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BEHAVIORAL CONTROL OF SEAGULLS AT LANGLEY AIR FORCE BASE

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INTRODUCTION

Sea gulls *(Laridae)* of various species are more frequently reported in bird-aircraft collisions than any other group of birds. Various sources (Thorpe, 1976; Salter, 1976; Blokpoel, 1976) report that gulls were involved in 40 to 60% of all bird strikes for both civilian and military aircraft. A majority of these incidents occurred during landing or takeoff in the immediate vicinity of the airport. Thus, reducing the number of gulls in operationally critical areas of the airport is an important goal for flight safety management.

Sea gulls at Langley Air Force Base (Harrison and Godsey, 1976) and other airports (Blokpoel, 1976) seek loafing areas which are visually unobstructed. The extensive pavement around airport runways provides large areas where gulls can loaf with a clear view of surrounding areas. Shallow pools of freshwater, found around poorly drained airports after a rainstorm, provide additional strong attractants. Food sources, such as organic refuse, insects, worms or other soil organisms provide even stronger attractants to gulls.

Procedures that reduce the attractiveness of airports to gulls and other birds have been reviewed extensively in other sources (e.g. Blokpoel, 1976; Wright, 1968). It has been generally noted (Saul, 1967; Stout et al., 1975) that gulls can be more easily dispersed from sites that have been made less attractive. Stout et al. (1975) observed that gulls were more difficult to disperse from natural sites where the gull's site tenacity was greater. For example, gulls which were dispersed from their reproductive territories by playing back distress calls returned almost immediately, and habituated very rapidly to repetitions of the call. Gulls along the seashore were more difficult to disperse than those that loafed along a runway less than 100 yards from the seashore. Gulls actively feeding at a dump were also more difficult to disperse than those that loafed in large, flat areas several hundred feet from the organic refuse source. All dispersal procedures for sea gulls are less successful in areas where environmental and/or behavioral factors increase the gulls' site tenacity.

Procedures commonly used for dispersal of gulls include playback of their distress calls, use of pyrotechnics such as shell crackers, falcons or flying models of falcons, and other forms of harassment (Blokpoel, 1976). These procedures are only effective on a short-term basis. Gulls readily return to the sites of dispersal as nothing remains at the site after dispersing the gulls to keep them from returning.

Saul (1976) described the use of formalin-preserved gull corpses nailed with wings outstretched to a board. When these corpses were placed in habitual loafing areas of southern black-backed gulls and red-billed gulls, the gulls did not return. The corpses retained effectiveness for as long as three months (or until they began to deteriorate). Dejong and Blokpoel (1966) reported less effective results with deploying stuffed gulls in Holland. They found that if the stuffed gulls were not moved frequently, or became water-soaked, they rapidly lost their effectiveness. Stout, et al. (1975) reported on experiments evaluating the effectiveness of stuffed gull models and plastic gull models in dispersing gulls from runways and other loafing areas, feeding areas and in the colony. They showed that models would prevent the return of gulls to loafing areas where the models were placed for as long as the models were deployed (up to eight days). Gulls returned to the sites of model deployment within a few hours of model removal.

Visual characteristics of the gull models that were effective in causing dispersal were also evaluated by Stout, et al. (1975). A model that was in an upright position was ineffective. The same model, placed on its side was completely effective in dispersing the gulls. In preparing plastic models of the gulls, it was found that the visual features had to be almost perfect replicas of the three dimensional appearance of a gull. Early attempts that duplicated the shape of the gulls, but lacked some visual details, were ineffective. The fiberglass models that we are now using have the appearance of a gull that died and dropped to the ground.

GULLS AND GULL ATTRACTANTS AT LANGLEY AIR FORCE BASE

Langley Air Force Base is surrounded on three sides by water and the shoreline of the Back River's junction with the Chesapeake Bay. Additional major attractants included the Hampton city landfill, 8000 feet west of the airbase, and the Williams' landfill along the southwestern boundary of the base. Edible arthropods (isopods and insects), worms and other grass-living or soil-living organisms provided additional attractants.

Gulls were observed picking up and eating isopods (sow bugs) that were crawling on the concrete on several different occasions. Each of these sightings occurred several hours after a rain when the concrete was damp in areas, and contained a few puddles of standing water. Gulls were observed feeding on grasshoppers over large areas of the airport, leading to a gull strike in one instance.

Both the Hampton city landfill and Williams' landfill offer excellent feeding and loafing areas near water. Less than a third of the birds at these areas at any given time were scavenging and feeding. The attractiveness of these two sites to gulls is shown by the large numbers to be found there.

Estimates made at the Hampton landfill during the wintering season indicated three to seven thousand sea gulls feeding and loafing daily. The Williams' landfill, which is much smaller, attracts fewer gulls because of the lower volume of edibles dumped. Counts made there on different days varied from 75 to 500 sea gulls.

Species composition of wintering gulls at the Hampton landfill was roughly 50% herring gull *(Larus argentatus),* 45% ring-billed gull *(Larus delawarensis),* and 5% greater black-backed (*Larus marinus*) and laughing gulls (*Larus attracilla*). This mixture appears to be average except on the base and Williams landfill where very few greater black-backed or laughing gulls were seen during the winter. The winter proportion of ring-billed gulls on the base increased to 50-55% with herring gulls comprising the balance. Summer flocks of gulls both at the Hampton landfill, Williams landfill and on the base were made up almost exclusively of laughing gulls with a few immature herring and ring-billed gulls.

EVALUATION OF THE GULL HAZARD AT LANGLEY AIR FORCE BASE

Methods

Since January of 1977 a Daily Bird Survey has been made. This survey noted the location and estimated size of bird aggregations along with species of bird, date, time, weather conditions, dispersal procedures carried out, and results of dispersal. These data were encoded, and entered into a computer. Most of the following figures were plotted on a graphics terminal from these data.

