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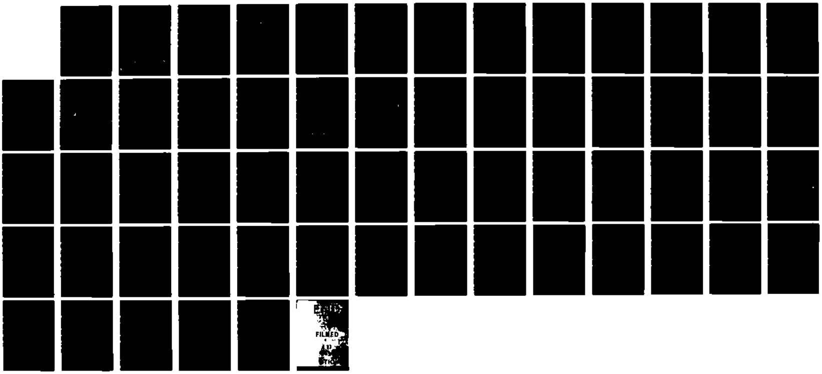

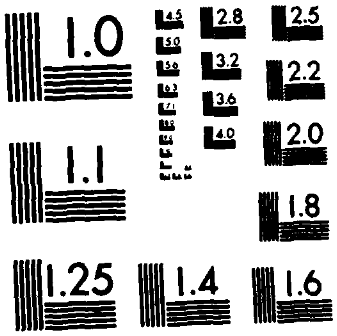

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A Study of Bird Ingestions into Large High Bypass Ratio Turbine Aircraft Engines

AD A128640

Gary Frings

March 1983

Interim Report

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US Department of Transportation
Federal Aviation Administration
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15. Supplementary Notes

In order to acquire the data contained herein, contracts were awarded by the FAA Technical Center to the Pratt and Whitney Aircraft Group, General Electric Company and Rolls-Royce, Incorporated.

16. Abstract

A 1-year study has been conducted to document the numbers, weights, and species of birds being ingested into large high bypass ratio aircraft turbine engines. This study will continue into a second year. This interim report presents the findings to date.

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Bird Ingestion, CF6, RB211, JT9D, Revenue Service, Turbine Engines, High Bypass Ratio, Fan Blades, Birds	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

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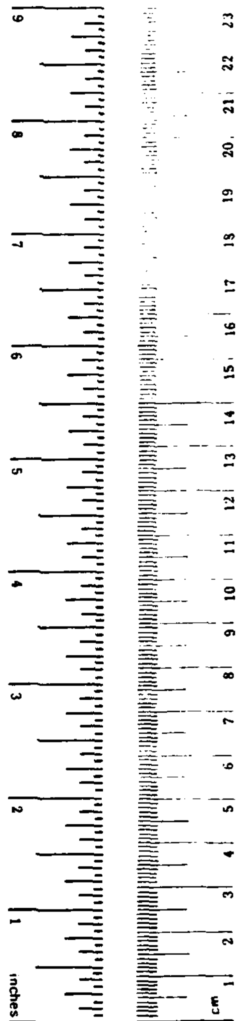
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

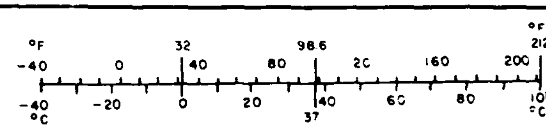
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

An investigation was initiated by the Federal Aviation Administration (FAA) Technical Center in May 1981 to determine the numbers, weight, and species of birds which are being ingested into large high bypass ratio turbine aircraft engines on a worldwide basis and what damage, if any, resulted. This interim report presents a summary of the first year's data. Continuation into a second year is currently in progress. A final report covering both years' data will be issued during the first quarter of fiscal year (FY) 1984.

This report is limited to large high bypass ratio turbine aircraft engines which experienced revenue service during the first year of this study. Therefore, only bird ingestions into Pratt and Whitney's (PWA) JT9D, General Electric's (GE) CF6, and Rolls-Royce's (RR) RB211 type engines are included. It is anticipated, during the second year of this study, that bird ingestion data will become available for the GE CF6-80A, RR RB211-535 and GE CMF56-2 engines as used on the B767, B757, and reengined DC8-70 series, respectively. The total number of wide-body aircraft (DC10, L1011, A300, and B747) active during this first year's effort was 1,256. These aircraft accounted for approximately 1.2 million operations.

These aircraft experienced 289 engine ingestion events during the initial contract period, May 1981 through April 1982. The FAA is continuing this data gathering effort for one more year in order to minimize questions of statistical uncertainty and trend verification. Limited analysis of the data is included in this interim report.

The following summary highlights the data contained in this report:

1.	Airlines reporting events	63
2.	Airports involved	88
3.	Total events	289
4.	Engine damage, minor and/or major	188
5.	Multiple engine ingestions per aircraft	11
6.	Multiple bird ingestions per engine	13
7.	Takeoff and climb phase events	43%
8.	Approach and landing phase events	28%
9.	Most commonly ingested bird species, United States	Gull
10.	Most commonly ingested bird species, Foreign	Kite, Gull
11.	Average bird weight, United States	37 ounces
12.	Average bird weight, Foreign	25 ounces

Analysis of the first year's data indicated that the engine failed in 17 of the 188 cases where engine damage occurred. Twelve of these failures occurred at bird weights of 20 ounces or less, and eight failures involved more than one bird per engine.

Preliminary observations relative to the first year's data are: (1) The first year's data sample is considered too small to form conclusions, (2) The bird weight versus engine failure trend is inconsistent in many cases, (3) United States and foreign data sets are not statistically similar, and (4) the approach and landing phase of flight should also be considered in all data analysis.

INTRODUCTION

OBJECTIVE.

The purpose of this investigation is to determine the numbers, weight, and species of birds which are ingested into large high bypass ratio turbine aircraft engines during service operation on a worldwide basis and what damage, if any, resulted. This validated data base will be used to determine if amendment of existing standards is warranted.

BACKGROUND.

National Transportation Safety Board (NTSB) Recommendation A-76-64 was issued April 1, 1976, as a result of an aircraft accident involving a rejected takeoff after "a number of large birds" were ingested into one of the engines. This recommendation stated in part.

> "Amend 14 CFR 33.77 to increase the maximum number of birds in the various size categories required to be ingested into turbine engines with large inlets. These increased numbers and sizes should be consistent with the birds ingested during service experience of these engines." (Class III - Longer Term Follow-up)

In response to the Safety Board's subsequent inquiry of July 30, 1980, the FAA on October 30, 1980, summarized the status of the work addressing the recommendation made by NTSB. The FAA had made several examinations of NTSB, FAA, and industry engine records to determine the numbers and weights of birds being ingested into turbine engines with large inlets. These engines entered airline service early in 1969. A study of available records was also made by an Ad-Hoc Committee of the Aerospace Industries Association of America, Inc., in 1978. All of these industry and government efforts show available records do not provide the information necessary to enable FAA to make a decision concerning revision of the weights and numbers of birds required to be ingested for engine type certification.

The FAA acknowledged the need for better data relating to the number and weights of birds being ingested in service operation. Because normal reporting activity was not providing sufficient information of this kind, the FAA initiated a special project at the FAA Technical Center. This project is limited to engine bird ingestions being encountered on high bypass ratio turbine aircraft engines during worldwide service operations.

Completeness of the data and the reliability of data sources are major considerations of any effort. In order to achieve the desired valid data base, the FAA Technical Center deemed the following elements essential:

- Worldwide consideration of data
- Familiarity with the engine design criteria
- Proven expertise and prior experience on engine foreign object ingestion interpretation
- Standardized reporting
- Minimum impact on the operational fleet
- Proven expertise in bird identification
- Airline cooperation and understanding of need

- o Quick response
- o Report of all engine bird ingestions

Among others manufacturing of large high bypass ratio turbine aircraft engines is conducted by Pratt and Whitney Aircraft, General Electric Company, and Rolls Royce Inc. The FAA determined that the most effective approach to encompass the essential elements was to have each of these engine manufacturers investigate the engine bird ingestion incidents which occurred on their respective engines. This course of action maximizes the benefit of the engine manufacturer's expertise in damage tolerance assessment and their worldwide service organizations. Thus the information required for this study was obtained by the manufactureres of high bypass ratio turbine aircraft engines with the cooperation of the Air Transport Association of Amercia (ATA) and the International Air Transport Association (IATA) and their member airlines. Standardized bird identification was achieved by each engine manufacturer by utilizing the services, whenever possible, of a recognized ornithologist.

DISCUSSION

WORLDWIDE EXPOSURES.

The raw data received from each of the engine contractors are encoded prior to inclusion into the Technical Center's data system. The three engine contractors, Pratt and Whitney Aircraft Groups (JT9D), General Electric Company (CF6), Rolls-Royce Inc. (RB211) and four airframe manufacturers of wide-body jet aircraft, Boeing (B747), McDonnell Douglas (DC10), Lockheed (L1011) and Airbus Industrie (A300) - were arbitrarily assigned coding of 1 through 3 for the engine identifier and 1 through 4 for the airframe identifier. This coding is not necessarily in the order shown.

To understand the magnitude of the bird ingestion problem, it was necessary to determine the numbers of aircraft and engines which were exposed, on a worldwide basis, to potential bird strikes. Figure 1a shows that a total of 1,256 aircraft were operational during the first year of this effort. Of the 526 type 1 aircraft, 408 are powered by engine model 1, 86 are powered by engine model 2 and 32 are powered by engine model 3. Of the 344 type 2 aircraft, 300 are powered by engine model 2 and 44 are powered by engine model 1. All 220 type 3 aircraft are powered by engine model 3. Of the 166 type 4 aircraft, 158 are powered by engine model 2, and 8 are powered by engine model 1. Alternatively, this data can be discussed from the engine viewpoint instead of the aircraft viewpoint. Of the 4,128 engines which were involved in this study, 1,780 are engine model 1, 1,560 are engine model 2, and 788 are engine model 3.

To compare and contrast the bird ingestion rates of the various aircraft types, it was necessary to determine the total number of operations conducted during the study period. An "operation", as used in this study, is contrary to normal FAA practice and is defined as either a takeoff or a landing, but not both. Therefore, a flight, for example, from airport "A" to airport "B" is counted as one operation, one revenue departure, or one takeoff. The main tool used in determining numbers of operations was the Official Airline Guide (OAG) computer tapes which are updated every month. These tapes are used to identify the airline schedules and provide valuable data such as, aircraft type, departure and arrival airports, frequencey of flight, and domestic/foreign operations. To validate the accuracy of the OAG operational data, engine manufacturer's data were obtained as a cross-check. Their operational count was 5.7 percent higher (69,000 operations) than the OAG data. Further analysis revealed that 57,000 of these operations pertained to the type 1 aircraft which is extensively utilized for freighter operations and, therefore, not always included in OAG data. The operational data reported in this study reflect these increased operations. Approximately 1.2 million operations occurred during the study period. Aircraft type 1 had 411,000 operations, aircraft type 2 had 316,000 operations, aircraft type 3 had 263,000 operations; and type 4 had 214,000 operations (figure 1b). These data were used in the analysis section of this report to construct ingestion rates.

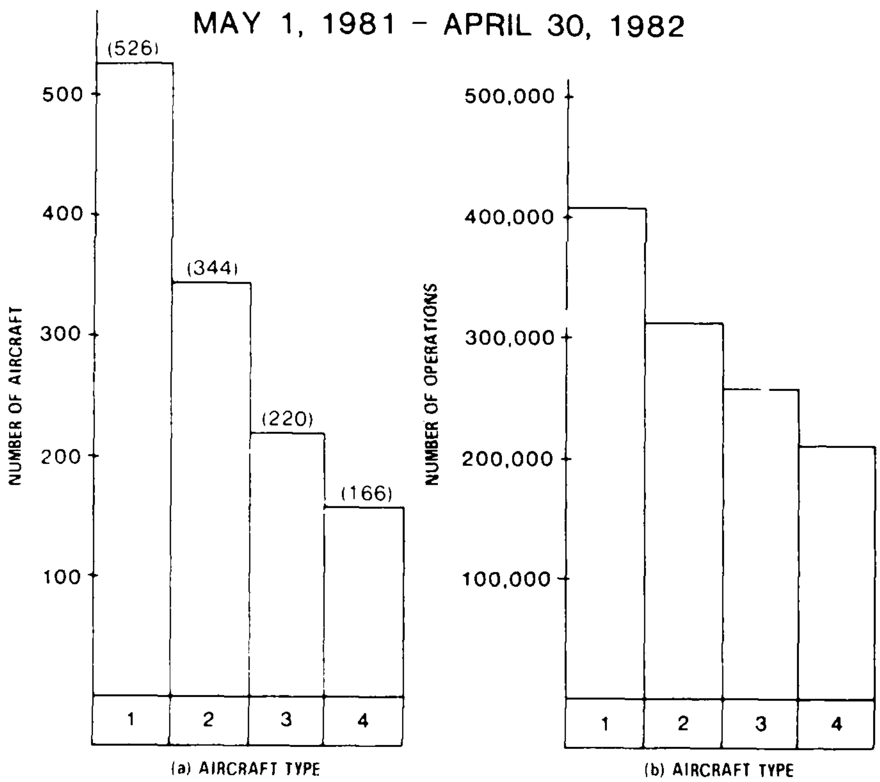


FIGURE 1. EXPOSURE CRITERIA

AIRPORTS.

From the OAG tapes it was determined that 384 airports worldwide accommodated the wide-body aircraft types studied. Fifty-eight of these airports are located in the United States (U.S.) and 326 are foreign. During this study, engine bird ingestions were experienced at 14 known U.S. and 74 known foreign airports. Figure 2 depicts 88 airports, with the number of events reported at each airport. The tabulation of "U.S. Only" data has been included in figure 2. The acronym identifiers for these 88 airports are listed in appendix A. It should be noted that an identifier of "XXX" is shown. This identifier denotes occurrences at unknown airports. Eighty-five such events occurred. Traces of a bird ingestion which are found on the engines during maintenance, post- or preflight-inspections make the location of the ingestion unknown.

Although the specific airport where the bird ingestion occurred may not be known, it is possible, in many cases, to determine whether the ingestion occurred in the United States or in a foreign country. By "extrapolating" data, such as operations between United States or foreign city pairs and operator route structures, it is possible to reduce the number of unknown bird ingestion locations from 85 to 33 by allocating 45 ingestion events into the foreign category and 7 into the U.S. category (table 1).

TABLE 1. BIRD INGESTION EVENTS GEOGRAPHICAL DISTRIBUTION

	U.S.	Foreign	Worldwide
Total Ingestions	-	-	289
Validated Locations	37	167	-
Extrapolated Locations	7	45	-
Unknown Locations	-	-	33
Minimum (validated plus extrapolated)	44	212	-
Maximum (minimum plus unknown)	77	245	-

ENGINE INGESTIONS.

During the course of this study no attempts were made to compare the relative merits or shortcomings among the engine models or aircraft types.

Table 2 lists the type of information which was reported by the engine manufacturers for each bird ingestion event. It was not possible in all cases to obtain all the information desired (see appendix D). For example, when the local time of the ingestion is unknown, the column entry is listed as "0000." Likewise, when the bird number or weight is unknown, the column entry is "0." In all other cases, an unknown quantity is listed as "UNK." In those cases where a particular column entry does not apply, the term "N/A" is entered. An example of this might be a

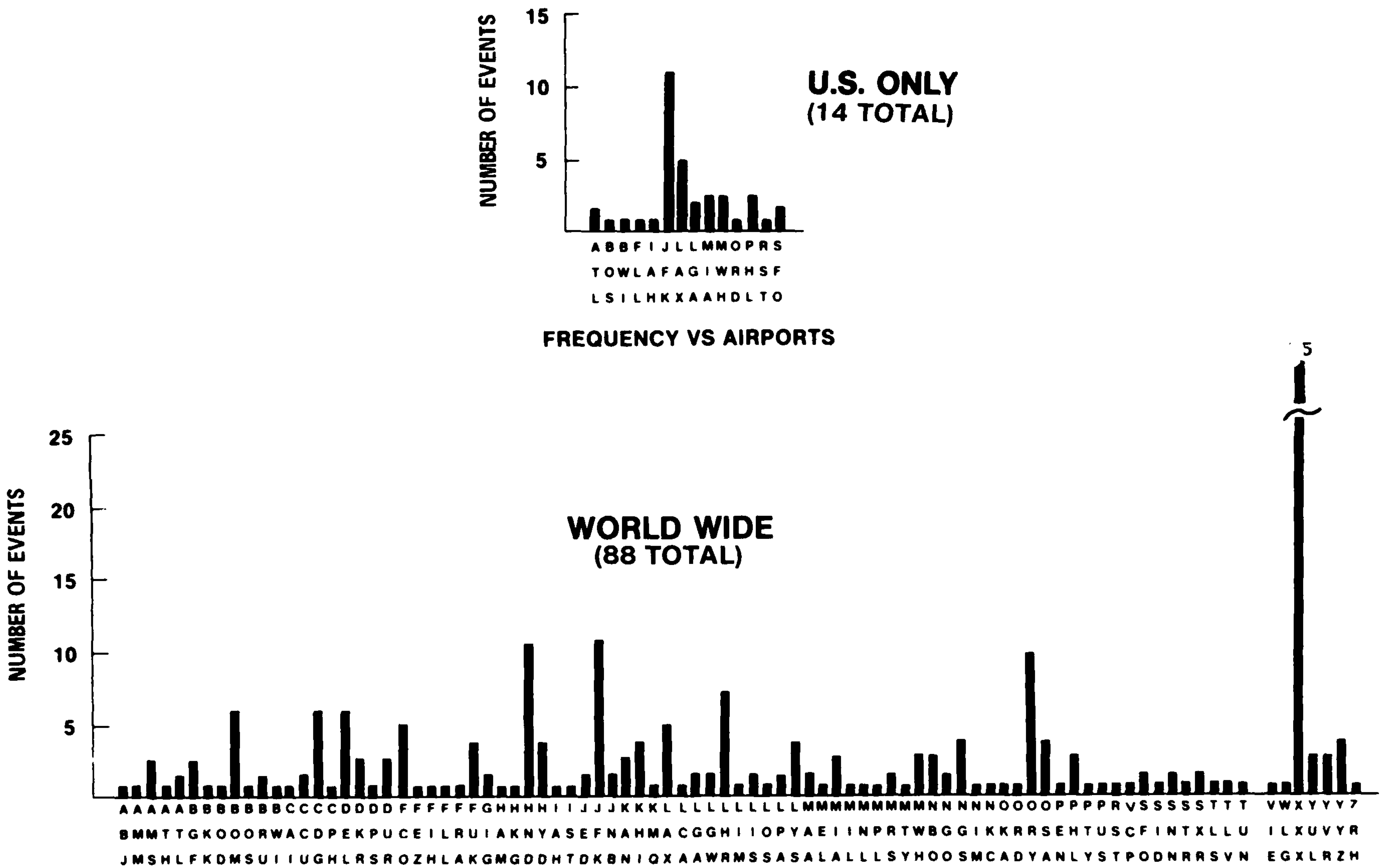


FIGURE 2. FREQUENCY VERSUS AIRPORTS

case where a bird ingestion has occurred but no damage resulted, therefore, the "In-flight Shutdown," "Pilot Action," and "Significant Reason" columns would all have an "N/A" entry.

