

AFAMRL-TR-80-88

LEVEL



AD A 092923

# AN ANALYSIS OF COMMUNITY COMPLAINTS TO AIR FORCE AIRCRAFT NOISE

J. L. MABRY  
R. B. CAREY

MAN-ACOUSTICS & NOISE, INC.  
2105 NORTH 45TH STREET  
SEATTLE, WASHINGTON 98103

OCTOBER 1980

NTIC  
DEC 15 1980

Approved for public release; distribution unlimited.

FILE COPY

AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

## NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from Air Force Aerospace Medical Research Laboratory. Additional copies may be purchased from:

National Technical Information Service  
5985 Port Royal Road  
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Documentation Center should direct requests for copies of this report to:

Defense Documentation Center  
Cameron Station  
Alexandria, Virginia 22314

## TECHNICAL REVIEW AND APPROVAL

AFAMRL-TR-80-88

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



HENNING E. VON GIERKE

Director  
Biodynamics and Bioengineering Division  
Air Force Aerospace Medical Research Laboratory

19 REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
18 1. REPORT NUMBER AFAMRL-TR-80-88	2. GOVT ACCESSION NO. AD-A092	3. RECIPIENT'S CATALOG NUMBER 923	
4. TITLE (and Subtitle) 6 AN ANALYSIS OF COMMUNITY COMPLAINTS TO AIR FORCE AIRCRAFT NOISE		9 5. TYPE OF REPORT & PERIOD COVERED Technical Report Jan 1979 - June 1980	6. PERFORMING ORG. REPORT NUMBER 14 MAN-1042
10 7. AUTHOR(s) J. E. Mabry and R. B. Carey	15 8. CONTRACT OR GRANT NUMBER(s) F33615-79-C-0507 new	9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 11 122T 21 / 62202F, 7231-07-11 17 07	
9. PERFORMING ORGANIZATION NAME AND ADDRESS MAN-Acoustics & Noise, Inc. 2100 North 45th St. Seattle, WA 98103		10. REPORT DATE October 1980	
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Aerospace Medical Research Laboratory Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, OH 45433		13. NUMBER OF PAGES 77	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Same as Controlling Office		15. SECURITY CLASS. (of this report) Unclassified	
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE			
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.			
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Noise complaints Aircraft noise Land use planning			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Community complaints to AF aircraft operations were studied for 7 different AF Bases. For the 7 AF Bases, the number of years that complaint records were available ranged from 2-6 years. Some 95% of the complaints received could be attributed to aircraft operations noise (flyover and ground runup noise), low flying aircraft, or sonic boom noise. The main interest for this study involved complaints to aircraft operations noise which comprised 57% of the total number of complaints received. The number of noise complaints for these 7 bases, an average of 43.3 per year, is considered low relative to those for some commercial airports.			

7-11-80

## SUMMARY

Community complaints to Air Force aircraft operations were studied for seven different Air Force Bases. For the seven AF Bases, the number of years that complaint records were available ranged from two to six years. Some 95% of the complaints received could be attributed to aircraft operations noise (flyover and ground runup noise), low flying aircraft, or sonic boom noise. The main interest for this study involved complaints to aircraft operations noise which comprised 57% of the total number of complaints received. The number of noise complaints for these 7 bases, an average of 43.3 per year, is considered low relative to those for some commercial airports.

With the exception of one AF Base where noise complaints were at a relatively low level and remained almost constant over a four-year period, noise complaints were appreciably reduced in recent years. This reduction in noise complaints can, in part, be attributed to local AF Base programs for working with noise complainants and where possible, utilization of noise abatement procedures. A cursory inquiry involving fourteen additional AF Bases plus detailed study of the complaint records for the seven AF Bases of this study shows that TAC operations have a significantly greater noise impact on communities than do SAC and MAC operations.

A

## PREFACE

This report describes work performed under Contract F33615-79-C-0507 which was an exploratory effort relative to complaints involving Air Force aircraft noise and the  $L_{DN}$  method of measuring noise impact on communities. The work was sponsored by the Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base. We wish to thank Dr. C. Stanley Harris, 6570 AMRL/BBA, who was the technical monitor for the program, for his counsel and assistance. Garry Vest, AF/LEEV, The Pentagon, also provided valuable assistance in the selection of Air Force Bases for the study of noise complaints and we thank him. A large number of other Air Force Personnel provided invaluable help. Included in this group are the various Command Environmental Specialists, Air Force Base Environmental Specialists, Air Force Base Information Officers, and Air Force Base Information Specialists who work with the noise complainants. The study could not have been completed without their assistance and we thank all of them.

## TABLE OF CONTENTS

	Page
INTRODUCTION. . . . .	6
APPROACH AND DATA ANALYSIS CONSIDERATIONS . . . . .	8
COMPLAINT COMPILATIONS. . . . .	10
McChord Air Force Base Complaint Data. . . . .	10
Tacoma, Washington	
Selfridge Air National Guard Base Complaint Data . . . . .	16
Mount Clemens, Michigan (Detroit Metropolitan Area)	
McClellan Air Force Base Complaint Data. . . . .	23
Sacramento, California	
Carswell Air Force Base Complaint Data . . . . .	28
Fort Worth, Texas	
Fairchild Air Force Base Complaint Data. . . . .	32
Spokane, Washington	
Davis-Monthan Air Force Base Complaint Data. . . . .	37
Tucson, Arizona	
Nellis Air Force Base Complaint Data . . . . .	47
Las Vegas, Nevada	
Summary Information for the Seven Air Force Bases. . . . .	50
AIR FORCE BASE PROCEDURES FOR WORKING WITH COMPLAINANTS . . . . .	58
NOISE COMPLAINTS AND $L_{DN}$ . . . . .	60
QUANTIFICATION OF AN EXCEPTION TO $L_{DN}$ . . . . .	65
CONCLUDING OBSERVATIONS . . . . .	72
REFERENCES. . . . .	74

LIST OF ILLUSTRATIONS

	Page
<u>MC CHORD AF BASE</u>	
Figure 1. Complaint Totals for McChord AFB. . . . .	11
Figure 2. Number of Noise Complaints Received by Month at McChord AFB for 1976, 1977 and 1978. . . . .	13
Figure 3. Percent Noise Complainants Reporting Sleep Interference. . . . .	14
Figure 4. Percent Complainants Female . . . . .	15
<u>SELFRIDGE ANG BASE</u>	
Figure 5. Complaint Totals for Selfridge ANG Base . . . . .	16
Figure 6. Total Complaints and Noise Complaints as a Function of Aircraft Operations . . . . .	17
Figure 7. Comparison of Selfridge Complaint Counts with Obtained Counts. . . . .	19
Figure 8. Number of Noise Complaints Received by Month at Selfridge for 1977, 1978 and 1979 . . . . .	20
Figure 9. Percent Noise Complainants Reporting Sleep Interference . . .	22
Figure 10. Percent Females Complain to Noise & Low Flying Aircraft . . .	22
<u>MC CLELLAN AF BASE</u>	
Figure 11. Complaint Totals for McClellan AFB. . . . .	24
Figure 12. Percent of Noise Complaints Due to Ground Runup Noise . . . .	25
Figure 13. Number of Noise Complaints Received by Month at McClellan for 1978 and 1979 . . . . .	26
Figure 14. Percent Noise Complainants Reporting Sleep Interference . . .	27
Figure 15. Percent Females Complain to Noise & Low Flying Aircraft . . .	27
<u>CARSWELL AF BASE</u>	
Figure 16. Complaint Totals for Carswell AFB . . . . .	29
Figure 17. Number of Noise Complaints Received by Month at Carswell AFB for 1977 and 1978 . . . . .	30
Figure 18. Percent Noise Complainants Reporting Sleep Interference . . .	30
Figure 19. Percent Females Complain to Noise . . . . .	31
<u>FAIRCHILD AF BASE</u>	
Figure 20. Complaint Totals for Fairchild AFB. . . . .	33
Figure 21. Number of Noise Complaints Received by Month at Fairchild for 1976, 1977, 1978 & 1979. . . . .	34
Figure 22. Percent Noise Complainants Reporting Sleep Interference . . .	35

LIST OF ILLUSTRATIONS (Cont'd.)

	Page
Figure 23. Percent Females Complain to Noise . . . . .	35
Figure 24. Number and Percent of Total Complaints Are to Sonic Boom Noise . . . . .	36
 <u>DAVIS-MONTHAN AF BASE</u>	
Figure 25. Complaint Totals for Davis-Monthan AFB. . . . .	38
Figure 26. Number of Complaints Received by Month at Davis-Monthan for 1977, 1978 and 1979. . . . .	39
Figure 27. Number of Noise Complaints Received by Month at Davis-Monthan for 1978 and 1979. . . . .	40
Figure 28. Number of Low Flying Aircraft Complaints Received by Month at Davis-Monthan for 1978 and 1979 . . . . .	41
Figure 29. Ratio of Low Flying Aircraft Complaints to Noise Complaints by Month at Davis-Monthan for 1978 & 1979. . . . .	42
Figure 30. Number of Sonic Boom Complaints Received by Month at Davis-Monthan for 1978 & 1979 . . . . .	43
Figure 31. Percent of Complaints Made by Women by Three Categories . . . . .	44
Figure 32-a. Number of Aircraft Complaint Events Confirmed, Denied or Not Determined at Davis-Monthan in 1978 . . . . .	45
Figure 32-b. Number of Aircraft Complaint Events Confirmed, Denied or Not Determined at Davis-Monthan in 1979 . . . . .	46
 <u>NELLIS AF BASE</u>	
Figure 33. Complaint Totals for Nellis AFB . . . . .	47
Figure 34. Number of Total Complaints Received by Month at Nellis for 1977, 1978 and 1979 . . . . .	48
Figure 35. Number of Noise Complaints Received at Nellis for 1977, 1978 and 1979 . . . . .	49
Figure 36. Number of Sonic Boom Complaints Received at Nellis for 1977, 1978 and 1979 . . . . .	50
Figure 37. Number of Low Flying Aircraft Complaints Received at Nellis for 1977, 1978 and 1979 . . . . .	51
Figure 38. Percent of Complaints Made by Women by Three Categories . . . . .	52

## AN ANALYSIS OF COMMUNITY COMPLAINTS TO AIR FORCE AIRCRAFT NOISE

### INTRODUCTION

A number of research methods or strategies have been employed as a means of quantifying community response to aircraft noise. These methods, in terms of face validity, have ranged from austere laboratory investigations to questionnaire surveys of persons residing around commercial airports and Air Force Bases. However, in respect to application and usefulness of research findings, all of these various methods are indebted to the fact that persons in the community complain about noise from aircraft operations. Various methods for investigating response to aircraft noise evolved due to noise complaints to aircraft operations. Thus, the main aim of this study is to determine the extent that an analysis of community noise complaints (the most direct method) can contribute to quantification of community response to aircraft generated noise around Air Force Bases.

Since the majority of noise exposure measurements at both Air Force Bases and commercial aviation airports are based on a computer model, there is particular interest in determining the appropriateness of the various elements and basic assumptions of the model. The aim of the computer model is to provide a single-number noise measure based on Air Base noise exposure during a one-year period. The elements of the noise measure to which complaint data can contribute relative to appropriateness or validity are:

- The practice of deriving a single-number noise measure by "averaging" noise exposure over a one-year period.
- The effect of the time-of-day that noise events occur has on community response to noise.
- The extent that aircraft ground runup noise contributes to community noise annoyance response.

In addition to the aim of determining the extent that an analysis of complaint data can contribute to the quantification of community response to aircraft noise, a compilation of complaint data can have intrinsic value relative to such questions as:

- Are complaints to aircraft noise increasing, decreasing or remaining relatively constant?
- Are there differences in complaint intensities among Air Force Bases?
- What procedures are effective in working with noise complainants?
- Can complaint analysis contribute to other methodologies designed to aid in the quantification of community response to aircraft noise?

## APPROACH AND DATA ANALYSIS CONSIDERATIONS

During the planning stage for this study program, there was the expectation that analysis of noise complaints could be based on statistical compilations already available at the selected AF Bases. In conjunction with these available compilations, a verification program was planned through visits to two of the bases and reviewing a sample of the actual complaint records. After interviewing the various AF Command Environmental Specialists, specific AF Base Environmental Specialists, and Base Information Officers (usually receive noise complaints) at twenty-one AF Bases, evidence was available that this approach would not lead to meaningful comparisons among AF Bases selected for this study. For the most part, noise complaints are dealt with by the base receiving the complaint along with other types of complaints. Since the magnitude and qualitative aspects of the noise complaint problem differ markedly among AF Bases and since the practice is for each base to work, to a considerable extent, on their own with complaints of all types, methods of recording and categorizing complaints differ from base to base. Thus, arrangements were made to obtain actual copies of complaints received so that all files could be examined in a like manner.

Beginning with a tentative list of AF Bases provided by the AF Headquarters Environmental Specialist and augmenting this list via telephone interviews with the various Command Environmental Specialists, twenty-one AF Bases were selected as tentative candidates. AF personnel receiving complaints at each of these twenty-one bases were interviewed by telephone. Primary interest was in the extent of the complaint files including number of complaints per year and number of years files were available, whether-or-not a standard form was used to record noise complaints, and a description of methods for dealing with noise complaints. On the basis of these interviews and consultation with AF Technical Personnel, eight AF Bases were selected. Two of the bases represented SAC, two were TAC Bases, and one each from MAC, AFLC, ANG and ATC. Although it was known at the time that the ATC Base was selected, that a logging approach (not a complaint form developed by the base) was used to track noise complaints, it was not known that all noise complaints were not logged. Consequently, complaint records for seven bases were available for detailed analysis. There is a practice at a number of AF Bases to retain complaint files only for the year just preceding a current year but time at which files

are discarded does vary from base to base. Due to this practice, files available at the seven AF Bases ranged from a low of two years to a high of six years with an average of approximately 3.6 years per base. Personnel receiving complaints were interviewed at three of the bases on a face-to-face basis. Emphasis during these interviews was on procedures and methods of working with complainants.

Since the various bases use different approaches for recording complaints and since the number of complaints differs greatly among bases, the kinds of data presented in the following section will differ somewhat. In the next section, "COMPLAINT COMPILATIONS", data for each AF Base is given individually with a summary section for all seven AF Bases as a final part. Occasionally complainants mentioned more than one aircraft effect which was a concern to them. For example, they might complain of noise and low flying aircraft. Since our interest is primarily in noise complaints, such a complaint would be categorized as a noise complaint and the low flying aspect ignored for that particular complaint. On the other hand, if only low flying aircraft were mentioned, the complaint was attributed to that category. In categorizing, the guideline was to accept the literal meaning of the recorded words and to interpret as little as possible. Other than the fact that there is dependence on what is recorded and not on what was actually spoken, there is a second worthwhile observation relative to all types of complaints received. There is a wide difference in intensity among complainants ranging from what appears to be a simple inquiry or report of an incident to a state of being highly irate. Thus, as a method of measuring noise annoyance response, some of the complainants are highly annoyed while others are, at the other extreme, simply making an inquiry relative to a noise situation.

Following the complaint compilations or data base section, there is a section dealing with procedures developed at the various bases for working with complainants. A section involving noise exposure metrics emphasizing  $L_{dn}$  follows with a conclusions section ending the report.

## COMPLAINT COMPILATIONS

Since one objective was to assess complaint response to aircraft noise events which are measured by the NOISEMAP computer modeling approach, all recorded complaints were examined so complaints attributable to either aircraft flyover noise or ground runup noise could be isolated. Complaints were categorized into six independent sets which are:

1. Complaints concerning aircraft flyover noise.
2. Complaints concerning ground runup noise.
3. Sonic boom complaints which were usually not in any manner in the vicinity of the air base under investigation.
4. Complaints to aircraft overflights (not sonic boom) which were not in the vicinity of the air base ( $L_{dn} < 55$ ).
5. Complaints concerning "other" events which could be related to Air Force activities or be of interest to the Air Force. Some of these were:
  - UFO sightings.
  - Inquiries concerning previous claims of damage.
  - Presumed activation of automatic garage doors by AF radio frequencies.
  - Interference with TV reception.
  - Inquiries concerning explosions which were usually related to non-AF construction activities.
6. Complaints involving low-flying aircraft with overflight noise not being at issue.

When the complainant reported that any of the flight activities interfered with sleep or had an adverse effect on animals, this information was categorized. Interference with sleep was almost always associated with aircraft overflight or ground runup noise while the noise events that reportedly had adverse effects on animals were sonic booms or due to aircraft overflights which were not in the vicinity of the Air Base.

### MC CHORD AIR FORCE BASE COMPLAINT DATA

Complaint records for this base were available from 1974 through 1979. A summary of number of complaints by year is given in Figure 1. with the solid line (●—●) showing the total complaints received. The dashed line (●— —●) gives the number of noise complaints due to aircraft flyover noise and ground runup noise; these are the events which contribute to the NOISEMAP computer modeling method and are of primary interest. Comparing the noise

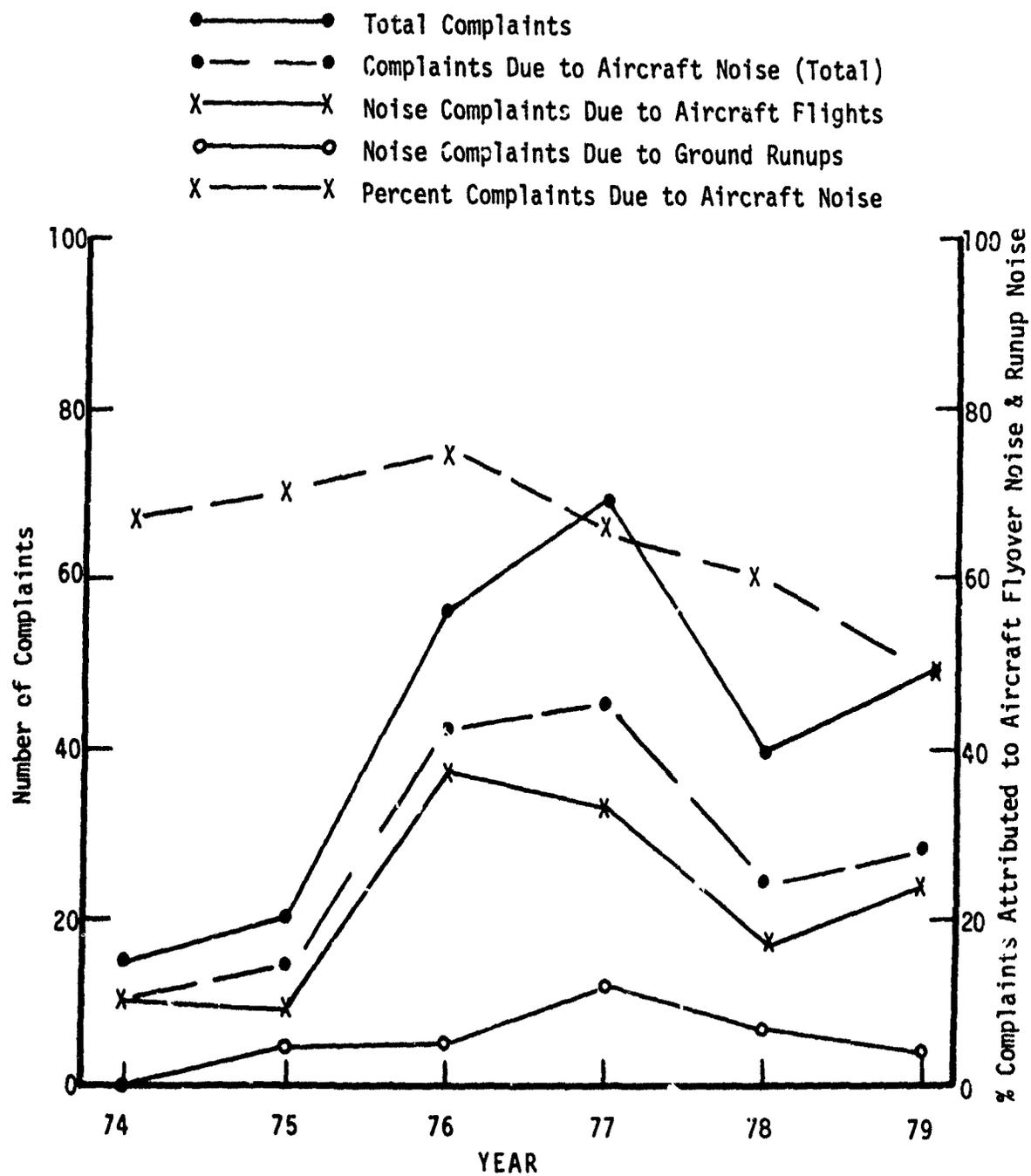


Figure 1. Complaint Totals for McChord AFB

complaints (flyover and ground runup noise) received in 1976 and 1977 to those received in 1974 and 1975, there is an appreciable relative increase in that for 1976 and 1977, noise complaints are three times greater than noise complaints received in 1975. For the years 1978 and 1979, noise complaints are reduced to an average of approximately one-half of those received in 1976 and 1977. The relative contribution of flyover noise vs. ground runup noise is provided by the solid lines using "x" and "o" respectively. Proportion of noise complaints attributable to ground runup noise varies from a low of 0% to a high of 36% of noise complaints received in 1975. For the six-year total, ground runup noise resulted in slightly more than 20% of the noise complaints received. The final plot of Figure 1. uses the right-hand ordinate and gives the percentage of complaints received which are attributable to flyover and ground runup noise (X— —X). Percent of complaints due to events that contribute to Air Base noise modeling varies from a high of 75% in 1976 to a low of 49% in 1979. Even though complaints to AF aircraft noise has varied from year to year, peaking in 1976 and 1977, the absolute numbers cannot be considered high. The average number of noise complaints over this six-year period is approximately 2.25 per month.

For this particular AF Base, due to the relatively small number of noise complaints received, caution is employed relative to interpretation of the results. However, based on previous studies there are a number of expectations concerning complaint behavior that can be examined. Such an expectation is that, on average, there would be more noise complaints during the summer months due to less noise attenuation with windows open. One study reported that more than 90% of the noise complaints at a large commercial aviation airport occurred during the summer months (Ref. 1). Number of noise complaints received during 1976, 1977 and 1978 are given in Figure 2. For 1976, the greatest number of noise complaints were received in November and December and for 1977, the highest number occurred in March and April. For 1978, with fewer noise complaints received than in 1976 and 1977, highest number of complaints were for July and August; however, the bulk of these noise complaints were due to visiting tactical type of aircraft. Time of year does not markedly influence complaint behavior at this Air Base.