Results

These surveys provide a composite picture of sites on the runways and taxiways used by loafing gull aggregations from 1 January 1977 to 31 August 1979 (Fig. 1). Groups of loafing gulls were most frequently located near the ends of runways and taxiways, or near intersections. Sites on the west end of the airbase were most frequently used by gulls for loafing. These included taxiway 8, the intersection of runway 07 with taxiway 8 and immediately adjacent areas, and the intersection of runway 07 with taxiway 7 including adjacent areas of the runway and taxiway. In the eastern half, aggregations were primarily concentrated at the ends of runways 17,25 and 35 and adjacent taxiways. The west end of the main runway, which was the most frequent site for aggregations, was also the area that represented the greatest hazard to aircraft during landing and taking off. Probable cause for the frequent occurrence of gull aggregations at this end was the location of the Williams' landfill about 1,000 feet due south of taxiway 8.

Several hours of observation spent studying gull movements into and out of the landfill revealed birds flying from the dump and landing on nearby runways. This was especially true of birds congregating early in the morning. On three mornings, when these observations were made, initial west end aggregations and one or two subsequent aggregations were formed primarily or entirely of gulls flying over from the landfill.

Upon dispersal, many of the west end aggregations flew south, or directly to the dump. Some aggregations split up when dispersed and the birds left multidirectionally. Usually a majority of the birds would fly to the Williams' landfill. We analyzed dispersal flight direction by dividing the airport into four equal sections along runway 07-25 and totaling the number of dispersal flights at 45 degree compass directions for each section of the airport. A composite diagram showing the dispersal flight direction chosen by flocks of gulls reveals that approximately 70% of the aggregations formed on the west end of the airfield dispersed to the south and were usually observed entering the landfill (Fig. 2). The remaining west end aggregations flew primarily north or northeast with a few dispersing west or northwest.

Dispersal flight direction in the next area east snowed the strongest component south (40%) with southeast following in frequency. The gulls flying south frequently shifted to the southwest and flew to the dump, thus increasing that component considerably.

The next area east also showed a strong southwest dispersal flight direction. North, east, and northeast flight directions frequently took the gulls toward the Back River.

The predominant return of the birds on the west half of Langley Air Force Base toward the Williams' landfill strongly implicated the landfill as the primary attractant for gulls on the west half of the airport. Apparently the landfill was a much less important influence on gulls in the east half of the base, as gulls dispersed toward the landfill less frequently. This suggests that east half and west half gulls come from different source groups, namely the landfill and the Back River, respectively.

The length of each flight vector in Fig. 2 expresses the percentage of all gull flights from all areas of the airbase, that flew in the indicated direction from that area of the airport. Thus, the greatly predominant source and returning point of gulls from the whole base from January through December of 1977 was the Williams' landfill.

The daily incidence of gulls at the landfill and their return to the landfill from the runways strongly suggested the presence of a resident population of gulls. The gulls did not remain in the landfill at night. However, gulls were in the landfill at dusk and dawn. Apparently, the same gulls were returning to the area on a daily basis. Aggregations composed of gulls from Williams' landfill frequently attracted gulls flying overhead from the direction of the Hampton landfill, which then joined them in loafing on the air base, thus amplifying the inherent dangers of a resident population. The presence of a resident population also implies the same birds will loaf on the runways repeatedly, and receive a concentrated exposure to the dispersal inducing stimuli. This may decrease their responsiveness to dispersal procedures.

In July of 1978, dumping of organic refuse in the Williams' landfill was discontinued. The importance of the Williams' landfill as a primary gull attractant was made more apparent by the change in dispersal flight directions after the dump was closed to organic refuse. In the period August to October, 1978, although organic refuse was no longer being dumped in Williams' landfill, the same groups of laughing gulls that had fed in the dump into July were present until the October migration. Flight directions (Fig. 3A) from the west end of the airport were still very predominantly southward, back to the landfill. The next two sections eastward showed very strong southwestern dispersal flight orientation back to the landfill. Apparently a group of laughing gulls continued to use the landfill as an area for congregating after organic refuse was no longer dumped in the landfill. After October, the arriving ring-billed and herring gulls, and in the spring the arriving laughing gulls dispersed back to the landfill only infrequently (Fig. 3B) on the west end. The primary dispersal directions ranged between northeast and northwest with due north the most frequent dispersal direction across the complete airbase. This demonstrated that after the elimination of organic refuse from the Williams' landfill, the gulls developed a new pattern of movements between the golf course, the Back River, other attractive areas to the north, and the runways.

The importance of the Williams' landfill as a gull attractant is further emphasized by comparing the numbers of gulls loafing monthly on the west half of the airbase near the landfill with those on the east half. Organic refuse was first dumped in August of 1977 and was continued until July 1978. The immediate predominance of gulls on the west end is very evident (Fig. 4) in the months of August through November 1977. The difference is less pronounced from December 1977 through June 1978. In July 1978 the gulls again showed a marked predominance on the west end. From August 1978 onward, after dumping of organic refuse was prohibited, the numbers of gulls on the east and west halves were approximately equal.

The number of monthly aggregations of gulls at Langley A.F.B. showed consistent lows in the months of June and September (Fig. 5). Lows also occurred in February and/or March. The greatest numbers were usually encountered in July, August, and October through January. Laughing gulls migrate to, and herring and ring-billed gulls migrate away from, Langley A.F.B. in February-March. Laughing gulls breed in May to June. Laughing gulls migrate away from, and herring and ring-billed gulls to Langley A.F.B. in September-October. The low points in the incidence of gulls at Langley A.F.B. correlate with the migration and nesting periods.

