level.

4. MODEL/SOUND EXPERIMENTS

The Glaucous-winged Gull Distress call was tested for its effect on gulls in a breeding colony. The Distress call was played at 5 minute intervals for 15 seconds, the total experimental time being 30 minutes. The number of birds in a prescribed area were recorded before and after each call. Time was also recorded from the moment the sound stimuli ceased to the moment the first bird returned. Two series of sound experiments were conducted. They are as follows:

Series 6. The Distress call consisted of a 15 sec. tape loop that was started at random spots on the tape loop.

Series 7. The Distress call consisted of different 15 second calls taken from a continuous recording.

A proportion of birds remaining after the call was determined. This was used to show a possible difference in habituation between Series 6 and 7.

A number of experiments were conducted with models in different positions. The function of these experiments was to determine combination of models with sound to see if model types make any difference in keeping gulls away from a prescribed area. Experiments were run both with and without the Distress call. The Distress call was the same call used on Series 6 of the model/sound experiments. In each experiment where the Distress call was used, the call was played at 10 minute intervals for 15 seconds. In the experiments where no call was used, observations were made on the same 10 minute interval. The number of birds in a prescribed area were recorded before and after the call or the placing of a model. Time was recorded from the moment the sound stimuli ceased to the moment the first bird returned.

The model experiments with an imitation head, neck and wings mounted on a wooden body in the Upright posture are referred to as the "imitation model". The model with a real head, neck and wings mounted on a wooden body in the upright posture are referred to as the "real model". The taxidermy mount of a complete dead gull is referred to as the "real whole mount" and the fiberglass model of a complete dead gull is referred to as the "imitation whole mount".

The series of experiments conducted are as follows:

Series 8. One imitation model lying on its side was placed in territories and used with the Distress call until 20 experiments were recorded.

Series 9. One real model lying on its side was placed in territories and used with the Distress call until 25 experiments were recorded.

Series 10. Two models, both imitation and real, standing upright or lying down were placed in territories and used with the Distress call until 10 experiments were recorded.

Series 11. Two models both imitation and real were either standing upright or lying down, were placed in territories and used with no Distress call until 10 experiments were recorded.

Series 12. One real whole mount was placed in territories and used with the Distress call until 11 experiments were recorded.

Series 13. One imitation whole mount was placed in territories and used with the Distress call until 11 experiments were recorded.

5. DISPERSAL EXPERIMENTS

Dispersal experiments using models and Distress calls were conducted at the WNAS Sanitary Landfill. Data was collected on the behavior of birds subjected to models and Distress calls. Experiments consisted of a 15 second Distress call, played with an imitation and real models lying on their side and the imitation whole mount. The number of birds before and after the placing of the models or the playing of the Distress call was noted. Time was recorded from the beginning of the sound stimuli to the moment the birds returned. Particular attention was given to how long the birds stayed away.

SECTION III

RESULTS

1. FACTORS INFLUENCING THE AGGREGATION OF GULLS

Figure II shows that on 11 of the 14 distribution surveys of the Glaucous-winged Gull at Shemya AFB a greater proportion of gulls were found on the north coast than on the south coast. Weather data showed that during 13 of the 14 surveys the wind was from the south or southwest. Thus, it appears that gulls usually oriented to the leeward side of the island. Wind conditions on Shemya were quite variable, but generally there was a moderate to strong breeze. On 22 August gusts of up to 54 knots were recorded with a mean wind speed of 31 knots during our survey period. One solitary bird was counted along the southeast beach. The north coast, however, sheltered hundreds of birds, many in dense aggregations, crowding as close to the ground as possible.

The effects of tidal fluctuations were also considered. All three times that more gulls were found along the south coast than along the north coast minus tides were being experienced.

A mean 17 percent of the birds counted during the distributional surveys were juveniles. A large number of these juveniles were newly fledged. In one case two juveniles were observed eliciting the begging response to an adult bird on an abandoned runway. Upon being induced to fly, the young birds displayed a rather weak and erratic flight pattern typical of newly-fledged birds.