Another variable involves community concerns with noise from aircraft during periods when persons are sleeping. For the majority of the complaints,

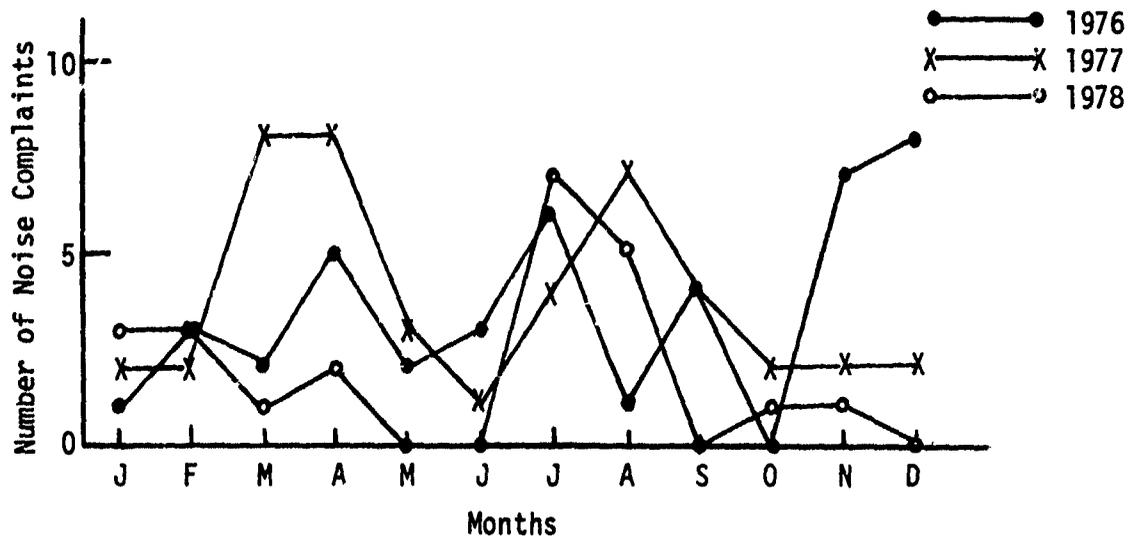


Figure 2. Number of Noise Complaints Received by Month at McChord AFB for 1976, 1977 and 1978.

mention of sleep interference due to aircraft noise resulted from night flights or night ground runups and only occasionally were there complaints of sleep interference during the daytime period. Table 1. provides the basic data concerning mention by the complainants of interference with sleep. Results are provided separately for flyover noise and ground runup noise. As shown by a comparison of total percent mentioning sleep interference for flyover noise vs. ground runup noise, persons complaining about runup noise are

TABLE 1. NUMBER AND PERCENT OF COMPLAINANTS REPORTING INTERFERENCE WITH SLEEP AT MC CHORD AFB

YEAR	Flyover Noise			Runup Noise			Totals		
	Total No.	Sleep Int.No.	%	Total No.	Sleep Int.No.	%	Total No.	Sleep Int.No.	%
1974	10	1	10	0	0	0	10	1	10
1975	9	1	11	5	2	40	14	3	21
1976	37	6	16	5	5	100	42	11	23
1977	33	9	27	12	7	58	45	16	35
1978	17	3	18	7	5	71	24	8	33
1979	24	9	38	4	4	100	28	13	46
TOTALS	130	29	22	33	23	70	163	52	32

much more likely to complain about sleep interference than persons complaining about flyover or flyby noise. For ground runup noise complainants some 70% mentioned sleep interference while 22% complaining of flyover or flight noise reported that there was interference with sleep. The percents reporting sleep interference by the two categories (flyover noise and runup noise) plus percents based on a total of the two noise categories for the six years are given in Figure 3. The data clearly show that sleep interference is more closely

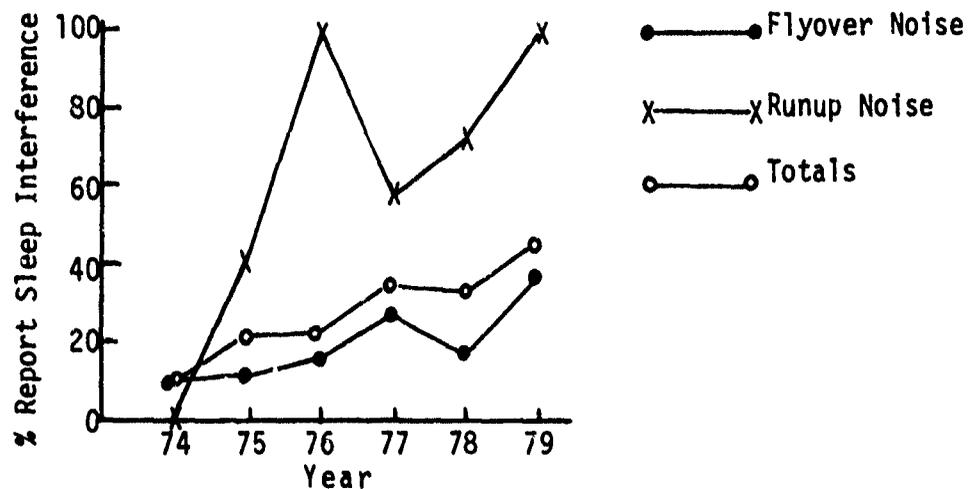


Figure 3. Percent Noise Complainants Reporting Sleep Interference

associated with ground runup noise than flyover noise and that, on the average, there was a tendency for reports of sleep interference to increase over the years. In 1979, 13 of the 28 persons who complained about AF aircraft noise or some 46% indicated that noise interfered with sleep.

A final consideration for the McChord AF Base complainants involves whether-or-not they were males or females. Since, on average, there is an expectation that females would be at home a greater percentage of the time than males, a likely finding is that a greater proportion of the complaints would be by females. Some 57% of the noise complaints over the six-year period were by females. Figure 4. shows percent complaints by females for the six years that noise complaint records were available. The greater number of complaints by females begins in 1977 and continues through 1979; this upsurge of complaints by females accounts for the greater proportion over the six-year period. Prior to 1977, 30 of the 66 complaints or

approximately 45% of the complaints were due to female callers.

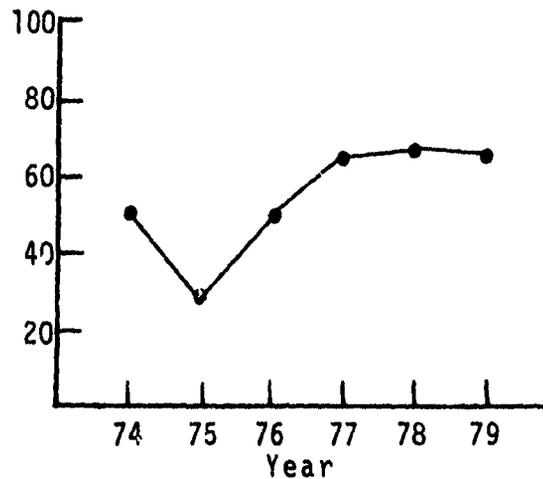


Figure 4. Percent Complainants Female

Observations and summary information concerning complaints received during a six-year period at McChord AF Base are:

1. Number of noise complaints received is relatively low. For example, during a nine-year period, one commercial aviation airport averaged over 1100 noise complaints per year (Ref. 1) and other AF Bases which were examined as part of this study received more noise complaints in a single year than did McChord over a six-year period.
2. Noise complaints peaked in the 1976 and 1977 period.
3. Ground runup noise was associated with 20% of the noise complaints.
4. Some 32% of all noise complaints were associated with sleep interference - with 70% of complaints to ground runup noise associated with sleep interference.
5. On the average, more noise complaints were received from women than men.
6. Some 63% of complaints directed to aircraft activities were due to noise effects.
7. Approximately 10% of all complaints received (257 during six years) were due to "low flying" aircraft.

8. Approximately 15% of all complaints were attributable to sonic booms.

SELFRIDGE AIR NATIONAL GUARD BASE COMPLAINT DATA

Complaint records for Selfridge Air National Guard Base were available for a three-year period, from 1977 through 1979. A summary of number of complaints is provided in Figure 5. Information giving the total number of

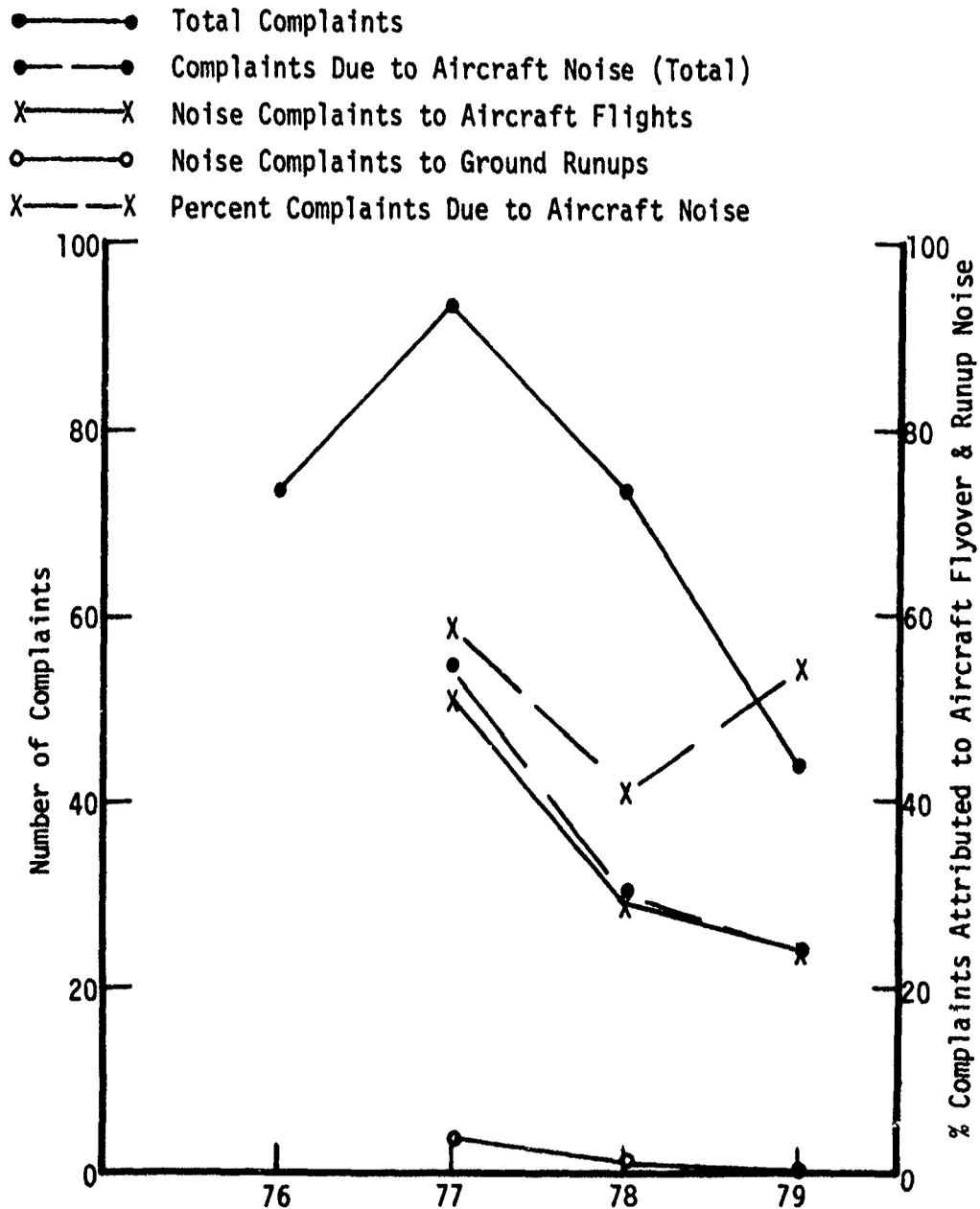


Figure 5. Complaint Totals for Selfridge ANG Base

complaints for 1976 was available so that number is plotted as a reference point. Total number of complaints received (●—●) decreases from 1977 through 1979 but complaints attributable to aircraft noise (flyover noise and ground runup noise) as represented by the dashed line (●—●) did not decrease in 1979 as dramatically as the total number of complaints. Complaints to ground runup noise were not at all extensive with four in 1977 (7% of noise complaints) and but one such complaint in 1978 or 4% of noise complaints for that year. The percentage of complaints which could be attributed to aircraft noise ranged from 59% in 1977 to 41% in 1978 with 55% of complaints received in 1979 attributable to aircraft noise (X—X). That total number of complaints and complaints to aircraft noise decreased over the years that records were available, suggested the possibility that this decrease in complaints was due to decreased flight activity. Summary information providing number of sorties and transient aircraft using Selfridge was available. A plot of total number of complaints and complaints to aircraft noise as a function of the sum of sorties and transient aircraft is given in Figure 6. There is no

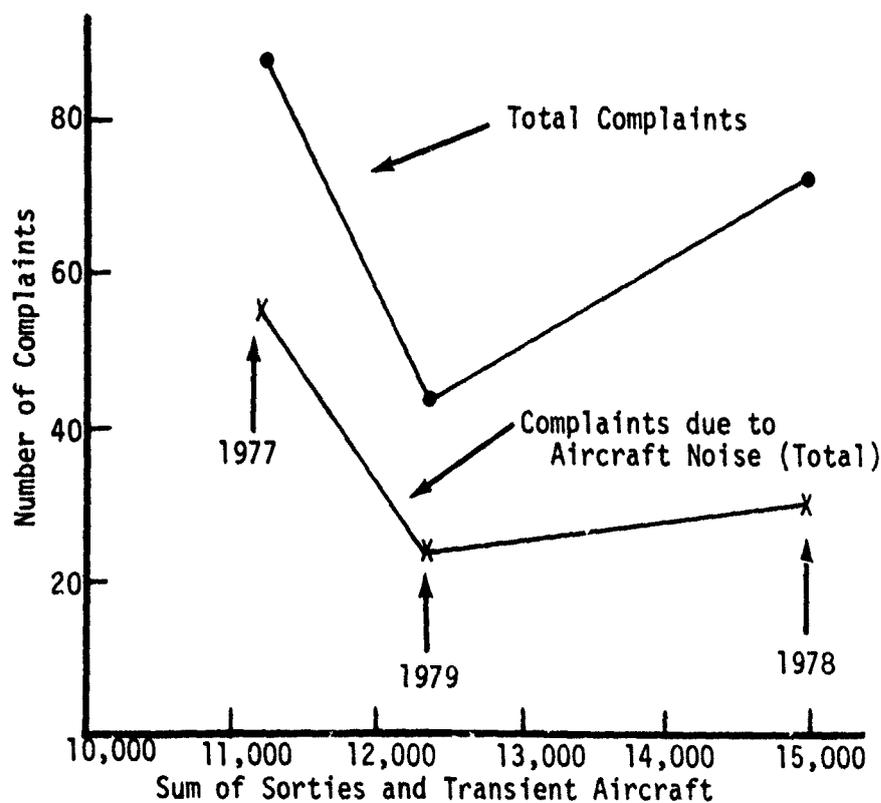


Figure 6. Total Complaints and Noise Complaints as a Function of Aircraft Operations

consistent relationship between operations and complaints received. If anything the relationship is negative. For example, the sum of sorties and transient aircraft increased in 1979 over 1977 but total number of complaints and complaints to aircraft noise decreased as shown in Figure 6. There was a larger increase in operations in 1978 over 1979 but only a minimal increase in complaints to aircraft noise. The ratio of aircraft noise complaints to the sum of sorties and transient aircraft is 5 per 1000 in 1977 and 2 per 1000 in both 1978 and 1979. Some factor or combination of factors other than number of operations led to the decrease in noise complaints from 1977 through 1979.

As discussed in the APPROACH section, for complaint records with no mention of aircraft noise annoyance and only mention of "low flying aircraft", complaints were categorized as concern and annoyance with low flying aircraft and not with aircraft flyover noise. Since approximately 35% of the 210 complaints received were categorized as concern with low flying aircraft and since the Selfridge complaint form utilized a checking off approach with the following categories:

- Noise
- Low Flying
- Sonic Boom
- Other,

a comparison was made between the "after-the-fact" categorization and the "on-the-spot" Selfridge categorization. This comparison is given in Figure 7. The comparisons cannot match perfectly as categorization by Selfridge personnel permitted multiple categorizations while our "after-the-fact" categorization allowed the complaint to be assigned to but one category. The match-up between the actual counts and Selfridge counts for noise complaints are relatively close. Selfridge shows more complaints to noise (flyover and runup) in 1977 than the actual counts while the actual counts are slightly greater in 1978 and 1979 than the Selfridge counts. For complaints concerning low flying aircraft, the difference is considered relatively high. Of the 210 complaints received over the three-year period, 73 of them or approximately 35% of all complaints were attributed to low flying aircraft while for Selfridge counts, 60 of the 220 categorizations on 191 completed forms (19 forms provided no categorizations) or some 27% of all categories checked were attributed to concern or annoyance with low flying aircraft. There were few complaints to sonic boom noise and agreement between the two methods was perfect. Use of an "other" category was slightly greater by Selfridge personnel than an "after-the-fact" categorization. The last comparison of Figure 7. provides a comparison

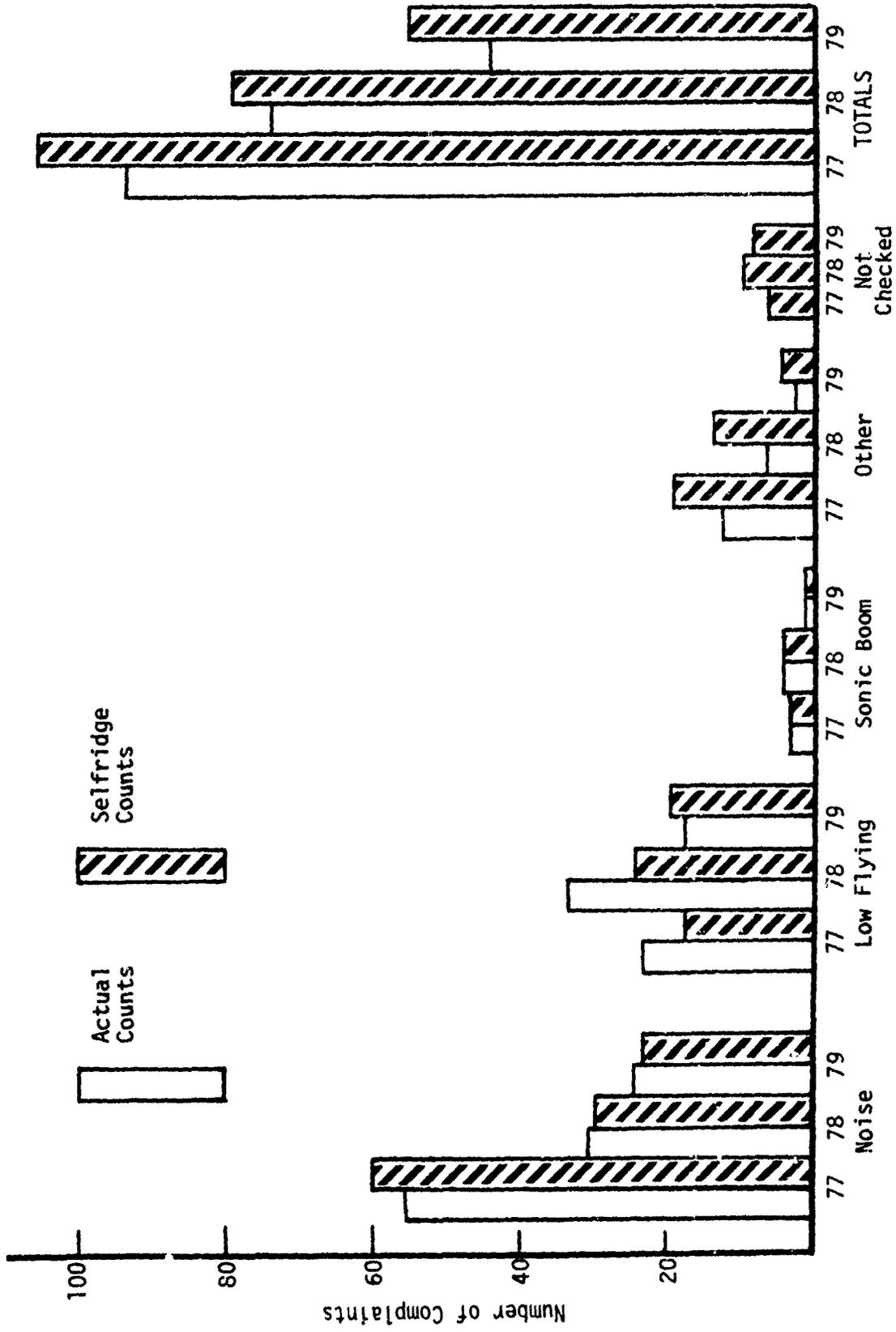


Figure 7. Comparison of Selfridge Complaint Counts with Obtained Counts

between the two methods of categorizing and shows the expected relatively greater number of Selfridge counts for each of the three years. The main interest in making the comparisons of Figure 7. was concern with the relatively high percentage of complaints which were categorized as concern or annoyance with low flying aircraft. As an example, some 10% of the complaints at McChord were attributed to low flying aircraft as compared to 35% at Selfridge. The comparisons in Figure 7. do show that the methods of this study did not de-emphasize noise complaints due to possibly overemphasizing concern with low flying aircraft. The actual counts of complaints over the three year period to noise is but three complaints greater than obtained by the "on-the-spot" Selfridge method.