Gull aggregations were generally much more frequent at Langley A.F.B. before 0900 (Fig. 7A). Through the rest of the day (Fig. 7B-D) gull incidence was much lower, with somewhat more gulls observed between 0900 and 1200.

Weather had different effects on the two populations of gulls present at Langley A.F.B. Laughing gulls were most common when ground conditions were dry during the months of May through October whether the skies were overcast or clear (Fig. 8A). Conversely, herring gulls and ring-billed gulls were most common between October and March when ground conditions were wet, especially if it was actively raining (Fig. 8B).

DEPLOYMENT OF 21 MODELS

Methods

Loafing aggregations of gulls in the areas between taxiways 7 and 8 on runway 07 at Langley Air Force Base represented an important hazard to landing and take-off. A model deployment scheme was developed which included 2400 feet of runway 07 and encompassed the intersections with taxiways 7 and 8. This deployment used 21 fiberglass gull models, representing adult herring gulls, ring-billed gulls, and laughing gulls, and was especially designed to reduce the entry of gulls onto runway 07 from taxiways 7 and 8 and keep the full 2400 feet of runway as clear of gulls as possible. The deployment started on 3 January 1979 and terminated on 31 August 1979.

Results

The locations of sites chosen by gulls for loafing at Langley A.F.B. between 1 October 1978 and 31 December 1978 before the models were deployed is shown in Fig. 8. Comparison of Fig. 8A and Fig. 8B, which shows the sites used by gulls for loafing after model deployment, demonstrates a marked reduction in the frequency of gull aggregations in the model deployment area. The model deployment area, which had been the most frequently used region for loafing on the runways before model deployment, became the least frequently used area with an 80% reduction in the incidence of loafing gulls. A comparison of the incidence of gulls loafing on runway 07 and nearby taxiways outside of the deployment area, with the incidence of gulls loafing in the areas where models were deployed, is shown in Fig. 9, both before and after model deployment. It is apparent from Fig. 9 that, after model deployment in January 1979, the incidence of gulls in the model-deployment area, as compared with the surrounding areas, was much lower. Before model deployment there was a ratio of four loafing aggregations on the west end, outside of the area where models were later deployed, to three aggregations within the prospective deployment area. After deployment, there were seven aggregations outside the model area to one aggregation inside of the area.

The model deployment area was the area of runway 07, where gull strikes occurred most frequently in the eight months before model deployment (Fig. 10). In the eight months after model deployment, two gull strikes occurred in the model-protected areas, as compared with nine gull strikes in the eight months before model deployment. Although the number of collisions between gulls and aircraft was "fortunately" small, the differences between gull strikes before and after model deployment indicate that the gull models reduced the incidence of gull strikes. Gull strikes in the remaining 4000 feet of runway 07, outside of the model deployment area, occurred four times in the eight months before model deployment, and four times in the subsequent eight months when gull models were deployed in the adjacent area of runway 07. This similarity in the number of strikes in the two eight-month periods on runway 07 outside the model-protected areas further suggests that the models reduced gull strikes in the deployment area.

DISCUSSION

Two years and nine months of data detailing bird locations and activities have revealed much about the factors attracting gulls to Langley Air Force Base. These data stress the importance of making the airbase environment as unattractive to sea gulls as possible. Three factors, which include the location of the base, availiability of an abundance of food, and physical features of the base, contributed to the attraction of gulls to the vicinity of the runways and taxiways.

The location of Langley Air Force Base, near the Chesapeake Bay and surrounded on three sides by shorelines of the Back River, provided a large, but as yet unestimated, population of gulls in the surroundings. There is little that could be done to reduce the natural attractiveness of this area to gulls. A sizeable population of gulls will remain in the Langley A.F.B. vicinity providing a potential bird-airplane strike hazard. Thus, an effective gull control program will need to be continued.

Environmental features of Langley A.F.B. needing continued attention and/or alteration have been described by Harrison and Godsey (1976). However, the elimination of organisms living in grass or soil should be further stressed. As noted earlier, we found on several occasions that gulls were feeding on organisms, living in the soil or on the grass. In at least one instance when gulls were observed feeding on grasshoppers, a gull-aircraft strike occurred. As any potential food source or food-finding behavior (i.e. the sight of other gulls feeding) is an especially strong gull attractant, measures to control organisms living in grass or soil should be continually practiced.

The most important attractants for gulls in the vicinity of Langley A.F.B. were the two landfill operations. The Hampton city landfill, 8000 feet away from Runway 07, brought 3000-7000 gulls per day into the vicinity. It provided an especially significant hazard, as it is directly on the approach to Runway 07. The high incidence of gull strikes over the Hampton landfill in the months of February and March emphasizes the importance of reducing the number of gulls feeding there on a daily basis.

The Williams' landfill, 1500 feet south of Runway 07, was the major factor influencing bird movement onto the runways and taxiways. Data presented (Figs. 2 and 3) demonstrated that while edible organic wastes were being deposited in the landfill, for the western half of the base, the dump was the major source of gulls flying onto the runways and taxiways, and also the refuge area sought by gulls when dispersed. Our data also demonstrate the presence of a group of gulls residing in the dump on a daily basis. The hazards of developing such a resident population in the area of the base are apparent. The importance of habit in creating such a local population was demonstrated by the fact that during August to October 1978, gulls continued to return to the landfill following dispersal (Fig. 3A), even though organic wastes were no longer being deposited there. After October 1978, following the fall migration, the new group of gulls flew primarily northward away from the dump following dispersal. Elimination of organic wastes at the Williams' landfill also resulted in a more even distribution of gulls across the base and a reduction in the number of gulls coming onto the base. A more exhaustive study of the effects of waste disposal sites on gull movements onto and around Charleston A.F.B. (Forsythe, 1979) showed a clear reduction in gulls and gull strikes when waste disposal sites were consolidated and located in such a way that gulls were not attracted to the immediate vicinity of the airbase.