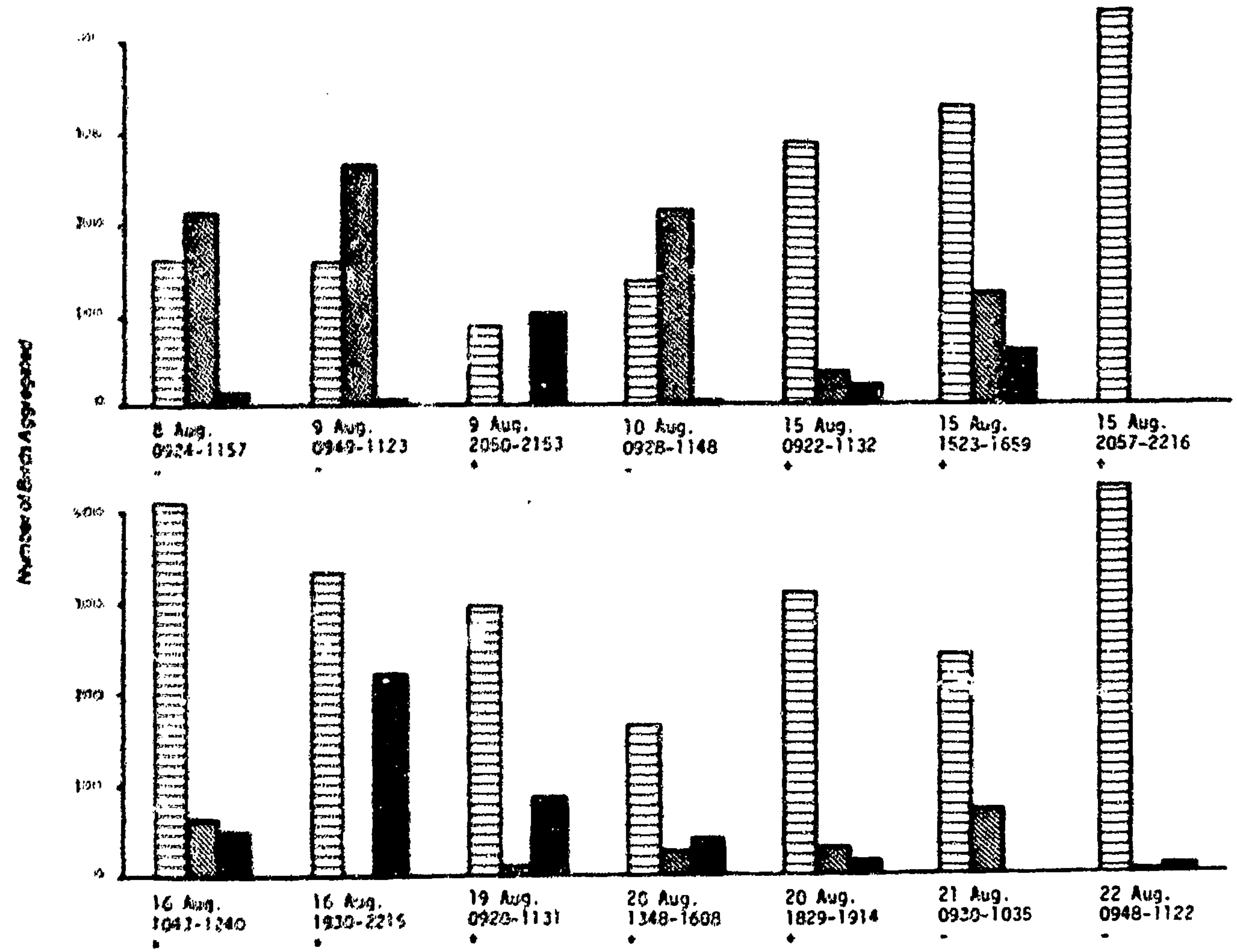

Figure 2 Histogram showing the number of birds in aggregations of the Glaucous-winged Gull (Larus glaucescens) counted during 14 surveys of Shemya Island. The following three areas are represented: north coast (horizontal cross-hatching); south coast (diagonal cross- hatching); inactive runways (solid). Below the graph the following data are given for each survey period: date; time; plus (+) or minus (-) tide.

In the work at Ellington AFB with the Ring-billed Gull, observations at the Pasadena Sanitary Landfill showed that gulls usually arrived between 0900 and 1200 hours. A similar observation was made by Boulter et al. (Ref. 11). The arrival of gulls greatly depended on weather conditions. In mornings of thick fog no gulls were observed. As the fog lifted, however, gulls began appearing from the northeast. The most typical behavior was for gulls to arrive in small groups and begin circling the landfill. The elevation achieved while circling was between 500 and 2,000 feet. As the flock became larger they began settling. At times well over one thousand birds were observed. Gulls in the dump fed on edible garbage and soil organisms exposed by the bulldozers.

In the late afternoon gulls began leaving the landfill. This usually took place between 1500 and 1730 hours. The direction of their departure was always to the northeast. On three occasions gulls leaving the landfill were followed with a helicopter and were found to be traveling to Peggy Lake, Jenning Island and the San Jacinto Bay area. Large groups of gulls were also found on the mud flats of these areas. A landfill used by the city of La Porte located near the east end of San Jacinto Bay was also frequented by gulls.

No large aggregations of Ring-billed Gulls were observed in the western portion of Galveston Bay or in areas south and west of Ellington AFB. This was determined by both ground and air observations.

Gulls moved onto the base and runways during rainy periods. They often aggregated around puddles and pools of water.

2. DISPERSAL DUE TO SOUND STIMULI

Each of the five calls played back to aggregations of the Glaucous-winged Gulls at Shemya AFB were effective in dispersing birds. In fact, we found that playback of any loud sudden noise was briefly effective, though gulls quickly habituate to this kind of stimulus.

Table I shows the mean percentages of birds remaining following playback of the five calls to aggregations of 20 or more birds on runway and along coastal areas. Forty-six of the 73 playbacks resulted in some birds remaining after the sound was turned off. A two-way analysis of variance test showed that significant differences occurred both among the effectiveness of the calls and between the responsiveness of birds in the two environments (Table II). Birds in natural shore environments were more resistant to dispersal than birds loafing on runway areas. A Duncan's multiple comparison test (Table I), showed that the Distress call resulted in significantly fewer birds remaining following playback than did the Trumpet or Choke calls. No statistically significant differences were shown between the effects of the Distress call compared with the effects of the Alarm and Mew calls.

Table III shows the number of times birds returned before 2 minutes after playback of the calls in the two environments. A Chi-squared test showed that birds returned more frequently to natural shore areas than to runways. No differences were shown among the effects of the five calls with respect to the number of times birds returned.

No habituation by birds to playbacks of the Distress call was noted. The Distress call was played approximately 120 times to aggregations during preliminary tests and during the actual experiments. The Distress call was played back more times than any other call. The gulls did not appear to habituate to any of the other calls.

The results (Table IV) of the experiments with sound playback to Ring-billed Gulls at the Pasadena landfill near Ellington AFB indicated that the Distress call was effective in dispersing Ring-billed Gulls. No noticeable habituation to the call was observed.

TABLE 1 Mean percentages of birds remaining following playbacks of five recorded calls to aggregations of 20 or more Glaucous-winged Gulls (Larus glaucescens) on runways and along the shore.

The brackets beside the mean percentage remaining for the call indicate the separation of the calls into homogenous subgroups. Calls within the same bracket are not significantly different at the five percent level. Calls not enclosed by the same bracket are significantly different.

	SHORE		RUNWAY		
	NUMBER TRIALS	MEAN PERCENT	NUMBER TRIALS	MEAN PERCENT	MEAN FOR CALL
Distress	17	11.94	8	0.25	8.20
Alarm	5	25.60	5	3.00	14.30
Mew	13	27.54	2	0	23.87
Choke	10	37.80	3	1.33	29.38
Trumpet	7	53.00	3	2.67	37.90
MEAN FOR ENVIRONMENT		27.65		1.38	

TABLE II Analysis of variance table for data in TABLE III

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	VARIANCE ESTIMATE
Rows (calls)	7370.75	4	1842.69
Columns (environment)	10180.72	1	10180.72
Interaction	2584.41	4	646.10
Within Cells	34547.58	63	585.37
TOTAL	54683.46	72	

$$F_{interaction} = \frac{S_i^2}{S_w^2} = 1.1782 \qquad F_{call} = \frac{S_r^2}{S_w^2} = 3.3603^*$$

$$F_{environment} = \frac{S_c^2}{S_w^2} = 18.5653^*$$

*Significant at the .05 level

TABLE III Number of times Glaucous-winged Gulls (<u>Larus glaucescens</u>) returned before two minutes following the playbacks of five recorded calls in two environments.

	NUMBER TRIALS	TIMES RETURNED	PERCENT TIMES RETURNED	NUMBER TRIALS	TIMES RETURNED	PERCENT TIMES RETURNED
Distress	22	18	81.8	22	4	18.2
Alarm	7	3	42.9	6	2	33.3
Mew	18	6	33.3	5	0	0
Choke	14	7	50.0	4	1	25.0
Trumpet	9	4	44.4	6	1	16.7
TOTALS	70	38	54.3	43	8	18.6

TABLE IV The number of Ring-billed Gulls remaining and the time the first bird returned after playback of the Ring-billed Gull Distress call.