Plottings of noise complaints by month are given in Figure 8. Results do indicate that complaints to noise are associated with "open-window" periods

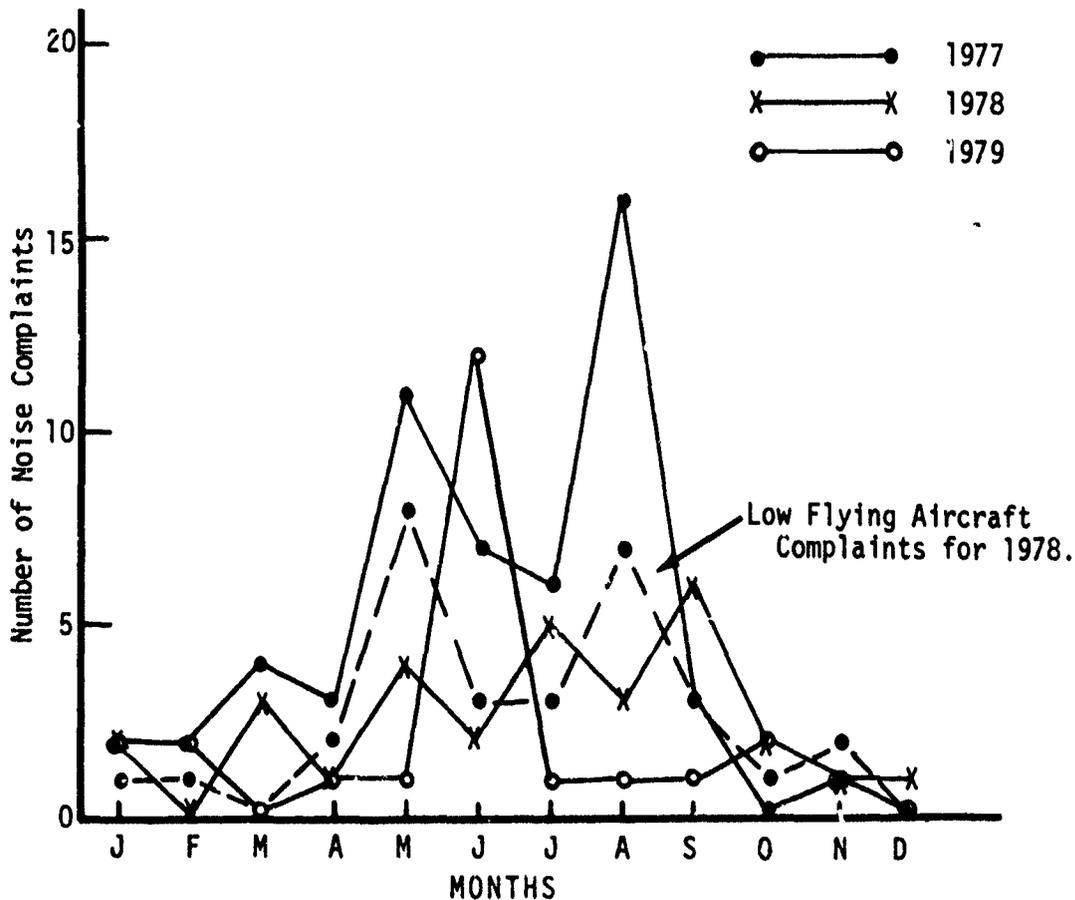


Figure 8. Number of Noise Complaints Received by Month at Selfridge for 1977, 78 & 79.

occurring in the May through August months. In 1977, almost 70% of the noise complaints occurred during that four-month period. For 1978, with total number of noise complaints appreciably reduced over 1977, some 67% of the noise complaints occurred from May through September. From the standpoint of occurrence of noise complaints, 1979 is most interesting in that 50% of all noise complaints for that year occurred during June. Almost all of these June noise complaints (approximately 80%) were to aircraft flights taking part in a special NORAD exercise which involved night and early morning flights. This 1979 distribution of complaints along with the fact that summer months at an Air National Guard Base result in an increase in flight activities suggest that it is not so much the absence of noise attenuation due to open windows (higher noise levels) but an increase in flight activities which accounts for an increase in noise complaints. That complaints involving low flying aircraft (not noise) are increased during these "open-window" months tends to support the position that increased flight activity leads to an increase in complaint behavior to a greater extent than open windows. The dashed line of Figure 8. plots number of complaints to low flying aircraft for 1978 and shows the increase in complaint behavior during the May through September period.

Proportionally, complaints of sleep interference due to aircraft noise was not as extensive at Selridge as at some of the other AF Bases. Approximately 17% of the noise complainants reported sleep interference. As shown in Figure 5., complaints to ground runup noise was not extensive in that less than 5% of the noise complaints were attributed to runups and no person complaining about runup noise complained of interference with sleep. Percentages of noise complainants mentioning sleep interference are given in Figure 9. and are based on total noise complaints (sum of flyover and runup complaints). That the percentage of complainants who mentioned interference with sleep reached 38% in 1979 was almost entirely due to the NORAD exercise of June 1979. Of the 12 persons who registered complaints in June 1979, eight of them also reported interference with sleep.

Since there were relatively large numbers of complaints to aircraft noise and low flying aircraft, 52% attributed to aircraft noise and 35% to low flying aircraft with the remaining 13% attributable to other sources or sonic booms, the percentage of females registering complaints for both

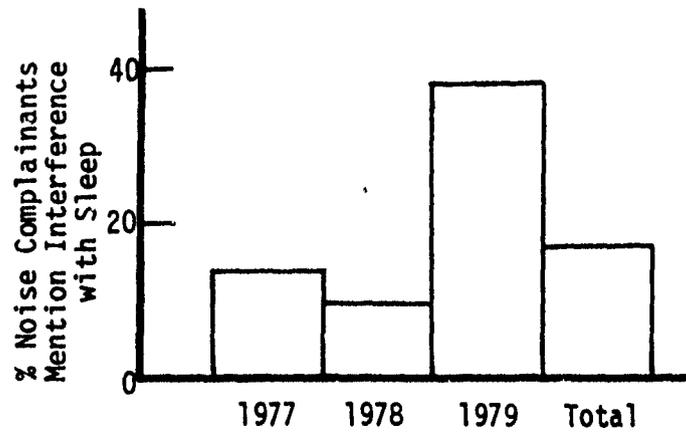


Figure 9. Percent Noise Complainants Reporting Sleep Interference

of these categories is provided. Figure 10. gives these results. On the average, females are more likely to register a complaint with emphasis on the noise effects with males emphasizing concern with low flying aircraft.

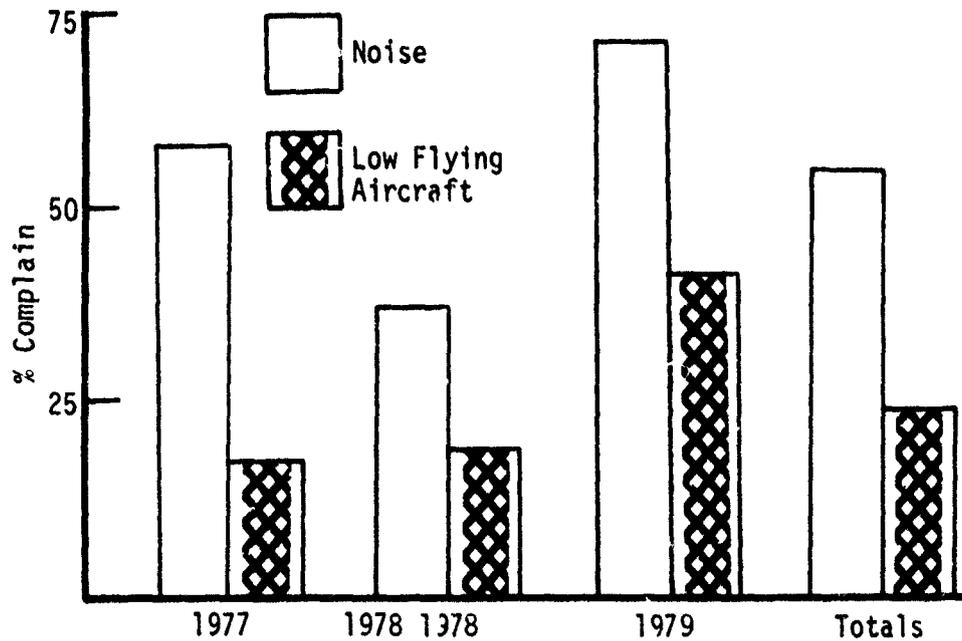


Figure 10. Percent Females Complain to Noise and Low Flying Aircraft

Of the noise complaints received over the three-year period, 55% were made by females while but 23% of the complaints to low flying aircraft were by females.

Observations and summary information concerning complaints received during a three-year period at Selfridge ANG Base are:

1. The number of noise complaints is considered relatively low. An average of 36.3 noise complaints were received over the three-year period.
2. Noise complaints decreased each year from 1977 through 1979. There was no relationship between number of operations and noise complaints.
3. Ground runup noise is not a significant problem at Selfridge in that but 5% of the noise complaints were associated with ground runup noise.
4. Some 17% of the noise complaints were associated with sleep interference.
5. More noise complaints were received from women than men.
6. Approximately 52% of complaints directed to aircraft activities were due to noise effects.
7. Some 35% of all complaints received were attributed to "low flying" aircraft.
8. Slightly less than 5% of the complaints received were to sonic boom noise.

#### MC CLELLAN AFB COMPLAINT DATA

Records for this base were available from August through December of 1977 and for all of 1978 and 1979. For 1977, all presentations involving number are increased by a factor of 2.4 so that comparisons to 1978 and 1979 are somewhat reasonable. For example, a total of 37 complaints were received from August through December 1977 but it is assumed that a total of approximately 89 complaints (roughly the same number received in 1979) would have been received for 1977 had all of the records been available. A summary

of complaints is given in Figure 11. Total number of complaints decreased in

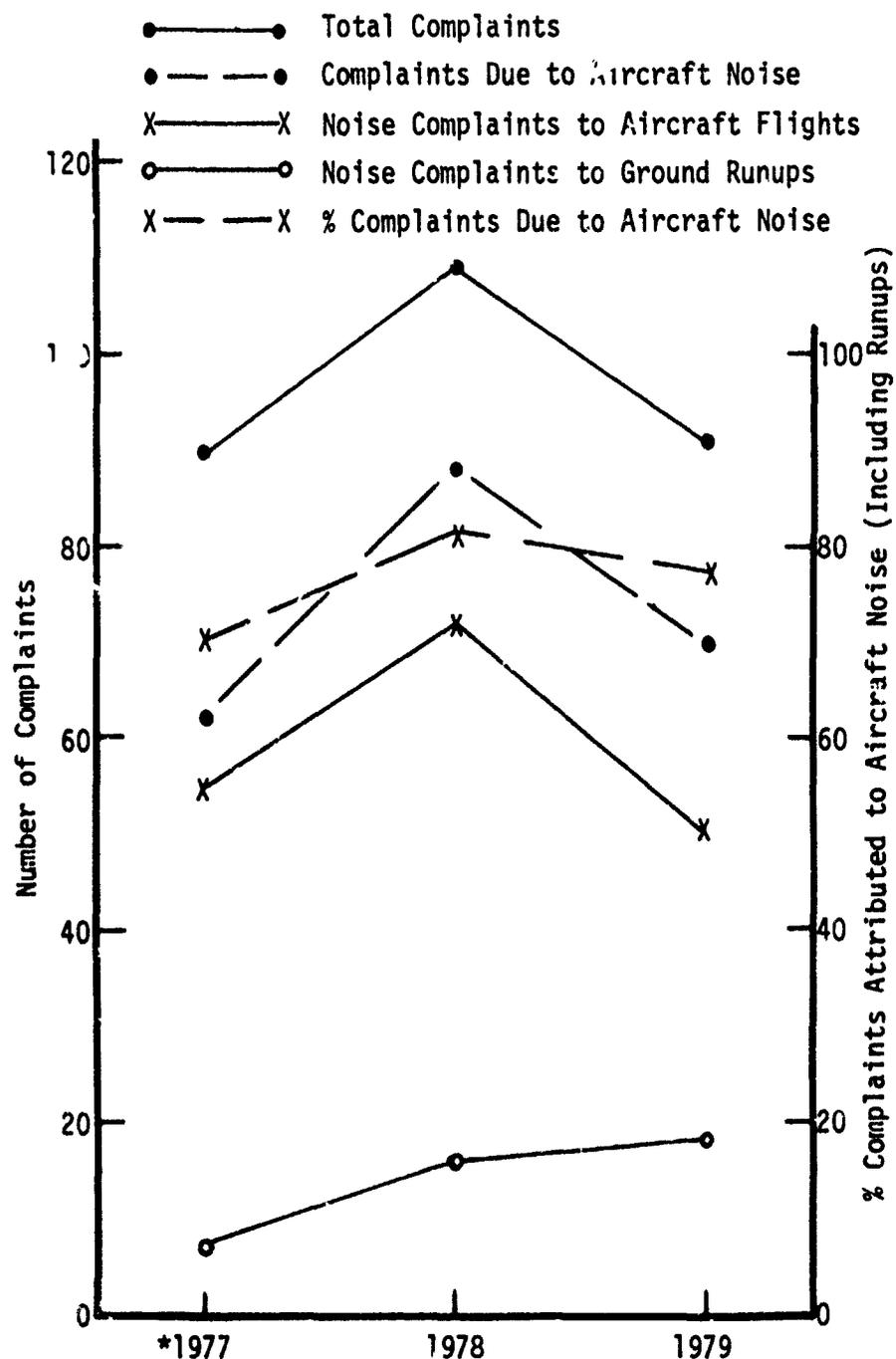


Figure 11. Complaint Totals for McClellan AFB

\*1977 totals are increased by a factor of 2.4 due to but 5 months of complaint records (July through December) being available.

1979 over 1978 as did complaints due to aircraft noise (both flyover and runup noise). However, the absolute number and proportion of complaints to ground runup noise increased in 1979 over 1978 as shown in Figure 12., reaching 35% of the noise complaints received in 1979. The percentage of noise complaints is higher for this case than at other AF Bases, ranging from 70% to 81% and averaging 78% over the two-year and five-month period for which records were available.

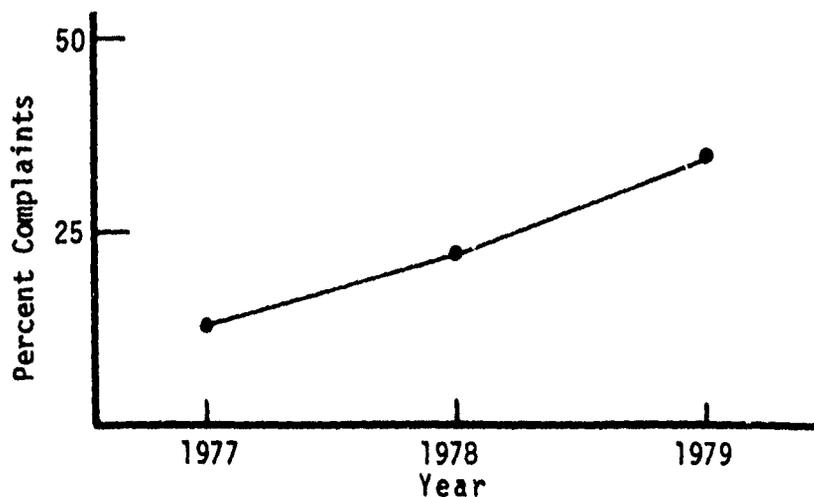


Figure 12. Percent of Noise Complaints Due to Ground Runup Noise

An examination of complaints to noise by month for the two full years (1978 and 1979) is instructive. These data are provided in Figure 13. For 1978, the month of September clearly stands out. Thirty-one complaints to aircraft noise were received in that month or 35% of all noise complaints received in 1978. Review of the complaint records reveals that nineteen of these thirty-one noise complaints were received on September 11. Three of these nineteen noise complaints were fairly routine in nature in that one of them was to engine runup noise occurring in the late evening, a second complaint was to a takeoff of an F-111, while the third noise complaint presumably involved two Coast Guard helicopters. However, the remaining sixteen noise complaints were due to a C-5 aircraft which was practicing approaches between approximately 8:00 and 11:00 a.m. For 1979, December stands out somewhat in that there were thirteen noise complaints during that month. Examination of the December records shows that the majority of the complaints were to ground

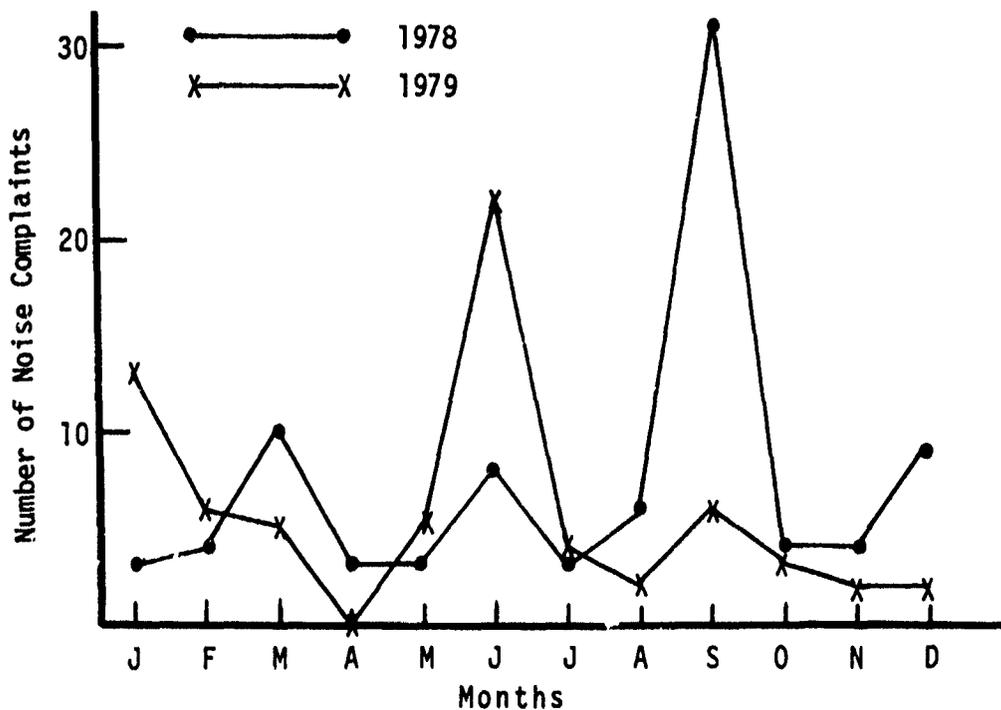


Figure 13. Number of Noise Complaints Received by Month at McClellan for 1978 and 1979.

runups, a total of eight, with seven of the complaints occurring in the 2200-2300 time period on December 18, 1979. For 1979, June was also a heavy month for noise complaints in that there were twenty-two or 31% for the year. Of these twenty-two June 1979 noise complaints, thirteen of them occurred on June 24 which was a Sunday. All of these noise complaints were to takeoffs of five transient aircraft (four of them heavily loaded KC-135's) which had landed at McClellan for refueling. Due to a cross wind, takeoff direction was not typical. These three examples of unusual high complaint behavior were all a result of unusual or somewhat atypical aircraft activities and involved high concentration of noise for relative short periods of time.

Percent of times that sleep interference was associated with a noise complaint is given in Figure 14. Over the two-year and five-month period, 23% of the noise complainants reported that noise due to aircraft activities interfered with sleep. That there was a higher percentage of sleep interference complaints in 1977 may not be representative since but five months of complaint

records were available for that year.

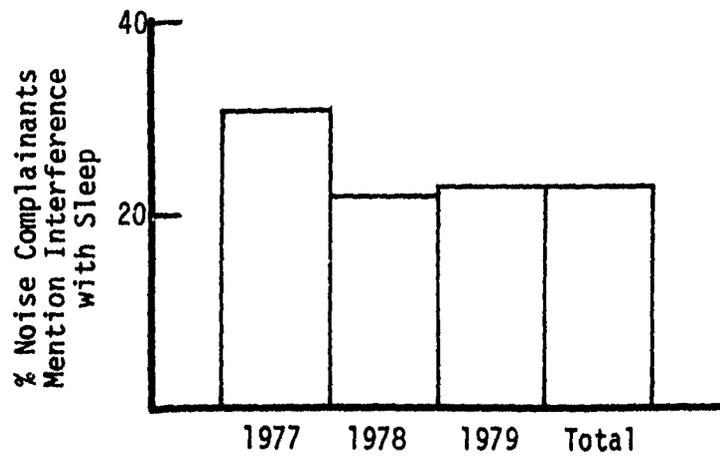


Figure 14. Percent Noise Complainants Reporting Sleep Interference

The extent that noise complaints and complaints involving low flying aircraft were reported by females was also considered at McClellan. Figure 15. provides these results. For the previous two bases (McChord and Selfridge) there was a tendency for females to register the greater percentage of noise

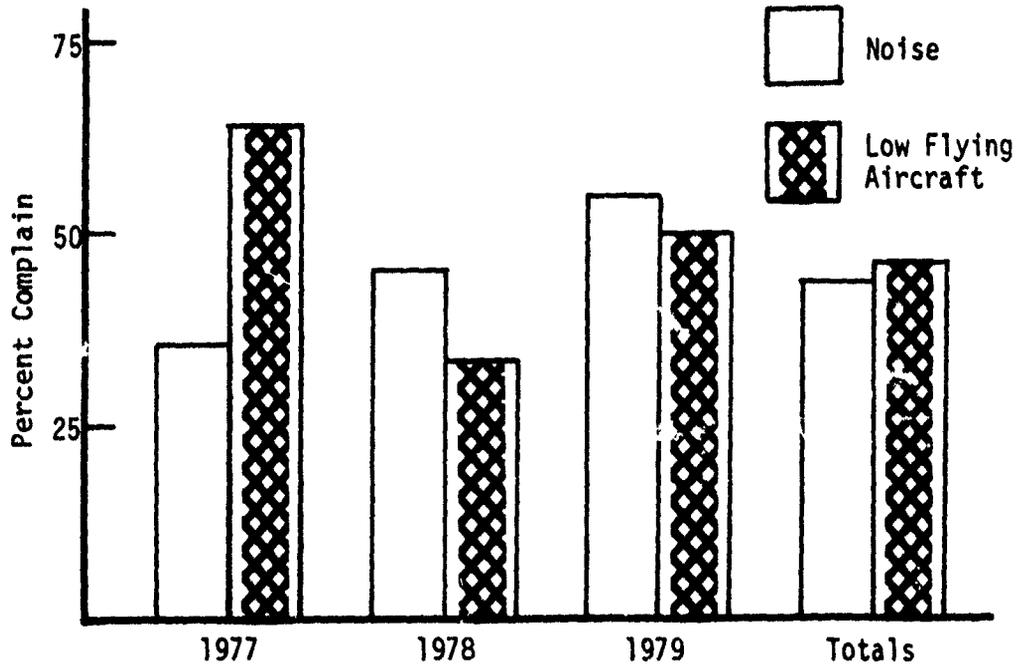


Figure 15. Percent Females Complain to Noise and Low Flying Aircraft

complaints (57% and 55% respectively) and for females to complain proportionally less to low flying aircraft. This is not the situation at McClellan where 44% of the noise complaints were by women with some 46% of complaints to low flying aircraft by women which is considerably greater than 32% at McChord and 23% at Selfridge.