The data which deal with time and weather correlates of gull movements onto Langley A.F.B. suggest that some prediction of gull hazards can be made. It is clear that gulls were most likely before 0900. It also seems clear the laughing gulls were most likely during dry ground conditions in the months of July and August. Herring or ring-billed gulls were most likely when the ground was wet, especially during active rain from October through January. The probability of gulls on the base was especially low during the months of June and September. February through May were usually also periods of reduced incidence of gulls.

It is possible that more detailed weather correlations would improve the ability to predict the arrival of gulls onto the base. However, laughing gulls were more likely during dry ground conditions, whether the sun was shining or not. This suggests that the weather correlations were more general rather than more specific. As we do not have data on the number of dry, wet, sunny, etc. days each month, and the times of day the weather conditions occurred, it is possible that the weather correlations suggested merely reflect the most prevalent type of weather for a particular season of the year.

It is apparent that Langley A.F.B. will retain a significant gull strike hazard in spite of the most careful environmental controls and changes. Thus behavioral control of gulls, involving procedures with both long-term and short-term effectiveness, will be a permanent feature of the bird control program at Langley A.F.B.

The procedures for dispersing gulls and other problem bird species in the U.S. Air Force and other bird control programs involve harassment of different forms (Blokpoel, 1976). The most frequently used procedure has been to playback the distress call of the species. Pyrotechnics, falcons and more general harassment have also been employed. As pointed out by Stout, et al. (1975), these procedures are effective only for a short-term. Gulls readily and rapidly return to the dispersal site.

Models of dead sea gulls have been effective in reducing the incidence of gulls in the areas where they are located by 80% for a period of eight months. Thus, these fiberglass models retain a long term effectiveness that can significantly reduce the hazard of gull-aircraft collisions. There has been no evidence to suggest that the gulls habituate to the models, resulting in the models gradually losing their effectiveness.

This study demonstrates that the gull models will only be most effective when integrated into an ongoing bird control program. Gulls that do, on occasion, move into the area where models are deployed must be dispersed immediately, as they would be anywhere else on the airbase, using the distress call and other usual forms of harassment.

The pattern for deployment of gull models cannot be determined without two types of information. First, the area to be protected with models must be defined, based on the operational hazard of gulls to the aircraft. Areas of the airport where gull aggregations are less hazardous should be left free of models to provide alternative loafing areas for the gulls. Gulls in these areas should be dispersed by the usual means. Second, the preferred loafing areas for gulls, and the factors attracting them to these areas should be determined. Gull models should be concentrated around the areas most attractive to gulls.

From data presented earlier in this report, and from Stout, et al. (1975), It is clear that certain areas of the runways and taxiways are more attractive to gulls than others. Obvious attractants such as food organisms and standing fresh water do not adequately explain these preferences of loafing sites. Neither are the preferred loafing sites necessarily correlated with areas receiving minimal disturbance from aircraft. They are often located at points of maximum usage. As already pointed out for Langley A.F.B., the intersections of Runway 07 with Taxiway 8 and with Taxiway 7 are among the most frequently used loafing sites and are also focal points of aircraft activity. Gulls will most frequently congregate at the end or at intersections of runways or taxiways. Unusually wide areas of a runway or taxiway (such as the arming-dearming area associated with Taxiway 8) may also be attractive. The basic attraction of gulls to airports appears to result from the large, paved areas offering long, visually unobstructed spaces (Blokpoel, 1976). The tendency to congregate at or near intersections may be caused by the unobstructed view offered in several directions by the intersecting runways or taxiways. However, It is apparent that gulls are using criteria that we still do not understand well to choose loafing sites. It is not apparent, for example, why anywhere along Runway 07 is preferable to Runway 25, or to the taxiway paralleling Runway 07.

The strongest attractant for a gull to choose a particular site to alight is the presence of other gulls already at the site. Gulls are highly social organisms (Tinbergen, 1959). All of their activities are carried out In groups. Thus, the attraction to join a group of gulls may outweigh the procedures used to keep them away. The obvious solution, therefore, is to keep the first gulls from alighting. A deterrent, such as the fiberglass models used in this study, that remains in position and effective for extended time periods will be most effective in preventing gulls from alighting in operationally critical areas of an airport.

ACKNOWLEDGEMENTS

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DISCUSSION

Q: Do you use complementary methods, like shotguns?

A: These models were integrated into the normal dispersal program, which is very well developed by the Air Force base. In other words if gulls were in the deploy area, they were immediately dispersed, using distress calls, pyro techniques, whatever the dispersal personnel felt appropriate.

Q: Used along with the model?

A: Yes, definitely.

Q: Did the models look like a bird that was healthy or were they kind of scrawny?

A: I can answer that best by showing you one. I did bring one along. They need to look dead; but, interestingly, they can't look old. They've got to look completely fresh.

Q: What is the source of the gulls?

A: We make these ourselves. This is a second-year, juvenile ring-billed gull. We've got quite a bit of data showing the reproduction has to be very good. We've found that ring-bills, for example, can tell the difference between second-year and adult models. There is a very definite behavioral evidence that they will respond to them differently: second-year respond to second-year, adults to adults.