The Event Number" of appendix D are computer generated and sequential by date of bird ingestion occurrence. An "Event", as used in this report, refers to an aircraft bird ingestion occurrence. Computer program format limitations have by neccessity forced some of the entries of appendix D to be grammatically incorrect, such as the hyphenating of certain words.

TABLE 2. BIRD STRIKE REPORTING FORMAT

1. Date
2. Local Time
3. Aircraft Type
4. Engine Type
5. Engine Position
6. Operator
7. Airport
8. Phase of Flight
9. Weather
10. Damage
11. Power Loss or Reduction (yes or no)
12. Contained Damage (yes or no)
13. In-flight Shutdown (yes or no, if yes - reason)
14. Was the bird seen?
15. Bird Species
16. Bird Number
17. Bird Weight
18. Pilot Action (Aborted takeoff or air turn back)
19. Was this a significant event? (i.e., multiple engine ingestion, multiple birds per engine, transverse fan blade fracture, involuntary power loss, actual or suspected engine related airworthiness effects).
20. Manufacturer's Event Number
21. Remarks

Table 3 summarizes the worldwide bird ingestion events of the first year. A total of 289 bird ingestion events were reported worldwide, 278 of these events involved only one engine per ingestion. Eleven events involved two or more engines. The term damage, as used in this report, refers to any type of damage which the engine sustained as a result of the bird ingestion. This may range from minor damage such as a nicked or bent fan blade to extensive damage. A listing of bird ingestions by aircraft type and engine model is also shown in table 3.

It has been possible to validate the bird weights in 50 percent (145 cases) of the bird ingestion events. This high percentage of known bird weights results from the fact that all three engine manufacturers have contracted to send bird debris which is collected from the engine to the Smithsonian Institution for identification and analysis by an ornithologist. It should be noted here that upon engine impact many birds literally "explode" and very little of the bird remains for identification. However, sufficient bird debris - such as feather down and portions of feathers - remain attached to the engine crevices to allow not only identification of the species but also sex and whether the bird was mature or immature. This information, together with location of strike and time of year, allows the ornithologist to determine a range of weights for the bird(s). The bird weights reported in this study are the midpoints of the range of weights as reported by the ornithologist.

TABLE 3. ONE YEAR WORLDWIDE BIRD INGESTION SUMMARY

Events	289
Aircraft #1	119
Aircraft #2	54
Aircraft #3	41
Aircraft #4	75
Engine Model #1	87
Engine Model #2	146
Engine Model #3	56
Ingestion with Damage	188
Bird Weights	145
Multiple Engine	11
Multiple Birds Per Engine	13

Figure 3 depicts the bird ingestion events by month for the first year for all aircraft types. Although there appears to be a considerable increase in the number of engine bird ingestions in the late summer and early fall, it is too early to determine the cause of these increases (increased aircraft operations, bird migration habits, etc.).

Figures 4 through 7 present the same information by aircraft type, while figures 8, 9, and 10 present the information by engine model. Except for minor perturbations, the trend is similar for all the figures.

A necessary step in understanding the engine bird ingestion phenomena is to compare the ingestions of the four aircraft types. In doing so, one must address the problem in terms of rates since the number of ingestions and operations varies considerably among the aircraft types. The resultant ingestion rates do not take into account such influential factors as: number of engines and their location, route structure, operational procedures, and other factors. The number of bird ingestions per 10,000 operations is a convenient number which has been utilized by the industry to make this comparison. Using the total number of operations for each aircraft type, as shown in figure 1b, and the total number of bird ingestions occurring on each aircraft type, as shown in figures 4 through 7, the engine bird ingestion rate per 10,000 operations was constructed for each aircraft type. Figure 11 graphically depicts the results. The worldwide rates are 2.9, 1.7, 1.6 and 3.5 for aircraft types 1 through 4, respectively. The worldwide average ingestion rate considering all aircraft types as a unit is 2.4. It is outside the scope of this interim report to attempt a qualitative explanation of these variations in rates.