NUMBER OF BIRDS	NUMBER OF BIRDS REMAINING AFTER DISTRESS CALL	TIME FIRST BIRD RETURNED AFTER DISTRESS CALL	DISTANCE FROM AGGREGATION
95	0	5 min	100 yards
150	0	12 min	100 yards
187	180	-	50 yards
195	0	-	50 yards
400	0	-	100 yards
206	0	-	50 yards
500	0	3 min	50 yards
300	0	-	50 yards
31	0	-	50 yards
365	0	*1 min	100 yards
205	0	-	50 yards
110	0	-	50 yards
150	0	4 min	50 yards
250	0	2 min	60 yards
235	0	-	60 yards
130	0	-	50 yards

* Returned about 200 yards from original spot

The behavior exhibited by gulls reacting to the Distress call consisted of a circling flight towards the sound source. This would last for a couple of minutes with the circles becoming increasingly larger in diameter until the gulls flew off leaving the area completely clear of gulls. The effectiveness in keeping gulls away for long periods of time was not great however. It was observed that after an hour or so following playback, gulls often returned.

Experiments with the Glaucous-winged Gull Distress call played in a colony showed that when a 15 second call was played repeatedly, habituation occurred rapidly (Series 6; Figure III). After six calls 5 minutes apart 83% of the birds in a given area remained unaffected by the call. When a continuous recording was played for 15 seconds at 5 minute intervals habituation was not as apparent (Series 7; Figure III). In this series the Distress call was different for each interval and depending on the nature of the call the response was different. The calls that contained high shrill shrieks were observed to be more effective in causing birds to fly than low intensity calls.

3. DISPERSAL USING VISUAL STIMULI

At Shemya AFB, Glaucous-winged Gulls continued to come to the Upper Lake following placement of two model gulls in an upright position (Figure IV). However, the day after the models were placed, a fox knocked one of the models on its side. Following this incident no birds were seen at the lake until the models were removed two days later. During this time birds used the Middle Lake for drinking and washing, a lake which had not been used by the birds previous to the placement of the models at the Upper Lake. Also, during this time we frequently saw gulls fly over the Upper Lake without landing. Following removal of the models, birds were seen on the Upper Lake again within six hours.

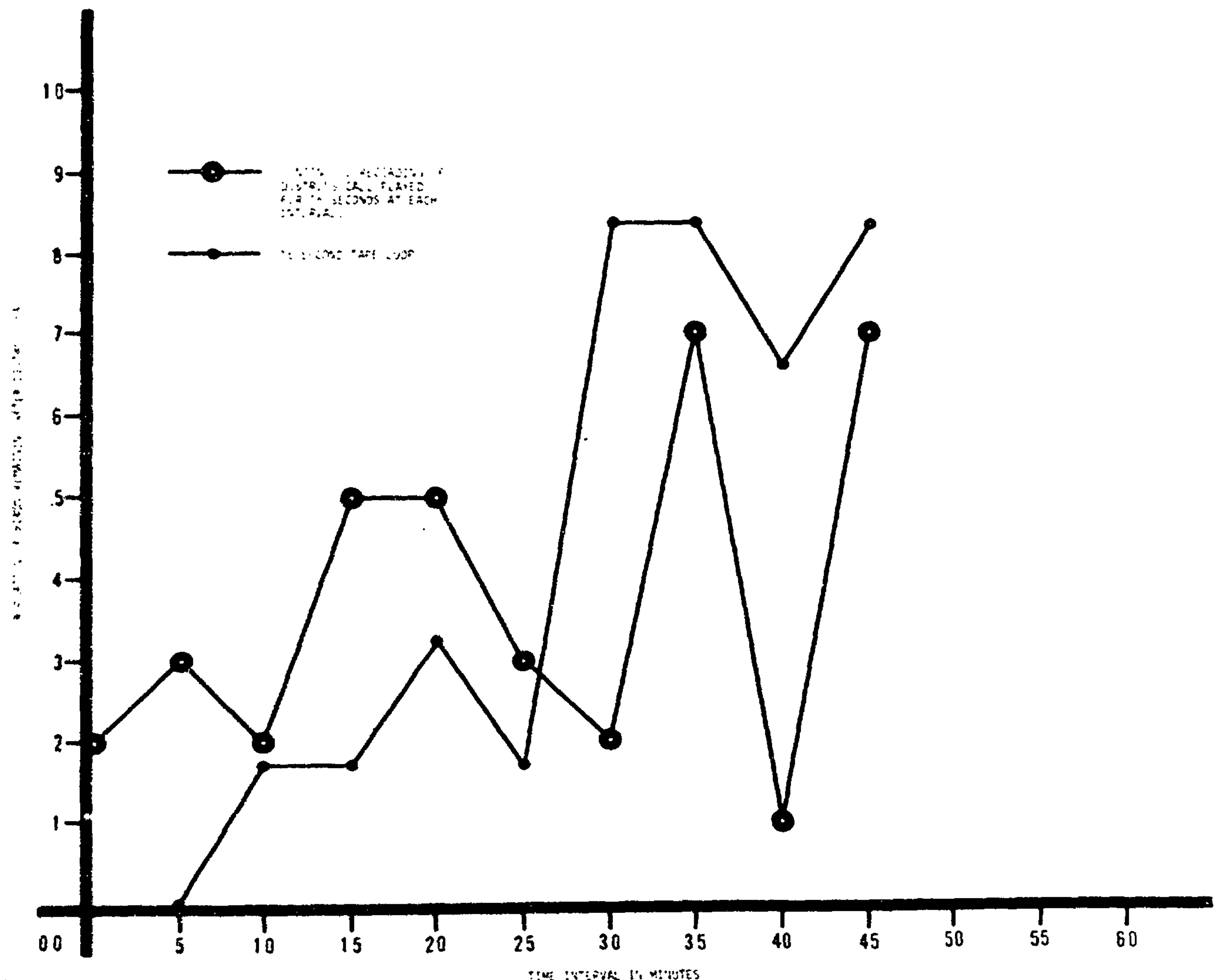

Figure III. Proportion of birds remaining after the Distress call is played.