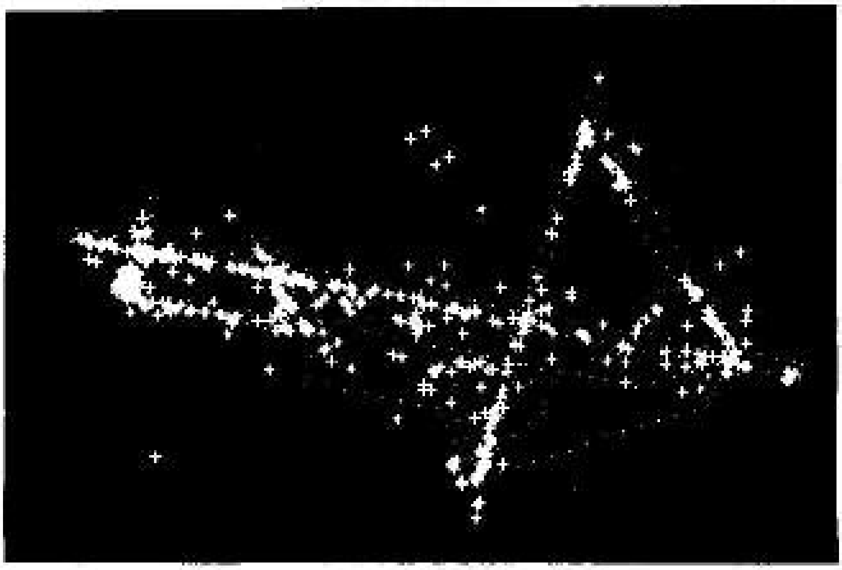


FIGURE 1. The locations of gull aggregations on the runways and taxiways of Langley Air Force Base during the complete survey period of January, 1977 through August, 1979. Each + symbol represents the location of an observed group of loafing gulls. The runways, taxiway, parking aprons, etc. are outlined in dots, with important runways (RWY) and taxiways (TXWY) indicated.

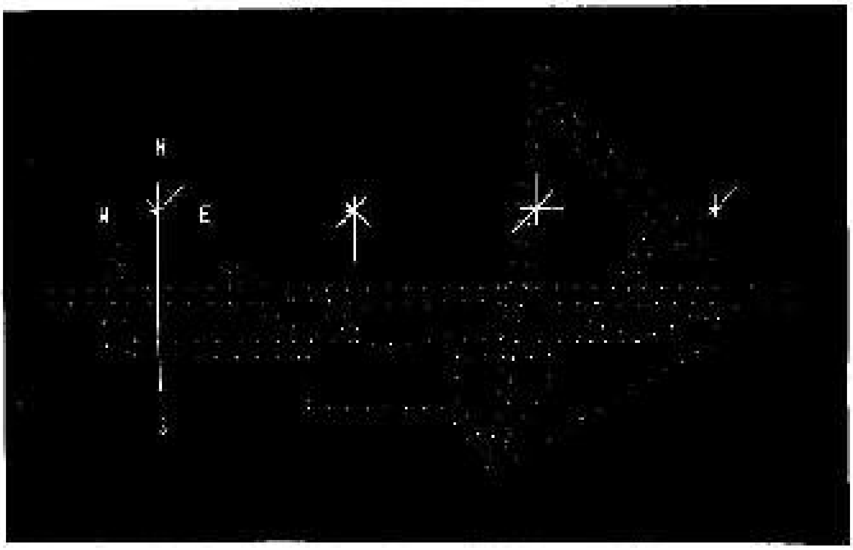
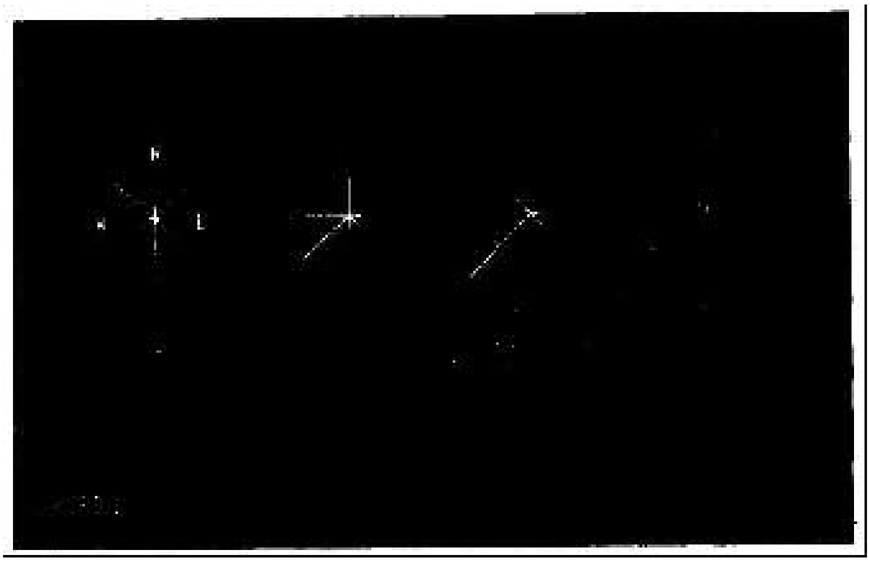


FIGURE 2. Flight directions chosen by gulls when dispersed from four regions of Langley Air Force Base, from January to December, 1977. Each region represents one-fourth of the airbase divided on an East-West axis along runway 07-25. The flight directions are shown at 45 degree intervals. The length of each line represents the percentage of all flights from all areas of the airbase that occurred in the indicated region, at the indicated direction. The location of the Williams' landfill is also indicated.