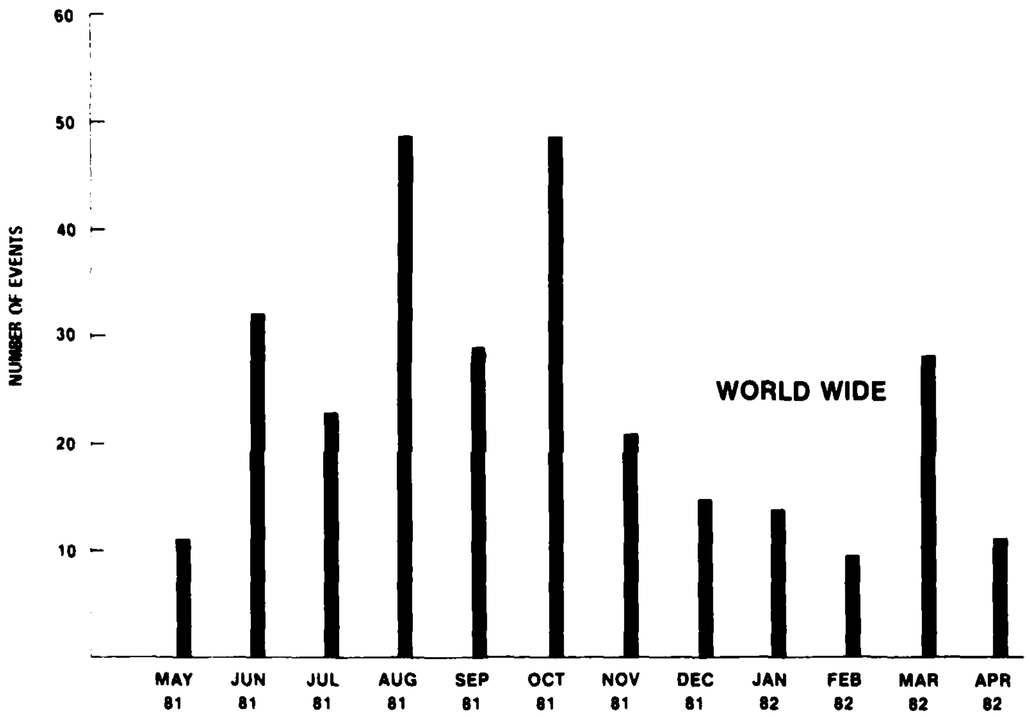


FIGURE 3. FREQUENCY BY MONTH FOR TOTAL EVENTS

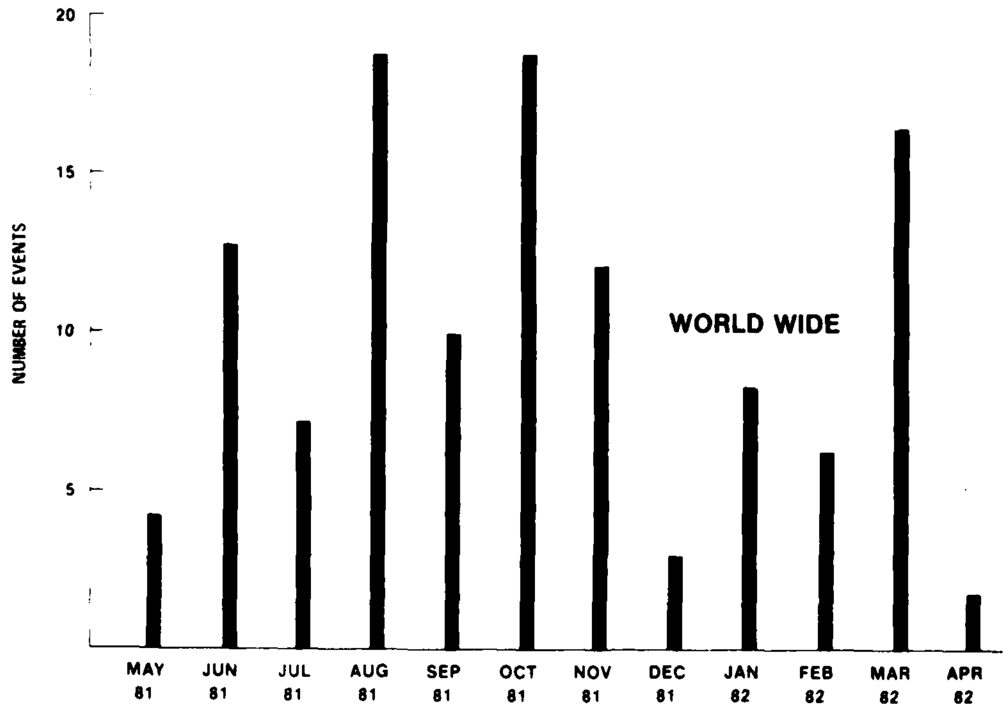


FIGURE 4. FREQUENCY BY MONTH FOR AIRCRAFT 1

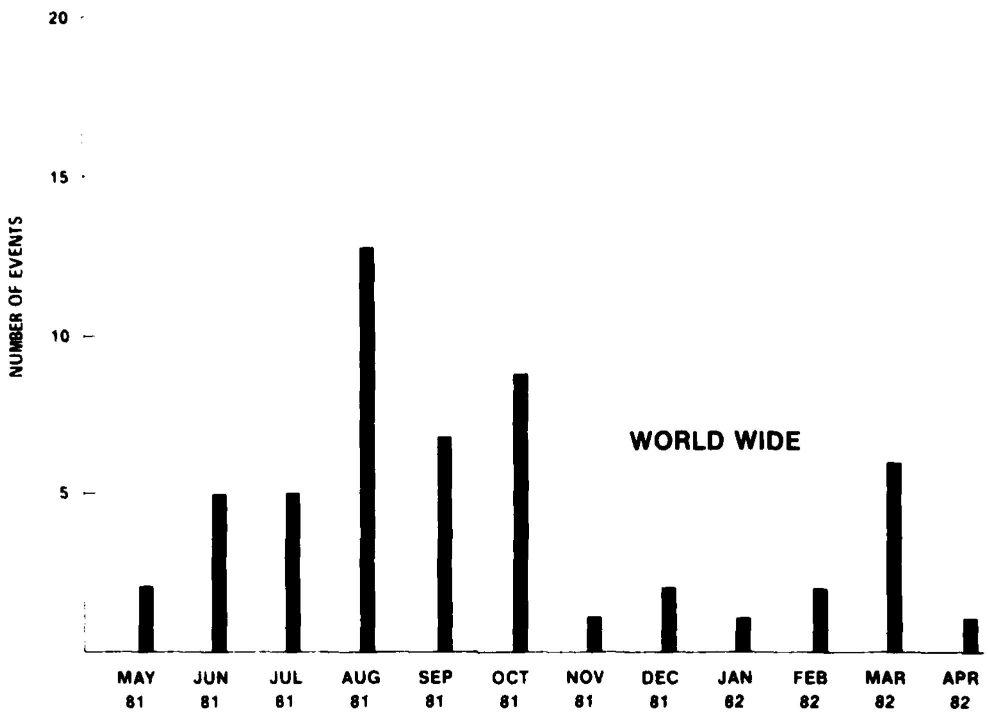


FIGURE 5. FREQUENCY BY MONTH FOR AIRCRAFT 2

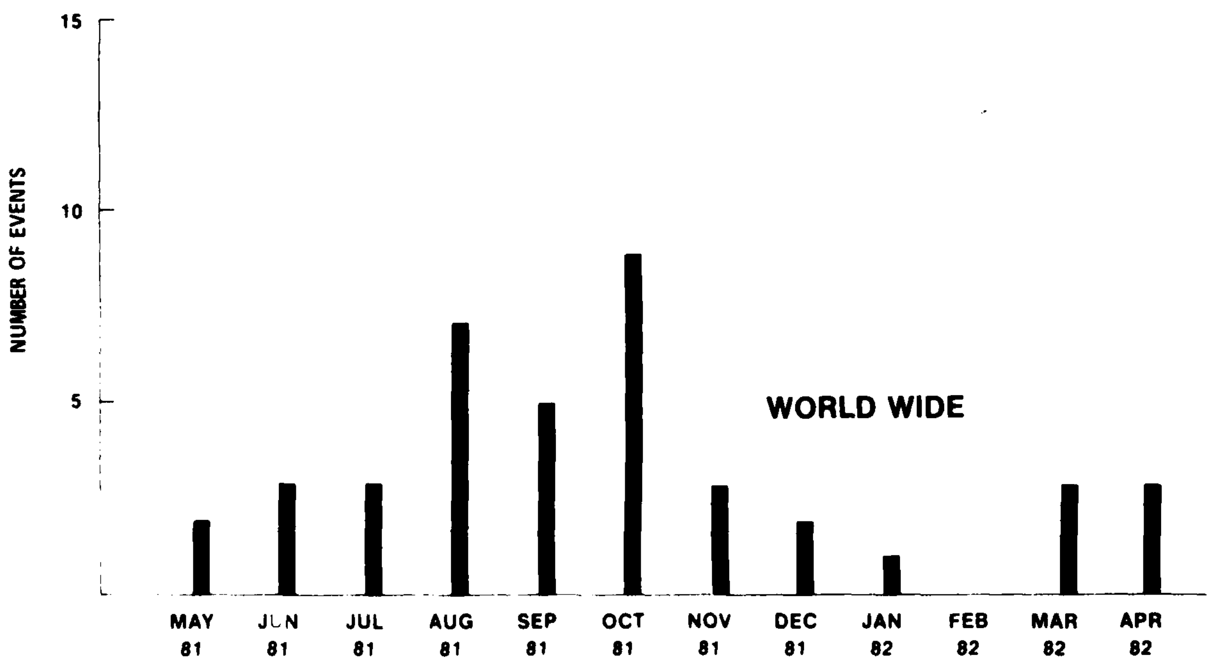


FIGURE 6. FREQUENCY BY MONTH FOR AIRCRAFT 3

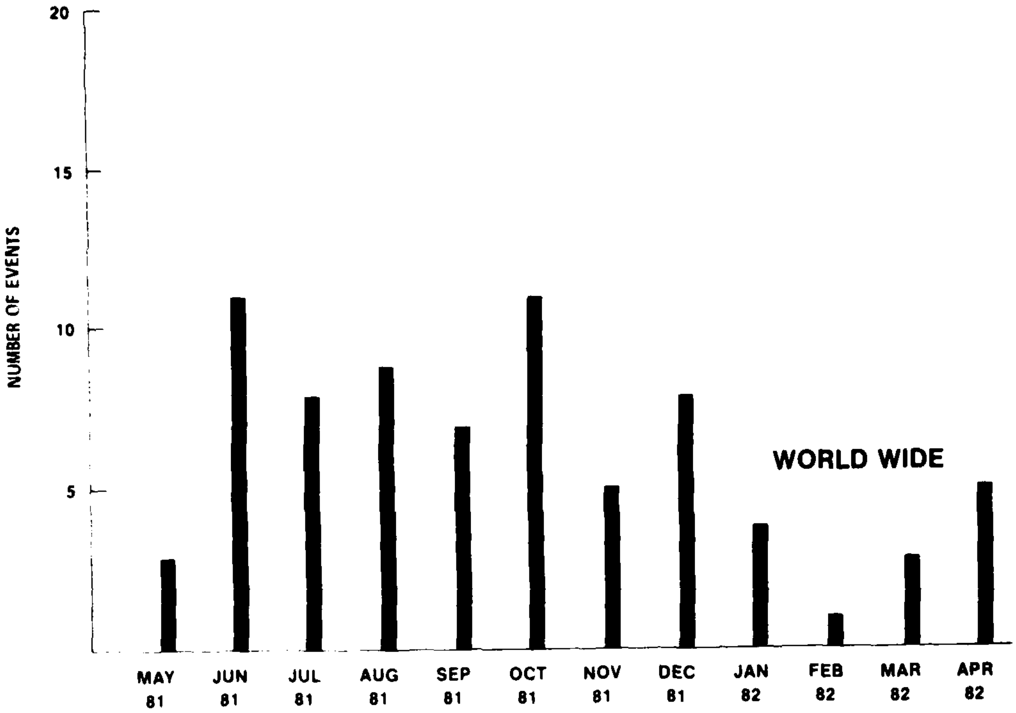


FIGURE 7. FREQUENCY BY MONTH FOR AIRCRAFT 4

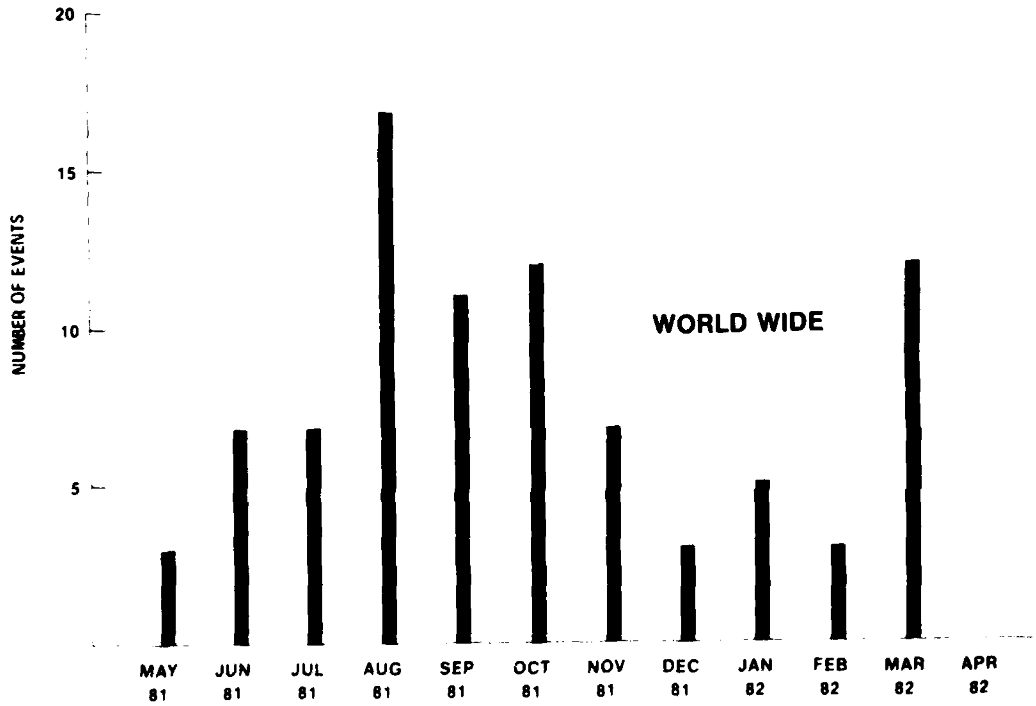


FIGURE 8. FREQUENCY BY MONTH FOR ENGINE MODEL 1

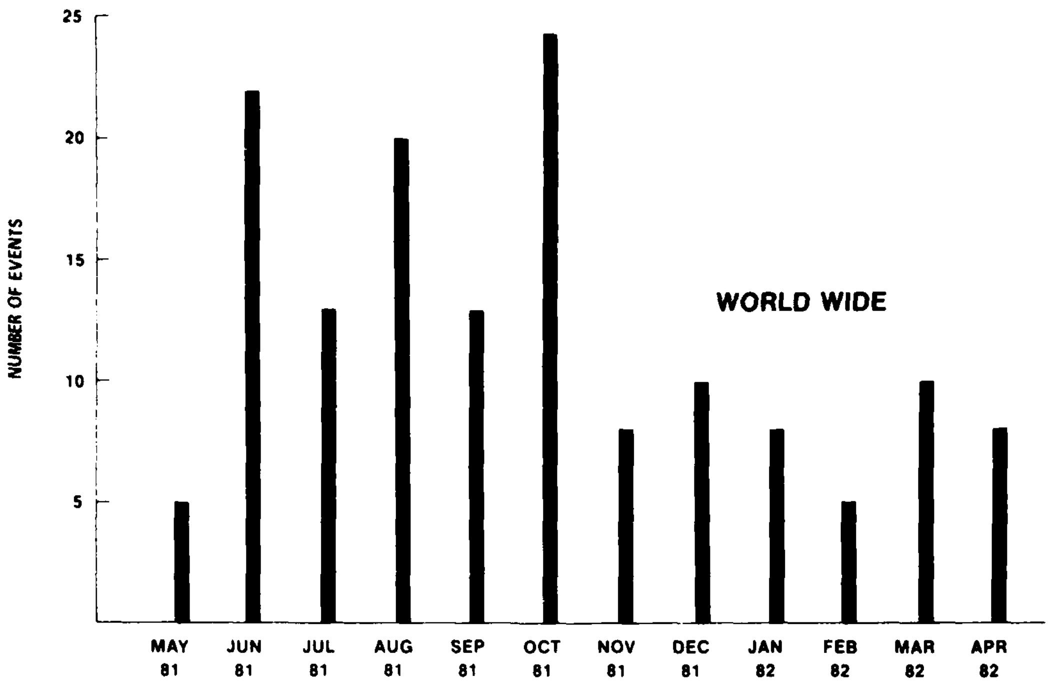


FIGURE 9. FREQUENCY BY MONTH FOR ENGINE MODEL 2

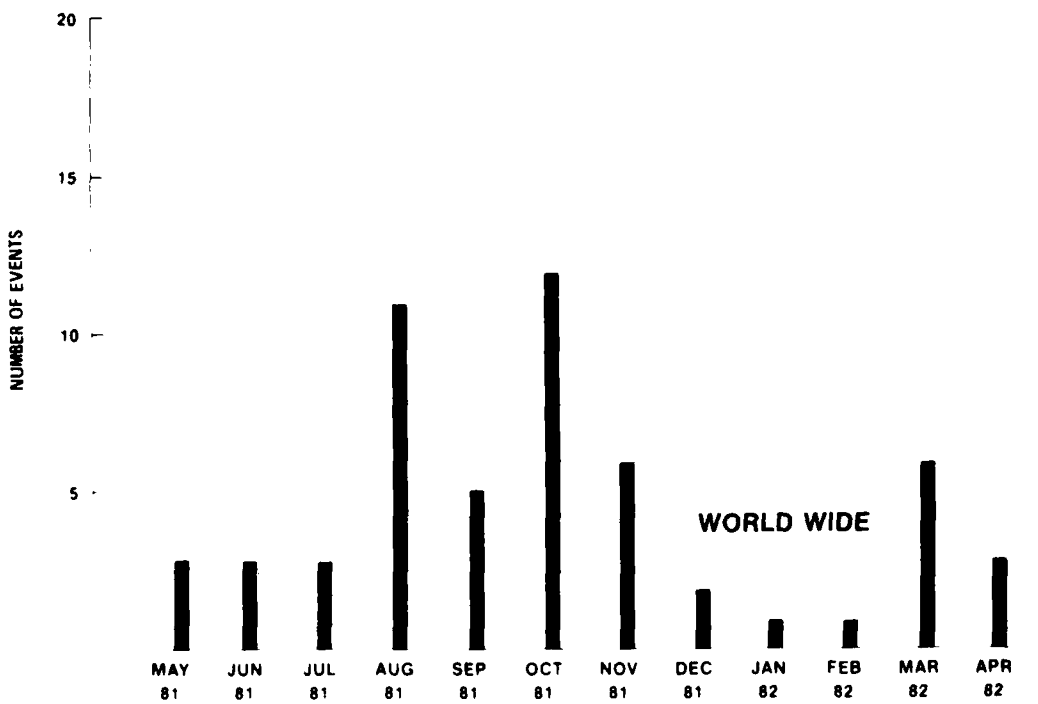


FIGURE 10. FREQUENCY BY MONTH FOR ENGINE MODEL 3

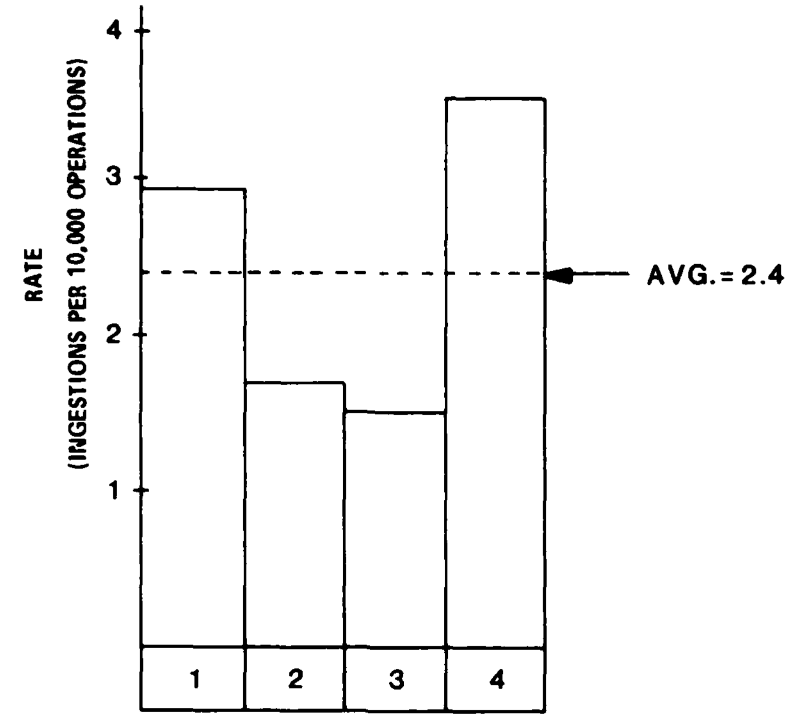


FIGURE 11. WORLDWIDE BIRD INGESTION RATES BY AIRCRAFT TYPE

The data of figure 11 addresses the worldwide ingestion rates. At this point it became apparent that the relationship between worldwide, U.S., and foreign operations must be established for comparison purposes. The OAG data tapes were used to determine this operational distribution. The results of this analysis are shown in table 4. In table 4, the "Fleet Total" figures may not be the sum of the individual aircraft types, due to rounding off of the numbers. Attempts were made to construct ingestion rates for individual aircraft types in U.S. and foreign operations. This approach was abandoned because of the inability to determine into which category, U.S. or foreign, the "Unknown" location events should be placed. A bias would have been introduced into either the U.S. or foreign ingestion rates had these "Unknown" location events been incorporated.

TABLE 4. OPERATIONAL DISTRIBUTION

Aircraft Type	United States (U.S.)		Foreign		Worldwide
1	114,000 (28%)	+	297,000 (72%)	=	411,000
2	151,000 (48%)	+	164,000 (52%)	=	316,000
3	125,000 (48%)	+	137,000 (52%)	=	263,000
4	35,000 (16%)	+	179,000 (84%)	=	214,000
FLEET TOTAL	426,000 (35%)	+	777,000 (65%)	=	1,203,000

NOTE. ( ) represent percent of worldwide total by type

It is important to understand during what portion of a typical flight a bird ingestion is likely to occur. Of the 289 events which were studied during the first year, 43 percent of the ingestions occurred during the takeoff and climb phase of flight, while 28 percent occurred during the aproach and landing phases. With few exceptions, such as descent and taxi, the remaining phases of flight (approximately 25 percent) were unknown. This is again attributable to those cases which were discovered during maintenance or post/preflight inspections.

Figure 12 graphically depicts the phases of flight where the ingestions occurred. The phase of flight data used to generate this graph is that which was reported by the engine manufacturers who ultimately received it from the operator of the aircraft. It is recognized that phase of flight definitions vary considerably in the industry, however, the data is a compilation from many operators and it is assumed normal data scatter would tend to mitigate any bias in phase of flight definitions.

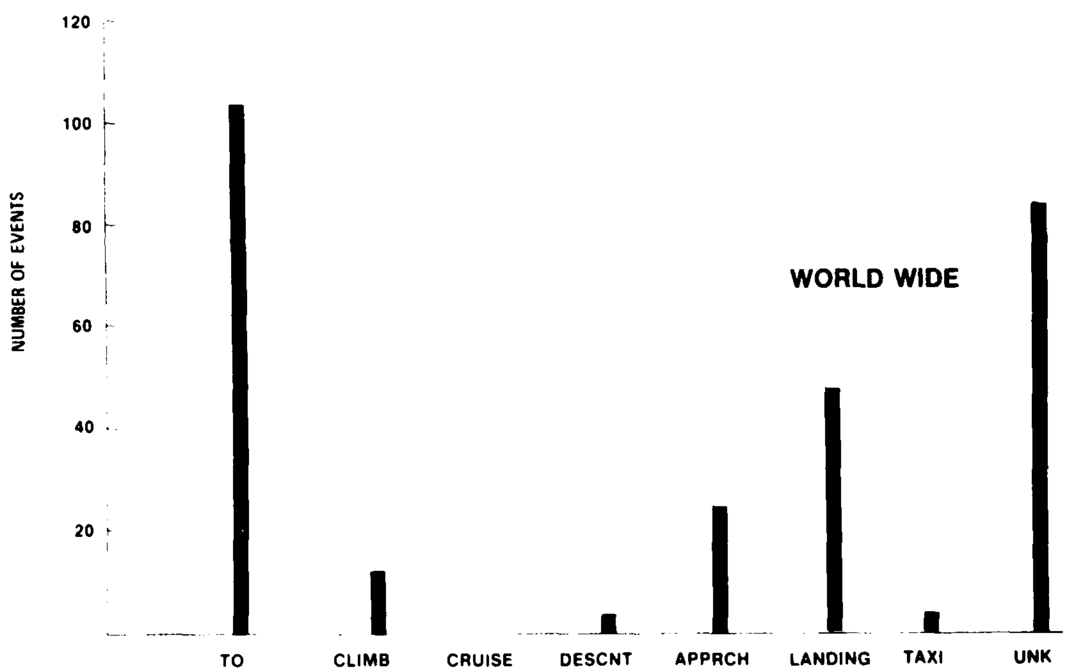


FIGURE 12. FREQUENCY VS PHASE OF FLIGHT

Tables 5 and 6 list the types of birds ingested during this study which have been identified. In the United States, the most frequently ingested birds are the gulls which account for 18 of the 28 known birds (out of 37 events). The two most frequently ingested foreign bird species are kites and gulls. Together, these two groups account for half of the foreign ingestions (38 out of 76 birds) in those cases where the bird is known. The range of weights of gulls is between 1 and 4 pounds, while kites average between 1 1/2 to 2 1/2 pounds.

TABLE 5. BIRD TYPES, UNITED STATES

Type of Bird	Number of Birds
GULL	18
Herring	
Ring-billed	
Great Black-back	
Laughing	
Undetermined	
CANADA GOOSE	3
MALLARD DUCK	2
PIGEON	2
HAWK	2
Red-tailed	
Rough-legged	
COWBIRD	1

TABLE 6. BIRD TYPES, FOREIGN

Type of Bird	Number of Birds	Type of Bird	Number of Birds
KITES	20	DUSKY THRUSH	1
Black		ROLLER	1
Red		MEADOWLARK	1
GULLS	18	CORNCRAKE	1
Herring		LAPWING	1
Great Black-backed		FRANCOLIN	1
Black-tailed		THICK KNEE	1
Black-headed		ROOK	1
Ring-billed		RED-TAILED HAWK	1
Gray-head		CANADA GOOSE	1
Common		HERON	1
Undetermined		WHITE VULTURE	1
PIGEONS	5	INDIAN VULTURE	1
DOVES	4	AFRICAN STORK	1
CROWS	3		
GODWITS	3		
PLOVERS	3		
DUCKS	2		
OWLS	2		
BATS	2*		

*Included with birds because of flight behavior

As mentioned, it has been possible to validate the weight of the birds in 145 cases out of the 289 events which occurred. Twenty-eight birds were ingested in the United States while 105 birds were ingested outside the United States (foreign). It was not possible to determine the location for 12 bird ingestion cases. Figure 13 depicts the worldwide bird weight distribution. For the foreign data, there were 5 cases where the bird ingestion weight was equal to or greater than 4 pounds (64 ounces). In the United States, this occurred in 3 cases.