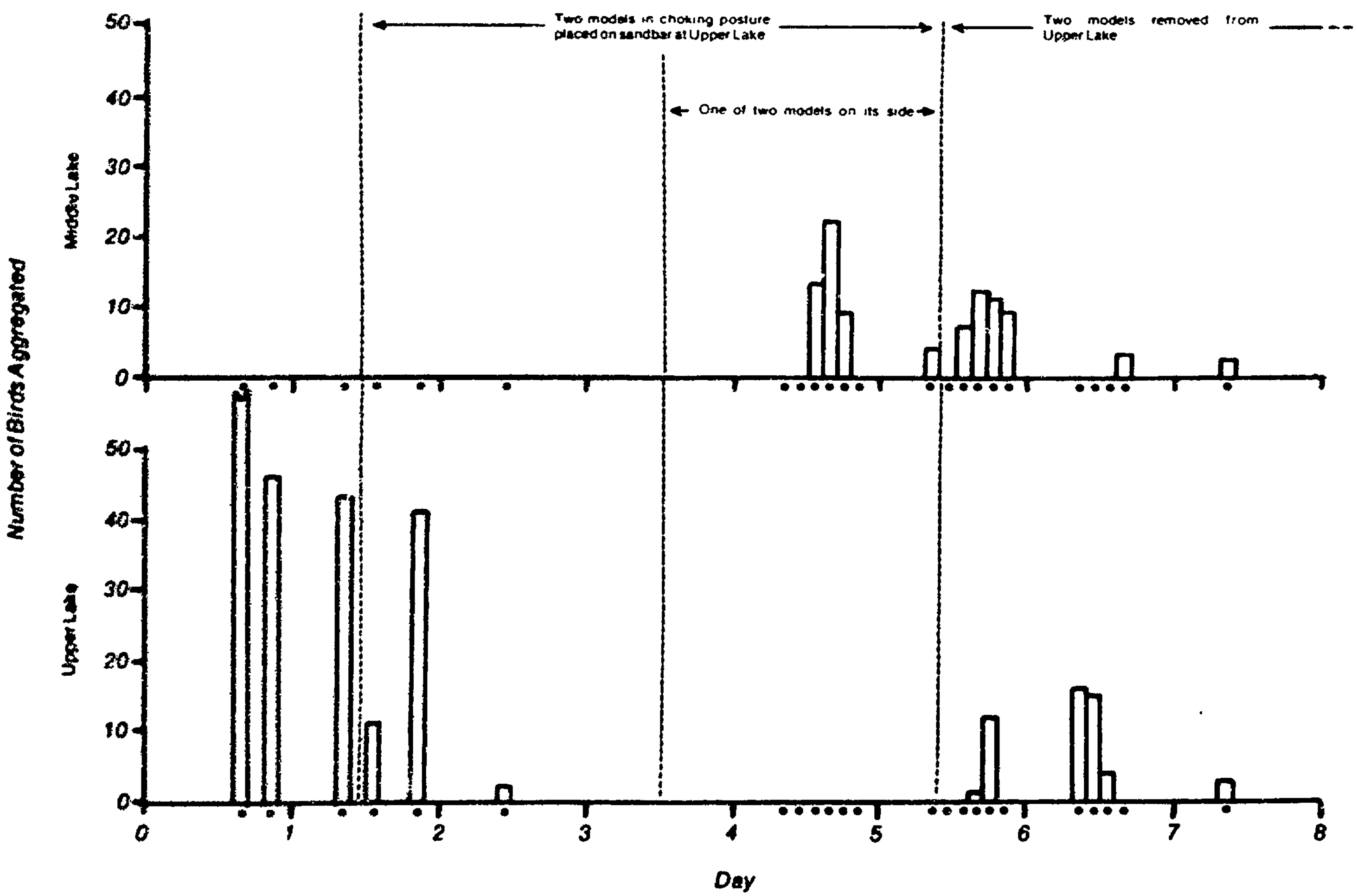

Figure IV. Comparison of aggregations of the Glaucous-winged Gull (Larus glaucescens) on the Upper and Middle Lakes, Shemya Island, in response to two static models placed on a sandbar of the Upper Lake. The dots (.) below the x-axes denote times of observation.

Table V summarizes the results of experiments with models on the dispersal of Ring-billed Gulls from the vicinity of the Pasadena Sanitary Landfill. The models in the upright position with wings folded proved least effective in causing gulls to disperse. Gulls readily returned near this model, but always remained 50 feet or so away.

The models on their sides with wings folded were effective in dispersing gulls for long periods of time (as long as eight days). The same was true for the model in the upright with wings outstretched. The effectiveness of this model appeared to be enhanced by wind blowing the primary feathers back and forth.

The typical response of the gulls to the models was similar to that observed to an injured or dying gull. Gulls would initially circle the models, sometimes in a dense mass. This would take place for two or three minutes with the circles becoming larger and larger. The gulls would then completely leave the area.

The control for the model experiments demonstrated that the reaction to the models was not the result of human disturbance as gulls returned almost immediately when disturbed by a human approaching their aggregations without placing gull models at the aggregation site. The experiment testing the effectiveness of models over long periods of time (eight days) indicated that as long as the models were present no gulls returned. Certain limitations were observed with the taxidermy mounted models. After extended periods of field use, the models began to deteriorate due to wet weather and insect infestation.

TABLE V The dispersal effectiveness of models mounted in different positions for Ring-billed Gulls.

NUMBER OF BIRDS	NUMBER OF MODELS	TIME FIRST BIRDS RETURNED	LENGTH OF EXPERIMENT
i. Model upright with wings folded			
400	3	5 min	5 min
325	3	50 min	120 min
255	4	4 min	5 min
170	4	3 min	5 min
ii. Model on its side with wings folded			
125	3	-	200 min
175	3	*1 min	120 min
225	1	-	240 min
350	3	-	120 min
325	3	-	120 min
440	3	-	90 min
365	2	-	90 min
iii. Model upright with wings outstretched			
225	1	-	30 min
1,300	1	-	120 min
250	1	-	120 min
325	1	-	120 min
380	1	-	200 min

*Left after 30 seconds

On one occasion approximately 750 gulls were observed loafing on the airfield at Ellington AFB. This large aggregation consisted of three groups situated at the beginning of runways 35, 17, and also 50 yards north of the center taxiway. Transit Alert attempted to disperse the gulls by driving their truck through aggregations only to find the gulls flew and quickly settled again close by. With the use of models and distress call playback, these gulls were cleared from the aerodrome within five minutes. It was shown that for the models to be effective they must first be visible to the entire flock. Models placed in position on the aerodrome, while gulls were loafing close by, had no effect on dispersal as the models were not sufficiently visible to birds on the ground. It was therefore, necessary to raise the gulls off the ground with the Distress call. The gulls then from the air began to exhibit the typical behavior pattern of flocking over the models and leaving the entire area.

The results of the experiments with paired models are reported in Table VI. When given a choice between a real and an imitation model both in an Upright posture, the Glaucous-winged Gull chose the real model to attack first. The gulls indicate fear in attacking or even approaching the imitation model. In Series 2 the real model was placed in a Choking posture which is more aggressive than the Upright (Ref. 13). Attack was observed most frequently to the imitation model in the Upright posture however, it was not statistically significant. In the reverse situation with the imitation model in the Choking posture and the real model in the Upright (Series 3), attack was observed most frequently to the real model and was statistically significant.

TABLE VI

The results of paired wooden model experiments which compared the initial attacks of territorial *L. glaucescens* on indicated models.

