WP/2

Bird Avoidance for Military Low-Level Operations in the United States

Abstract

In order to provide information as to waterfowl hazards along military low-level routes in the United States, the USAF Bird/Aircraft Strike Hazard (BASH) Team developed a computer-generated Bird Avoidance Model (BAM). The model is based on 40 years of waterfowl migration data and wintering areas coupled with longitude and latitude of all published military low-level routes. The computer output is a graph predicting the bird strike potential along any of the routes with respect to time of day and time of year. The BASH Team determined the model to be 70-75% effective and is in the process of incorporating raptor data into the model.

Introduction

Tactical, as well as strategic, warfare has over the years employed the use of very low-level, high speed flying to minimize radar detection when penetrating enemy territory. This flying scenario, while lessoning the time for activation of enemy defenses, forces airmen into a decreased margin of error when incurring any inflight emergency. In fact, as stated by Ramachandran (1980) "In the final analysis, the chances of survival would again get degraded by self-inflected accidents and thus the attrition rate would again show a reverse trend." (meaning an increased attrition rate).

In order to prepare our forces for these types of missions (i.e., deep penetration strikes, interdiction, and close air support) training is essential. For this reason, low-level flying hours has increased over the years to simulate the wartime environment. With the increased flying time in this low-level environment, exposure within the area in which birds frequent has become a real hazard. In fact, three out of the last four Air Force aircraft destroyed due to bird strikes have occurred during low-level flying. One pilot was killed.

Two approaches are possible in order to reduce the risk of a low-level bird strike; increased resistance of the aircraft and bird avoidance. The United States Air Force has documented extensively the upgrade of the windshield/canopy system to make them "bird proof" for specific aircraft that fly within this environment (Morolo 1983). The Air Force's Wright Aeronautical Laboratory at Wright-Patterson AFB OH has been successful in demonstrating that the improved windshield for the F-111 saved more than ten aircraft by 1979 (Simmons 1983). New systems are being designed for the T-38, F-4, A-7, and F-16 as well. But bird strikes on the windshield/canopy accounted for one fifth of the total number of strikes. Eighty percent of the bird strikes occurred on components like engines, wings, and radomes (Kull 1984). Impacts on these areas can also cause severe damage or total destruction. For these reasons, the BASH Team located at Tyndall AFB FL developed a Bird Avoidance Model (BAM) to effectively predict the risk of hitting a bird along any low-level route contained within the US. With this type of information, the BASH Team felt that aircrews, flight planners, and schedulers would be aware of the hazards birds cause and times of increased risk.

Low-Level Routes

Published military low-level routes contained within the US are carefully designed to avoid urban areas and obvious obstructions that could be a flying hazard. Low-level flight planners normally take into account the close proximity of wildlife refuges, mountain ranges and other topography that would be a factor in the route design. These published routes are based on longitude and latitude and specifically state the altitude at each point along the route.

In contrast to published routes, there are also located around the country Military Operating Areas (MOAs), restricted flying ranges, and Low Altitude Tactical Navigation (LATN) areas. These areas can be specifically designated within latitude and longitude boundries for definition in our BAM program.

Waterfowl

On the average, the US Air Force incurs approximately 2,000 bird strikes a year, mounting to several million dollars in damage repair costs. During the conception of the Bird Avoidance Model approximately 12-15% of the bird strikes were from ducks, geese, and swans (Short 1982). Even though this amount is a small percentage of the total number of strikes, information on migration of waterfowl was readily available in order to determine the feasibility of the model. In 1981, the BASH Team contracted Dr Frank Bellrose, author of the book Ducks, Geese, and Swans of North America (1976), to provide waterfowl migration data for the risk model. The data represents the most comprehensive compilation of waterfowl migration and population density information available. The data included timing of migration, concentration density, and movements of waterfowl populations throughout North America (Bellrose 1971). Waterfowl wintering refuges were mapped in order to determine feeding routes since waterfowl can travel great distances to feed. Distances of 30 miles or more are not uncommon. With this information coupled with the low-level route coordinates, the BAM model was devised.