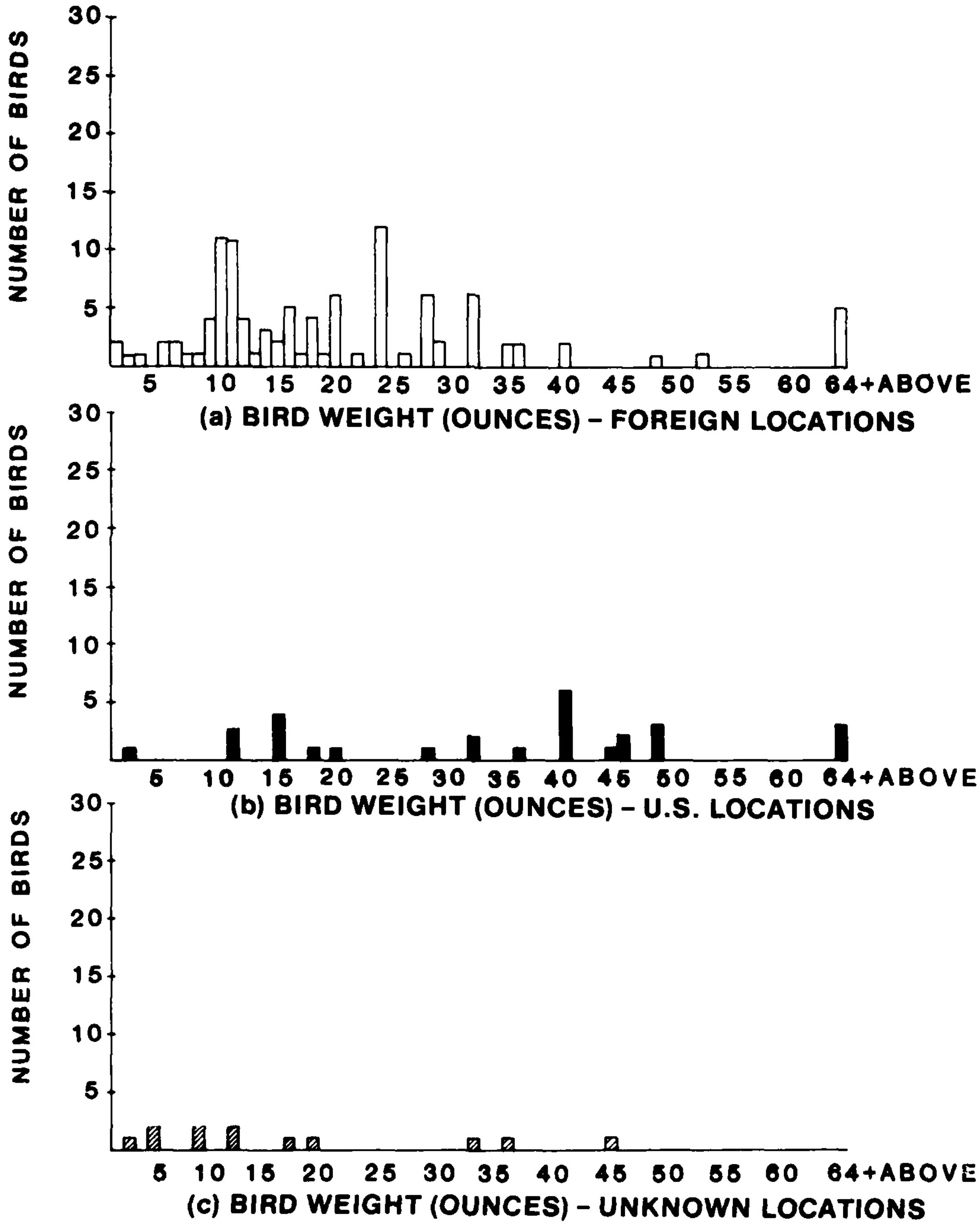


FIGURE 13. WORLDWIDE BIRD WEIGHTS

Table 7 summarizes the bird weight distribution. The most likely weight is that weight which occurs the most frequently. The weight at which an equal number of weights occur, both above and below it, is called the median weight. Examination of table 7 shows a decidedly different distribution of weights most noticeably the smaller size of the foreign versus U. S. birds.

TABLE 7. BIRD WEIGHT (IN OUNCES) SUMMARY

	Foreign	(+) U.S.	(+) Unknown	(=) Worldwide
Number	105	28	12	145
Average Weight	25	37	16	25
Most Likely Weight	24	40	4-8-11	11
Median Weight	17	40	11	11

Of the 289 bird ingestion events which were reported during the first year of this study, there were 11 events in which two or more engines per aircraft ingested at least one bird each (multiple engine ingestion), and 13 events wherein two or more birds were ingested into one engine (multiple birds per engine). Although these two types of ingestions can be considered independent events (one can occur without the other), during this study 3 events were reported wherein both phenomena occurred simultaneously. Figures 14 and 15 show the distribution of these events during the study period.

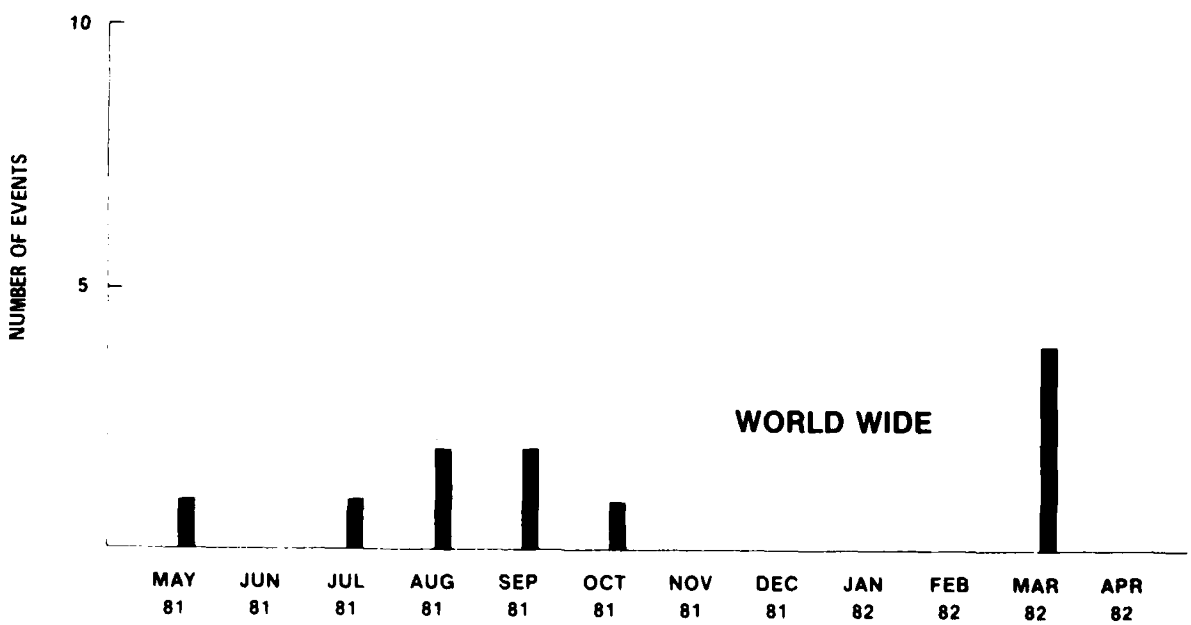


FIGURE 14. FREQUENCY BY MONTH FOR MULTIPLE ENGINE INGESTIONS

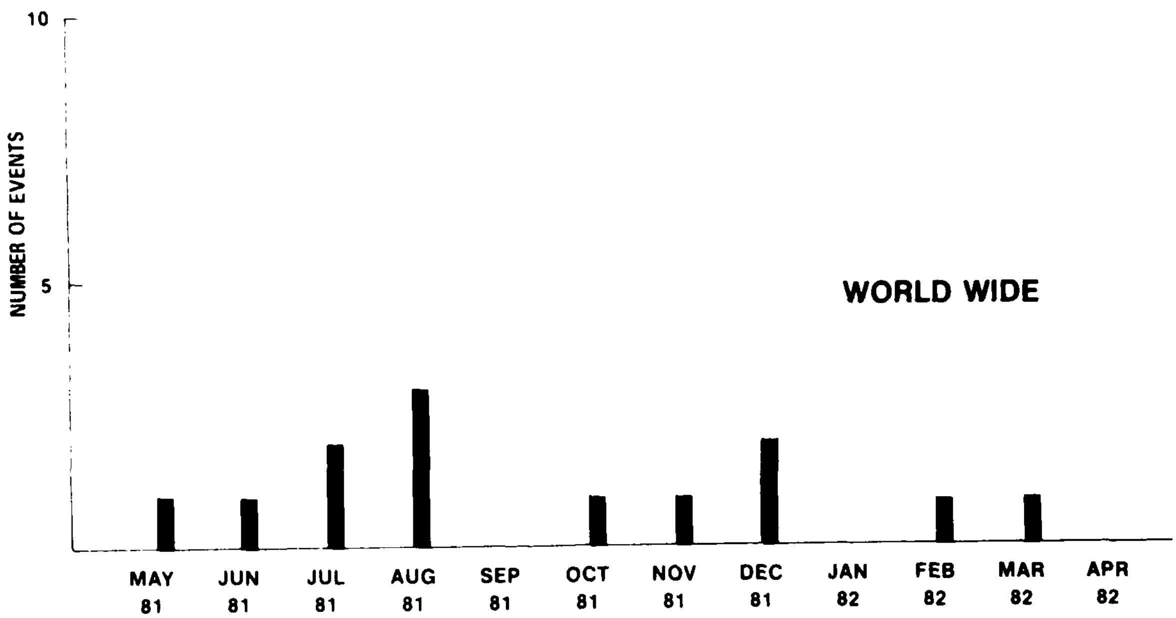


FIGURE 15. FREQUENCY BY MONTH FOR MULTIPLE BIRDS PER ENGINE

The first year's data emphasized that in some instances it was difficult to assess the exact number of birds ingested into an engine. To minimize this problem, a meeting of the three engine manufacturers' representatives and FAA Technical Center personnel was held to discuss "bird printing" methodology. As a result, it is anticipated, during the second year's effort of this study, that the reporting of multiple bird ingestions per engine events will be more consistent. This information is necessary since the present engine certification criteria are based, in part, on a fixed quantity of birds which are required to be ingested into an engine. NTSB recommendation, A-76-64, specified, in part, that "the numbers and sizes (of birds which are ingested during certification) should be consistent with inservice experience."

ANALYSIS

To examine certain hypotheses, statistical and analytical examinations of the data have been conducted. The results of these examinations are presented in the OBSERVATIONS section of this interim report.

The question has been asked "Are the U.S. and foreign rates similar for both the single and multiple engine ingestions?" Table 8, which combines the data from table 1 and table 4, presents the bird ingestion rates for U.S., foreign, and worldwide areas. Figure 16 graphically illustrates the data of table 8.

TABLE 8. BIRD INGESTION RATES

	Ingestion Events	Operations	Rate (Ingestions/10,000 Ops.)
Worldwide	289	1,203,000	2.40
Foreign			
*Minimum	212	777,000	2.73
*Maximum	245	777,000	3.15
U.S.			
*Minimum	44	426,000	1.03
*Maximum	77	426,000	1.81

* See Table 1.

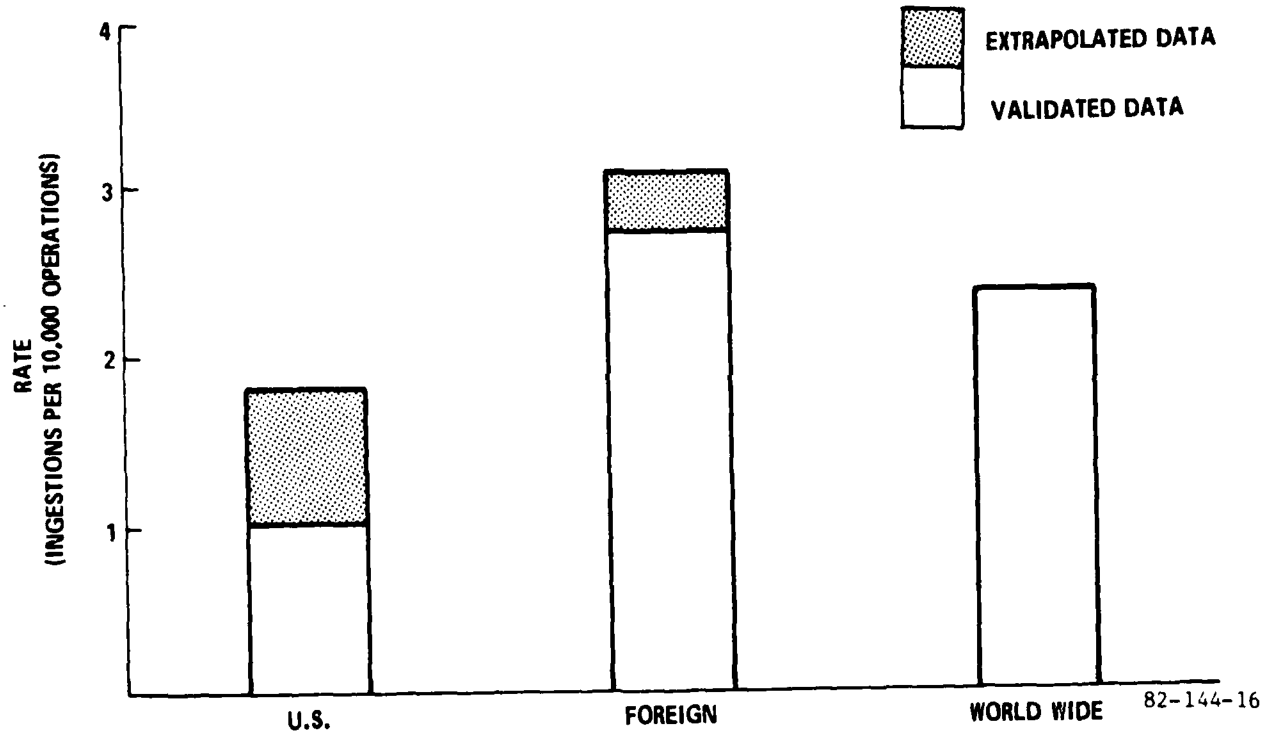


FIGURE 16. BIRD INGESTION RATES

To examine the question posed, a statistical test-of-hypotheses procedure was employed. The procedure is explained in appendix B. Examining the multiple engine ingestion events first (figure 14), the data reveals that two U.S. and nine foreign events occurred. Two events per 426,000 operations (see table 8) yields a U.S. multiple ingestion rate of 4.69×10^{-2} per 10,000 operations.

The 9 foreign multiple ingestions in 777,000 operations (see table 8) yields a foreign multiple ingestion rate of 1.16×10^{-1} per 10,000 operations. The upper and lower bounds of the 95 percent confidence interval about the foreign multiple engine ingestion data have values of 2.25×10^{-1} and 5×10^{-2} respectively. Since the U.S. ingestion rate is not encompassed by the 95 percent confidence interval of the foreign data, one may conclude that the U.S. and foreign multiple engine ingestion rates are statistsically different. These computations are illustrated in figure 17.

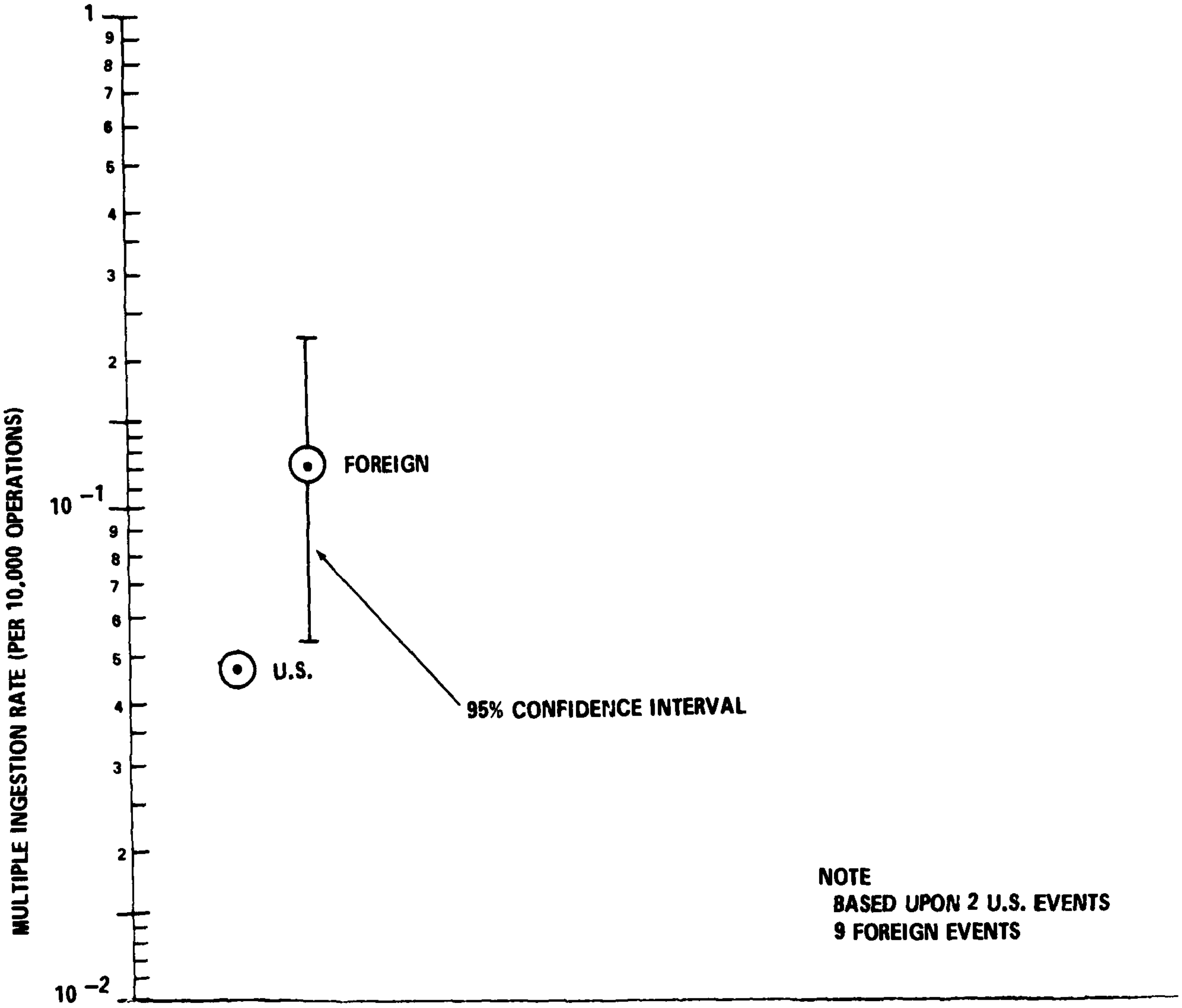


FIGURE 17. MULTIPLE ENGINE INGESTIONS, U.S. VERSUS FOREIGN

A similar test was conducted for the rate of U.S. versus foreign ingestion events (table 1). The calculated U.S. validated ingestion rate is 0.87 per 10,000 operations. Using the described statistical procedure, the confidence interval for the U.S. ingestion rate ranges between 0.61 and 1.20 per 10,000 operations. The foreign validated ingestion rate is 2.15 ingestions per 10,000 operations. Since the foreign ingestion rate does not lie within the 95 percent confidence interval of the U.S. ingestion rate, (figure 18) the conclusion is that the U.S. and foreign rates of bird ingestions per 10,000 operations are, in fact, statistically different.