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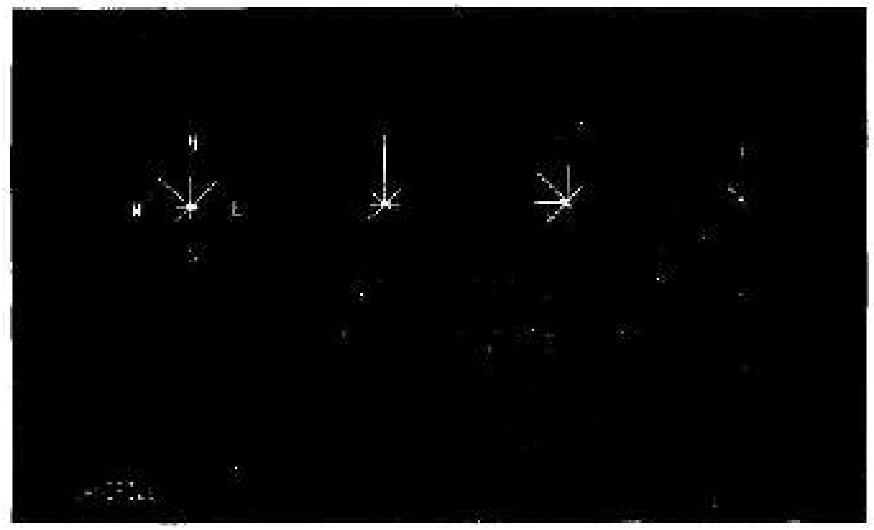

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FIGURE 3. Flight directions chosen by gulls when dispersed from four regions of Langley Air Force Base from August to October, 1978 (A) and from December, 1978 through August, 1979 (B).

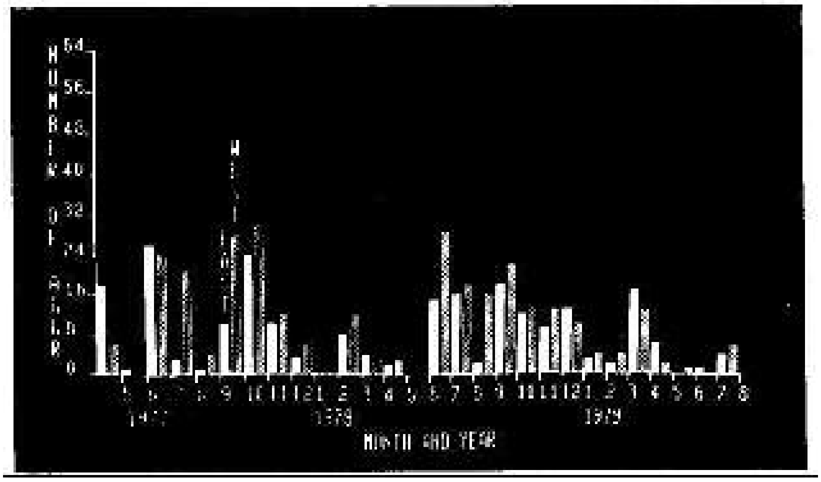


FIGURE 4. **The number of loafing gull aggregations observed monthly on the East (solid bars) and West (shaded bars) halves of Langley Air Force Base between May, 1977 and August, 1979.**

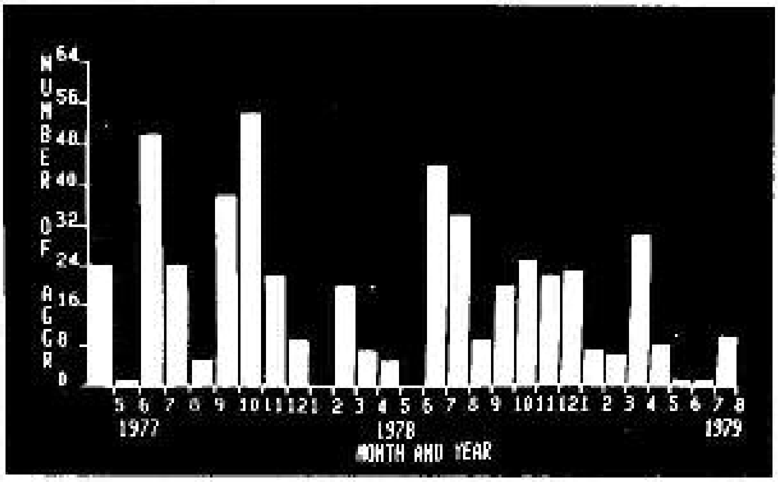
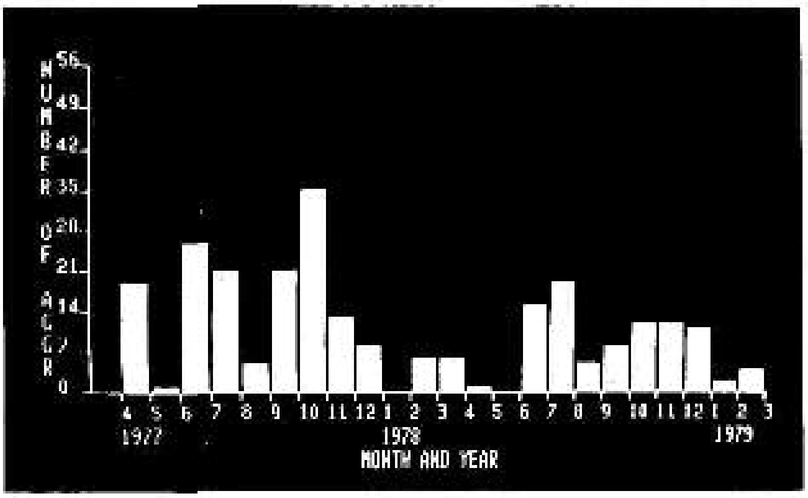


FIGURE 5. **The number of loafing gull aggregations observed monthly from May, 1977 through August, 1979 on runways, taxiways and adjacent areas at Langley Air Force Base.**