Bird Avoidance Model

Bird strike risk is directly proportional to the density of the birds in the airspace and the volume of airspace swept by an aircraft (Short 1982) as well as the time spent in the bird airspace (Lawrence 1980). Of course the volume of space swept by an aircraft is the frontal surface area of the craft. As indicated by Short, the extent of damage that occurs as a result of a strike is related to the aircraft speed, the size of the bird, the location of the strike on the aircraft and the composition of the material at the point of impact.

Obviously, to predict the risk of a bird strike, one would calculate the density of the birds within a defined airspace at a given time. In order to estimate waterfowl densities, the following assumptions of waterfowl activity were made:

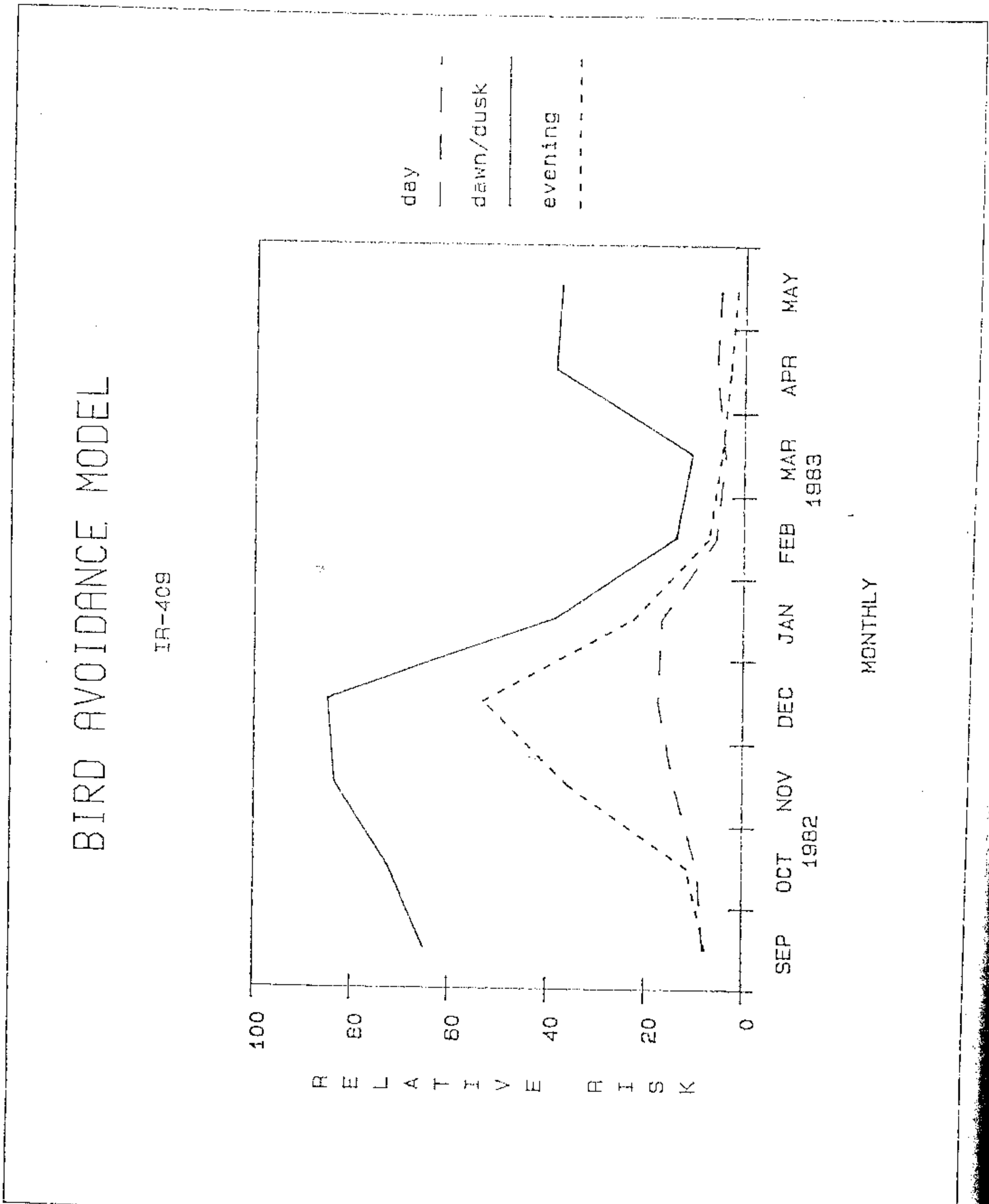
1. Morning or afternoon flights from refuges to feeding areas are normally at altitudes below 750 feet AGL (Above Ground Level).