Observations and summary information concerning complaints received during a two-year and five-month period at McClellan AF Base are:

1. The average number of noise complaints received per year was seventy-six. Although this is more than two times the number received per year at McChord and Selfridge, the number is not considered high in that it is considerably lower than complaint totals received at some major commercial airports.
2. Noise complaints decreased in 1979 in comparison to 1978.
3. Some 20% of the noise complaints at McClellan were associated with ground runup noise.
4. Approximately 23% of the noise complaints involved interference with sleep.
5. Slightly fewer noise complaints were received from women than from men.
6. Almost 78% of the complaints received were due to noise.
7. Eighteen percent of all complaints received could be attributed to low flying aircraft and not to noise.
8. There were few complaints involving sonic boom noise at McClellan in that but 1% of all complaints received involved sonic booms.

#### CARSWELL AIR FORCE BASE COMPLAINT DATA

Five years of complaint records were available for this base, 1973 and 1976 through 1979. A summary of number of complaints by year at Carswell is given in Figure 16. As for the summary plots for the other bases, the solid line (●—●) shows the total number of complaints received with the dashed line (● — ●) giving the number of complaints attributable to noise. Complaints to noise is divided further into complaints attributable to either flyover noise or to ground runup noise with approximately 12% of the noise

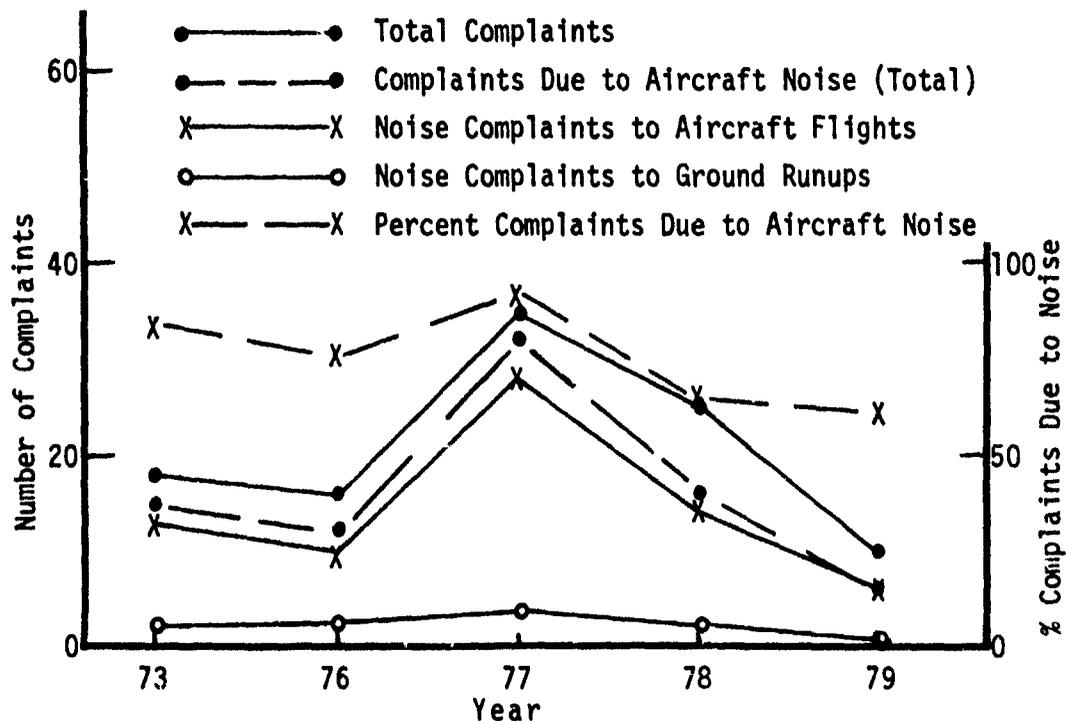


Figure 16. Complaint Totals for Carswell AFB

complaints due to runup noise. Although the total number of noise complaints is not at all high at this Air Base, there is enough difference in numbers between 1977 and the other years to reach the conclusion that complaints to noise peaked in 1977. There were thirty-two complaints to noise in 1977 with the next highest year being 1978 with sixteen noise complaints. As shown in Figure 16., the percentage of total complaints attributable to noise is relatively high, ranging from 60% in 1979 to 91% for 1977; percentage of total complaints attributable to aircraft noise over the five-year period was almost 78%. Thus, relatively few complaints were due to sonic booms, low flying aircraft or miscellaneous occurrences such as reports of UFO's.

A plot of the number of noise complaints by month for 1977 and 1978 is given in Figure 17. For 1977, there is a tendency for noise complaints to be greater during the September through December period and for 1978, the largest number of noise complaints were registered in May. There is certainly no support for the idea that noise complaints increase dramatically during the

warm weather periods.

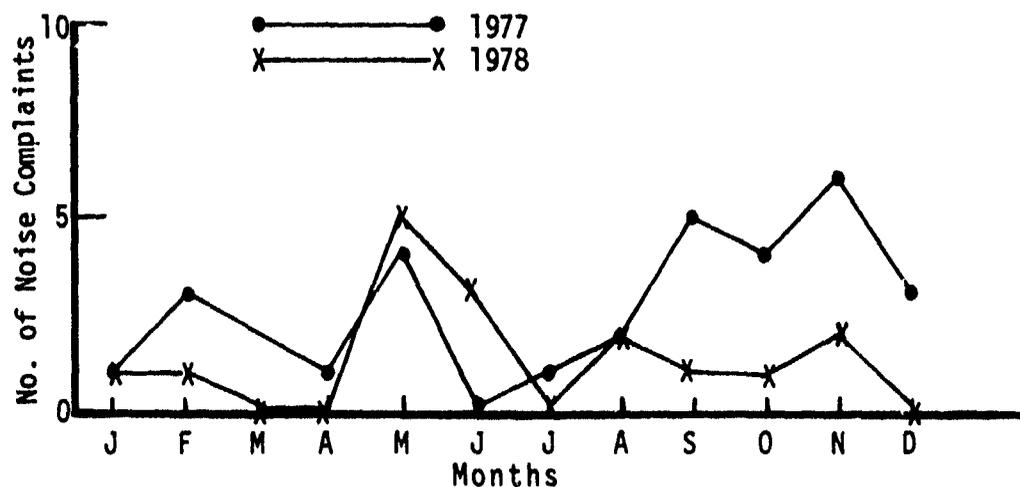


Figure 17. Number of Noise Complaints Received by Month at Carswell AFB for 1977 and 1978.

For the five-year period, 31% of the persons complaining about noise indicated that the noise interfered with sleep. The percentage of those complaining of sleep interference by year is given in Figure 18. The highest

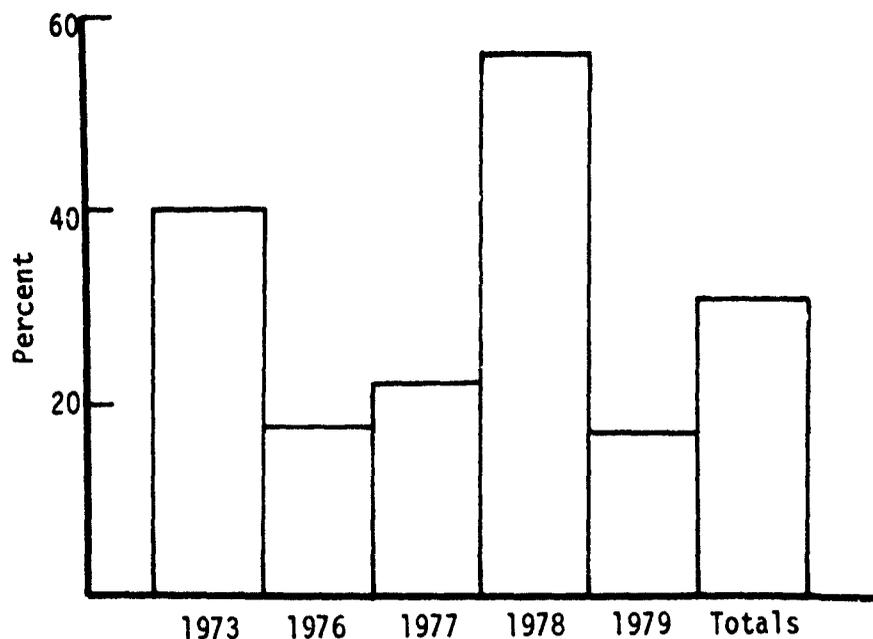


Figure 18. Percent Noise Complainants Reporting Sleep Interference

percentage reporting interference with sleep was in 1978 with nine of the sixteen noise complainants or 56% mentioning that the noise interfered with sleep. Complaints to ground runup noise was some 12% of total noise complaints and one-half of those complaining about runup noise reported interference with sleep.

As for the records for the other AF Bases, the number of complaints registered by women were determined. Figure 19. provides these results. Based on the totals for the five-year period, 56% of the noise complaints were from women. In 1976, 83% of the complaints were by females with no complaints by women in 1979. However, but six noise complaints were received in all of 1979.

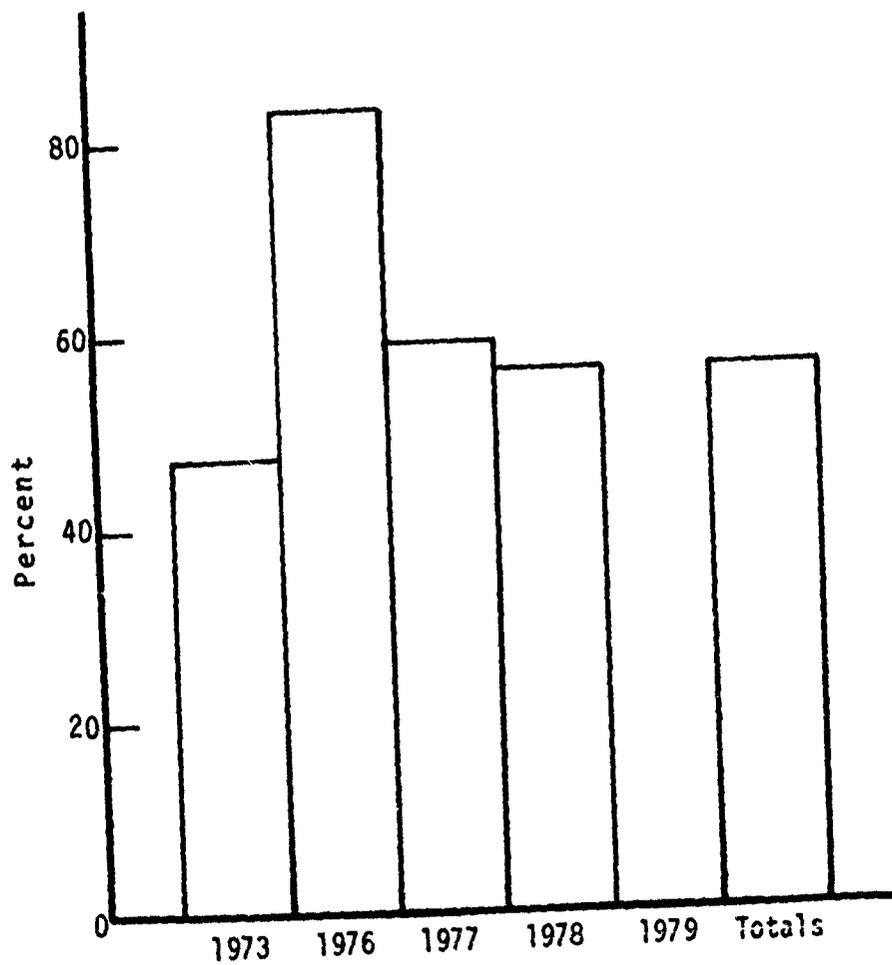


Figure 19. Percent Females Complain to Noise

There was some concern with low flying aircraft at Carswell in that 16% of all complaints received over the five-year period were due to perceptions of low flying. Women were less inclined to base their complaints on low flying aircraft. Approximately 41% of the complaints concerning low flight were by women.

Summary information and comments concerning complaints received over five complete years at Carswell AF Base are:

1. The number of noise complaints was unusually low in number, averaging slightly greater than sixteen per year.
2. Noise complaints peaked in 1977 and significantly decreased in 1978 and particularly in 1979.
3. Some 12% of the noise complaints were to ground runups.
4. Almost 31% of the noise complainants reported that the noise interfered with sleep.
5. More noise complaints were received from women than from men but greater numbers of men complained about low flying aircraft than did women.
6. Almost 78% of total complaints received were due to noise in and around the Air Base.
7. Approximately 16% of all complaints received were attributed to low flying aircraft.
8. Complaints to sonic boom noise averaged 4% for the five-year period.

#### FAIRCHILD AIR FORCE BASE COMPLAINT DATA

Records for this base were available for 1976 through 1979. A summary of complaints for the four years is given in Figure 20. After 1976, total number of complaints received drops and remains fairly constant with a slight decrease in 1979 relative to both 1977 and 1978. Complaints due to aircraft noise are considered constant over the four-year period but with a slight increase in 1979. There are minimal complaints to runup noise in that only two of the 131 complaints to noise were due to ground runups. The percentage of total complaints attributable to aircraft noise increased from 1976 through 1979 which

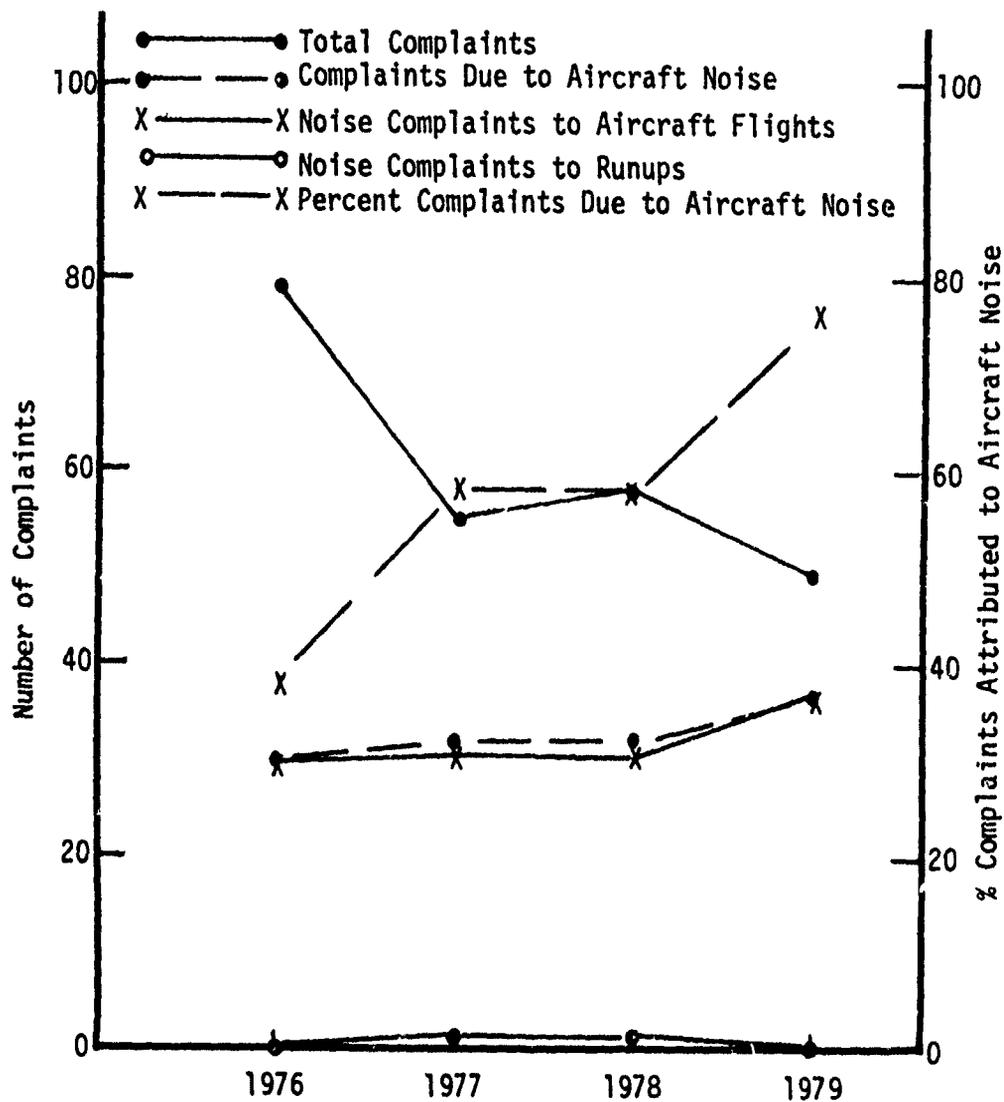


Figure 20. Complaint Totals for Fairchild AFB

was almost entirely due to decreases in complaints to sonic boom noise. As mentioned previously, almost all sonic boom complaints are out of the vicinity of an Air Base, often more than 100 miles distance from Fairchild. Since both Fairchild and Carswell are SAC Bases, there is relevance in comparisons between the two bases. The average number of total complaints at Fairchild is approximately 60 per year while Carswell showed a yearly average of 21 total complaints, a ratio of almost 3 to 1. Part of the greater number of total complaints at Fairchild is that Fairchild has evolved into a center for receiving sonic boom complaints at large distances from the base and due to aircraft not associated

with Fairchild. Carswell receives very few complaints to sonic boom noise. However, the number of noise complaints in the vicinity of the Air Base was still two times greater at Fairchild than at Carswell, 33 to 16 respectively for the yearly average.

Complaints to noise by month are plotted in Figure 21. for each of the four years that records were available. There is little agreement among months across the four years but a greater tendency for noise complaints to occur during the May through September period. That noise complaints were unusually low from June through September for 1976 may have been due to relatively few aircraft operations during that period.

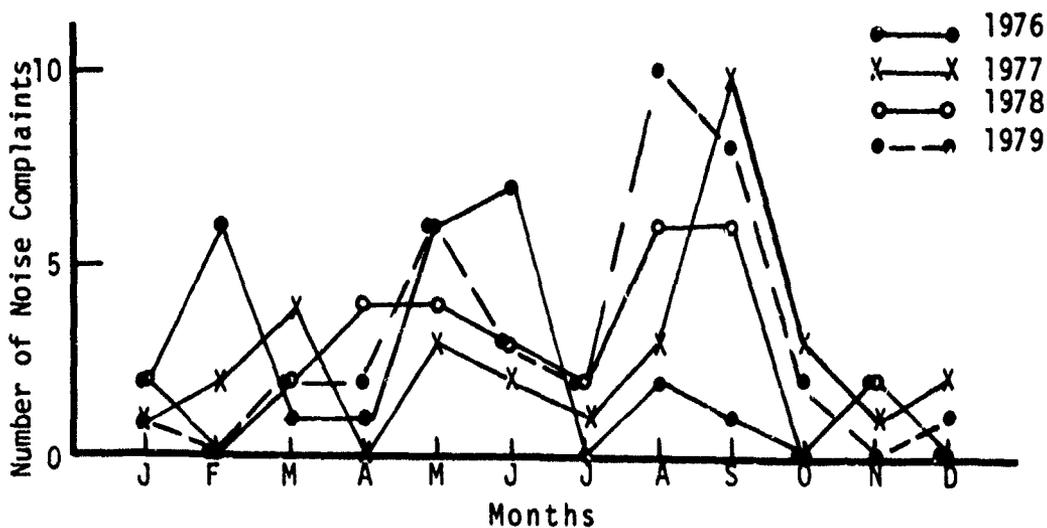


Figure 21. Number of Noise Complaints Received by Month at Fairchild for 1976, 77, 78 & 79.

Reports of interference with sleep were not particularly high at Fairchild in that over the four-year period but 12% of the noise complainants mentioned that the noise interfered with sleep. The percent of complainants reporting sleep interference by year is given in Figure 22. Some 30% of the noise complainants reported sleep interference in 1976 with it dropping to 5% or less in 1978 and 1979.

As for the preceding Air Force Bases, the proportion of noise complaints registered by females was determined. These results are given in Figure 23. Over the four-year period, 40% of the noise complaints were made by women

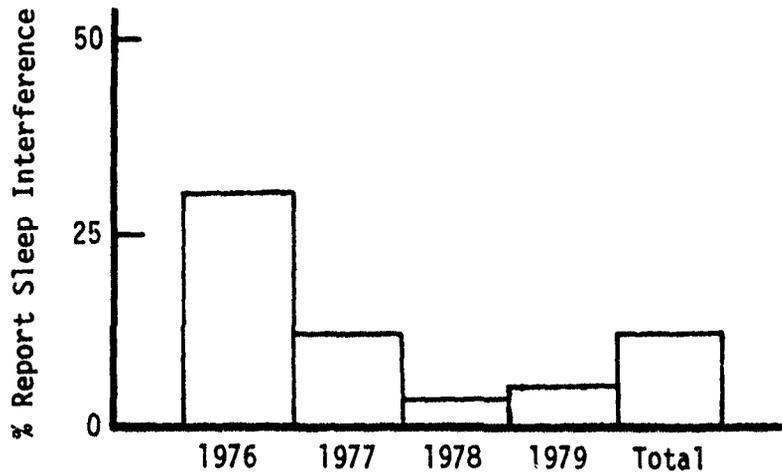


Figure 22. Percent Noise Complainants Reporting Sleep Interference

which is less than at any of the previous bases.