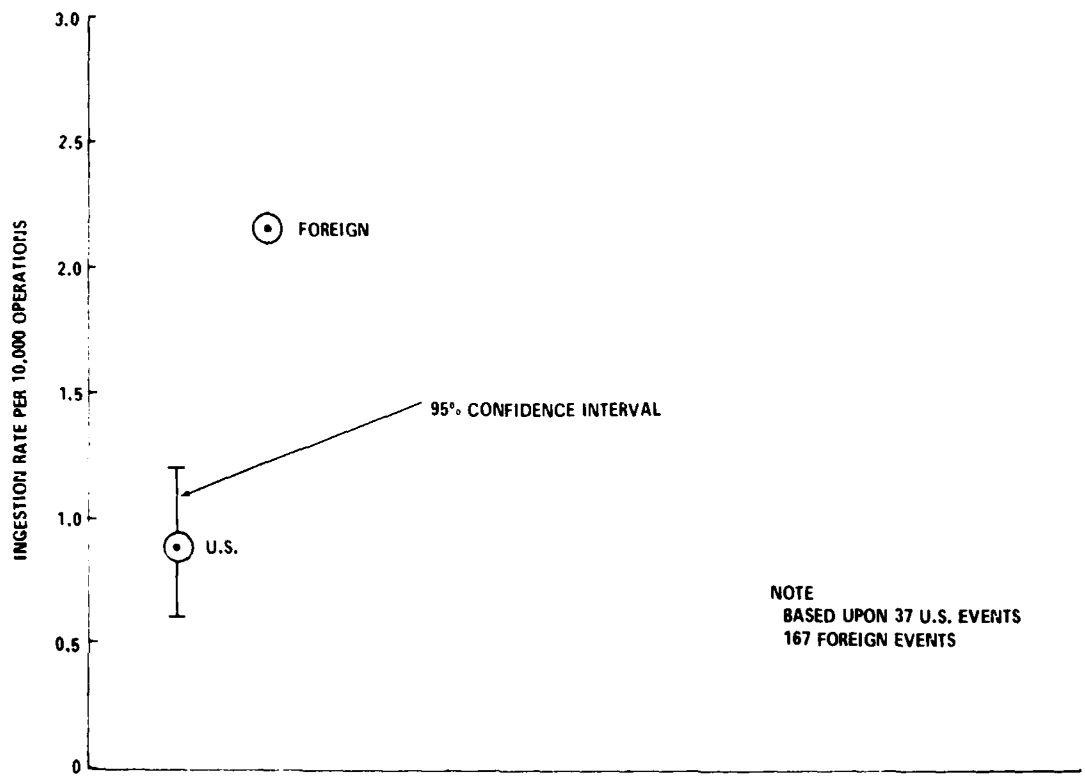


FIGURE 18. INGESTION RATES, U.S. VERSUS FOREIGN

Attempts have been initiated to determine why the U.S. and foreign ingestion rates are different, but the results to date are inconclusive. As mentioned previously, such factors as operator route structure, operational procedures, and others may contribute to this difference, but these parameters are difficult to assess.

Figure 19 illustrates the differences between the U.S. and foreign bird ingestion occurrences. The data used to construct figure 19 consists of 28 U.S. events and 105 foreign events for which the bird weights and locations are known (figure 13). Both sets of weight data were grouped into quarter pound increments to determine what percentage of the weights occurred at or below a specific weight. Beyond 48 ounces (3 pounds) the data became too sparse to be meaningful. The figure also presents the 95 percent confidence interval of the U.S. weights at the discrete quarter pound increments. As an aid to the reader, the discrete quarter pound increments of the U.S. and foreign distributions are connected by a smooth line but it must be remembered that this analysis is valid only at the discrete quarter pound increments. It is interesting to observe that the foreign data set is intersected by a U.S. confidence interval only at the extremely low and high weights. The inference is that although U.S. bird weights are generally higher than foreign bird weights (table 7) the probability of the bird ingestion being of the same weight is about the same only for the extremes of the weight data. However, between approximately three-quarters of a pound and 3 pounds, the data sets are different. For example, a bird weight of approximately one pound or less is ingested 50 percent of the time in the foreign environment, however, the U.S. data suggests that for the same 50 percent of the time a 2 1/2 pound or less bird will be ingested.

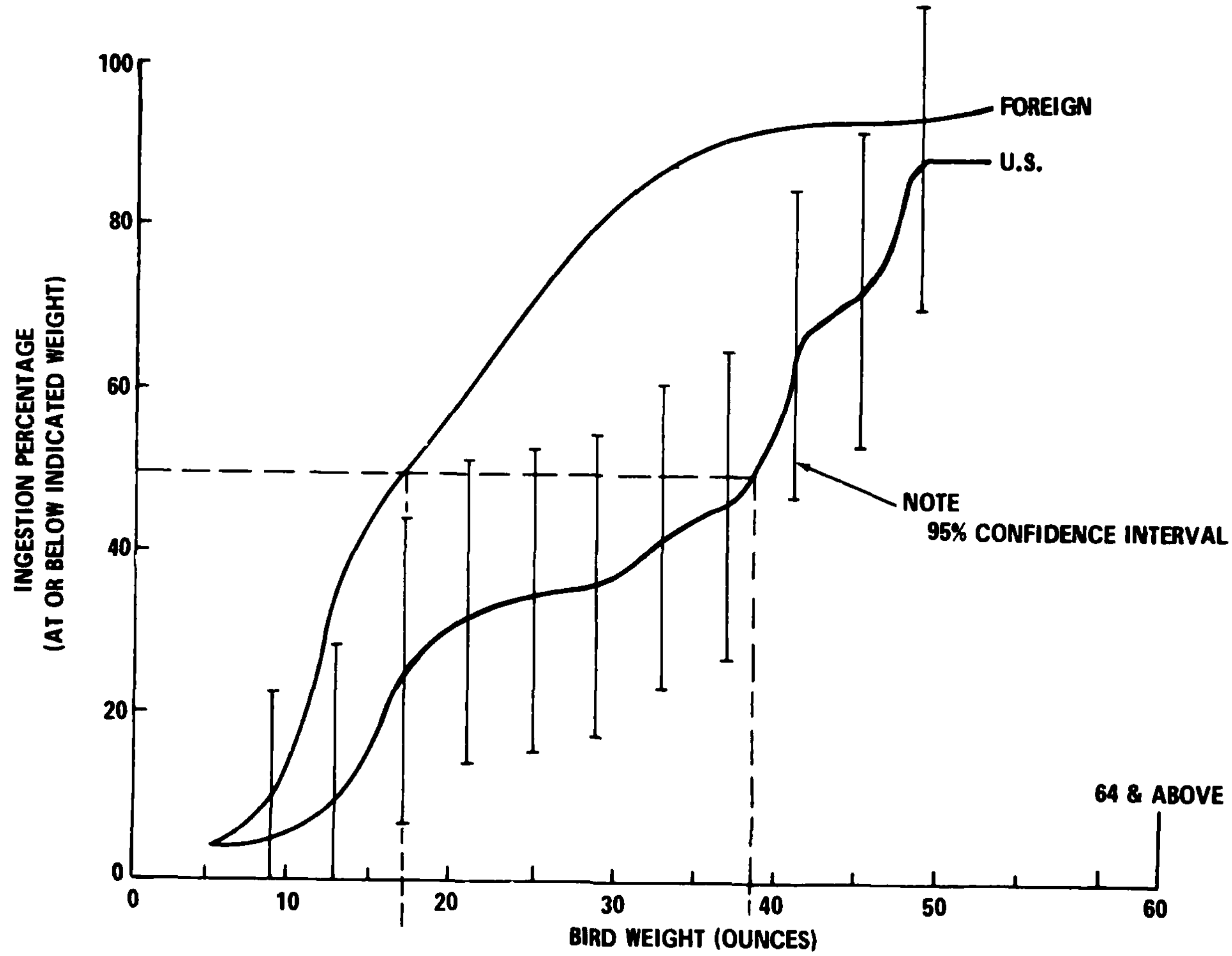


FIGURE 19. U.S./FOREIGN INGESTION AT OR BELOW A GIVEN WEIGHT

The question of which airports, where high bypass ratio turbine engine aircraft operations are conducted, experience the greatest number of ingestions is partially answered in table 9. Figure 20 illustrates table 9 data. It is not possible to compare the absolute number of ingestion events among airports because of the diversity in the numbers of operations conducted. Therefore, a comparison of ingestion rates per 10,000 operations is given. It is apparent, however, that a calculation of the ingestion rate at an airport which has an extremely low operations count produces an ingestion rate which is subject to considerable statistical uncertainty. For example, an airport which experiences one bird ingestion in a year and has only 124 operations (such a case exists), produces an ingestion rate of 80.65 which has such a wide interval of uncertainty associated with it as to make it meaningless. In order to avoid such unfair comparisons, table 9 presents only those airports at which the operations counts for the aircraft types which were monitored during this study are at least 10,000. In order not to bias the data, airports which have had at least 10,000 operations, even though no bird ingestions were reported, are included in table 9.

TABLE 9. AIRPORT WIDE-BODY INGESTION RATES

(10,000 or More Operations)

Airport	Operations	Ingestions	Rate	Rank
ORY	18454	10	5.42	1
BOM	11407	6	5.26	2
FCO	12080	5	4.14	3
HND	30247	11	3.64	4
YYZ	11271	4	3.55	5
CDG	19600	6	3.06	6
LGA	10639	2	2.91	7
LHR	28853	7	2.43	8
JFK	53271	11	2.07	9
JED	11035	2	1.81	10
OSA	25708	4	1.56	11
LAX	46058	5	1.09	12
ATH	10201	1	0.98	13
MIA	31883	3	0.94	14
SFO	22762	2	0.88	15
ATL	27841	2	0.72	17
BKK	16466	1	0.61	18
HKG	18438	1	0.54	19
BOS	19511	1	0.51	20
ORD	35924	1	0.28	21
NRT	24008	0	-	-
HNL	20007	0	-	-
SIN	19224	0	-	-
SEA	13777	0	-	-
SYD	12766	0	-	-
RUH	11266	0	-	-
TPE	10962	0	-	-
CTS	10498	0	-	-
EWR	10351	0	-	-
ANC	10091	0	-	-

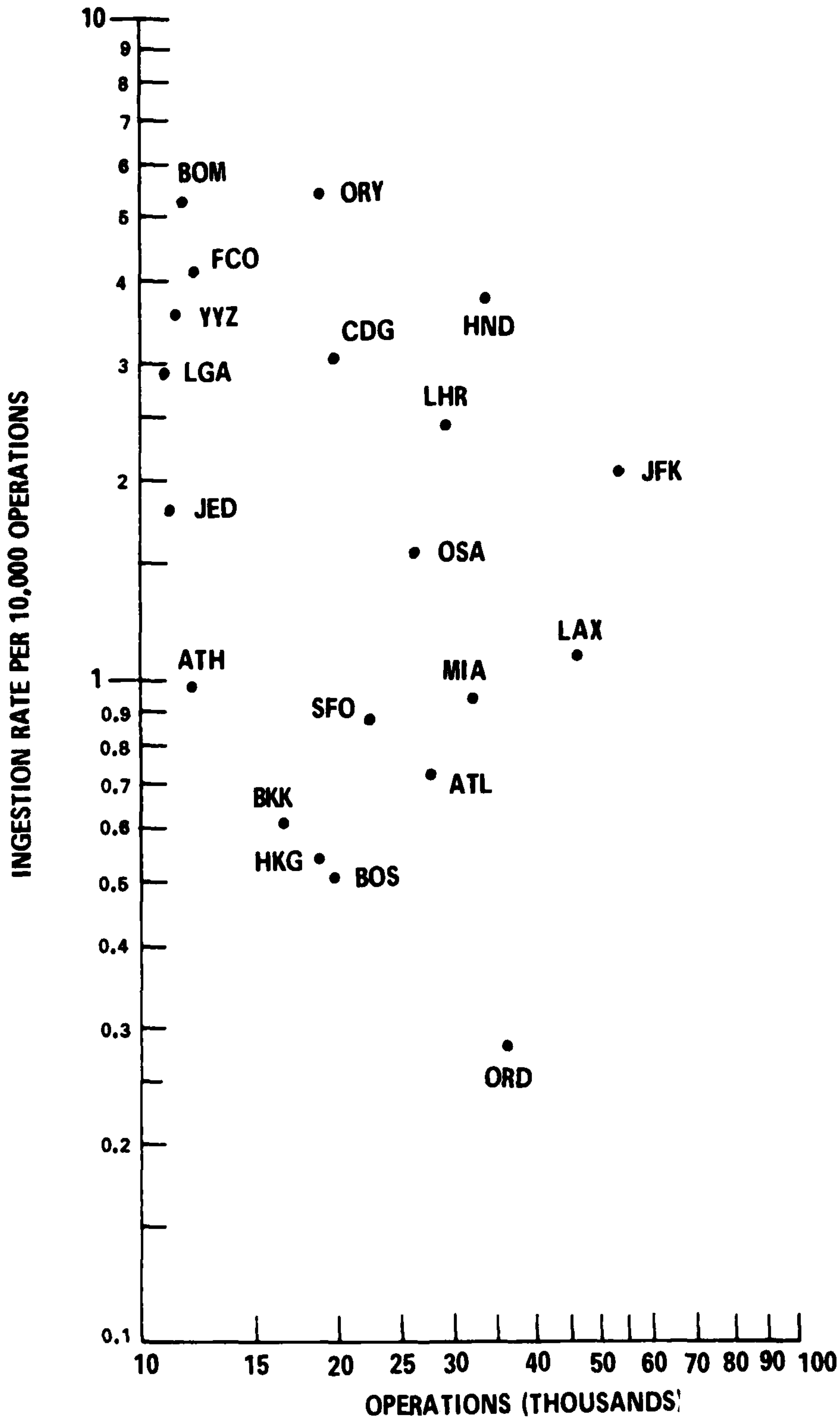


FIGURE 20. INGESTION RATE VERSUS AIRPORT OPERATIONS (WIDE-BODY ONLY)

It has been stated that of the total 289 events which were reported, 188 events resulted in some type of damage, whether minor or major. Of these 188 damaging events it has been determined that 17 of these resulted in engine failure. For this study an engine failure is based upon engineering judgement which encompasses many criteria among which is the engine's ability to attain and/or maintain 50 percent thrust. Figure 21 illustrates the number of birds ingested at a specific weight range. Each open circle represents an ingestion, each filled-in circle represents a resultant engine failure.

An engine failure upon ingestion of a 4-pound or heavier bird is not unexpected and this occurred in 3 out of the 8 ingestions reported. Similarly, ingestion of 8 or more medium size (1 1/2 pound) birds is not unexpected (although no such event occurred during the study period). However, 2 ingestions of 8 or more birds were reported in the 1/2 to 3/4 pound category which resulted in engine failure. Significantly, the engine also failed in the 6 remaining ingestions (out of 13 total) where 2 or more birds per engine were ingested. Finally, in 12 out of the 17 engine failure events the individual bird weight ranged between 1/2 and 1 1/4 pounds. These observatons are depicted in figure 21. Based upon these observations it becomes apparent that the correlation between bird weight and engine failure is inconsistent in many cases.

Table 10 reviews some of the relationships which have been presented in this report.