2. There is minimized waterfowl flying activity at midday.

3. Nighttime migration altitudes are between 1,500 and 3,000 feet AGL.

By coupling the longitude, latitude, altitude, and frontal surface area of an aircraft with the predicted waterfowl density through the given airspace at a given time, a computer-generated graph of the bird strike risk is created. The BAM program can compile the risks of flying one particular route during the migration season for of three time periods (i.e., day, dawn/dusk, and night) (Figure 1), or compile different routes on the same graph for a given time period (Figure 2). Up to eight routes can be displayed on one graph which allows the user to easily compare risks of different routes.

Decision-making on the low-level route to be flown depends on many criteria. The BASH Team invisions the use of the graphs to be helpful when flying a particular route is not mission essential and alternate routes may be considered. BAM graphs may be used to provide pilots with a "heads up" warning while flying particularly hazardous routes. Even before the route is to be flown, BAM graphs may be helpful in route design analysis. After a planner has completed a rough draft of a low-level route, a graph can be generated to evaluate the bird hazard for each route segment. If a segment is shown to be excessively risky, environmental attractions that would cause increse waterfowl density can be examined and route changes proposed to avoid these hazardous areas.



BIRD AVOIDANCE MODEL
IR-409
day
dawn/dusk
evening
RELATIVE RISK
100
80
60
40
20
0
SEP
OCT
1982
NOV
DEC
JAN
FEB
MAR
1983
APR
MAY
MONTHLY