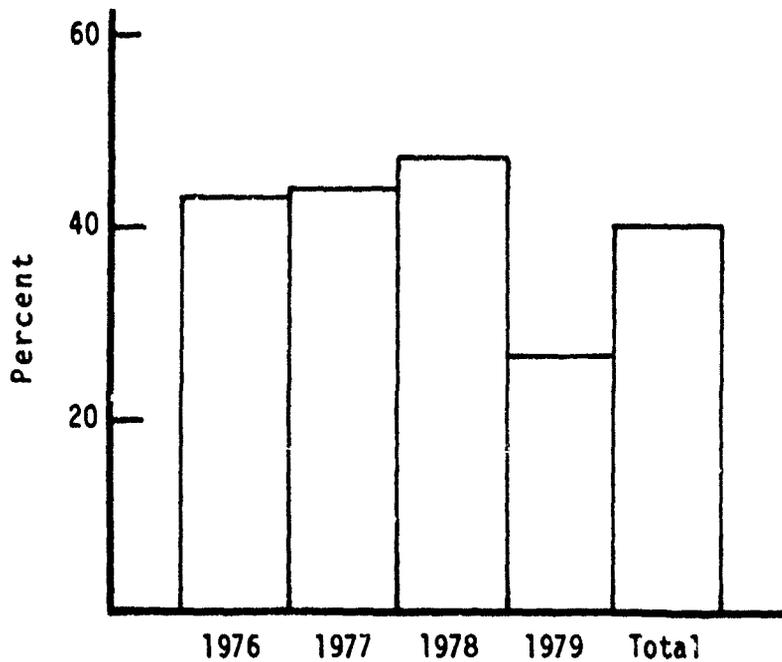


Figure 23. Percent Females Complain to Noise

Since a considerable number of sonic boom complaints are received at Fairchild, results for these complaints are given in Figure 24. As shown in Figure 24., the number and percent of total complaints to sonic booms is unusually high for 1976. Some 45 complaints to booms were received during that

year which was 57% of the total number of complaints received. The rate of 24% for sonic boom complaints during 1979 is also higher than for any of the Air Force Bases previously examined. That the complaint records show such a marked decrease in complaints to boom noise after 1976 should be considered tentative as there is a small possibility that the reduction is, in part, due to changes in record keeping methods.

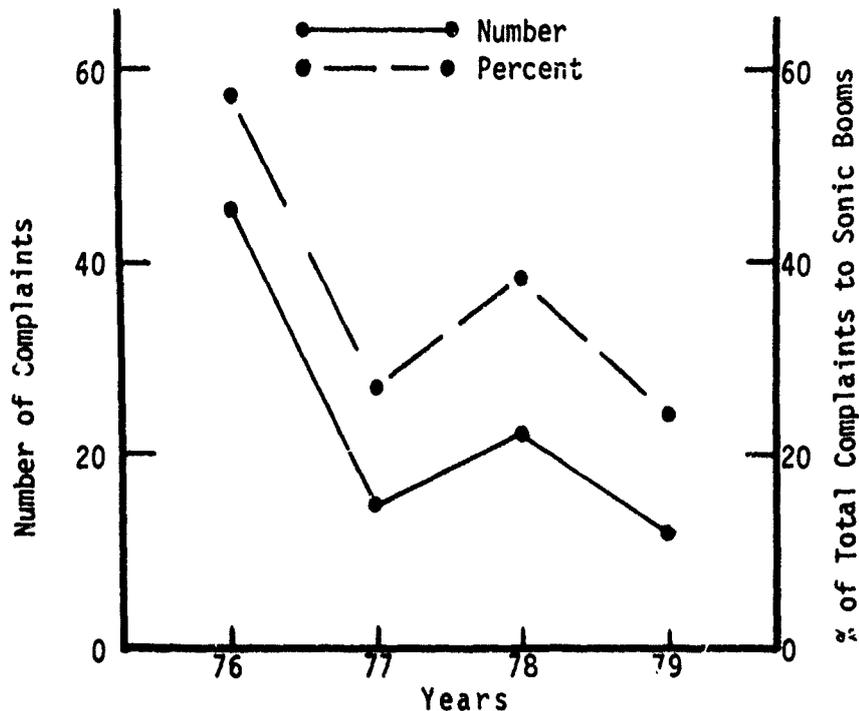


Figure 24. Number and Percent of Total Complaints Are to Sonic Boom Noise

Observations and summary information involving complaints received over a four-year period at Fairchild AF Base are:

1. The number of complaints received was relatively low in that over the four-year period, noise complaints averaged approximately thirty-three per year. However, this average was two times greater than noise complaints received at the other SAC AF Base which was Carswell.
2. In contrast to other bases, average number of noise complaints was relatively stable over the four-year period. Noise complaints ranged from 30 in 1976 to 37 in 1979.

3. Only 2% of all noise complaints were to ground runup noise.
4. Some 12% of the noise complainants mentioned that noise interfered with sleep. Reports of sleep interference were highest in 1976 when 30% of persons complaining about aircraft noise reported sleep interference.
5. Fewer noise complaints were received from women than men. There were no complaints concerning low flying aircraft by women.
6. Some 54% of the complaints received were to noise in the vicinity of the Air Base.
7. Only 3% of all complaints received were attributed to low flying aircraft.
8. Complaints concerning sonic boom noise were unusually high in that of all complaints received, 39% were due to sonic booms. This is the highest percentage of boom complaints received at any of the AF Bases studies.

#### DAVIS-MONTHAN AIR FORCE BASE COMPLAINT DATA

Complaint records were available for two years, 1978 and 1979. A compilation of data based on 1977 complaint records which was prepared by the Davis-Monthan staff was also provided. We will, for the most part, base our discussion on the actual records for 1978 and 1979 and utilize the 1977 Davis-Monthan compilation in a supplementary manner. A summary of complaint data is provided in Figure 25. Compared to total complaints received at the five Air Bases discussed above, this base receives a high number of complaint calls, averaging a minimum of 190 per year over the two-year period. The previous base with the next highest number of total complaints was McClellan with approximately ninety-eight per year. Complaints attributable to aircraft noise were relatively high in 1978 with more than 72% of all complaints received attributed to either flyover noise or runup noise. The number of noise complaints dropped dramatically in 1979, from 146 in 1978 to 66 as did percentage of noise complaints to total complaints received; there were 72% noise complaints in 1978 and 37% in 1979. This unusually low percentage of noise complaints, based on total number of complaints received, was primarily due to a shift from mentioning noise as a concern to completely emphasizing concern with low flying aircraft.

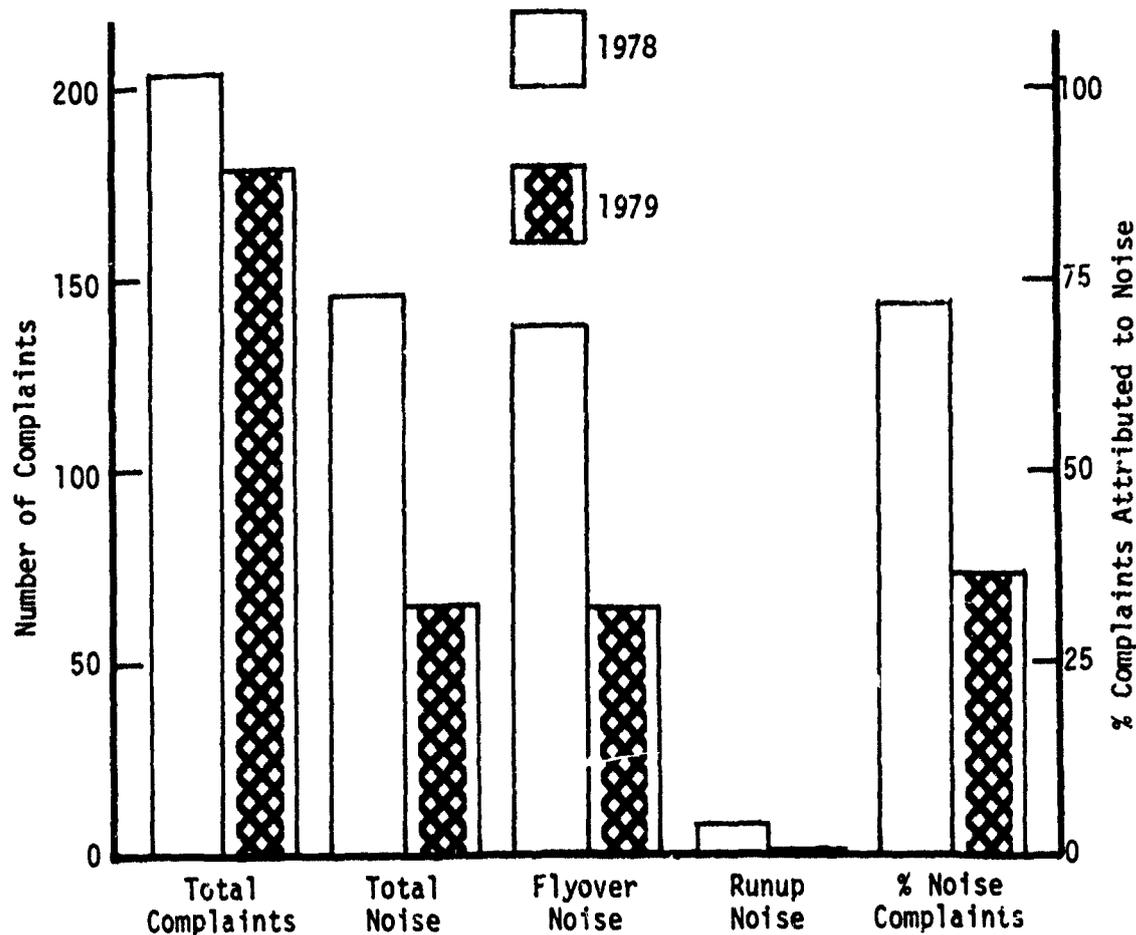


Figure 25. Complaint Totals for Davis-Monthan AFB

This concern with low flying aircraft was prompted by an aircraft crash in the Tuscon vicinity during October 1978. As Figure 25. shows, there was little need to isolate runup noise from flyover noise at this base. Of the 146 complaints associated with aircraft noise in 1978, seven were to runup noise. For 1979 there were no noise complaints attributable to ground runup noise.

As a means of providing additional data relative to a noise complaint analysis at Davis-Monthan AF Base, plottings of total complaints received by month for 1977, 78 and 79 are given in Figure 26. The 1977 data is compiled by Davis-Monthan AF personnel while the plots for 1978 and 79 were based on a count of complaint records. Since there is the expectation that 1978 would be an atypical year due to the crash of an aircraft in October 1978, there was interest in an examination of complaints based on more than one year.

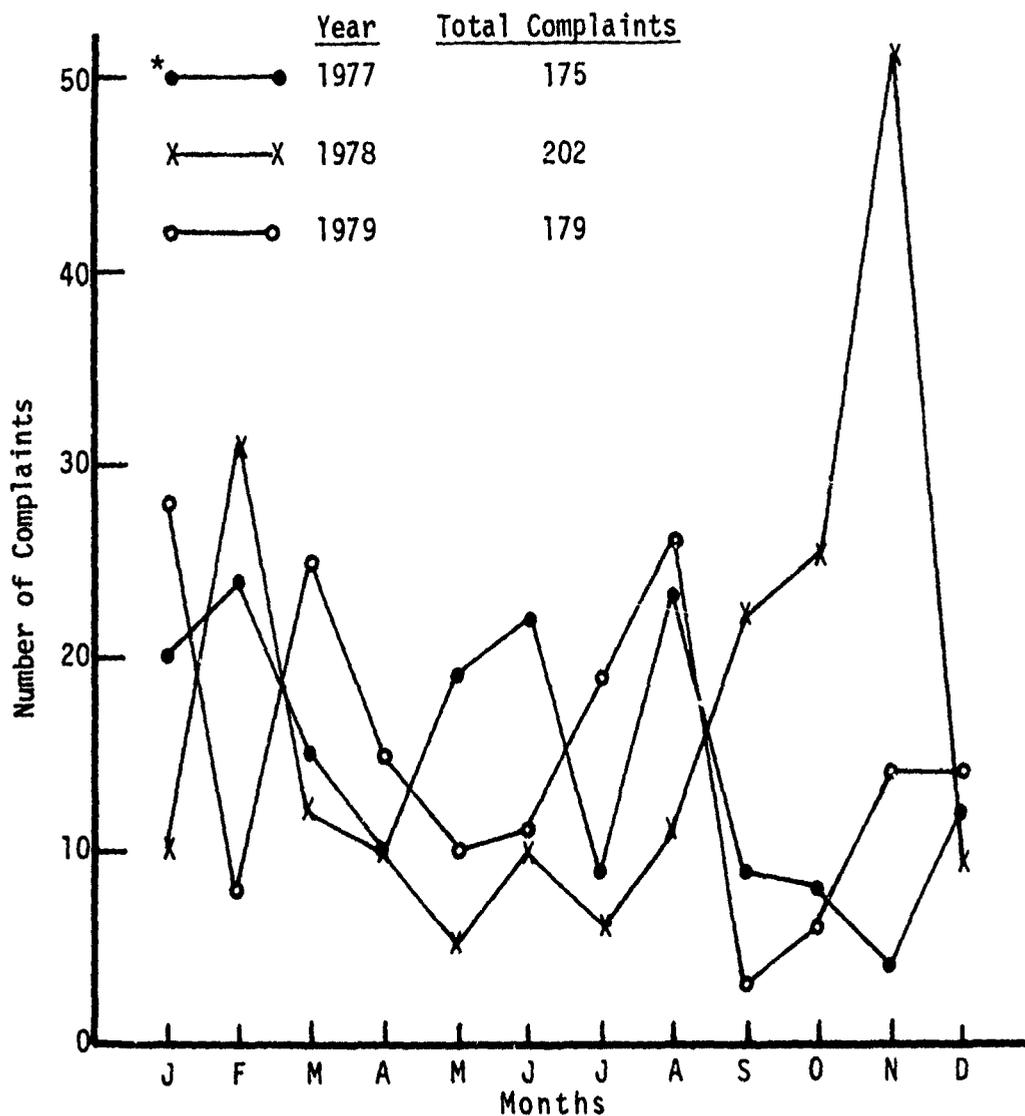


Figure 26. Number of Complaints Received by Month at Davis-Monthan for 1977, 78 and 79.

\*Compiled by Davis-Monthan Staff

The basic idea is that if the two years other than 1978 are comparable but both different in a significant characteristic from 1978, it could be concluded that 1978 is atypical due to the crash. Total number of complaints in 1977 was 175 and for 1979 there was a total of 179 complaints. Comparing number of total complaints by individual month for 1977 vs. 1979 shows fluctuations; e.g., for seven of the months a greater number of complaints per month were registered in 1979 than in 1977 with the remaining five individual months showing more complaints in 1977. As shown by the previous plots of noise

complaints only by month, fluctuations in number of complaints by month over years is expected. Thus the main difference between 1978 and the two comparison years (1977 and 1979) is the unusually large number of complaints received in November 1978. Based on maximum number of complaints received during highest months prior to October 1978 (25 to 30 complaints), it is estimated that a minimum of 20 additional complaints were received in November of 1978 with the news of the October crash supplying the motivation for this increase.

The number of complaints to noise for 1978 and 1979 are given in Figure 27. There is certainly little correspondence between the warmer-weather months and number of complaints, particularly for 1978. Noise complaints for December of

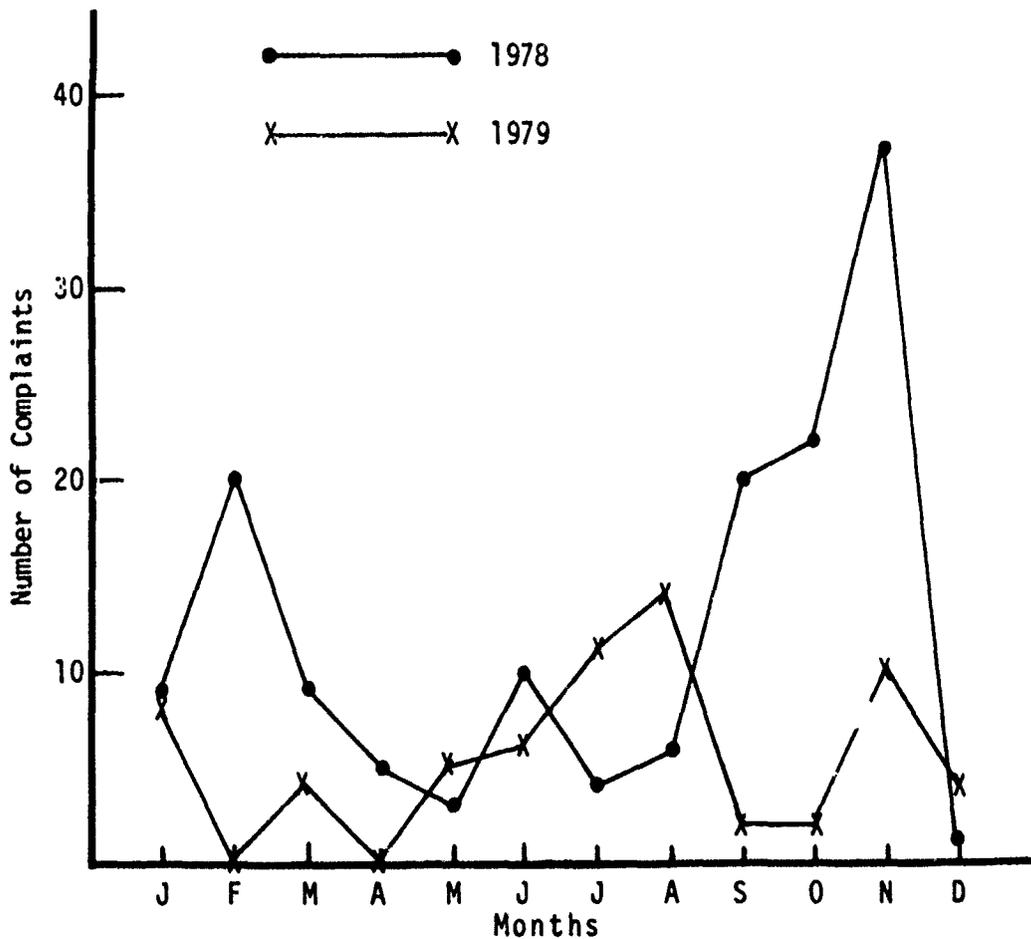


Figure 27. Number of Noise Complaints Received by Month at Davis-Monthan for 1978 & 79.

1978 are unusually low which is attributed to decreased flight activity during that month. Complaints to aircraft noise continue at a somewhat lower level

for January, February, March and April of 1979. One of the causes of this lower number of noise complaints in December of 1978 and January through April of 1979 is that complainants are clearly concerned about low flying aircraft and are not mentioning noise in their complaint calls. This finding is shown in Figure 28. which provides plots of low flying aircraft complaints by month for 1978 and 1979. Complaints to low flying aircraft and not to noise clearly increase as a function of the October 1979 crash and begin to return to "normal"

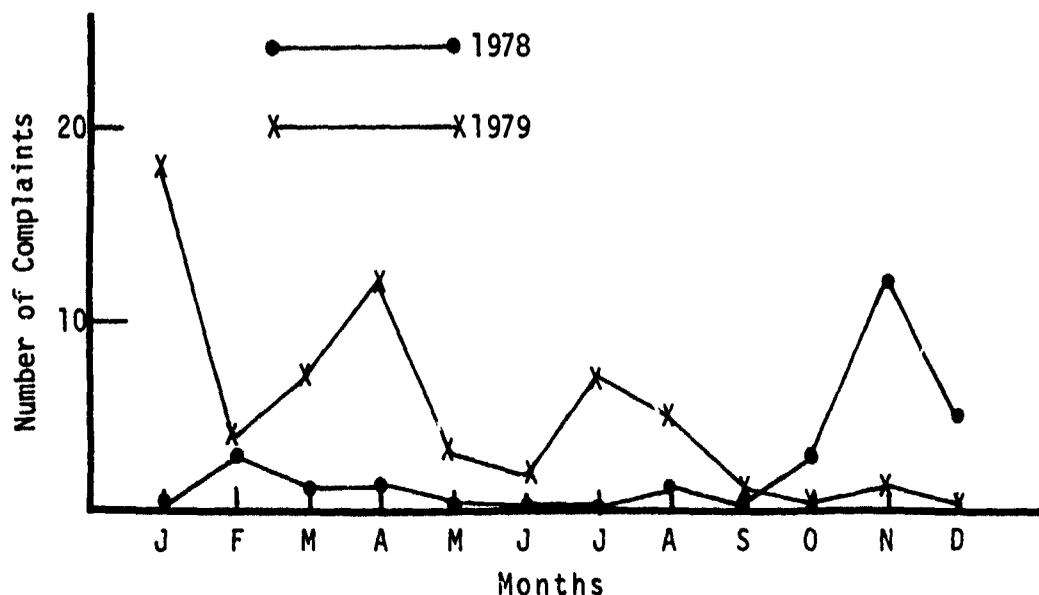


Figure 28. Number of Low Flying Aircraft Complaints Received by Month at Davis-Monthan for 1978 & 79.

about May of 1979 when the ratio of complaints to low flying aircraft vs. noise complaints is less than one. Figure 29. provides a plot of the ratio for low flying aircraft complaints to noise complaints. Until December of 1978 the ratio of low flying aircraft complaints to noise complaints is less than one, meaning that there are fewer complaints to low flying aircraft than to aircraft noise. However, the ratio for November 1978 did increase by more than 50% over any preceeding month in 1978, showing that concern with low flying aircraft is beginning to surface after the October 1978 crash. For the next five months (December 1978 through April 1979), the ratio is greater than one. In April of 1979, there were twelve complaints to low flying aircraft and no complaints to aircraft noise. In May of 1979, the ratio is again less than one. However, the ratio remains relatively higher in May through September of

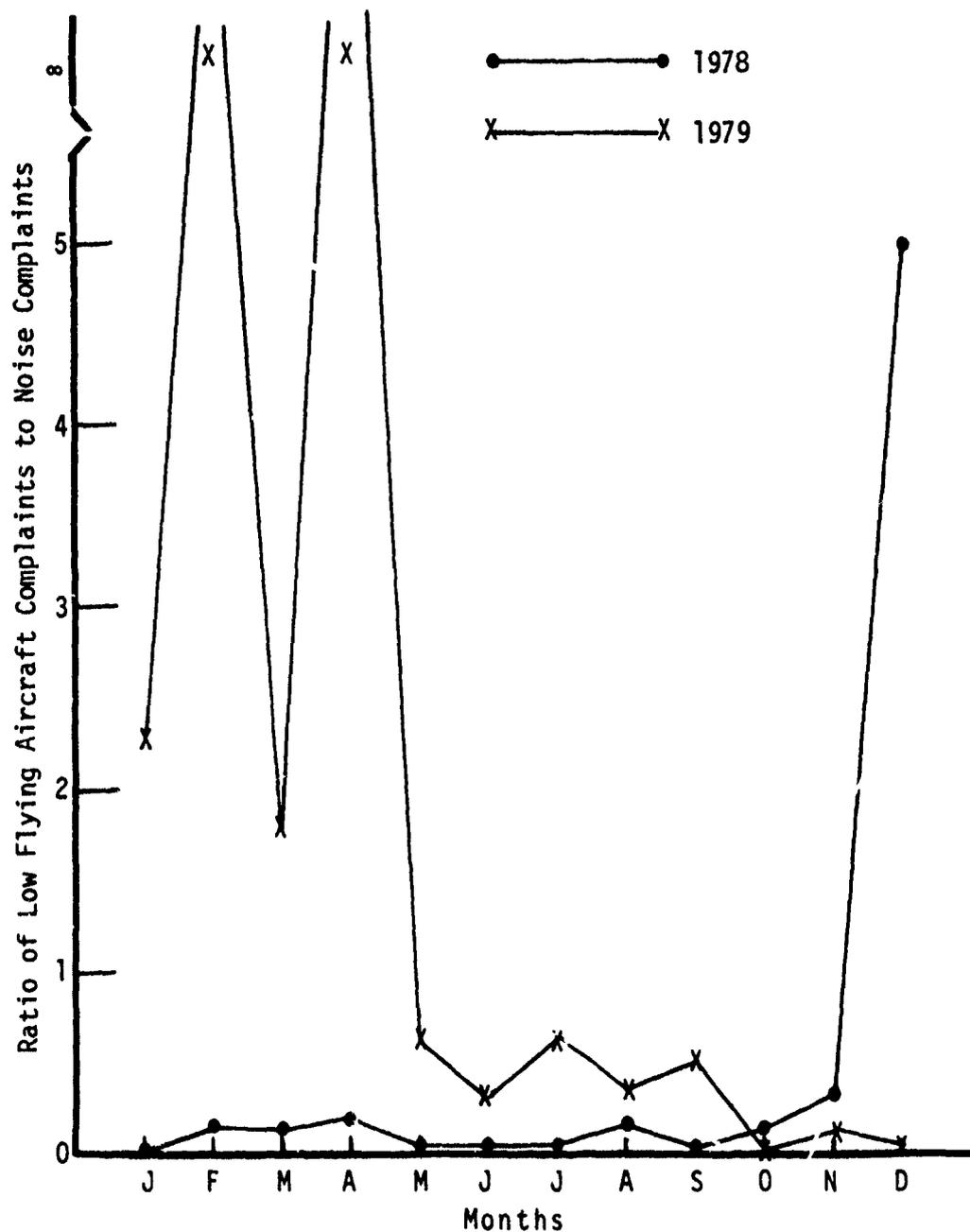


Figure 29. Ratio of Low Flying Aircraft Complaints to Noise Complaints by Month at Davis-Monthan for 1978 & 1979.