	MODEL TYPE AND POSTURE	NUMBER OF ATTACKS	MODEL TYPE AND POSTURE	NUMBER OF ATTACKS	X^2 VALUE
Series 1	Imitation Model, Upright	2	Real Model, Upright	10	5.33*
Series 2	Imitation Model, Upright	14	Real Model, Choking	6	3.20
Series 3	Imitation Model, Choking	2	Real Model, Upright	12	7.14*
Series 4	Imitation Head and Neck; Real Wings, Upright	8	Real Model, Upright	12	0.80
Series 5	Imitation Model Upright	4	Real Head, Imitation Neck and Wings, Upright	8	1.33

* Significant at the 5 per cent level

Series 4 indicates that real wings had a moderate effect in causing an increase in attack on an imitation model in the Upright. In this series there was no preference in attack for the imitation model or the real model. The experiment in Series 5 comparing two imitation models, one with a real head attached and both in the Upright, showed that the real head had a tendency to increase the number of attacks. It was not, however, significant at the 5 per cent level.

4. DISPERSAL DUE TO MODEL/SOUND EXPERIMENTS

The results of the model/sound experiments are summarized in Table VII. No distinct habituation was observed in these experiments; in fact, in many cases the reverse was found to be true. The imitation model on its side reinforced with the Distress call (Series 8) was demonstrated to have the least proportion of birds remaining after the call. The gulls, however, returned fairly rapidly. In all the experiments involving models reinforced with the Distress calls the gulls that returned would not settle close to the models. In fact in many experiments there seemed as if an invisible fence was placed 5 feet around the model. Series 9 and 12 were the only experiments involving just real models. In these experiments the proportions of birds remaining after the call were the greatest.

The experiment in Series 11 involving a combination of models used with no Distress call was observed to have the shortest time for the first bird to return. The same experiment was repeated in Series 10 except the Distress call was played. It was observed that the mean time for the first bird to return was doubled indicating the effect of the Distress call.

TABLE VII

The results of experiments conducted to show the effect of different model/sound combinations in keeping Glaucous-winged gulls out of their territory.

	EXPERIMENT	MEAN PROPORTION OF BIRDS REMAINING	S.D.	MEAN TIME FIRST BIRD RETURNED	S.D.
Series 8	An Imitation Model on Its Side with Distress Call	.02	.08	21.1 seconds	13.79
Series 9	A Real Model on Its Side with Distress Call	.13	.24	27.0 seconds	17.8
Series 10	A Combination of Models with Distress Call	.12	.17	39.2 seconds	24.4
Series 11	A Combination of Models with No Distress Call	.05	.06	19.4 seconds	9.8
Series 12	Real Whole Mount with Distress Call	.16	.16	39.7 seconds	26.5
Series 13	Imitation Whole Mount with Distress Call	.07	.11	53.0 seconds	27.5

The experiments with the real and imitation whole mounts (Series 12 and 13) were shown to have consistently longer times for the first bird to return. The imitation whole mount with Distress call had not only the longest time for the first bird to return but also had a low proportion of birds remaining.

5. DISPERSAL EXPERIMENTS AT WNAS SANITARY LANDFILL

Table VIII summarizes the results of experiments conducted at the WNAS Sanitary Landfill. Models reinforced with sound proved effective in keeping gulls away from certain areas. When models were placed close to a food source keeping gulls out for a long period of time was difficult. As soon as one gull landed the rest would soon follow. This was observed when both the imitation or the real models were present. In all cases gulls would not stay close to the models but would remain 5 feet or so away. The imitation whole mount was probablv the most effective in preventing gulls from landing. No gulls were observed close to this model. It was noted that all the models must be visible at all times for maximum effectiveness.

The reaction of the gulls to the models was similar to that observed in previous studies. The gulls would initially circle the models with the circles becoming increasingly larger. After two or three minutes the gulls completely left the area. Gulls returning to the landfill would observe the models, fly low over them and land some distance away or in many cases leave the area entirely.

TABLE VIII

The dispersal effectiveness of different models for Glaucous-winged Gulls

NUMBER OF BIRDS	NUMBER OF MODELS	TIME FIRST BIRD RETURNED	LENGTH OF EXPERIMENT
i Imitation Model Lying on Its Side			
50	2	20 minutes*	20 minutes
75	2	---	60 minutes
60	2	---	60 minutes
75	2	35 minutes *	35 minutes
30	2	---	60 minutes
ii Real Model Lying on Its Side			
50	2	20 minutes*	20 minutes
75	2	---	60 minutes
60	2	---	60 minutes
75	2	35 minutes*	35 minutes
30	2	---	60 minutes
iii Imitation Whole Mount			
75	1	---	120 minutes
40	1	---	60 minutes
25	1	---	60 minutes
50	1	---*	60 minutes

* Models were placed close to food source

SECTION IV

DISCUSSION

Wind direction and tide fluctuation appeared to have a major influence on distribution of aggregations of the Glaucous-winged Gull (Larus glaucescens) on Shemya Island. The data indicate that these birds normally criented to the leeward side of the island. However, during periods of especially low tides, the exposure of feeding areas caused the birds to spread to windward areas where food was readily available. Since such low tides are not a daily occurrence on Shemya, predation by gulls on the south coast invertebrate fauna was probable less than on the north coast fauna. Thus one would have expected to find a greater abundance of food along the south coast explaining the greater number of birds in that area during exceptionally low tides.

On 22 August when strong south winds were recorded, minus tides were also experienced. However, only one bird was found along the south coast, whereas hundreds of birds were counted along the north coast. Apparently minus tides do not influence the distribution of gulls during exceptionally strong winds.

The active runway on Shemya is positioned parallel with the south coast of the island. Thus, we predicted that the occurrence of gulls on the runway was correllated with tidal conditions, the birds being most prevalent at exceptionally low tides provided that winds are not from the south and strong. We observed that gulls often dropped green sea urchins

(_Strongylocentrotus drobochiensis_) on the runway pavement to break them open for feeding. We also noticed that gulls often loafed about a small depression in the pavement where water collected. Our observations indicated that shallow freshwater bodies such as this one were used by gulls for drinking and washing, probably after feeding.

Aggregations of gulls were frequently seen at places other than along the coastline and on the runways. A dump located at the north side of the island usually contained a sizeable aggregation. Birds at the dump fed on garbage which was sometimes left exposed. Even when no garbage was available birds could usually be found in the area resting along the embankment above the dump or in the dump itself. The dump is located about 1.5 miles from the main runway and on the opposite side of the island. The dump probably has no direct influence on the frequency of birds on the active runway. However, this site does provide an unnatural source of food for the birds, thus providing an added attraction on the island for gulls.

A moderate size aggregation could usually be found outside the non-commissioned officer's club where food was thrown to the birds. The club is located about one mile from the runway, and like the dump, increases the amount of food available to gulls, but probably has no direct influence on the runway problem.