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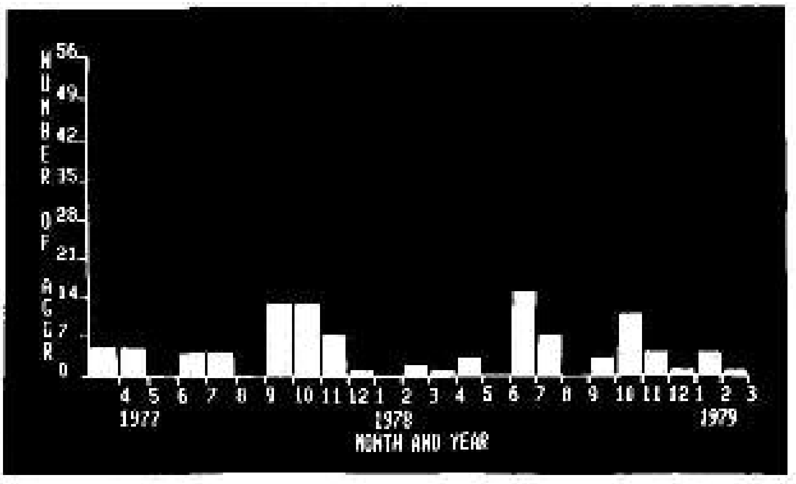

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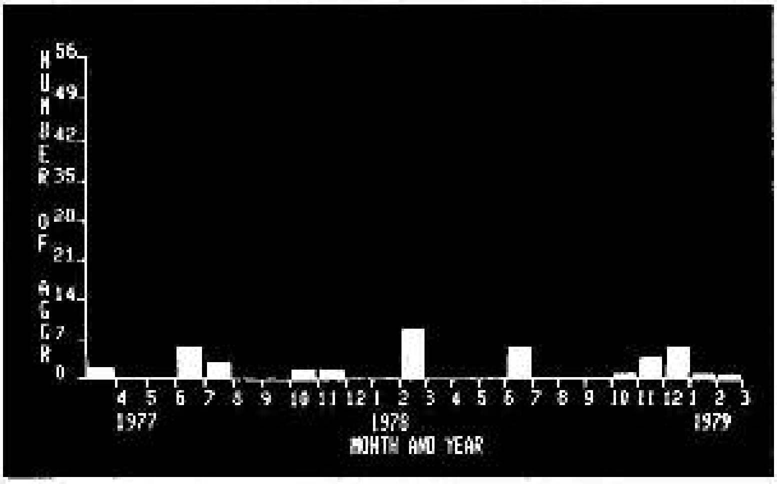
FIGURE 6. **The number of loafing gull aggregations observed monthly from April, 1977 through March, 1979 between the hours of 0600-0900 (A), 0900-1200 (B), 1200-1500 (C), and after 1500 (D).**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1977
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NUMBER OF AGGR
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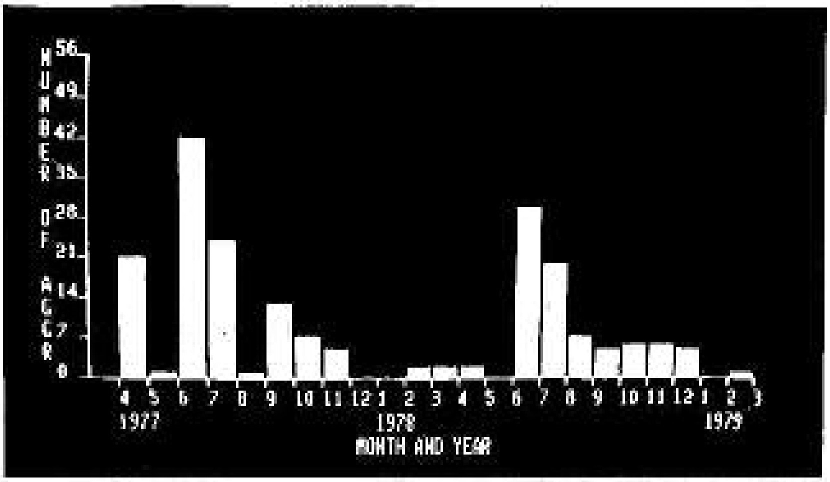
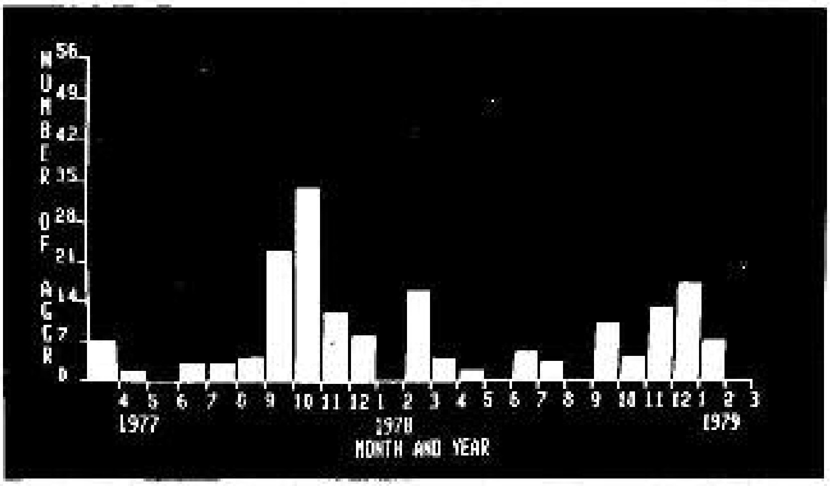
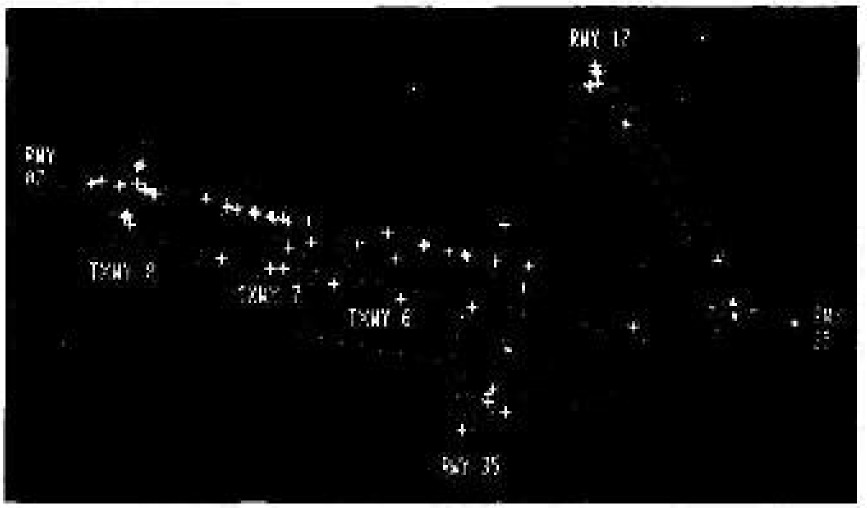