1979 (0.33 to 0.64) and does not really return to "normal" until October 1979.

Since sonic boom noise is more of an integral part of the total aircraft noise exposure situation at TAC AF Bases than at AF Bases which do not utilize supersonic equipment, monthly tabulations of complaints to sonic booms are

provided for Davis-Monthan. Of total complaints received over the two-year period, 18% of them were to sonic booms. This is not as high as the 39% complaints to sonic boom noise received at Fairchild which has developed into a center for sonic boom complaints in Eastern Washington State and parts of Idaho. However, average number of boom complaints per year received by Fairchild is approximately twenty-four while Davis-Monthan averaged approximately thirty-four per year for the two years that records were available. Figure 30. gives the number of sonic boom complaints by month at Davis-Monthan. With the exceptions of March and December of 1979, number of sonic boom complaints ranges from zero to six per month and is thus relatively stable for these months. These increases in sonic boom complaints during March and December of 1979 resulted in 25% of all complaints received in 1979 being attributable to sonic booms in comparison to 11% in 1978.

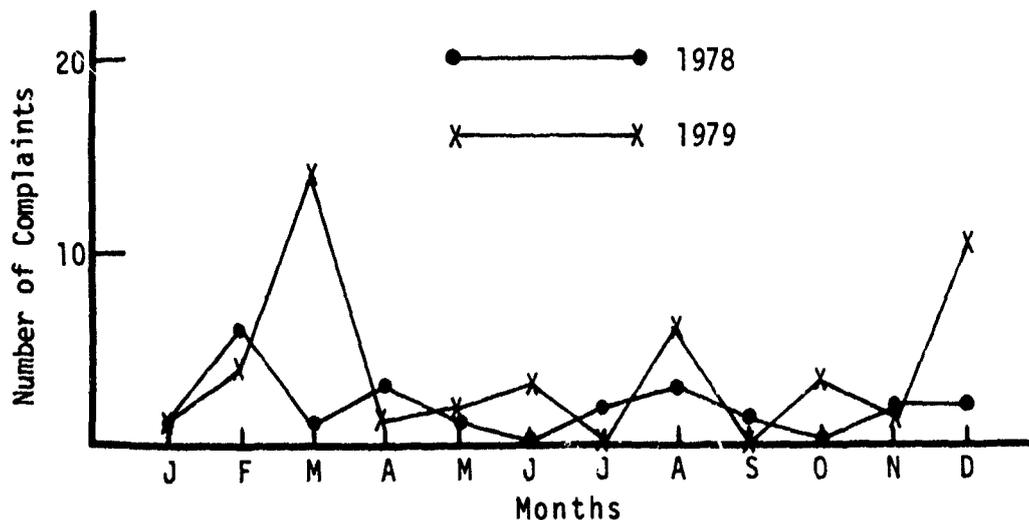


Figure 30. Number of Sonic Boom Complaints Received by Month at Davis-Monthan for 1978 & 1979.

The incidence of noise complaints associated with sleep interference was unusually low at Davis-Monthan. For 1978, the percentage of noise complainants reporting interference with sleep was 4% while this percentage was 9% in 1979 and averaged 6% for the two-year period. Of the six noise complainants reporting sleep interference in 1978, two of the six were associated with ground runup noise while no noise complainants who reported sleep interference in 1979 were complaining to ground runup noise.

Again the records at Davis-Monthan were examined relative to the number of women complainants with the slight expectation that complaints from women would outnumber those from men. As Figure 31. shows, this was not the situation. For noise complaints, but 36% of the complainants were women with 38% of the complaints to low flying aircraft from women. A lesser proportion of women registered complaints to sonic booms in that over the two-year period, 28% of the sonic boom complaints were by women.

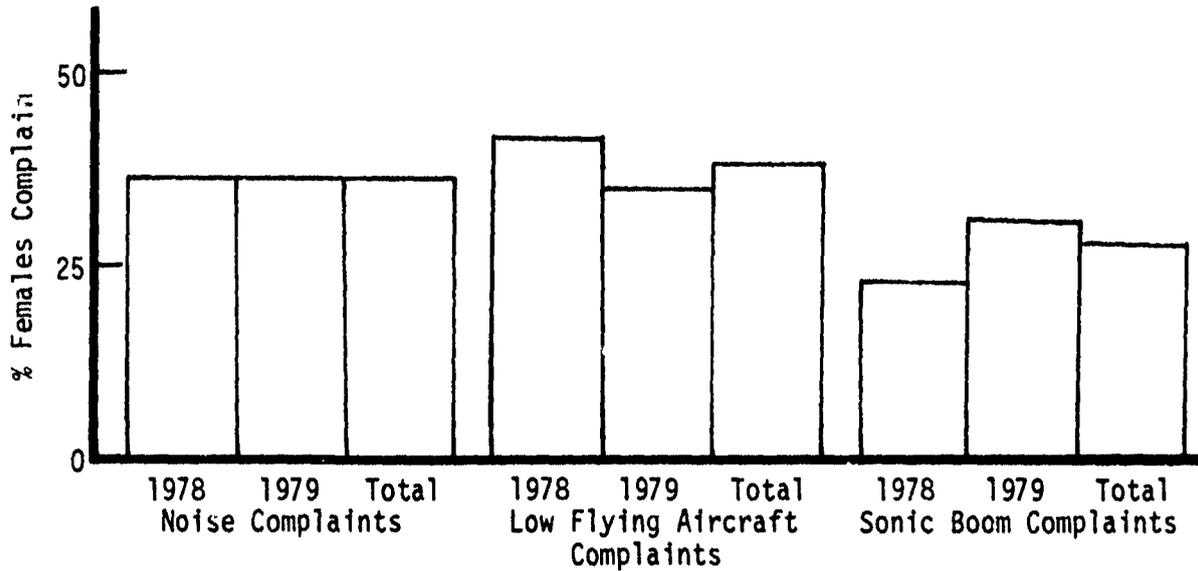


Figure 31. Percent of Complaints Made by Women by Three Categories

A final set of data involves determining whether-or-not the aircraft in question could be attributed to Davis-Monthan aircraft activities. On the complaint form, for both sonic boom and jet noise, there are provisions for checking either a "confirmed" or "denied" that the sonic boom or jet noise was attributable to Davis-Monthan. Results based on the utilization of this aspect of the complaint form are provided in Figures 32-a. and 32-b. The proportion of complaint events "confirmed" or "denied" is quite low compared to events where no determination is made. During 1978, thirty-one of the aircraft events were "confirmed" and seven were "denied" which translates into accounting for approximately 19% of the aircraft activities associated with complaints. The number of complaints received during a month does not necessarily lead to accounting for greater numbers of aircraft events associated with the complaint. In 1978,

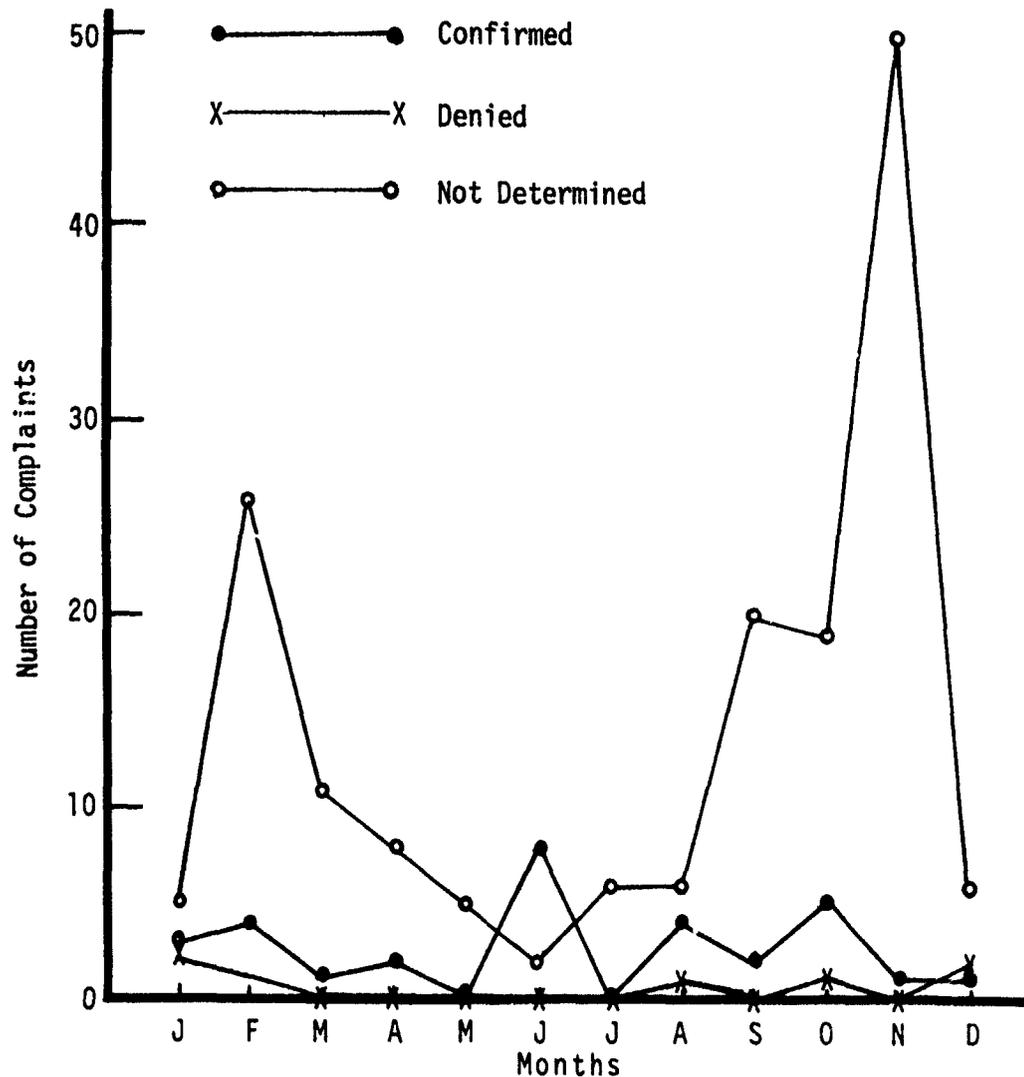


Figure 32-a. Number of Aircraft Complaint Events Confirmed, Denied or Not Determined at Davis-Monthan in 1978.

of the thirty-eight events which were checked as "confirmed" or "denied", eighteen of them were from the six low complaint months while twenty were from the high complaint months. The highest percentage of accountability was for July of 1978 when all six complaints (four to flyover noise and two to sonic booms) were "denied" while for the month logging the highest number of complaints in 1978 (Nov.), but one of the fifty-one was "confirmed". For 1979 (Figure 32-b.), twenty of the complaints were "confirmed" and twenty-seven were "denied". Thus, 26% of the aircraft events associated with complaints were determined. There is a marked increase in denials in comparison to confirmations for 1979 vs. 1978.

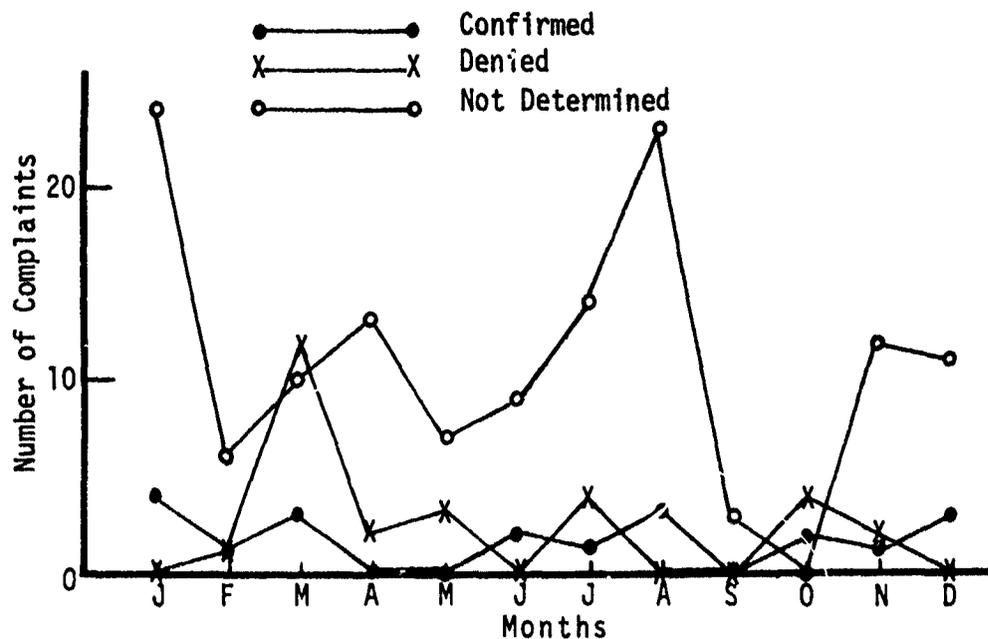


Figure 32-b. Number of Aircraft Complaint Events Confirmed, Denied or Not Determined at Davis-Monthan in 1979.

Observations and summary information for complaints received during a two-year period at Davis-Monthan AF Base are:

1. Compared to the other AF Bases studied, the number of noise complaints (almost entirely to aircraft flyover noise) received at Davis-Monthan was relatively high. The average number of noise complaints per year was 106.0 with 76.0 per year received at McClellan which had the next highest number of noise complaints per year.
2. Noise complaints markedly decreased in 1979 relative to 1978.
3. Ground runup noise is not a significant problem at Davis-Monthan in that but 3% of those complaining to noise identified runup noise as the source.
4. Approximately 6% of the noise complaints involved sleep interference with roughly one-third of this small number complaining of day-time sleep interference.
5. Fewer noise complaints were received from women than from men.
6. Of the total complaints received, 56% were directed to flyover and runup noise.

7. Approximately 23% of all complaints received were attributed to "low flying" aircraft.
8. Sonic boom noise accounted for 18% of all complaints received.

#### NELLIS AIR FORCE BASE COMPLAINT DATA

At Nellis, complaint records were available for a three-year period, 1977 through 1979. A summary of the data is given in Figure 33. The total

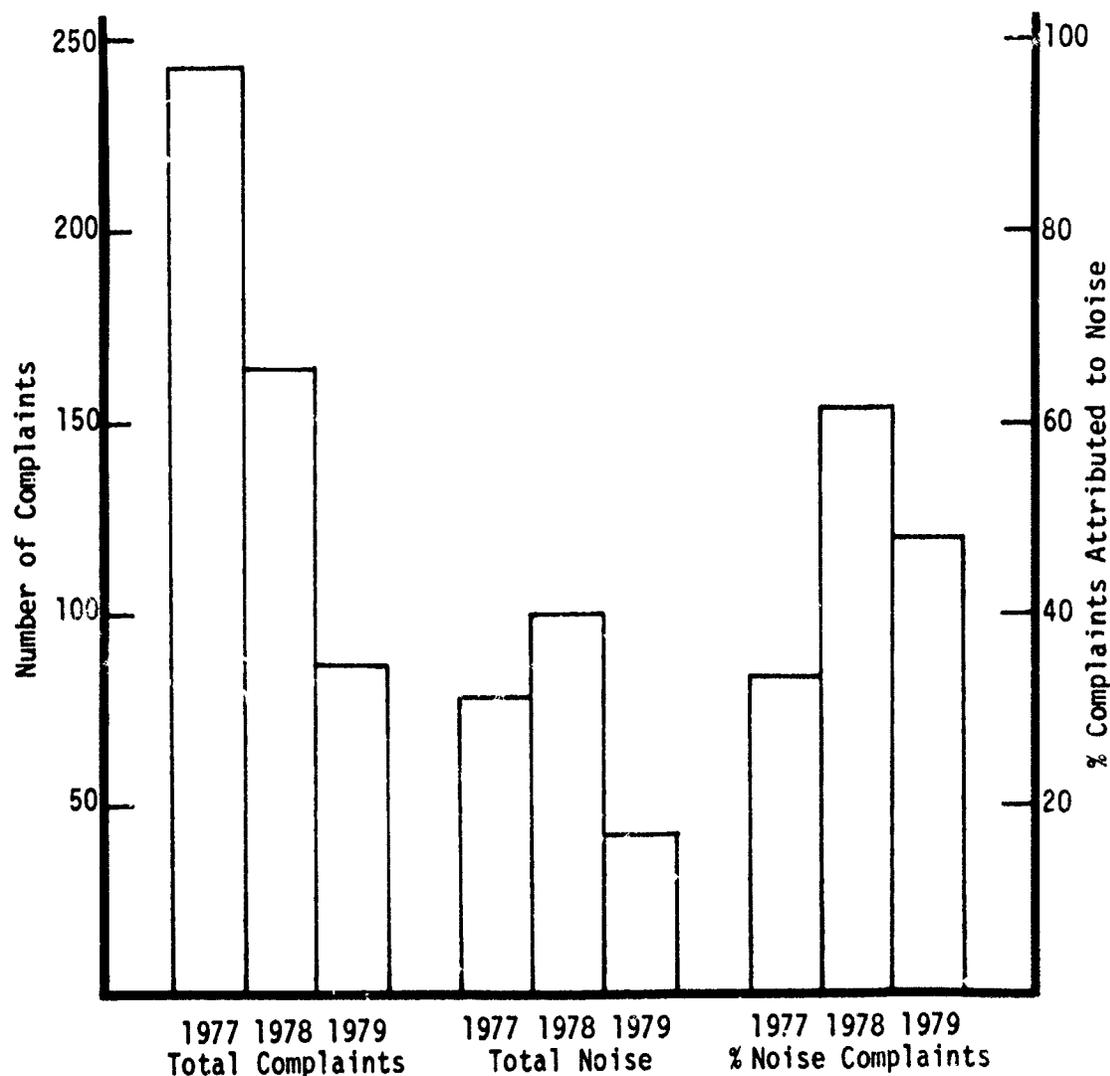


Figure 33. Complaint Totals at Nellis AFB

number of complaints decrease dramatically over the three-year period. The 1977 complaint total was unusually high and was the greatest total number of

complaints received during a one-year period at any of the seven AF Bases studied. Total complaints at Nellis were 242 in 1977 with the next highest total at 202 for Davis-Monthan during 1978. Complaints to aircraft noise (flyover noise and runup noise) increased in 1978 over 1977 but in 1979 there was a sharp drop in complaints in this category along with the drop in total complaints. The percentage of complaints attributable to aircraft flyover noise was unusually low in 1977 at 33% of the total. Over the three year period, Nellis showed the highest response rate of sonic boom complaints for the entire study; this is the main reason that percentage of noise complaints is so low. Complaints to ground runup noise are not isolated in Figure 33. due to the fact that the problem is practically non-existent at Nellis. Of the 493 complaint records examined at Nellis, only one could be attributable to runup noise.