The Upper Lake attracted large numbers of gulls. However, the lake usually served as only a temporary habitat for the birds. Gulls were almost continually flying to or from the lake. Aggregations at other locations were much more stable and usually less active than those on the lake. Shallow water along the west lake shore provided the birds with an ideal area for washing and drinking. Most birds at the lake were engaged in one of these activities. We noted that the Upper Lake was used by the gulls to the exclusion of other freshwater lakes of similar size located nearby. The birds obviously favored the shallow water sand bar of the Upper Lake as the other lakes had no such shallow water.

The relatively large number of juvenile gulls and the presence of newly-fledged young led us to conclude that gulls were breeding nearby. We found no evidence of nesting gulls on Shemya Island itself. However, on Hammerhead Island, a small island approximately one helf mile west of Shemya the occurrence of aggressive interactions between individual birds made us believe that territories were being defended by nesting gulls on Hammerhead Island. Unfortunately, we had no means of transportation to Hammerhead and our observations had to be made through binoculars. The distance between the two islands was too great to make detailed observations.

Wooten et al. (Ref. 10) reported that no gulls roosted on Shemya Island during the night. It was suggested that the birds used Hammerhead Island as a roost. However, we counted large numbers of gulls resting and sleeping along the shore and abandoned runway areas after dark several times. The study of Wooten et al. was made between 24 September and 5 October 1971. It is possible that at that late date territories on Hammerhead had broken down and non-nesting birds were allowed to roost.

Within a ten mile radius from Ellington AFB, large flocks of Ring-billed Gulls (Larus delawarensis) winter during the late fall and winter months. The population was estimated at more than 5,000 birds.

The majority of gulls were found northwest and northeast of Ellington at the Pasadena Sanitary Landfill and San Jacinto Bay/Peggy Lake area.

During the mid-morning and late afternoon large numbers of gulls flew between the San Jacinto Bay/Peggy Lake area and the Pasadena City Landfill. The landfill is located only two miles northwest from Ellington and was responsible for attracting large numbers of gulls into the immediate area. The weather was found to have a major effect on the number of gulls observed at the landfill. On foggy days no gulls were observed until the fog began to lift. A typical behavior of gulls at the landfill was to circle and glide on air currents around the area. The elevation achieved while soaring ranged from 500 to 2000 feet. This behavior presents a serious hazard to aircraft flying over the landfill at low altitude which might result from a runway misapproach.

Ring-billed Gulls were attracted to the Ellington Airfield during periods of severe wet weather. The soil in the fields surrounding the taxiways and runways is heavy, containing clays that do not allow rapid percolation. As a result frequent wet areas are present after a rain storm. These areas were found to attract gulls which either loaf or feed on soil organisms driven to the surface by the moisture.

The short vegetation and wide open space of the aerodrome environment was also an attractant to gulls. Many species of gulls and shore birds find security in open spaces and roost and rest in exposed places with good all around visibility (Ref. 14). As cited by Boulter (Ref. 11) long grass is not permissible for fear the area may become repopulated with Attwater's Prairie Chickens (<u>Tympanuchus cupido attwateri</u>) which were once present. Long grass also provides cover for small mammals and thus may cause an increase in predatory birds. It is therefore advisable to keep the grass in the middle of the two extremes. A recommended length would be between 5 and 8 inches.

No differences were observed by Wooten et al. (Ref. 10) in the responses of Glaucous-winged Gulls on Shemya Island to the Distress and Alarm calls. They concluded that either one of these calls would be effective for dispersing gulls from runways. We likewise found that each of the five recorded calls and any sudden loud sound were at least somewhat effective in gull dispersal. Differences in responses to the various calls were apparent, however, so we attempted to test each call individually to determine which call was most effective.

At times only one or a few birds flew at the beginning of sound playback, while the majority of birds remained to fly several seconds later. At other times entire aggregations flew off in unison. Still other times, most of the birds flew away and a small number of "stubborn" individuals remained after the 15 second playback. Such variableness of response made it difficult to measure the effectiveness of the calls in terms of movement of the birds away from the area. It proved more efficient to compare the numbers of birds remaining following call playback and the number of times birds returned before two minutes.

Significant differences were shown between the effects of the Distress call and the Trumpet and Choke calls. Call playback to Glaucous-winged gulls in a Washington breeding colony by Stout et al. (Ref. 15) showed that playback of the trumpet call reduced the latency with which defending birds attached stuffed gulls mounted in the Trumpet posture and placed within defender territories. Thus, it appeared that the Trumpet call does not repel other birds, but may actually increase their readiness to attack (approach).

Similar experiments involving playback of the Choke call resulted in an inhibition of attack to Choke models (Ref. 15). Thus we might have expected that playback of the Choke call would be quite effective for dispersal. The fact that Choke is used almost exclusively within breeding territories, however, may explain why this call was so ineffective. We noted that when the Choke call was played back there was general confusion among the birds. Some birds flew up and then landed again and others milled about the area in a confused, disoriented manner.

Playback of the Mew and Alarm calls to aggregation did not result in significantly more birds remaining than playback of the Distress call. Experiments by Stout et al. (Ref. 15) showed that playback of Mew and Alarm calls inhibited attacks on models placed within territories of defending birds. Since both the Mew and Alarm calls are frequently used outside of breeding territories they would be expected to be more effective in dispersal. The Alarm call resulted in fewer birds remaining than did the Mew call. This was to be expected since the Alarm call is used by gulls to advertise the presence of a predator or other disturbance whereas the Mew call is used in calling chicks, defending territories and during courtship responses (Ref. 15).

The Distress call resulted in a lower mean percentage of birds remaining following call playback than did the other four calls. In response to the Distress call the gulls often flew toward the loud-speaker and circled above for several seconds then flew completely away from the area. Other times the birds just flew away without first flying towards the source of the call. Responses of Ring-billed Gulls to their Distress call near Ellington AFB were similar to those shown by the Glaucous-winged Gulls at Shemya AFB, and at Whidbey Naval Air Station.

It appeared, then, that the Distress call was the most effective sound used to disperse aggregations of gulls. Additional work needs to be done to determine if some sequential playback of the Distress and Alarm calls or some other combination of calls would be more effective than the use of the Distress call alone.

The Distress call is a more variable sound than other calls used by gulls. A variety of moan-like sounds interspersed with higher frequency, more intense shrieks is typical of this call. The gulls seemed more responsive to the intense, high frequency shrieks than to other segments of the call. A recording of only these high intensity shrieks should be made and tested to see if it would be more effective in dispersal than the natural, more variable recording.

It was surprising that no differences were shown among the calls with respect to the number of times birds returned before 2 minutes at Shemya AFB. It is possible that Distress calls played back for a longer duration would result in birds returning fewer times. This needs to be tested. Also, the number of birds returning within a specific time interval should be found for the various calls.