Fig 1

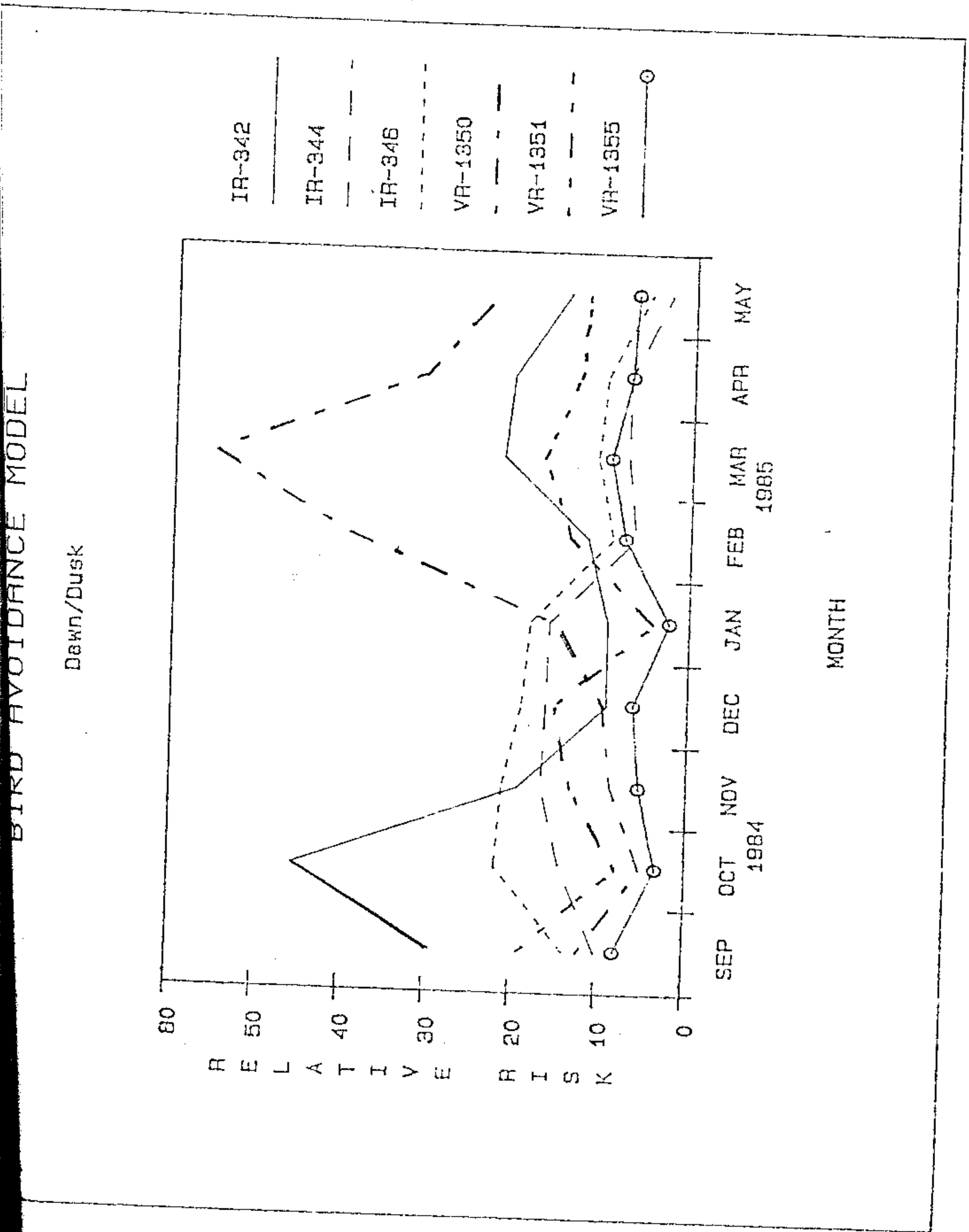

BIRD AVOIDANCE MODEL
Dawn/Dusk
IR-342
IR-344
IR-346
VR-1350
VR-1351
VR-1355
RELATIVE RISK
0
10
20
30
40
50
80
SEP
OCT
1984
NOV
DEC
JAN
FEB
MAR
1985
APR
MAY
MONTH

Fig 2

In order to examine the effectiveness of the BAM graphs, the BASH Team compared actual strike data with the predicted values. In 75% of the cases waterfowl strikes occurred when the model showed a peak in waterfowl activity for that route. As compared to US Air Force Strike statistics in 1980-1982 where 13% of identified bird strikes were caused by waterfowl (Kull 1983), I found that only 8% of the 1983 strikes were from waterfowl. This decrease of 6% of the strikes due to waterfowl may indicate to some extent that the model is effective. Of course, other factors must also be considered in this decrease (hours of low-level flying, general increase in bird hazard awareness, waterfowl population fluctuations, etc).

Raptors

Since the BAM program appears to be effective, other groups of birds can possibly be added to the waterfowl data base. As seen in Figure 3, of the types of birds involved in low-level bird/aircraft strikes, raptors (hawks and vultures) rank highest. For this reason, the BASH Team determined that this group of birds would be the next logical type to incorporate into the model. Unfortunately, migration data on raptors if not as well defined as waterfowl. Certain vantage points around the United States are well known for large mass flights of hawks and vultures. Detailed documentation of raptor migration exists for much of the east coast and around the Great Lakes. Not as much is known about the extent of broad fronts of raptor movements in the midwest and west. In 1983 the BASH Team contracted to have all raptor migration data within the United States compiled in a similar fashion as the waterfowl data (Mindell 1984). That project is now complete and will be incorporated into the BAM program by early 1985.