Total complaints received by month are plotted in Figure 34. As for

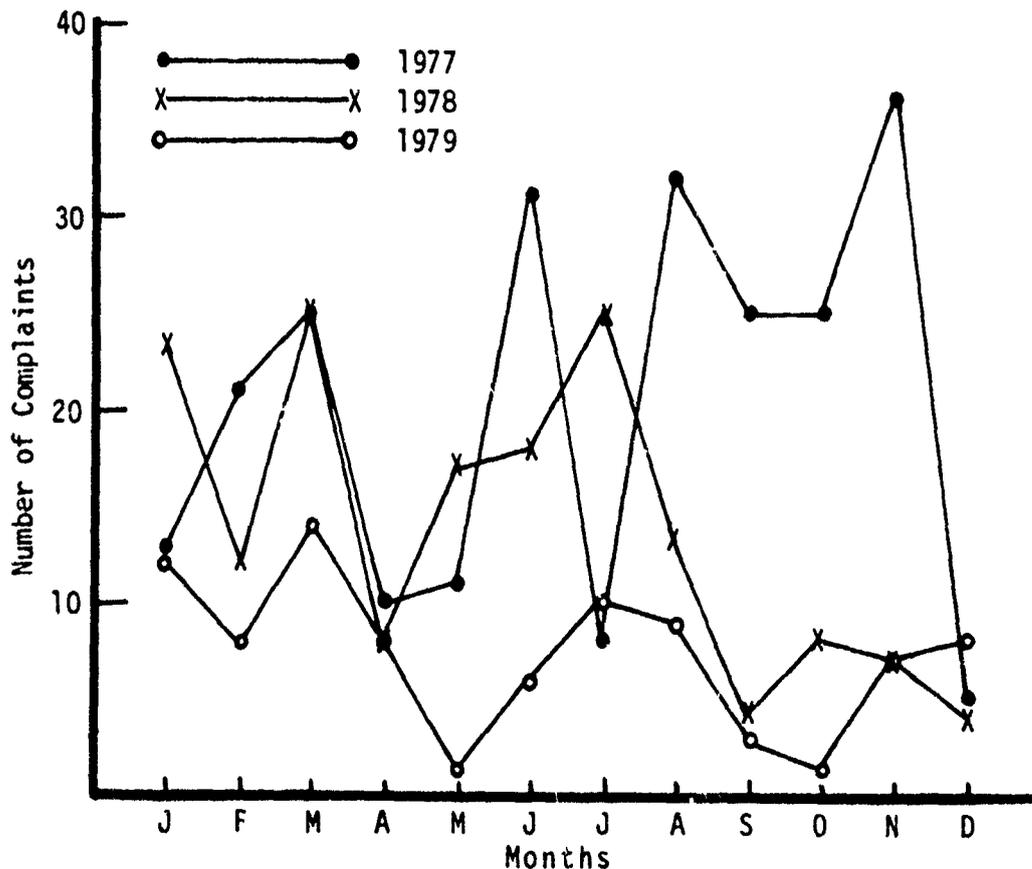


Figure 34. Number of Total Complaints Received by Month at Nellis for 1977, 78 & 79.

a number of the other AF Bases, there is little correspondence between number of complaints and time of the year. For example, June and August of 1977 show thirty-one and thirty-two complaints respectively but there were thirty-six complaints in December of 1977. For 1978, July does provide the highest number of complaints for that year but both January and March show almost as many in each month. In 1979, January through March shows more complaints than does June through August. For AF Bases, operation of aircraft is more significant in the generation of complaints than weather conditions.

The number of noise complaints by month is given in Figure 35. With the exception of the August through October period, noise complaints in 1978 are greater for 1978 than 1977. Noise complaints for 1979 are relatively lower across most months in comparison to 1977 and 1978. As for the plots of total complaints in Figure 34., there is little relationship between time of year and number of noise complaints. In 1977, the majority of the noise complaints (57%) were registered during a three-month period of August through October. While for August through October in 1978, only 15% of the noise complaints for that year were received.

Complaints to sonic boom noise at Nellis were unusually striking. Not only did complaints to sonic booms dominate in 1977 and significantly decrease in 1978 and 1979 but Nellis was the only AF Base studied which reasonably appeared to base the majority of the equipment causing the sonic booms. Plots

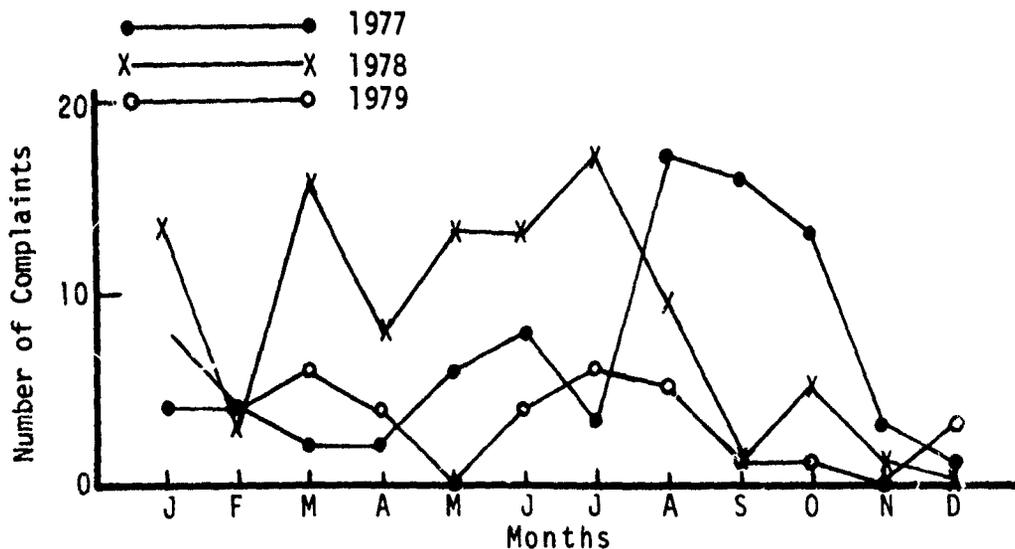


Figure 35. Number of Noise Complaints Received at Nellis for 1977, 1978 & 1979.

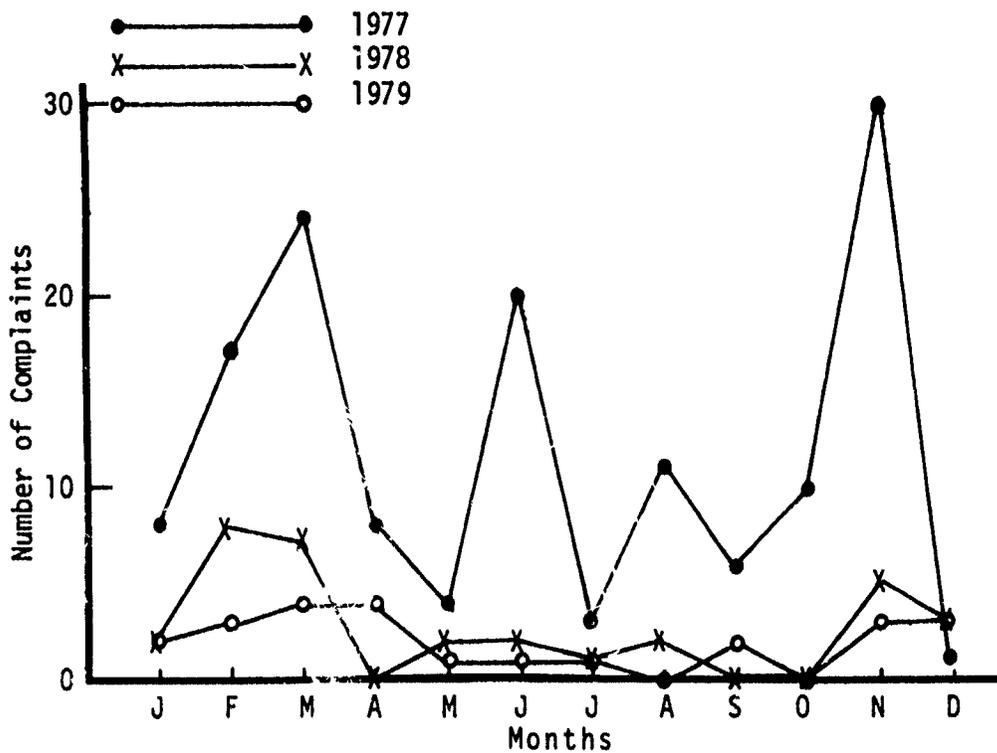


Figure 36. Number of Sonic Boom Complaints Received at Nellis for 1977, 78 & 79.

by months over the three-year period of complaints to sonic booms are provided in Figure 36. There is little doubt that complaints to sonic booms are markedly reduced in both 1978 and 1979 in comparison to 1977. There is also a small decrease in number of sonic boom complaints in 1979 over 1978. For the three-year period, sonic boom complaints decreased markedly in 1978 in comparison to 1977 and slightly in 1979 relative to 1978. An interesting aspect of the sonic boom complaints for 1977 was that twenty-nine of them were from one person who lived in the "range" area where low level flight exercises are practiced by TAC aircraft. This is more than 20% of the sonic boom complaints for 1977. Calls by this complainant were reduced to two in 1978 and a final call in November 1978.

Complaints which completely emphasized low flying aircraft concerns comprised 14% of the total complaints at Nellis. These are also plotted by month in Figure 37. There were twenty-one complaints to low flying aircraft in 1977 and 1979 with thirty in 1978. Thus, complaints in this category peaked in 1978.

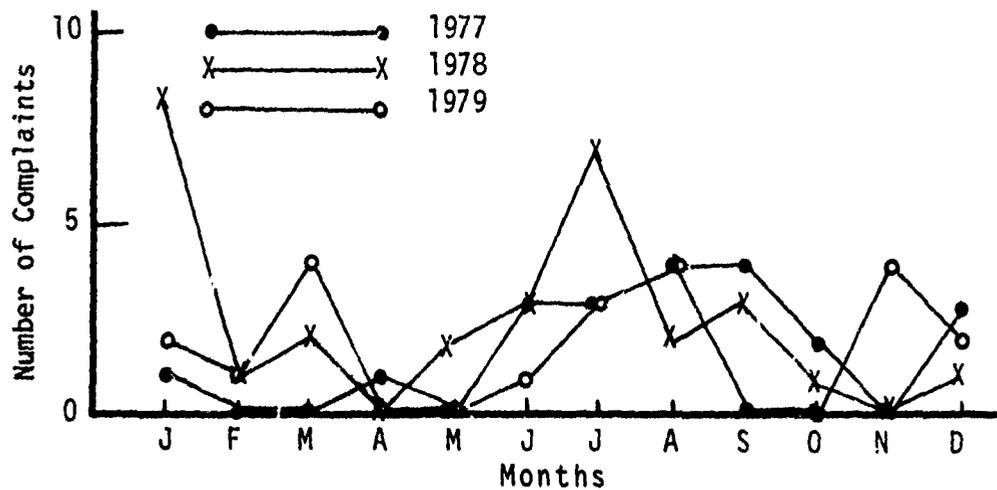


Figure 37. Number of Low Flying Aircraft Complaints Received at Nellis for 1977, 78 and 79.

For the noise complaints, some 15% reported that the noise interfered with sleep. Interference with sleep was evenly distributed over the three-year period in that 16% mentioned interference with sleep in 1977, 14% in 1978 and 17% in 1979. For the other six AF Bases, only very occasionally would a complainant mention that daytime flights or runup noise interfered with sleep. This was not the situation at Nellis as 44% of those who complained concerning sleep interference did so as a result of daytime aircraft flights.

The percentages of women complainants by noise, sonic boom, and low flying categories are given in Figure 38. For all categories woman registered the greater number of complaints with a total of 57% in the noise category, 64% in the sonic boom category and 53% in the concern with low flying aircraft category. As at the majority of the other six bases, there is a tendency for women to complain less to low flying aircraft than to aircraft flyover noise. That 52% of the complaints to low flying aircraft were made by women at Nellis is unique in that it was the only base at which female complainants exceeded 50% for the low flying aircraft.

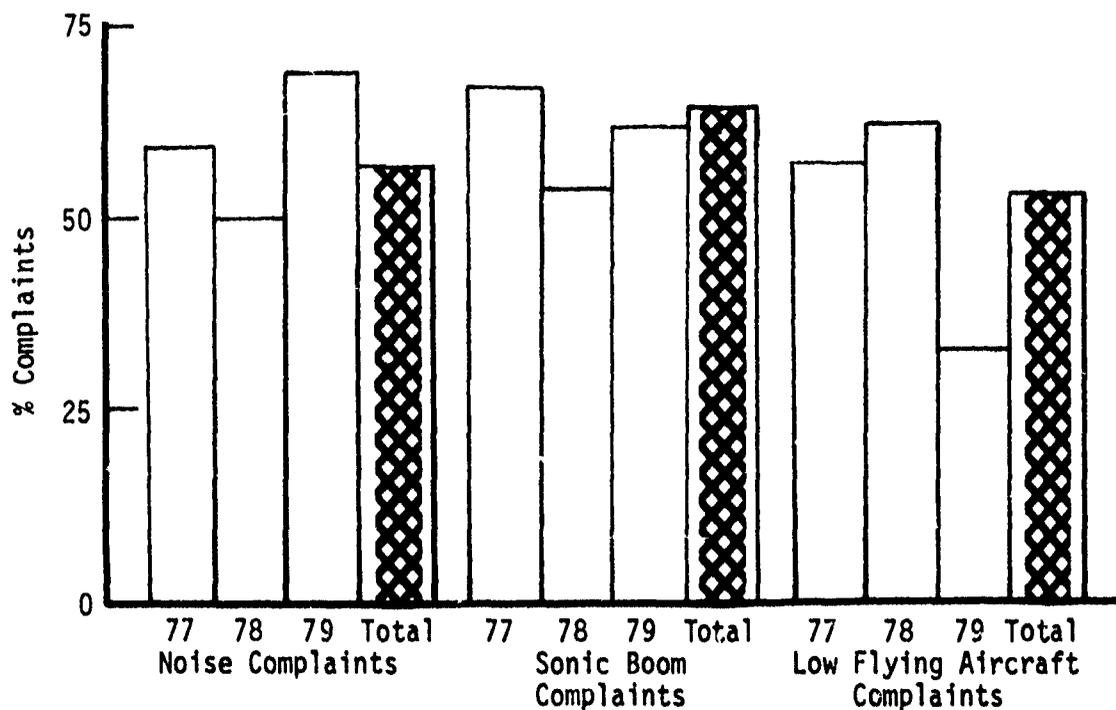


Figure 38. Percent of Complaints Made by Women by Three Categories

Summary information for complaints received at Nellis AF Base over a three-year period are:

1. Complaints to aircraft flyover and runup noise (noise complaints) were at 45%, the smallest percentage of total complaints received at any of the AF Bases studied. The average number of noise complaints per year was 73.3 which along with Davis-Monthan and McClellan placed Nellis in the top three for the seven AF Bases studied.
2. Noise complaints markedly decreased in 1979 over 1978. There were 100 complaints to noise in 1978 and forty-two in 1979.
3. Ground runup noise is not a problem at Nellis. Of the 220 noise complaints received, only one of them could be attributed to runup noise.
4. Some 15% of the persons complaining about aircraft noise reported sleep interference as part of their complaint. Of those reporting sleep interference, 44% of the complainants reported daytime sleep

interference.

5. More noise complaints were received from women than men. This was also the situation for complaints to sonic boom noise and low flying aircraft.
6. For total complaints received, 45% of them were aircraft flyover noise. This is the smallest percentage for any of the AF Bases studied.
7. Approximately 14% of all complaints received were due to low flying aircraft and not to noise.
8. Sonic boom noise complaints comprised 40% of the total received. This is the highest percentage of sonic boom complaints received at any of the seven AF Bases. There was a sharp drop in sonic boom complaints in 1978 and 1979 in comparison to 1977. The drop in boom complaints was 77% in 1978 and 83% in 1979 in comparison to 1977.

#### SUMMARY INFORMATION FOR THE SEVEN AIR FORCE BASES

As a means of obtaining comparisons among the seven bases, summary information is provided in Table 2. A description of each of the fifteen columns of data follows.

- Col. 1. This column provides the number of years that complaint records were available at the seven bases. They range from a low of two years at Davis-Monthan to a high of six years at McChord. In the aggregate, complaint records were available for 25.42 years.
- Col. 2. The total number of complaints received during the period that complaint records were available is given. For the seven bases, total complaint records available was 1923.
- Col. 3. This is the average of the total number of complaints received at a particular AF Base and is the result of dividing total complaints received in Column 2. by years records were available as given in Column 1. The average number of total complaints received at all seven AF Bases was 75.6 per year.
- Col. 4. This column lists the number of complaints to aircraft flyover or flyby noise and ground runup noise. These are the noise events

modeled by the NOISEMAP computer program. The total number of noise complaints received at all bases studied was 1100.

- Col. 5. The average number of noise complaints received during a year is listed in Column 5. They range from a low of 16.2 per year at Carswell to 106.0 per year at Davis-Monthan. The average number of noise complaints per year at all seven bases was 43.3.
- Col. 6. This column gives the percentage of all complaints received that could be attributed to aircraft flyover and runup noise. These percentages range from a low of 45% at Nellis to a high of 78% at both McClellan and Carswell. Based on all available records, 57% of the total complaints reviewed were attributable to aircraft flyover and ground runup noise.
- Col. 7. The percentages of this column represent that part of complaints to noise (flyover and runup) which were attributed to runup noise. They range from 0% (1/220) at Nellis to 20% at both McChord and McClellan. Over all seven AF Bases, 9% of the noise complaints could be attributed to runup noise. [Since there are such wide differences in average number of total complaints and noise complaints received (see Col. 5.), the percentages in the various columns can be used to gain further perspective. For example, 20% of all noise complaints received at McChord were attributed to runup noise. This translates into  $.20 (163) = 32.6$ - or 33 complaints to runup noise or an average of 5.5 per year. McClellan also shows 20% of the noise complaints due to runup noise. In terms of numbers, this is  $.20 (184) = 36.8$ - or 37 complaints to runup noise or 15.3 per year. Thus there are roughly three times as many complaints to runup noise at McClellan than at McChord.]
- Col. 8. This column provides the percentage that sleep interference was mentioned in association with a noise complaint. The range is from 6% at Davis-Monthan to 32% at McChord. Of the 1100 noise complaints identified, 17.7% or 195 persons mentioned that noise interfered with some aspect of sleep.

- Col. 9. The percentage of persons registering complaints to low flying aircraft and not aircraft caused noise or sonic booms is given in this column. They range from a low of 3% at Fairchild to a high of 35% of total complaints at Selfridge. For the periods investigated, 17% of all complaints voiced concern related to low flying aircraft.
- Col. 10. These percentages are based on number of persons complaining about sonic booms. The range over the seven AF Bases is extensive with 1% at McClellan to 40% at Nellis. Of the 1923 complaints reviewed, 413 of them or slightly over 21% were due to sonic booms.
- Col. 11. The percentage of noise complaints registered by women is given in this column. Since the percentages for the individual AF Bases show a greater number of complaints from women than men (4 vs 3 bases), it was surprising that, based on the total number of noise complaints, that women registered approximately 48% of the noise complaints and men 52%.
- Col. 12. The percentage of women complainants to low flying aircraft is provided. They range from a low of 0% for Fairchild to 52% at Nellis. For all complaints to low flying aircraft, 38% were made by women.
- Col. 13. There is considerable interest in "non-auditory effects" due to noise exposure. Non-auditory effects involve any damage to health other than loss of hearing. One could surmise that persons voicing annoyance to aircraft noise would mention their opinions in this area concerning effect of the noise on their own health or members of their immediate household. All complaint records were examined relative to mention of any opinion on the part of the complainant that the noise was adversely influencing complainant's health or a member of their household. Of the 1923 complaint records, 15 persons reported that noise caused a health problem (1 person of the 15 reported decreased hearing ability) with an additional 15 persons reporting that the noise aggravated an already existing health problem. Of the

413 complaints to sonic booms, two persons mentioned health problems. One mentioned that the sonic booms were "detrimental to health" and thus was not specific while the second person proposed that one sonic boom caused hearing loss and also reported that her doctor would not confirm a loss due to the boom. Column 13. gives the percentage of noise complaints in which complainants purported that the noise caused an adverse health effect. An example is a "headache". The percentages range from 0.0% at both McClellan and Davis-Monthan to 2.3% at Nellis. Over all AF Bases, 1.4% of the complainants report that the noise results in adverse health effects.

Col. 14. This column gives the percentage of complainants who report that the noise is aggravating or interfering in the recovery of a health problem. An example is a person recovering from a surgical procedure and noise is interfering with recovery. For two AF Bases, Carswell and Fairchild, no one reports that the noise aggravated a health problem while 3.6% of the noise complainants at Nellis report that noise is aggravating an existing health problem. Again, as for "causing a health problem" (Col. 13.), 1.4% report that noise is aggravating an existing health situation.

Col. 15. The sums of Columns 13. and 14. are given in this column and show that 2.7% of those registering noise complaints mentioned that it was having some effect on their health or the health of a member of their household.

A final comment concerning the summary information in Table 2. involves Columns 6, 9 and 10 which are all based on total complaints received and thus are independent. The sum for the totals of these three columns is 95%. This means that 95% of all complaints received were attributed to "noise", "low flying aircraft", or "sonic booms". Thus, but 5% of the total complaints received involved other areas.

TABLE 2. SUMMARY INFORMATION FOR ALL AF BASES

Air Base	1 Number of Years	2 Total Complaints	3 Average Total Per Year	4 Total No. of Noise Complaints	5 Av. Noise Complaints Per Year
McChord	6	257	42.8	163	27.2
Selfridge	3	210	70.0	109	36.3
McClellan	2.42	237	97.9	184	76.0
Carswell	5	104	20.8	81	16.2
Fairchild	4	241	60.2	131	32.8
Davis-Monthan	2	381	190.5	212	106.0
Nellis	3	493	164.3	220	73.3
Totals	25.42	1923	75.6	1100	43.3
Air Base	6 % Complaints to Noise	7 % Noise Comp. to Runup Noise	8 % Noise Comp. Cause Sleep Int.	9 % Total Comp. to Low Flying	10 % Total Comp. to Sonic Booms
McChord	63%	20%	32%	10%	15%
Selfridge	52%	5%	17%	35%	4%
McClellan	78%	20%	23%	18%	1%
Carswell	78%	12%	31%	16%	4%
Fairchild	54%	2%	12%	3%	39%
Davis-Monthan	56%	3%	6%	23%	18%
Nellis	45%	0%	15%	14%	40%
Totals	57%	9%	18%	17%	21%
Air Base	11 % Noise Complaints Females	12 % Low Fly Complaints Females	13 % Noise Causes Health Prob.	14 % Noise Aggravates Health Prob.	15 *% Noise Both Causes & Aggravates
McChord	57%	32%	1.8%	1.2%	3.1%
Selfridge	55%	23%	2.8%	0.9%	3.7%
McClellan	44%	46%	0.0%	1.1%	1.1%
Carswell	56%	41%	1.2%	0.0%	1.2%
Fairchild	40%	0%	2.3%	0.0%	2.3%
Davis-Monthan	36%	38%	0.0%	0.9%	0.9%
Nellis	57%	52%	2.3%	3.6%	5.9%
Totals	48%	38%	1.4%	1.4%	2.7%
*With health related complaints to two sonic booms included, percent of health related complaints to total number of complaints is 1.7%.					