There was no correlation between the sound levels of the five recorded calls and their effectiveness in dispersal. For example, Trumpet had the highest sound level (110-115 dB) but it was the least effective call in dispersal. Alarm was the second most effective call though it had the lowest sound level (85-90 dB). Thus, quite clearly, it was the calls themselves and not their sound levels which were most significant in determining their effectiveness.

The fact that at Shemya Island birds in natural shore environments were more resistant to dispersal and return more frequently than birds on runways is significant to the bird hazard problems airports face. Birds loafing on runways and nearby areas would likely be more resistant to dispersal if these areas contained natural attractants such as shallow water or food.

Wooten et al. (Ref. 10) reported that no habituation occurred to Distress and Alarm calls played back to gulls on Shemya Island. Similarly, the birds did not habituate noticeably to approximately 120 playbacks of recorded Distress calls during our work. This may have been due to the fact that we did not usually play the calls for longer than 15-20 seconds per experiment. Longer playbacks may have resulted in habituation. Likewise, habituation to the other four calls was not observed. Our results are in contrast, however, with results obtained by Brown (Ref. 16) who observed rapid habituation to Distress calls played back to Black-headed Gulls (Larus ridibundus) in England.

The possibility that habituation could eventually occur to Distress calls and the fact that these calls did not result in a permanent dispersal of gulls caused us to examine the results of the preliminary experiments with static models at Shemya AFB with interest. Apparently, the gulls perceived the model on its side as a dead or injured gull and would not land in the area. Saul (Ref. 4) reported that crucified corpses of gulls tested at the Aukland International Airport, New Zealand, elicited similar responses from Black-headed Gulls (Larus dominicanus) and Red-billed Gulls (Larus novaehollandiae scopulinus).

The experiments conducted at the Pasadena City Landfill near Ellington AFB showed that models were definitely useful in dispersing gulls. Significantly, gull models mounted in an upright position with wings folded were not effective in dispersal. However, the models lying on their sides or upright with wings outstretched provided a stimulus that would disperse gulls. It was also significant that before a large aggregation of gulls on the ground would respond to the models placed on the airfield at Ellington AFB, they first had to be stimulated with the Distress call so that they could see the models from the air. This demonstrated the possibility that a combination of the Distress call played back with models may provide a more effective stimulus for dispersal than can be achieved using the Distress call or models alone.

However, the models were quickly deformed by the weather so tests were made with fiberglass as a molding agent. The addition of movement and/or sound to the models might further increase their effectiveness.

From our previous experiments and observations on Shemya AFB and Ellington AFB we followed with experiments using imitation fiberglass models. The paired comparison model experiments gave insight to the potential effectiveness of imitation models used in ridding aerodromes of gulls. When given a choice of an imitation model and a real model both in the Upright posture (Table VI, Series 1), the gulls first attacked the real model. The real model appeared less threatening. A possible explanation for this could be because the imitation heads were molded in an Aggressive Upright, more so than the taxidermy mounted real heads which were not perfectly errect. Table VI, Series 2 showed that the imitation model in the Upright posture was attacked more often than the real model in the Choking posture. It was suggested by Galusha and Stout (Ref. 13) that aggressive tendencies during displays are communicated by head postion, that is the lower the head the more aggressive the bird. The number of times attack was observed on the imitation model, however, was not statistically significant. There appeared still some reservations toward the imitation model. When the experiment was reversed (Series 3) with the imitation model placed in the Choking posture and the real model placed in the Upright posture, attack was observed a significantly greater number of times on the real model in the Upright posture. This series of experiments again indicates the preference of the gulls to attack the less aggresive bird first and shows their apprehension towards the imitation model. Series 4 showed that if real wings were attached to a model with an imitation head and neck the tendency for the model to receive an initial attack was much greater. A real head attached to an imitation fiberglass neck (Series 5) was also shown to increase the tendency to attack.

The gulls reacted to both types of models as intruders in their territory. They appeared to be more fearful of the imitation model, often quacking and walking around the model. The behavior pattern given to the imitation model might prove it to be a more effective stimulus in gull dispersal than the real model.

Habituation to the Distress call was observed to take place rapidly inside a gull colony (Figure III). A similar observation was made by Brown (Ref. 16) who experimented with the Distress call immediately outside a colony. In the non-colony situation, experiments made on Shemya AFB and Ellington AFB, indicated no noticeable habituation to the Distress call. It must therefore be important to distinguish between breeding birds in a colony and non-breeding gulls when predicting the effectiveness of the Distress call in gull dispersal. Habituation was observed to be not as apparent in the colony when the calls were varied as with the continuous recording (Series 7). This series of experiments showed that a combination of different calls inhibits habituation thereby improving its long term dispersal effectiveness.

A colony is an ideal place to conduct experiments with habituation as it occurs rapidly and techniques that are effective in a colony will be increasingly effective outside a colony. This is because gulls in a breeding colony defend their territories from intruding conspecifics during the breeding season and, consequently, are highly site-tenacious. It is important however to conduct such experiments when the majority of chicks have fledged, this way harmful disturbances are extremely small.

Models associated with Distress call were observed to have no noticeable habituation in the colony (Table VII). Upon hearing the Distress call the gulls would fly up and begin circling the models. The flight of most birds was not long and return to their territories took place rapidly. When the model or models were sighted by the gulls whose territory the models were in, the gulls would frequently continue circling periodically flying low over the model. When the gulls finally landed the birds would remain at the edge of the territory away from the models. In many cases it was as if an invisible fence was placed around the models 5 feet in diameter. The Distress call used with the model was always the same 15 second call. This same call, when used with no model was habituated too rapidly as cited above. It was apparent that the gulls must associate the Distress call with the model causing the absence of habituation.

The imitation model on its side with the Distress call was the most effective model/sound experiment causing the least proportion of birds remaining after the experiment (Table VII, Series 8). It was interesting to note that the gulls returned rapidly following theis experiment. The imitation model alone was not successful in keeping the gull away. It must be that from the air the gulls were not as threatened by the model. In Series 10, a combination of models which included both the real and imitation models placed side by side showed that the mean time for the first bird to return was greatly increased. In fact, Series 10 had the longest time for the first bird to return in all the wooden body model experiments. Without the Distress call (Series 11) the combination models had very short time for the birst bird to return. This again indicates the importance of using the Distress call with models for maximum effectiveness.

Experiments were also conducted in a non-colony situation at the WNAS Sanitary Landfill (Table VIII). All the models were found to be effective in dispersal. It was noted however, that when large quantities of food were present the gulls would overcome the fear of the models and land close by. In no instances did the gulls stay close to the models but would always stay 5 or 6 feet away. In all cases of gulls returning, a single gull first took the initiative and landed, followed soon by others. A second burst of the Distress call however, would rapidly cause the birds to leave again. With the imitation whole mount no gulls were observed to return near the location of the model. The imitation whole mount was the most effective model used in conjunction with the Distress call to cause gull dispersal.