TABLE 10. BIRD INGESTION SUMMARY

	Total Ingestions (289 Events)	Damaging Ingestions (188 Events)	Engine Failure Ingestions (17 Events)
Takeoff + Climb	43%	56%	75%
Approach + Landing	28%	21%	25%
Multiple Bird Ingestions Per Engine	13 (5%)	11 (6%)	8 (47%)
Multiple Engine Ingestions	11 (4%)	5 (3%)	1 (6%)

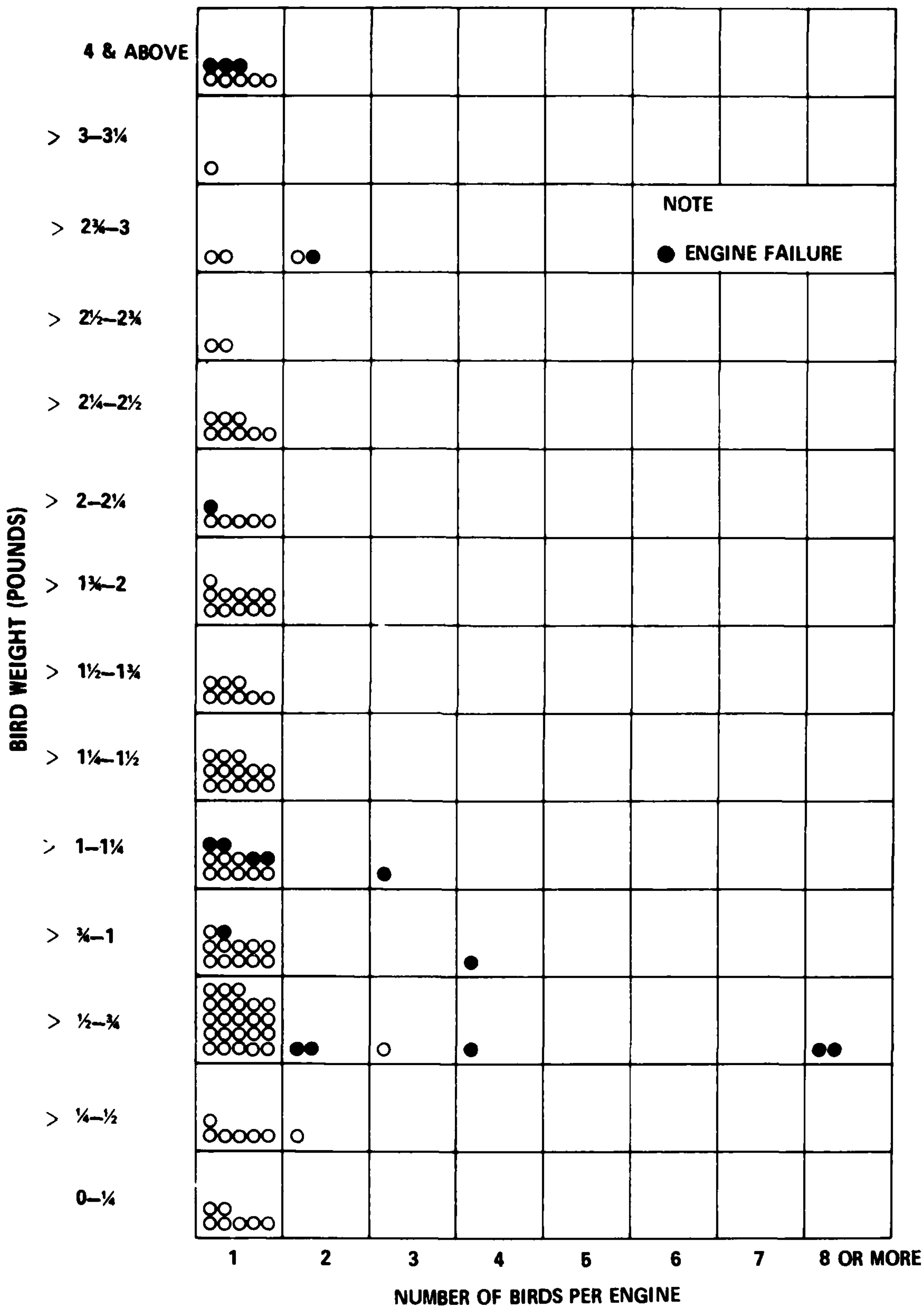


FIGURE 21. BIRD WEIGHT, NUMBER PER EVENT AND ENGINE FAILURE DISTRIBUTION

Certain aspects of table 10 warrant further attention:

1. Takeoff and climb phases of flight produce the highest percenta es in all categories.

2. Not withstanding item 1, the approach and landing phases of flight produce a constant percentage across all three categories of engine ingestions.

3. Multiple bird ingestions per engine occur in a significantly high percentage of the engine failure events.

4. Multiple engine ingestions do not produce significant percentages (relative to item 3) in any category (columns).

OBSERVATIONS

Some preliminary observations can be made based upon the first year's data.

1. The first year's data sample is considered too small in most instances to allow conclusions. This was apparent during the statistical analysis of the United States (U.S.) versus foreign multiple bird ingestion evaluation and also during the airport bird ingestion rate analysis.

2. The bird weight versus engine failure correlation is inconsistent in many cases as evidenced by figure 21. It is outside the scope of this investigation to explain this inconsistency.

3. The U.S. versus foreign engine ingestion rates are not statistically similar. This may be biased by the sample size.

4. The approach and landing phase of flight should also be considered in all bird ingestion data analysis since a significant portion of the events occur in these phases.

APPENDIX A

AIRPORT IDENTIFIERS

APPENDIX A

AIRPORT IDENTIFIERS

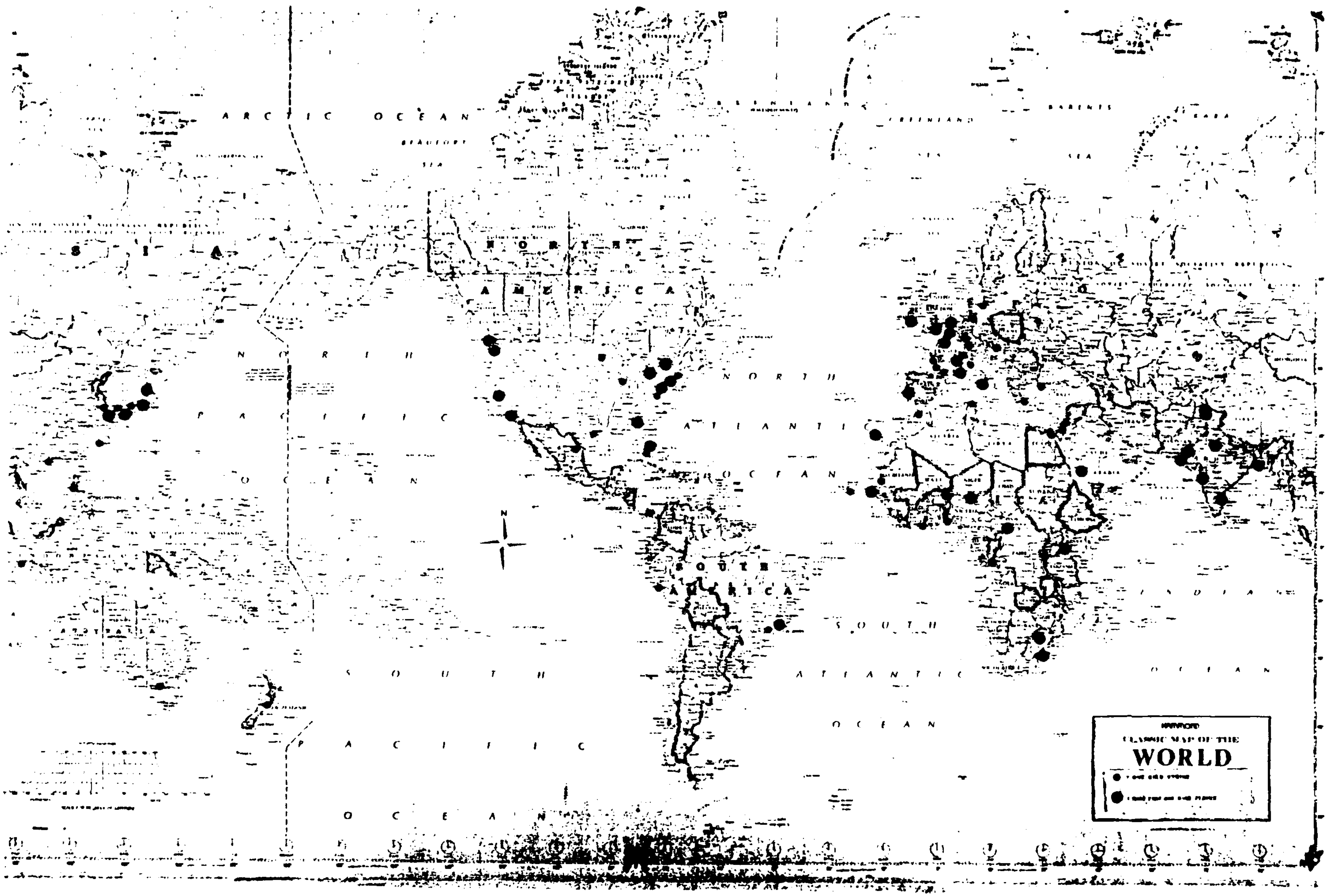
ABJ	Abidjan, Ivory Coast
AMM	Amman, Jordan
AMS	Amsterdam, Netherlands
ATH	Athens, Greece
ATL	Atlanta, Ga., USA
BGF	Bangui, Cen. African Republic
BKK	Bangkok, Thailand
BOD	Bordeaux, France
BOM	Bombay, India
BOS	Boston, Mass. USA
BRU	Brussels, Belgium
BWI	Baltimore, MD., USA
CAI	Cairo, Arab Rep. of Egypt
CCU	Calcutta, India
CDG	Paris, France, Charles De Gaulle Arpt.
CPH	Copenhagen, Denmark
DEL	Delhi, India
DKR	Dakar, Senegal
DPS	Denpasar, Indonesia
DUR	Durban, South Africa
KMQ	Komatsu, Japan
LAX	Los Angeles, CA, USA
LCA	Larnaca, Cyprus
LGA	Laguardia Airport, NY, USA
LGW	London Eng., Gatwick Airport
LHR	London Eng.,Heathrow Airport
LIM	Lima, Peru
LIS	Lisbon, Portugal
LOS	Lagos, Nigeria
LPA	Las Palmas, Canary Is.
LYS	Lyon, France
MAA	Madras, India
MEL	Melbourne, Australia
MIA	Miami, Fla., USA
Mil	Milan, Italy
MNL	Manila, Philippines
MPL	Montpellier, France
MRS	Marseille, France
MTY	Monterrey, Mexico
MWH	Moses Lake, Wash. USA
NBO	Nairobi, Kenya
NGO	Nagoya, Japan
NGS	Nagasaki, Japan
NIM	Niamey, Niger
NKC	Nouakchott, Mauritania
FCO	Rome, Italy, L. Da Vinci Arpt.
FEZ	Fez, Morocco
FIH	Kinshasa, Zaire
FLL	Ft. Lauderdale/Hollywood, Fla., USA
FRA	Frankfurt, Republic of Germany
FUK	Fukuoka, Japan
GIG	Rio de Janeiro, Brazil (International)
HAM	Hamburg, Rep. of Germany
HKG	Hong Kong, Hong Kong
HND	Haneda Airport, Tokyo, Japan
HYD	Hyderabad, India
IAH	Houston, Texas, USA
IST	Istanbul, Turkey
JED	Jeddah, Saudi Arabia
JFK	John F. Kennedy Int. Airport, New York, USA
JNB	Johannesburg, So. Africa
KAN	Kano, Nigeria
KHI	Karachi, Pakistan
OKA	Okinawa, Ryukyu Is., Japan
ORD	Chicago, Ill, O'Hare Airport, USA
ORY	Paris, France, Orly Airport
OSA	Osaka, Japan
PEN	Penang, Mayalasia
PHL	Philadelphia, PA., USA
PTY	Panama City, Panama Republic
PUS	Pusan, Rep. of Korea
RST	Rochester, Minn., USA
VCP	Sao Paulo, Brazil, Viracopos Airport
SFO	San Francisco, CA, USA
SID	Sal Island, Cape Verde IS.
SNN	Shannon, Rep. of Ireland
STR	Stuttgart, Rep. of Germany
SXR	Srinagar, India
TLS	Toulouse, France
TLV	Tel Aviv-Yafo, Israel
TUN	Tunis, Tunesia
VIE	Vienna, Austria
WLG	Wellington, New Zealand
YUL	Montreal, Quebec, Canada
YVR	Vancouver, Br. Columbia, Canada
YYZ	Toronto, Ontraio, Canada
ZRH	Zurich, Switzerland

APPENDIX B

STATISTICAL PROCEDURE

APPENDIX C

WORLD MAP: BIRD INGESTION LOCATIONS, FIRST YEAR


CLASSIC MAP OF THE
WORLD
ARCTIC OCEAN
NORTH AMERICA
SOUTH AMERICA
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
ASIA

DATA RECORDED & PROCESSED AT FAA TECHNICAL CENTER, ATLANTIC CITY AIRPORT, N.J. 08405 ON 10/18/82 G FRINGS ACT-320

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# BD	AV WT OZ	PILOT ACT	SIGNIFICANT REASON
1	050381	0000	ABJ	CLIMB	UNK	3 BLDS	YES	YES	VIBES,PRECAUTION	UNK	UNK	0	0	ATB	N/A
2	050681	0000	DRY	TO	UNK	4 BLDS	YES	YES	N/A	YES	PIGEONS	0	0	ATO	MULT. ENG INGEST
2	050681	0000	DRY	TO	UNK	4 BLDS	YES	YES	N/A	YES	PIGEONS	0	0	ATO	MULT. ENG INGEST
3	050681	1830	KVP	TO	VFR	5 BLADES BENT	YES	YES	VIBES, BY PILOT	YES	CROW	1	24	ATB	MULTIPLE BIRDS
3	050681	1830	KVP	TO	VFR	5 BLADES BENT	YES	YES	VIBES, BY PILOT	YES	DUCK	1	48	ATB	MULTIPLE BIRDS
4	051381	0000	BOM	TO	UNK	ALL BLDS,1 BKN	YES	NO	N/A	UNK	KITE	1	16	ATO	BLD FRACTRE
5	051981	0000	XXX	TO	UNK	2 BLADES	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
6	051981	0000	XXX	UNK	UNK	1 BLD NICKED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
7	052281	0000	KFO	UNK	UNK	N/A	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
8	052381	1430	KFO	UNK	VFR	13 BLDS	NO	YES	N/A	NO	BLK PARTRIDGE	1	12	N/A	N/A
9	052781	0000	FCO	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
10	052881	1422	AMM	TO	UNK	N/A	YES	N/A	VIBES,PRECAUTION	YES	UNK	0	0	N/A	N/A
11	053081	1730	JFK	CLIMB	UNK	14 BLDS	NO	YES	N/A	NO	UNK	1	32	N/A	N/A