A

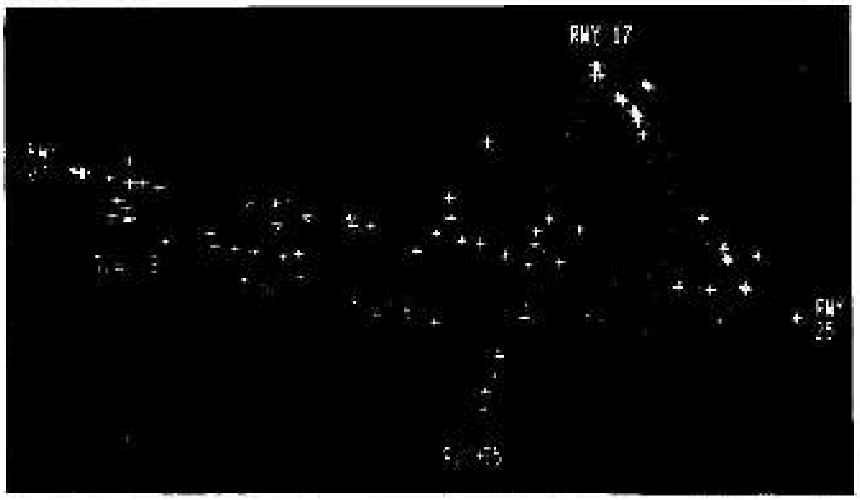


B

FIGURE 7. The number of loafing gull aggregations observed monthly from April, 1977 through March, 1979 during dry ground conditions (7A) and while it was raining (7B).



A



B

FIGURE 8. The loafing sites chosen by gulls between 1 October, 1978 and 4 January, 1979 before the second gull model deployment (8A) and from 5 January through 31 August, 1979 during the second model deployment (8B). The gull model deployment area (8B) is outlined in dots.

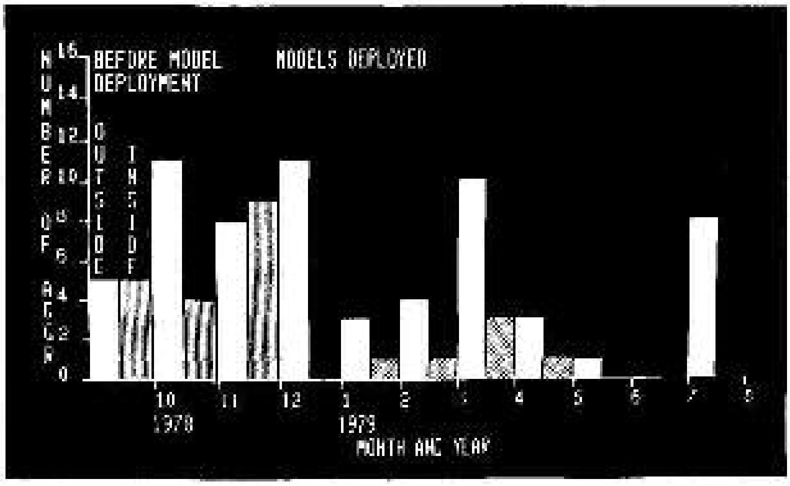


FIGURE 9. The monthly aggregations of gulls within the area where models were to be deployed (shaded bars), and on the runway and taxiways west of runway 17-35 outside of the model area (solid bars), before models were deployed (October through December), and during the second model deployment (January through August).

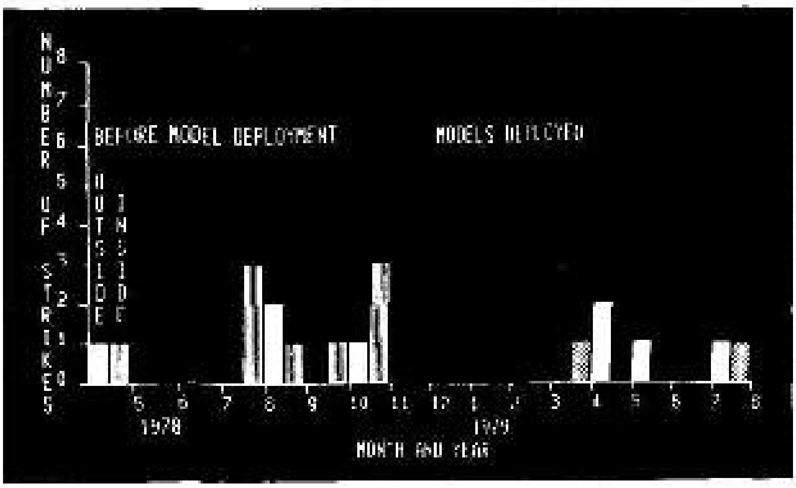


FIGURE 10. Gull-aircraft strikes on runway 07 Inside (shaded bars) and outside (solid bars) of the model area. The first eight months (May through December) show strikes before model deployment, and the last eight months (January through August) show strikes during model deployment.