The results presented in this paper clearly indicate that imitation model gulls have been developed that are effective in gull dispersal. It was shown that there is a definite model sound association that substantiates the added effectiveness of having both sound and visual stimuli. Use of models may achieve a permanent dispersal of gulls from critical areas.

In addition to the Glaucous-winged gull, a number of other bird species were observed on Shemya Island and can be considered minor hazards to aircraft. Two Common Loons (Gavia immer) were observed at the Lower Lake and Merganser (Mergus sp.) was seen at the Upper Lake. Red-faced Cormorants (Phalacrocorax urile) were common on the offshore rocks around the island. Common Eiders (Somateria mollissima) and White-winged Scoters (Melanitta deglandi) were common in offshore waters. A Peregrine Falcon (Falco peregrinus) was seen a number of times flying above the island, twice close to the flight-line. American Golden Plovers (Pluvialis dominica) and Ruddy Turnstones (Arenaria interpres) fed along the beaches. A number of Whimbrel (Numenius phaeopus) were seen in grassy areas. Arctic Terns (Sterna paradisaea) were observed feeding at the Upper Lake. Horned Puffins (Fratercula corniculata) and Tufted Puffins (Lunda cirrhata) were seen along the north coast of Shemya Island and on Hammerhead Island. Common Ravens (Corvus corax) were common at the dump and were also seen flying close to the flight-line. Song Sparrows (Melospiza melodia), Lapland Longspurs (Calcarius lapponicus), and Snow Buntings (Plectrophenax nivalis) were common in grassy areas throughout the island.

Wooten et al. (Ref. 10) reported seeing Stellar's Eiders (*Polysticta stelleri*), Surf Scoters (*Melanitta perspicillata*), Harlequin Ducks (*Histrionicus histrionicus*), a Glaucous Gull (*Larus hyperboreus*), a Rock Sandpiper (*Erolia ptilocnemis*), Northern Phalarope (*Lobipes lobatus*), Pintail (*Anas acuta*), and Fox Sparrows (*Passerella iliaca*) in addition to several species we listed. Obviously the avian faunal composition would vary throughout the year.

At Ellington we also observed a number of species considered minor potential hazards to aircraft. These included the Killdeer (*Charadrius vociferus*) which were common in open flat areas with short vegetation. Meadow Larks (*Sturnella magna*) were also common in fields surrounding runways. Marsh Hawks (*Circus cyaneus*) and Sparrow Hawks (*Falco sparverius*) were often observed singly hovering over the aerodrome. The following were observed in areas surrounding the airfield: Boat-tailed Grackel (*Cassidix mexicanus*), Brewer's Blackbird (*Euphagus cyanocephalus*), Mockingbird (*Mimus polyglotta*), Loggerhead Shrike (*Lanius ludovicianus*), Eastern Robin (*Turdus migratorius*), Savannah Sparrow (*Passerculus sandwichenisis*), House Sparrow (*Passer domesticus*), Starling (*Sturnus vulgaris*), and Cattle Egret (*Bubulcus ibis*).

SECTION V

SUMMARY AND CONCLUSIONS

This paper reports on research which evaluated the usefulness of certain accoustical and visual stimuli for the dispersal of gulls from aerodromes. The work reported was done at Shemya AFB, Alaska, Ellington AFB, Texas, Whidbey NAS, Washington and in breeding colonies of gulls along the coast of Washington. Environmental factors contributing to the gull hazard problem at Shemya AFB and Ellington AFB were also considered.

The following information was obtained during this study:

1. The distributions of gulls at Shemya AFB and Ellington AFB were highly influenced by environmental factors such as time of day, level of the tides, wind velocity and direction, fog, food availability (at Sanitary Landfill sites) and shallow bodies of fresh water. Based on these observations it would be possible to predict the times at which gulls are most hazardous to incoming or outgoing aircraft. There is insufficient data at this time, however, to make precise predictions possible.
2. Of the five calls played back to aggregations of gulls at Shemya AFB, the Distress call was most effective for dispersal. This call was also effective when played to gulls near Ellington AFB. However, habituation to the Distress call by nesting birds in the Washington colony was noted.
3. Experiments using taxidermically prepared models of real gulls showed that models positioned in the Upright Posture (as if standing) were not effective in dispersing gulls. However, if the same models were placed on their sides (as if dead) they were effective in keeping gulls away from

the area for as long as eight days. A similar response was obtained when a model was placed in the Upright Posture but with the wings spread out.

4. The taxidermically mounted gulls after extended periods of use began to deteriorate due to the wet weather and insect infestation. Consequently, fiberglass imitation gulls were designed which were responded to in nearly the same way as the taxidermically mounted models and the fiberglass models were resistant to adverse weather conditions. A fiberglass model of a dead gull with its wings outstretched was the most effective visual stimulus for dispersal of gulls.

5. A combination of the Distress call with the models was the most effective procedure for dispersing gulls. We found that for the models to be effective in dispersal they first had to be seen by all the gulls in a given area. This was achieved by playing the Distress call which caused the gulls to fly up in unison. Once in the air the gulls were able to see the models on the ground below. Apparently they perceived the models as dead or dying comrades and so fled the area.

6. Gulls were especially difficult to disperse when food was available (such as at sanitary landfills). The combination of Distress call playback with the models was only partially successful in dispersing gulls at these locations.

SECTION VI

RECOMMENDATIONS

The results of our work clearly indicated that playback of the Distress call reenforced by the model gulls was effective in dispersing aggregations of gulls. However, our work to this point has been of an experimental nature. The applicability and success of the methods we have described still need to be tested over a long term at a USAF Base experiencing problems. If method still proves to be successful after intensive long-term testing, then it is recommended that:

1. Methods be devised for the mass production of life-like model gulls out of a resistent material like fiberglass. The Distress calls are already available on tape from the Denver Wildlife Research Center.

2. Trained personnel be sent to implement control programs at any USAF bases experiencing gull hazard problems. Local base personnel could be instructed in how to most effectively use the techniques.

3. A brief, well-illustrated manual could be written to provide base personnel with step-by-step instructions on how to implement the program at their base. Manuals could be left at each base following the initial instruction program to insure proper on-going administration of the procedures.

In addition to the above recommendations it is suggested that further research be done to develop techniques useful in predicting those times at which gull hazards are expected to be greatest much in the same way a meteorologist predicts hazardous weather. Such a predictive capability could greatly strengthen the control program by providing it with forewarning of those times needing special vigilence. Such predictive capabilities are fully within the realm of possibility.

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