****** SAMPLE SIZE FOR MAY 81 = 11 # STRIKES WITH DAMAGE = 8 % = 72.727

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# BD	AV WT OZ	PILOT ACT	SIGNIFICANT REASON
12	060281	0000	LYS	TO	UNK	N/A	NO	N/A	N/A	UNK	RED KITE	1	36	N/A	N/A
13	060381	0000	OJP	TO	UNK	3 BLDS-M INOP	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
14	060581	0127	TLV	TO	VFR	4 BLDS BENT	NO	YES	N/A	NO	BARN OWL	1	16	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWER LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
15	060881	0000	SAO	TO	UNK	2 BLDS [illegible]	YES	YES	N/A	UNK	UNK	0	0	ATP	N/A
16	061381	0000	XFO	UNK	UNK	NO	NO	YES	N/A	UNK	RED KITE	1	32	N/A	N/A
17	061081	1200	LHR	TO	UNK	FRACTRD BLD,REFT	YES	YES	ENG QUIT,HI EGT	UNK	ROCK DOVE	2	11	ATP	TRANSVERSE FRACT
18	061281	0000	KHI	TO	VFR	4 BLDS-L [illegible]	YES	YES	N/A	UNK	BLK KITE	1	24	N/A	N/A
19	061381	0000	LYS	LANDNG	VFR	N/A	N/A	N/A	N/A	UNK	BUZZARD	0	0	N/A	N/A
20	061381	0000	XXX	UNK	UNK	1 BLD DEFRMD	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
21	061381	0000	MWH	TO	UNK	IGV/HPC BLD CLSH	NO	YES	N/A	UNK	SEAGULL	0	0	N/A	N/A
22	061481	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
23	061581	0700	PHL	LANDNG	VFR	10 PLANE S,CONL	NO	YES	N/A	NO	HERRING GULL	1	48	N/A	N/A
24	061681	0000	DKR	TO	VFR	3 BLDS BENT	YES	N/A	N/A	UNK	UNK	0	0	N/A	N/A
25	061681	0000	CDG	UNK	UNK	2 BLDS-MINOR	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
26	061781	0000	LYS	TO	VFR	7 BLDS DEFRMD	YES	YES	N/A	UNK	UNK	0	0	N/A	N/A
27	061781	0000	ORY	TO	VFR	3 BLDS DFRMD	YES	YES	N/A	UNK	PIGEON	1	35	N/A	N/A
28	061781	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
29	061881	0000	ORY	TO	VFR	N/A	NO	N/A	N/A	UNK	PIGEONS	0	0	N/A	N/A
30	061981	0000	AMS	TO	UNK	4 BLDS DMGD	YES	YES	VIBES	UNK	UNK	0	0	ATB	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
31	061981	0000	SIG	LANDNG	UNK	2 BLDS	NO	YES	N/A	UNK	UNK	0	0	ATB	N/A
32	062081	0000	KAN	TO	UNK	5 BLDS	YES	YES	VIBES	UNK	BLK KITE	1	24	UNK	N/A
33	062281	0000	XXX	UNK	UNK	1 BLD	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
34	062381	0000	JFK	APPRCH	VFR	N/A	NO	N/A	N/A	YES	SEA GULL	1	0	N/A	N/A
35	062381	0830	HND	APPRCH	IFR	N/A	NO	YES	N/A	YES	UNK	0	0	N/A	N/A
36	062581	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	BLACK SWIFT	1	2	N/A	N/A
37	062581	0000	OKP	TAXI	UNK	NO	UNK	YES	N/A	NO	FRANCOLIN	1	10	N/A	N/A
38	062681	0000	LYS	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
39	062 81	0000	LIS	TO	UNK	2 BLDS BENT	NO	YES	N/A	YES	ROCK DOVE	1	10	N/A	N/A
40	062781	0700	JNB	TO	VFR	NO	YES	YES	HI EGT,1 P4S C	UNK	GRAY HEADED GULL	1	16	ATB	INVLNTRY PWR LOSS
41	062881	0000	MPL	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	UNK	1	35	UNK	N/A
42	062881	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	BARN OWL	1	16	N/A	N/A
43	062981	0000	MNL	TO	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
****** SAMPLE SIZE FOR JUN 81 = 32				# STRIKES WITH DAMAGE = 20						% = 62.500					
44	070381	0000	DEL	LANDNG	VFR	2 HPC BL SHINGLED	NO	YES	N/A	UNK	BLK KITE	1	24	N/A	N/A
45	070381	0000	XUS	UNK	UNK	3 BLDS BENT	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
46	070381	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
47	070681	0000	BOD	LANDNG	UNK	5 BLADES BENT	NO	YES	N/A	UNK	BLK KITE	1	29	N/A	N/A
48	070681	0000	LGW	TO	UNK	ALL BLDS ,1 BKN	YES	NO	ENGINE FAILURE	UNK	WOOD PIG EON	3	18	ATE	TRNSVRS BLD FRAC
49	070881	0000	CDG	TO	VFR	3 BLDS B ENT	YES	YES	N/A	UNK	UNK	0	0	ATB	N/A
50	071081	0000	MPS	APPRCH	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
51	071081	0000	XXX	UNK	VFR	N/A	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
52	071081	1930	ATL	TO	VFR	2 BLADES BENT	YES	YES	N/A	YES	PIGEON	1	0	ATO	N/A
53	071181	0000	NGO	TO	UNK	4 BLDS	NO	YES	N/A	NO	LAPWING	1	10	N/A	N/A
54	071381	0000	XFO	UNK	UNK	2 BLDS	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
55	071481	0000	DKR	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
56	071481	0000	VKC	TO	VFR	N/A	YES	N/A	N/A	YES	SPARROW HAWK	0	0	ATO	N/A
57	071681	0000	XFO	UNK	UNK	N/A	N/A	N/A	N/A	NO	WHIPORWI LL	1	2	N/A	N/A
58	071681	2123	JFK	TO	VFR	5 BLDS B ENT	NO	YES	PRECAUTI ONARY	UNK	HERRING GULL	1	40	ATB	N/A
59	071781	0000	ORY	TO	VFR	2 BLDS	YES	YES	N/A	UNK	PIGEON	0	0	ATB	N/A
60	071981	0000	XUS	UNK	UNK	4 BLDS	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
61	072181	0000	XFO	UNK	UNK	3 BLDS	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
62	072181	2145	LHR	TO	UNK	ALL BLDS ,1 BKN	YES	NO	VIBES	YES	BLK HEAD ED GULL	2	10	ATB	BLD FRAC TURE

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
63	072281	0000	XUS	UNK	UNK	1 BLADE BENT	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
64	072581	0000	XUS	UNK	UNK	N/A	NO	YES	N/A	NO	GULL	1	0	N/A	N/A
65	072681	1200	XFO	LANDNG	IFR	ACOUSTIC LINING	NO	YES	N/A	NO	CROW	1	8	N/A	N/A
66	073181	0000	LHR	TO	UNK	ACOUSTIC LINING	NO	YES	N/A	YES	BLK HEADED GULL	1	10	N/A	MULTIPLE ENG STK
66	073181	0000	LHR	TO	UNK	3 BLADES DENTED	NO	YES	N/A	YES	BLK HEADED GULL	1	10	N/A	MULTIPLE ENG STK
****** SAMPLE SIZE FOR JUL 81 = 23							# STRIKES WITH DAMAGE = 16					% = 69.565			
67	080181	0000	TLS	TO	UNK	2 BLDS TWISTED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
68	080181	0000	VGS	TO	VFR	5 BLDS	UNK	YES	N/A	UNK	BLK KITE	1	28	UNK	N/A
69	080281	0000	BOM	TO	IFR	3 BLADES ,LINING	NO	YES	N/A	NO	BLACK KITE	1	40	N/A	N/A
70	080281	0000	TYO	LANDNG	UNK	7 BLDS,1 OGV	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
71	080281	0000	YUL	APPRCH	UNK	HPC DAMAGE	NO	YES	N/A	UNK	HOODED MERGANSER	1	19	N/A	N/A
72	080481	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	UNK	TURTLE DOVE	0	4	N/A	N/A
73	080681	0000	DEL	LANDNG	UNK	N/A	NO	YES	N/A	UNK	BLK KITE	1	24	N/A	N/A
74	080781	0000	KHI	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	BLK KITE	1	24	N/A	N/A
75	080781	1200	HND	TO	UNK	NO	NO	YES	MOM HI EGT VIPES	YES	BLUE HERRON	1	0	ATB	N/A
76	080781	2133	PHL	DESCNT	UNK	NO	NO	N/A	N/A	YES	UNK	1	0	N/A	N/A
77	080781	2350	YUL	TAXI	VFR	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
78	080881	0000	XXX	UNK	UNK	2 BLADES	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
79	080881	0000	ROM	TO	UNK	41 BLDS, 2 TORN	NO	YES	N/A	UNK	BLACK KITE	1	24	ATO	N/A
80	080881	0000	XXX	UNK	UNK	N/A	NO	YES	N/A	NO	MORNING DOVE	1	4	N/A	N/A
81	080881	0430	LCA	TO	UNK	NO	YES	N/A	N/A	YES	CORNCRAKE	1	7	ATO	N/A
82	080881	0651	KHI	TO	IFR	6 BLADES	NO	YES	N/A	YES	BLACK KITE	1	24	N/A	N/A
83	080981	0000	DEL	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	ROLLER	1	5	N/A	N/A
84	080981	0000	XFO	UNK	UNK	1 BLD LINING RUP	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
85	081281	0000	SXR	LANDNG	UNK	N/A	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
86	081481	0000	HAM	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
87	081481	0000	XXX	UNK	VFR	2 BLDS BENT	NO	YES	N/A	NO	ROCK DOVE	1	11	N/A	N/A
88	081681	0000	XFO	UNK	VFR	N/A	NO	N/A	N/A	NO	BLACK KITE	1	26	N/A	N/A
89	081781	0000	FIH	TO	UNK	8 BLDS	UNK	YES	VIBES	UNK	UNK	0	0	ATR	N/A
90	081781	0000	XXX	UNK	UNK	1 BLD	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
91	081881	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
92	081981	0000	DEL	LANDNG	UNK	3 BLDS	NO	YES	N/A	UNK	BLACK KITE	1	28	N/A	N/A
93	081981	0000	MAA	TO	VFR	1 BLD NICKED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
94	082081	0000	CDG	TO	VFR	2 BLDS R EPLACED	YES	YES	N/A	UNK	PIGEON	1	11	ATB	N/A
95	082081	0000	XXX	UNK	UNK	N/A	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
96	082181	0402	LHR	LANDNG	VFR	N/A	NO	YES	N/A	YES	GULLS	0	0	N/A	N/A
97	082381	0930	HND	APPRCH	IFR	N/A	NO	YES	N/A	YES	BLK TAIL ED GULL	0	20	N/A	MULT. EN G STRKE
97	082381	0930	HND	APPRCH	IFR	N/A	NO	YES	N/A	YES	BLK TAIL ED GULL	0	20	N/A	MULT. EN G STRKE
98	082481	0000	MIL	TO	VFR	4 BLDS B ENT	YES	YES	N/A	UNK	HOODED C ROW	1	17	ATO	N/A
99	082581	0000	FCO	TO	VFR	7 BLDS	YES	YES	N/A	UNK	UNK	0	0	N/A	N/A
100	082581	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	MULT ENG INGEST
100	082581	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	MULT ENG INGEST
101	082681	0000	FUK	APPRCH	UNK	N/A	NO	YES	N/A	YES	DOMESTIC PIGEON	0	10	N/A	N/A
102	082681	0000	OKA	UNK	UNK	1 BLADE	NO	YES	N/A	YES	GOLDEN P LOVER	2	6	N/A	MULT BRD INGEST
103	082681	0000	ORD	TO	UNK	ALL BLDS ,2 BKN	YES	YES	VIBES	UNK	RING BIL LED GULL	4	15	ATB	TRNSV BL D FRACT
104	082681	0000	XUS	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	1	0	N/A	N/A
105	082681	0750	CPH	TO	UNK	N/A	UNK	N/A	N/A	UNK	HERRING GULL	1	40	UNK	N/A
106	082781	1925	HND	TO	VFR	2 BLDS	NO	YES	N/A	NO	SEA GULL S	0	20	N/A	N/A
107	082881	0000	MTY	TO	VFR	5 BLDS B ENT	YES	YES	N/A	UNK	HAWK	1	29	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	PCWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
108	082981	0000	XXX	UNK	UNK	2 BLDS	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
109	082981	0730	MLG	TO	VFR	IPC/HPC BLDS DMT	YES	YES	3 STALLS OVERTEMP	YES	BLK BACKED GULL	1	32	ATP	N/A
110	082981	1900	OSA	LANDNG	VFR	N/A	NO	N/A	N/A	NO	BATS	0	1	N/A	N/A
111	082981	2030	OSA	APPRCH	VFR	N/A	NO	N/A	N/A	NO	BATS	0	1	N/A	N/A
112	083081	0000	SNN	TO	UNK	4 BLDS PENT	YES	YES	N/A	UNK	ROCK DOVE	1	11	N/A	N/A
113	083081	0000	BKK	LANDNG	UNK	NO	NO	N/A	N/A	UNK	UNK	1	0	N/A	N/A
114	083181	0000	LAX	TO	UNK	9 BLDS	NO	YES	N/A	YES	SEAGULLS	2	0	ATC	MULT BIRDS
****** SAMPLE SIZE FOR AUG 81 = 48				# STRIKES WITH DAMAGE = 29							% = 60.417				
115	090181	0000	STR	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
115	090181	0500	LHR	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
116	090181	0500	LHR	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
116	090181	0500	LHR	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
117	090281	0000	FCO	TAXI	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
118	090581	0000	BOM	TO	UNK	4 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
119	090681	0000	XXX	UNK	VFR	4 BLDS	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
120	090781	0000	YUL	TO	VFR	N/A	NO	N/A	N/A	UNK	CROW	1	16	N/A	N/A
121	090881	0000	KAN	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	WHITE HAWK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
121	090881	0000	KAN	LANDNG	VFR	2 BLDS	NO	YES	N/A	UNK	SHITE HA WK	0	0	N/A	N/A
122	090881	0647	PHL	APPRCH	VFR	IPC,HPC BLDS BNT	NO	YES	N/A	YES	CANADIAN GOOSE	1	112	N/A	N/A
123	091181	0000	LGW	LANDNG	VFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
124	091181	0900	FEZ	TO	VFR	12 BLDS	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
125	091281	1045	DEL	LANDNG	VFR	1 BLD BK N,15 DMG	YES	NO	HIGH EGT 1018 C	YES	INDIAN V ULTURE	1	176	N/A	BLD FRAC TURE
126	091281	1730	LAX	TO	UNK	2 BLDS	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
127	091381	0000	ATL	CLIMB	VFR	2 BLDS B ENT FWD	YES	YES	NOSE COW L DENTED	YES	RED TAIL HAWK	1	40	ATB	N/A
128	091581	0000	HYD	TO	VFR	8 BLDS	YES	YES	N/A	UNK	UNK	0	0	ATB	N/A
129	091581	0500	LHR	LANDNG	VFR	1 BLD BE NT	NO	YES	N/A	UNK	COMMON G ULL	1	15	N/A	N/A
130	091781	0000	ATH	TO	VFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
131	091781	0700	JFK	APPRCH	UNK	13 BLDS	NO	YES	N/A	YES	HERRING GULL	1	20	N/A	N/A
132	091881	1830	FUK	UNK	UNK	N/A	NO	N/A	N/A	NO	BLK TAIL ED GULL	1	20	N/A	N/A
133	092181	0000	HYD	TO	VFR	N/A	NO	N/A	N/A	UNK	BLACK KITE	1	28	N/A	N/A
134	092281	1230	XFO	APPRCH	VFR	N/A	NO	N/A	N/A	UNK	UNK	1	0	N/A	N/A
135	092381	0000	LGA	LANDNG	VFR	2 BLADES	NO	YES	N/A	UNK	HERRING GULL	1	32	N/A	N/A
136	092381	0942	KMQ	TO	VFR	N/A	NO	N/A	N/A	YES	KITE	1	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
137	092381	2400	FCO	TO	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	ATO	N/A
138	092681	1345	XFO	UNK	VFR	N/A	NO	N/A	N/A	NO	LITTLE EGRET	1	14	N/A	N/A
139	092781	0000	FCO	TAXI	UNK	N/A	NO	N/A	N/A	UNK	GULL	0	0	N/A	N/A
140	092781	0000	PUS	LANDNG	VFR	4 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
141	092981	1100	YYZ	LANDNG	UNK	4 BLDS	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
142	093081	0000	XXX	UNK	UNK	4 BLDS	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
143	093081	0000	HYD	LANDNG	VFR	5 BLADES	NO	YES	N/A	UNK	BLACK KITE	1	28	N/A	N/A

****** SAMPLE SIZE FOR SEP 81 = 29 # STRIKES WITH DAMAGE = 16 % = 55.172

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
144	100181	0000	CDG	TO	VFR	2 BLADES BENT	YES	YES	N/A	UNK	UNK	0	0	N/A	N/A
145	100381	0000	XXX	UNK	VFR	N/A	NO	N/A	N/A	NO	UNK	1	0	N/A	N/A
146	100481	0000	ZRH	TO	VFR	1 BLD DI STORTED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
147	100481	0000	BGF	CLIMB	UNK	ALL BLDS TORN	YES	YES	ENGINE STALL	YES	AFRICAN STORK	1	240	ATB	INV POWR LOSS
148	100581	0000	HYD	TO	VFR	1 BLD CU RLED	NO	YES	N/A	UNK	BLACK KITE	1	28	N/A	N/A
149	100581	0000	LIM	CLIMB	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
150	100681	0000	NBO	TO	UNK	10 HPC B LDS BENT	NO	YES	BANG AT TO	UNK	BLACK KI TE	1	0	ATB	N/A
151	100681	0735	DEL	LANDNG	UNK	ALL BLDS ,COWL	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
152	100881	0000	ORY	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
153	100881	0000	VBO	TO	UNK	ALL BLADES	YES	YES	N/A	UNK	VULTURE	1	0	ATO	N/A
154	100881	1330	LAX	TO	UNK	3 BLDS	NO	YES	VIBES	UNK	SEA GULL	1	28	ATB	N/A
155	100981	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
156	101081	0000	JFK	DESCNT	UNK	3 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
157	101081	0200	BOM	TO	UNK	N/A	NO	N/A	N/A	YES	KITE	0	0	ATO	N/A
158	101081	1240	VGS	LANDNG	VFR	N/A	NO	N/A	N/A	YES	KITE	1	0	N/A	N/A
159	101281	0000	XFO	UNK	UNK	2 BLDS	NO	YES	N/A	NO	UNK	1	22	UNK	N/A
150	101281	0000	KAN	LANDNG	UNK	3 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
151	101281	0900	VGO	LANDNG	VFR	2 BLDS & ENT	NO	YES	N/A	NO	PIGEON	1	0	N/A	N/A
152	101381	0000	ORY	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	PIGEON	1	0	N/A	N/A
153	101381	1400	LAX	TO	UNK	10 BLDS	YES	YES	VIBES	UNK	PIGEON	1	11	ATB	N/A
164	101381	1622	YYZ	APPRCH	VFR	11 BLDS	NO	YES	N/A	NO	MEADOWLARK	1	5	N/A	N/A
155	101481	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
156	101581	0000	BOS	TO	VFR	4 BLDS	YES	YES	N/A	UNK	HERRING GULL	1	44	ATB	N/A
157	101681	0000	ORY	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	PIGEON	1	0	N/A	N/A
158	101981	0000	TUN	TO	VFR	3 BLDS	YES	YES	N/A	UNK	UNK	0	0	ATB	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
159	102081	0000	MRS	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
170	102081	0700	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	BLK HEAD ED GULL	3	9	N/A	MULT ENG INGEST
170	102081	0700	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	BLK HEAD ED GULL	1	9	N/A	MULT ENG INGEST
171	102081	1745	HND	TO	UNK	4 BLDS	NO	YES	N/A	NO	PINTAIL DUCK	1	32	N/A	N/A
172	102181	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
173	102181	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
174	102181	0000	SXR	TAXI	VFR	1 BLADE BENT	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
175	102281	2050	YVR	APPRCH	UNK	HPC 789 STAGES	NO	YES	N/A	UNK	SNOW/BLU E GOOSE	1	80	N/A	N/A
176	102381	0000	XXX	UNK	UNK	4 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
177	102381	0000	XFO	UNK	UNK	4 BLDS	NO	N/A	N/A	UNK	SCAUP	1	32	N/A	N/A
178	102381	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	1	0	N/A	N/A
179	102381	0850	HND	CLIMB	VFR	UNK	NO	YES	N/A	NO	BLACK KITE	1	32	N/A	N/A
180	102581	0000	VGS	LANDNG	VFR	N/A	NO	N/A	N/A	YES	KITE	1	0	N/A	N/A
181	102581	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
182	102681	0000	IAH	TO	UNK	2 BLADES	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
183	102681	0000	XFO	UNK	UNK	2 BLDS N ICKED	NO	YES	N/A	NO	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT [illegible]	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
184	102681	0000	CCU	TO	VFR	5 BLDS BENT	YES	YES	N/A	UNK	UNK	0	0	ATO	N/A
185	102681	0530	JFK	TO	IFR	NO	NO	N/A	N/A	NO	HERRING GULL	1	40	ATO	SURGED,HI EGT
186	102881	0000	DPS	TO	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
187	102881	0000	SIG	DESCNT	VFR	4 BLDS	NO	YES	N/A	UNK	DUCK	1	32	N/A	N/A
188	103081	0000	XXX	UNK	UNK	1 IPC&R HPC BLDS	NO	YES	N/A	UNK	RING BILL GULL	1	18	N/A	N/A
189	103081	1230	FUK	TO	UNK	2 BLADES	UNK	YES	N/A	NO	SEAGULLS	1	24	N/A	N/A
190	103081	1500	NGS	TO	VFR	3 BLDS BENT	YES	YES	N/A	YES	KITE	1	0	ATO	N/A
191	103181	1125	SFO	CLIMB	UNK	N/A	NO	N/A	N/A	YES	DUCK	1	0	N/A	N/A