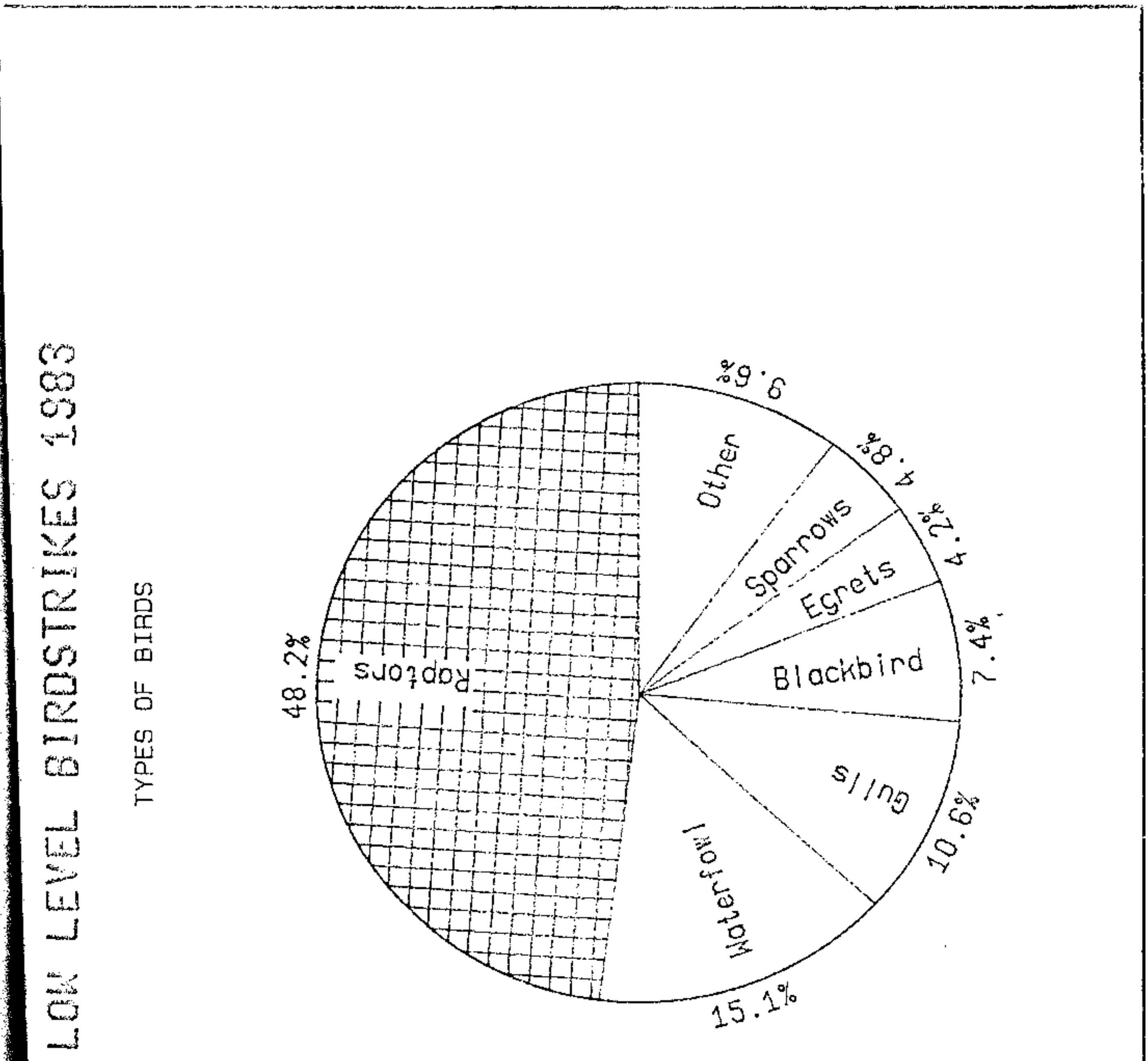

LOW LEVEL BIRDSTRIKES 1983
TYPES OF BIRDS
Raptors
48.2%
Other
9.6%
Sparrows
4.8%
Egrets
4.2%
Blackbird
7.4%
Gulls
10.6%
Waterfowl
15.1%

Fig 3

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