****** SAMPLE SIZE FOR OCT 81 = 48 # STRIKES WITH DAMAGE = 30 % = 62.500

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT [illegible]	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
192	110181	0000	XXX	UNK	UNK	4 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
193	110381	0000	HKG	TO	UNK	1 BLD TIP BENT	YES	YES	N/A	NO	BLACK KITE	1	32	N/A	N/A
194	110381	0000	DRY	LANDNG	IFR	N/A	NO	N/A	N/A	UNK	PIGEON	1	0	N/A	N/A
195	110581	0000	TYO	APPRCH	UNK	2 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
196	110681	0000	HYD	TO	VFR	ALL BLDS	YES	YES	N/A	UNK	UNK	0	0	ATB	N/A
197	110781	0000	XXX	UNK	UNK	NOSE COWL DENTED	NO	YES	N/A	NO	HERRING GULL	1	44	N/A	N/A
198	110881	0000	LPA	TO	VFR	4 BLADES	YES	YES	N/A	YES	SEAGULL	1	0	ATO	N/A
199	111081	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
200	111181	0815	MWH	CLIMB	VFR	1 BL, IN LT COWL	YES	YES	HI EGT, L O \1	YES	MALLARD DUCKS	2	45	ATB	MULT BIR DS
201	111381	1700	XXX	APPRCH	VFR	N/A	UNK	N/A	N/A	YES	HERRING GULL	1	34	N/A	N/A
202	111481	0000	MAA	TO	VFR	4 BLDS	YES	YES	VIBES	UNK	UNK	0	0	ATB	N/A
203	111581	1630	OSA	CLIMB	UNK	6 SETS BLADES	UNK	YES	N/A	NO	UNK	0	0	N/A	N/A
204	111781	2000	FUK	TO	UNK	1 BLADE	NO	YES	N/A	UNK	UNK	1	0	N/A	N/A
205	112081	0000	IST	TO	UNK	2 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
206	112181	0000	AMS	TO	UNK	HPC IGV/ 5 CLASH	YES	YES	ENGINE SURGED	NO	UNK	0	0	N/A	IFSD-HI EGT
207	112281	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
208	112381	0000	SNN	TO	UNK	2 BLDS	UNK	YES	N/A	UNK	UNK	1	13	N/A	N/A
209	112481	0000	XFO	UNK	UNK	2 BLDS	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
210	112481	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
211	113081	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
212	113081	1400	VIE	TO	VFR	1 TRNSV BLD FRAC	YES	NO	ENG PARA MTRS OFF	UNK	ROOK	1	14	N/A	BKN BLD

****** SAMPLE SIZE FOR NOV 81 = 21 # STRIKES WITH DAMAGE = 15 % = 71.429

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
213	120981	1720	TYO	APPRCH	VFR	N/A	NO	N/A	N/A	YES	UNK	1	0	N/A	N/A
214	121381	0000	BOM	UNK	UNK	SPINNER CWL, BLDS	NO	YES	N/A	NO	SHORT-EARED OWL	1	12	N/A	MAJR ENG DAMAGE
215	121581	0000	CDG	LANDNG	UNK	N/A	NO	YES	N/A	UNK	BLK HEADED GULL	1	10	ATB	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
216	121581	1215	CDG	TO	UNK	4 BLDS	YES	YES	N/A	UNK	PARTRIDGE	1	12	ATB	MULT BIRDS
216	121581	1215	CDG	TO	UNK	4 BLDS	YES	YES	N/A	UNK	BLK HEADED GULL	1	14	ATB	MULT BIRDS
217	121681	0000	NIM	TO	UNK	5 BLDS	YES	YES	VIBES	UNK	UNK	0	0	ATB	N/A
218	122181	0000	BPU	TO	UNK	10 BLDS SHINGLED	UNK	YES	N/A	UNK	UNK	0	0	ATB	N/A
219	122281	0000	JFK	TO	VFR	2 BLADES	NO	YES	2 STALLS	NO	GRTR BLK BAK GULL	2	48	ATB	POSS MULT BDS
220	122781	0000	LGA	APPRCH	IFR	4 BLDS	NO	YES	N/A	YES	PIGEON	1	11	N/A	N/A
221	122781	0000	XUS	APPRCH	VFR	N/A	NO	N/A	N/A	NO	GULL	0	0	N/A	N/A
222	122881	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
223	122981	0000	ORY	TO	UNK	2 BLDS	YES	N/A	N/A	UNK	UNK	0	0	ATB	N/A
224	122981	0000	XXX	UNK	UNK	3 BLDS	NO	YES	N/A	NO	UNK	1	0	N/A	N/A
225	122981	0000	PEN	TO	IFR	4 BLDS	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
226	123181	0000	LPA	CLIMB	VFR	N/A	NO	YES	PRECAUTIONARY	UNK	UNK	0	0	UNK	N/A
227	123181	0000	XFO	UNK	VFR	N/A	NO	N/A	N/A	UNK	BLK KITE	1	24	N/A	N/A
****** SAMPLE SIZE FOR DEC 81 = 15					# STRIKES WITH DAMAGE = 9						% = 60.000				
228	010182	1704	CCU	DESCNT	UNK	ALL BLDS	YES	NO	BLD PIECES LOST	UNK	WHITE B. VULTURE	1	176	N/A	TRANSVRS BLD FRAC
229	010382	1100	YVR	TO	VFR	BLD SET, COWL	NO	YES	BANG	YES	EAGLE,DUCK,OTHER	0	0	ATO	MULT BDS
230	010482	0000	XFO	UNK	UNK	3 BLDS LE DEFORM	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A

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EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
231	010482	0000	XXX	UNK	UNK	L/E NICK S,1 REPL	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
232	010982	0000	XFO	UNK	VFR	3 BLDS	NO	YES	N/A	UNK	SHOVELLE R	1	20	N/A	N/A
233	011482	0000	KHI	APPRCH	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
234	011482	0830	MIA	CLIMB	IFR	13 BLDS	NO	YES	N/A	NO	LAUGHING GULL	1	11	N/A	N/A
235	011682	0000	DUR	LANDNG	IFR	35 BLDS	NO	YES	N/A	YES	CROWN PLOVER	1	20	N/A	N/A
236	011782	0000	XFO	UNK	UNK	3 BLDS	NO	YES	N/A	NO	BLACK KITE	1	28	N/A	N/A
237	012282	0000	SID	UNK	UNK	4 BLDS	UNK	YES	N/A	NO	UNK	1	36	N/A	N/A
238	012382	0000	XXX	UNK	UNK	6 BLDS	YES	YES	N/A	NO	UNK	0	0	N/A	N/A
239	012682	1730	FLL	TO	VFR	18 BLDS IN HPC	YES	YES	3 STALLS WF FLUC	YES	RING BIL L GULL	1	18	ATR	N/A
240	012782	0000	DRY	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
241	012782	0000	FRA	APPRCH	UNK	3 BLDS BENT	NO	YES	N/A	UNK	UNK	1	0	N/A	N/A
****** SAMPLE SIZE FOR JAN 82 = 14							# STRIKES WITH DAMAGE = 12					% = 85.714			
242	020682	0000	JFK	TO	UNK	3 BLDS	NO	YES	N/A	UNK	HERRING GULL	1	40	N/A	N/A
243	020782	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	1	0	N/A	N/A
244	020982	0000	LOS	CLIMB	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
245	021182	0000	DSA	TO	VFR	NO	NO	YES	N/A	UNK	COMMON GULL	1	15	UNK	N/A
245	021382	0000	XFO	UNK	UNK	32 BLDS	NO	YES	N/A	NO	BLK HEAD ED GULL	1	11	N/A	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT DAMAGE	IFSD REASON	BIRD SEEN	BIRD SPECIES	# BD	AV WT OZ	PI-LOT ACT	SIGNI-FICANT REASON
247	021682	0000	VBO	LANDNG	UNK	4 BLDS DEFRMED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
248	022382	0000	DUR	TO	VFR	8 BLDS	YES	YES	N/A	UNK	UNK	0	0	ATO	N/A
249	022782	0000	XFO	UNK	UNK	1 BL LE BENT	NO	YES	N/A	NO	SEAGULL	1	0	N/A	N/A
250	022882	1200	BRU	TO	UNK	1 BLD FR ACTURED	YES	NO	MOM HI EGT	YES	BLK HEAD ED GULLS	4	11	ATB	MULT BDS PWR LOSS
****** SAMPLE SIZE FOR FEB 82 = 9						# STRIKES WITH DAMAGE = 7					% = 77.778				
251	030282	0000	XFO	UNK	UNK	2 BLDS D ISTORTED	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
252	030382	0000	MWH	APPRCH	VFR	CORE ING ESTION	NO	N/A	N/A	NO	CANADIAN GOOSE	1	80	N/A	MULT ENG
252	030382	0000	MWH	APPRCH	VFR	CORE	NO	YES	N/A	NO	CANADIAN GOOSE	1	80	N/A	MULT ENG
253	030582	0000	MIA	CLIMB	UNK	4 BLADES	YES	YES	N/A	YES	GULLS	0	0	UNK	N/A
254	030682	1200	XXX	UNK	UNK	5 BLDS	NO	YES	N/A	NO	LAPWING	0	8	N/A	N/A
255	030782	1700	SFO	TO	UNK	N/A	NO	N/A	N/A	YES	UNK	0	0	N/A	N/A
256	030882	0110	XFO	UNK	UNK	SEVERAL BLADES	NO	YES	N/A	NO	REDWATLD LAPWING	1	10	N/A	N/A
257	030982	0700	HND	TO	VFR	N/A	NO	YES	N/A	NO	DUSKY THRUSH	1	3	N/A	N/A
258	031182	0000	LAX	LANDNG	UNK	N/A	NO	YES	N/A	UNK	UNK	0	0	UNK	N/A
259	031182	1700	BGF	TO	UNK	2 BLDS	YES	YES	N/A	UNK	UNK	0	0	UNK	N/A
260	031382	1700	BWI	LANDNG	UNK	N/A	NO	N/A	N/A	UNK	UNK	0	0	N/A	MULT ENG INGEST
260	031382	1700	BWI	LANDNG	UNK	N/A	NO	YES	N/A	UNK	UNK	0	0	N/A	MULT ENG INGEST

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT DAMAGE	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
251	031582	0000	MIA	APPRCH	UNK	N/A	NO	N/A	N/A	UNK	UNK	1	0	N/A	N/A
252	031682	0000	XFO	UNK	UNK	4 BLDS, SHINGLED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
253	031682	2100	JNB	LANDNG	VFR	LEADNG E DGES BLD	NO	YES	N/A	NO	SPOTED T HIK KNEE	1	11	N/A	N/A
254	031782	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	1	0	N/A	N/A
255	031982	0000	XXX	UNK	UNK	ACOUSTIC LINING	NO	N/A	N/A	NO	BLK BEL PLOVER	1	8	N/A	N/A
256	031982	0220	LHR	LANDNG	VFR	N/A	NO	YES	N/A	YES	UNK	0	0	N/A	N/A
257	032082	0000	JFK	APPRCH	VFR	N/A	UNK	YES	N/A	UNK	HERRING GULL	1	40	N/A	N/A
258	032182	1845	JFK	APPRCH	IFR	N/A	NO	N/A	N/A	YES	COWBIRD	1	2	N/A	N/A
269	032282	0000	JED	TO	UNK	14 HPC B LDS BENT	YES	YES	TTT=880 VIBES	UNK	HERON	1	88	ATB	N/A
270	032382	0000	MEL	TO	IFR	SHROUD R U?	UNK	YES	N/A	YES	SEAGULLS	0	0	UNK	MULT ENG INGEST
270	032382	0000	MEL	TO	IFR	ABRDBL S HRUD RUB	UNK	YES	N/A	YES	SEAGULLS	0	0	UNK	MULT ENG INGEST
271	032382	0600	JFK	APPRCH	VFR	3 BLDS	UNK	YES	N/A	YES	HERRING GULL	1	40	N/A	N/A
272	032382	0700	JED	APPRCH	VFR	ROTOT,SP INR,COWL	YES	NO	VIBES	UNK	BLK TAIL D GODWIT	8	11	N/A	MULTIPLE BIRDS
272	032382	0700	JED	APPRCH	VFR	ROTOR,SP INR,COWL	YES	NO	HI EGT	UNK	BLK TAIL D GODWIT	8	11	N/A	MULTIPLE BIRDS
273	032682	1632	RST	UNK	UNK	2 BLDS,N OSE CAP	NO	YES	N/A	YES	ROUGH-LE GD HAWK	1	36	N/A	N/A
274	032782	0000	PTY	TO	UNK	BKN SPNR ,BLDS	UNK	YES	SEVERAL STALLS	YES	BROAD WI NGD HAWK	1	16	ATB	N/A

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
275	032782	0000	TYO	LANDNG	UNK	2 BLDS,1 CURLED	NO	N/A	N/A	UNK	UNK	0	0	N/A	N/A
276	032782	1415	CAI	TO	VFR	3 BLDS DENTED	YES	YES	N/A	UNK	BLACK KITE	1	24	ATB	N/A
277	032882	0000	XFO	UNK	UNK	ONE BLD BENT	UNK	YES	N/A	NO	UNK	1	0	N/A	N/A
278	032882	1700	AMS	TO	VFR	3 BLDS BENT	YES	YES	CRACKED OIL LINE	UNK	UNK	0	0	ATB	N/A

****** SAMPLE SIZE FOR MAR 82 = 28 # STRIKES WITH DAMAGE = 19 % = 67.857

EVT#	DATE	TIME	ARPT	FLIGHT PHASE	WX	FAN DAMAGE	POWR LOSS /RED	CONT	IFSD REASON	BIRD SEEN	BIRD SPECIES	# B D	AV WT OZ	PI- LOT ACT	SIGNI- FICANT REASON
279	040982	0000	LIS	CLIMB	UNK	3 BLDS B ENT	UNK	YES	VIBES	YES	UNK	1	0	ATB	N/A
280	041082	0000	XFO	UNK	VFR	1 BLADE TORN	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
281	041182	0000	XFO	UNK	UNK	1 BLADE DEFRMED	NO	YES	N/A	UNK	UNK	0	0	N/A	N/A
282	041382	1940	YYZ	TO	VFR	4 BLADES DMGD	YES	YES	N/A	UNK	SHORT EA RED OWL	1	12	ATB	N/A
283	041582	0000	XXX	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
284	041882	0000	XFO	UNK	UNK	ACOUSTIC LINING	NO	YES	N/A	NO	GLAUCOUS WNG GULL	1	52	N/A	N/A
285	042082	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	UNK	0	0	N/A	N/A
286	042182	0000	XUS	UNK	UNK	1 BLADE BENT	NO	YES	N/A	NO	UNK	0	0	N/A	N/A
287	042182	1000	YYZ	TO	IFR	5 BLADES BENT	UNK	YES	VIBES	YES	RING BIL LED GULL	1	18	ATB	N/A
288	043082	0000	XFO	UNK	UNK	3 BLADES DMGD	NO	N/A	N/A	NO	RED WATL D LAPWNG	1	10	N/A	N/A
289	043082	0000	XFO	UNK	UNK	N/A	NO	N/A	N/A	NO	SEAGULL	0	24	N/A	N/A

****** SAMPLE SIZE FOR APR 82 = 11 # STRIKES WITH DAMAGE = 8 % = 72.727

FILM