## AIR FORCE BASE PROCEDURES FOR WORKING WITH COMPLAINANTS

The following is based on the review of the complaint records, discussions with AF personnel who receive noise complaint calls and directly work with complainants, discussions with AF Base Information Officers who manage these and other contacts with members of the community, and Reference 2. which is a SAC Public Affairs Handbook with title "Sonic Boom". With the aim of informing the community and possibly reducing simple information types of calls, all bases contacted utilize news releases concerning special exercises and, if possible, concerning other unusual aircraft activities. Also, Information Officers attend meetings of civic and community groups, providing presentations concerning the mission of their AF Base which has a bearing on the volume of complaints. One Information Officer for an AF Base in a populated area reported that these kinds of efforts along with a change in the flight training area markedly reduced noise complaints to the extent that they were practically eliminated. One AF Base provides a copy of the Base Guide along with a letter from the Base Commander to new residents in subdivisions located in the area. These public information and relations activities were not reflected in the complaint records examined nor is there an expectation that they would be. However, these efforts are a part of the total noise complaint phenomena and may very much influence complaint data as a dependent measure. Another possible influence on complaint behavior involves the Base Environmental Specialist's utilization of the AICUZ program in conjunction with community planners representing counties, townships and cities near the base.

Methods for directly working with noise complainants are also basically similar at the various AF Bases and are reflected in the complaint records. The key to successfully working with complainants is personal attention. This includes:

- Courtesy and interest in the complainant's problem.
- Focusing interest on obtaining as much information as possible on the noise event or events that caused the complaint.
- In no manner, implying that the complainant should not be disturbed by the noise.
- Agreeing to look into the matter and to report findings as soon as possible to the complainant. There were a number of examples

of excellent perseverance on the part of information specialists who repeatedly attempted to get in touch with complainants by phone to provide additional information.

- If accurate information is available at the time that the complaint is called in, provide this information to the caller. As discussed in the next section, there are many examples of multiple noise complaints to special exercises or unusual aircraft operations. Air Force personnel are usually aware of such special exercises and can provide information concerning them to the complainant. This can be a very useful approach in that the termination time of the special exercise is known. Providing this information often ends the complaint sequence with evidence that the complainant is satisfied.

- If corrective action is possible, check with the complainant within a week or so after the action has been initiated to determine the effect of the corrective action. For example, at one base, it was possible to delay landing descent until the aircraft had passed a critical area. After initiating this corrective action, the complainant was contacted to determine his perception of the change; he reported complete satisfaction with the change. At another base, it was possible to change the flight path so as to not fly over the home of a complainant. As expected, the result was satisfactory.

In addition to working with complainants in a personal and reasonable manner by telephone and occasionally by mail, all of the bases studied utilized personal visits by Air Force personnel to complainants' homes and visits to the base by complainants as a means of providing personal contact and information. On some occasions these visits to complainants' homes also permitted first-hand experience with noise exposure conditions. Also, there is some evidence that constancy of AF personnel who are working with noise complaints is desirable.

In general, there is strong evidence that the complaint programs serve a very useful function and that the programs, on the whole, are successful. For six of the AF Bases studied, there were marked decreases in noise complaints for both the years 1978 and 1979 in comparison to 1977 or for 1979 in comparison to 1978. The seventh base showed a relative constant number of noise complaints for the years complaint records were available.

## NOISE COMPLAINTS AND $L_{DN}$

For both commercial and military aviation establishments in the United States, the procedure for measuring the effects of aircraft noise relative to community response involves development of noise contours based on average number of operations per day over a particular one-year period. At most AF Bases it is appropriate to average over "busy days" instead of the whole year since flight activities are often markedly reduced on weekends. A single-number measure is then derived based on this average number of daily aircraft operations. Weighted acoustic energy, with corrections, provides the measure. Several comparable measures are in use in the U.S. and other countries but the approach most widely used in this country and exclusively by the US Air Force is the  $L_{DN}$  noise exposure measure. The essentials of the  $L_{DN}$  noise measurement method for AF Bases is the following:

- Determine average daily operations for specific aircraft equipments.
- Determine operations characteristics (takeoff, landing, flight path) for each aircraft type.
- Derive acoustic energy generated by each aircraft type using noise-distance data from a standardized measurement program.
- Apply A-weighting to all acoustic energy including noise generated by engine testing and ground runups.
- For all operations occurring between 1900 and 0700 apply a nighttime correction of 10 dB.
- For any point of interest in the community, on an energy basis, sum all A-weighted energy from aircraft operations.

Using the above, general description of  $L_{DN}$ , are there results from the complaint data which either support the various elements of the  $L_{DN}$  methodology or indicate that additional corrections or changes to the method may be desirable? In respect to accounting for ground runup noise as an element of aircraft generated noise that results in noise annoyance response from the community, there is evidence that this practice is appropriate. For the noise complaints (flyover noise and runup noise) received at the seven AF Bases, the percentage of noise complaints that could be attributed to runup noise ranged from 0% to 20% with an average of 9% based on all seven AF Bases.

Persons around some AF Bases are annoyed by runup noise. Thus, in contrast to other widely used computer programs for measuring  $L_{DN}$  at commercial airports, ground runup noise does impact persons residing around AF Bases and is an essential element of the measurement program.

There is also evidence from the complaint data that a penalty for night flights is a valid element of the measurement methodology. The percentage of noise complainants who reported interference with some aspect of sleeping ranged from 6% to 32% with an average of 18% for the seven AF Bases. This 18% total is considerably greater than the 4.4% of over 9,000 telephone complainants mentioning sleep interference to aircraft noise at a large commercial airport (Ref. 3). However, for this same study (Ref. 3), there were 613 noise complaints by letter. Of these letter complaints, 17.9% reported interference with sleep or rest which is identical to that obtained from the telephone calls of this study. The percentage mentioning sleep interference based on both telephone calls and letters was approximately 5.3%. Thus, the percentage of complainants reporting interference with sleep is considerably greater at AF Bases than for this large sample of complainants at a commercial airport. This difference may be due to the fact that AF Bases often do not routinely operate during nighttime periods as do commercial aviation airports. Thus, nighttime noise is more of an unusual occurrence at an Air Base than at commercial airports.

The practice of using an average operational day for measuring noise exposure at commercial airports may be valid since aircraft movements are fairly consistent on a day-to-day basis. For Air Force Bases there are routine training operations that provide comparable noise exposures over time but there are also special training exercises and unusual noise exposure situations. Parts of the complaint data reflect these unusual flight activities. A description of some of these noise events which are rated as unusual follows:

•During 1976 at McChord, one complainant specifically reported that he didn't mind the usual takeoffs and landings but that noise from circling over the house was much greater than normal. Also, at McChord in 1976 visiting Marine F-4's using a different flight path provoked complaints. There were seventeen flyover noise complaints at McChord in 1978, ten of these occurred in July and August and were primarily due to visiting aircraft which

included Canadian F-101's flying on Saturday, visiting F-4's training with the Army at Ft. Lewis, and visiting Navy aircraft.

•During June 1979 at Selfridge ANG Base, twelve flyover noise complaints were received. Nine of these twelve complaints were due to a special NORAD exercise involving TAC aircraft. The special exercise occurred on June 5 and 6, and all nine complaints were received on June 6 or 7, 1979. The remaining three noise complaints appeared to be to usual aircraft activities at Selfridge. For the remaining eleven months of 1979, greatest number of complaints received was two during any one month; 50% of all noise complaints during 1979 were received in June and 75% of these were due to a special exercise.

•There are three clear examples of unusual or bunching of flight activities resulting in noise complaints at McClellan AFB. During August 1977, seven complaints to flyover noise were received. Five of these seven noise complaints were to three days of quite active flying of a C-135 aircraft over a three-day period. All five complainants called during the third day of the exercise. In 1978, 37% of all flyover noise complaints were received during September. For these September noise complaints, sixteen or 59% of the September noise complaints were received on September 11 in response to one C-5A aircraft that was making practice landings. Of the twenty-one flyover noise complaints during June 1979, there were thirteen complaints between the hours of 0925 and 1012 on 24 June to takeoffs of four transient KC-135's and one E 3-A which had landed at McClellan to refuel. This one incident accounted for 25% of all flyover noise complaints received at McClellan during 1979.

•For 1976 at Fairchild approximately 45% of all complaints to flyover noise appeared to be related to steady concentrations of flight activity over a relatively short period of time. Expressions by complainants were, "Planes flying over every two minutes." "Flying all day." "Flying every seven minutes since noon." Of the twelve flyover noise complaints received in September of 1977 at Fairchild, five of them were received from the same general area on September 2 and were all to a concentration of aircraft flights.

•During June of 1978, there were ten complaints to flyover noise at Davis-Monthan AF Base. Nine of these complaints were to two visiting KC-135 aircraft which were practicing touch-and-go's. All nine complaints were received on the same day.

These examples point to the possibility that measuring noise based on the average number of week-day flights at AF Bases underestimates the noise exposure. In respect to comparisons between different noise exposure situations, e.g., an Air Base with a number of unusual situations vs. one with very few such flight activities or perhaps an Air Base vs. a commercial airport, in terms of community response, an  $L_{DN}$  of 65 for these two qualitatively different exposure situations reflects different community annoyance response. Thus, it would be concluded in respect to aircraft noise exposure which displays these "unusual" activities, that in order to more accurately reflect noise annoyance response, a correction to current measurement practice is required.

In respect to firmly establishing that such a correction is required and relative to quantifying such a correction, complaint data is not considered adequate. For example, there is the possibility that there were other "unusual" aircraft activities at some of the AF Bases studied which did not provoke complaints. Also, due to the sporadic nature of these aircraft movements which result in increased numbers of noise complaints, it is not likely that interview approaches could be highly effective in quantifying the effect on communities surrounding AF Bases; interview techniques could aid in establishing that such a correction is desirable but locating different noise environments which could provide quantification data would be the problem. Simulated living approaches or in-the-home studies where there is control over the noise environment could both provide evidence that the correction is required and aid in quantification of the correction (Ref's. 4 and 5). Using the simulated-living-situation type of experiment, persons respond to noise environments over a period of time and not to individual events. For example, in the experiment of Reference 4., persons provided ratings to different commercial airport noise conditions over a 1½ hour period. Of the seven airport noise conditions studied, two were at almost identical  $L_{EQ}$ 's (52.1 and 51.9) but involved different aircraft and numbers of flights. Ratings to these two noise conditions did differ. Using this approach, persons would be exposed to realistic Air Force noise conditions over a particular period of time;

$L_{EQ}$  for pairs of conditions would be the same but concentration of flight activities would differ between pairs of conditions. An experiment using the in-the-home approach of Reference 5. could be completed on a similar basis. Advantages for this approach are that persons are in their usual living environment and that noise conditions can cover a longer period of time. To summarize, there is evidence from the complaint data that a correction to  $L_{DN}$  for sporadic or non-routine aircraft activity is required. Confirmation and quantification of this correction requires additional research involving other dependent measures.

## QUANTIFICATION OF AN EXCEPTION TO $L_{DN}$

Basic to the  $L_{DN}$  methodology for land use planning activities around AF Air Bases and commercial airports is the assumption that equal levels of A-weighted acoustic energy result in equal amounts of noise annoyance. As emphasized in the preceding section, "NOISE COMPLAINTS AND  $L_{DN}$ ," the complaint data provides evidence that to a considerable extent, it is the unusual or non-routine events which provide complaints at AF Bases. Such non-routine events include special exercises, transient aircraft, transition flight activities, deviations from usual flight paths with all having the common element that high noise level events are concentrated during a relatively brief period of time. Due to the relatively small number of noise complaints received at AF Bases (an average of 43.3 per year for the seven bases studied) it is not possible to estimate the extent that non-routine flight activities provide an exception to  $L_{DN}$ . The results do support the possibility that various  $L_{DN}$  measurements which are calculated as equal may result in unequal community annoyance response. Thus, as a land use planning tool an  $L_{DN}$  of 65 at a particular Air Base may be, in terms of community annoyance response, an  $L_{DN}$  of 67, 68 or 69. Confirming and quantifying this exception is not an easy task due to the fact that a relatively large number of variables are involved. When the same subjects are exposed to different levels of the same aircraft noise environment during a simulated living experience, noise exposure as measured by  $L_{EQ}$  or  $L_{DN}$  are often related as expected. Figure 39. provides an example. This data was obtained in a simulated leisure living situation where subjects were permitted to watch television, engage in conversation, read, and play cards or other games at their discretion. The measure of noise annoyance was based on the question, "If the sounds experienced here were to occur in the same manner during your usual leisure hours at home, would they be acceptable to you? Yes \_\_\_\_\_ No \_\_\_\_\_." The points "•" of Figure 39. represent the percent of "No" responses obtained from the same 48 subjects (thus serving as their own controls) and to three noise conditions which involved only a change of level (6 dB increments) among the three conditions. The "X's" of Figure 39. provide "not acceptable" percents to noise conditions with different aircraft noise signals and numbers of aircraft, and based on different subjects between groups. That the results for the conditions (X's) involving experimental differences other than just level changes do not track noise annoyance as effectively as those conditions involving only changes in

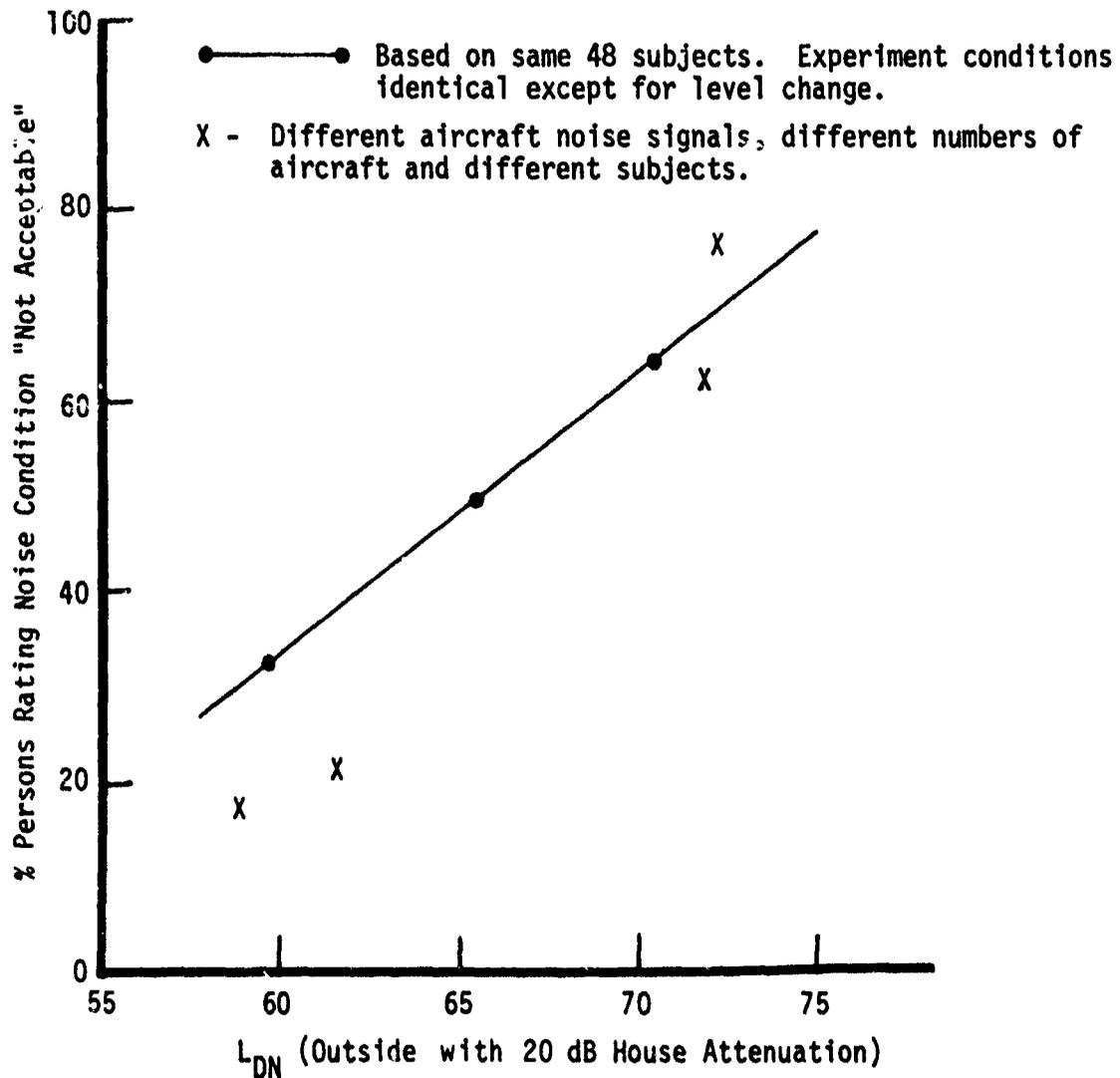


Figure 39. Relationship between  $L_{DN}$  and "Noise Condition Not Acceptable" Based on 1½-hour Simulated Leisure Living Condition (Ref. 4)

levels could be due to different subjects, different aircraft signals or different numbers of aircraft. The conditions from which the results of Figure 39. are derived are relatively simple in comparison to those which effect annoyance response in communities around AF Bases. Thus, it is doubtful that conditions for confirming and quantifying this exception to  $L_{DN}$  could be identified at various AF Bases.

Of the various methods for relating community annoyance response to aircraft noise environments, the method that utilizes an in-the-home simulation of the desired noise conditions can provide results which would quantify this exception to  $L_{DN}$  (See Ref. 5). Essentials for this study are:

## STUDY GUIDELINES

- Obtain airplane noise annoyance response from persons in their actual living environments as they experience their usual day-to-day activities.
- Maintain complete control over the airplane noise exposure conditions so that exposure can be accurately measured.
- Utilize a method which emphasizes a total noise exposure experience such as a twenty-four-hour period.
- Quantify non-routine effects on the basis of the experimental conditions.
- Obtain noise annoyance response so that it is directly associated with the experimental condition of interest.
- Strive for simplicity on the dependent measures with the aim of minimizing disruption of usual living activities.
- Expose all subjects to all experimental conditions so that they function as their own controls.

## EQUIPMENT DESIGN AND INSTALLATION

Basic components of the presentation systems are 4 speakers, an amplifier, timer, tape deck and a controller which employs a Read-Only-Memory (ROM) integrated circuit chip. The main speaker is a room-corner reentrant horn which is installed in the main living area and very much gives the perception that flyovers are occurring outside the house. The remaining three speakers are direct radiation type speakers which are installed in hallways, kitchens and bedrooms so as to augment the main speaker and provide even sound distribution. One of these direct radiation speakers would be installed in the adult participant's sleeping area so that exact presentation levels would be available for that living area. Only dBX recording and playback technology would be used so that tape noise would not detract from the realism of the signals. The systems are to be programmed so that five different 24-hour exposure conditions can be administered consecutively.

## SUBJECTS

Thirty family units would be hired as participants with the requirements that a unit consists of at least two adults and that one of these two adults is employed outside the home. This means that response data would be available

from 60 adults. After hiring procedures, which includes collection of socio-economic data, noise sensitivity ratings, audiometric examination, and training, each family unit would participate in the experiment for five consecutive weeks. The first week is a "control" week during which equipments are installed while 15 experimental exposure conditions plus a "standard" condition are to be used during the remaining four weeks. All noise exposure conditions are to be of 24-hours duration and participants will rate these 24-hour noise exposure conditions as each terminates. So that living conditions are comparable for the noise exposure conditions, conditions are to be presented on week days only with the just preceding nighttime period (10:00 p.m. to 7:00 a.m.) included as part of that 24-hour exposure period. There is a requirement that those taking part in the experiment reside in areas that are not impacted by any airport or air base noise ( $L_{DN} < 55$ ) or by high levels of traffic noise.

#### NOISE EXPOSURE CONDITIONS

The noise environments investigated would be patterned after those occurring around AF Bases and would include three  $L_{DN}$  levels of "routine" flight operations. Table 3. provides a description of fifteen noise conditions. The 24-hour day is divided into day (0700 - 1900), evening (1900 - 2200) and night (2200 - 0700). For each of the three "routine" conditions ( $L_{DN}$  equal 57, 65 and 73), flights are concentrated during day, evening and night only and during all three time periods simultaneously as shown in Table 3. Figure 40. provides a guessed result based on a comparison between response to the "routine" flight conditions vs. those which involve concentration of flight activities during all three time periods. The difference on annoyance response between the two curves provides quantification of the exception to  $L_{DN}$ .

TABLE 3. EXPERIMENT NOISE CONDITIONS

Condition Number	Outdoor L <sub>DN</sub>	Condition Description
1	57	Routine
*2	65	Routine
3	73	Routine
4	57	Flight Concentration, Day Period Only
5	65	Flight Concentration, Day Period Only
6	73	Flight Concentration, Day Period Only
7	57	Flight Concentration, Evening Period Only
8	65	Flight Concentration, Evening Period Only
9	73	Flight Concentration, Evening Period Only
10	57	Flight Concentration, Night Period Only
11	65	Flight Concentration, Night Period Only
12	73	Flight Concentration, Night Period Only
13	57	Flight Concentration, Day, Evening & Night Periods
14	65	Flight Concentration, Day, Evening & Night Periods
15	73	Flight Concentration, Day, Evening & Night Periods

\*Standard Condition

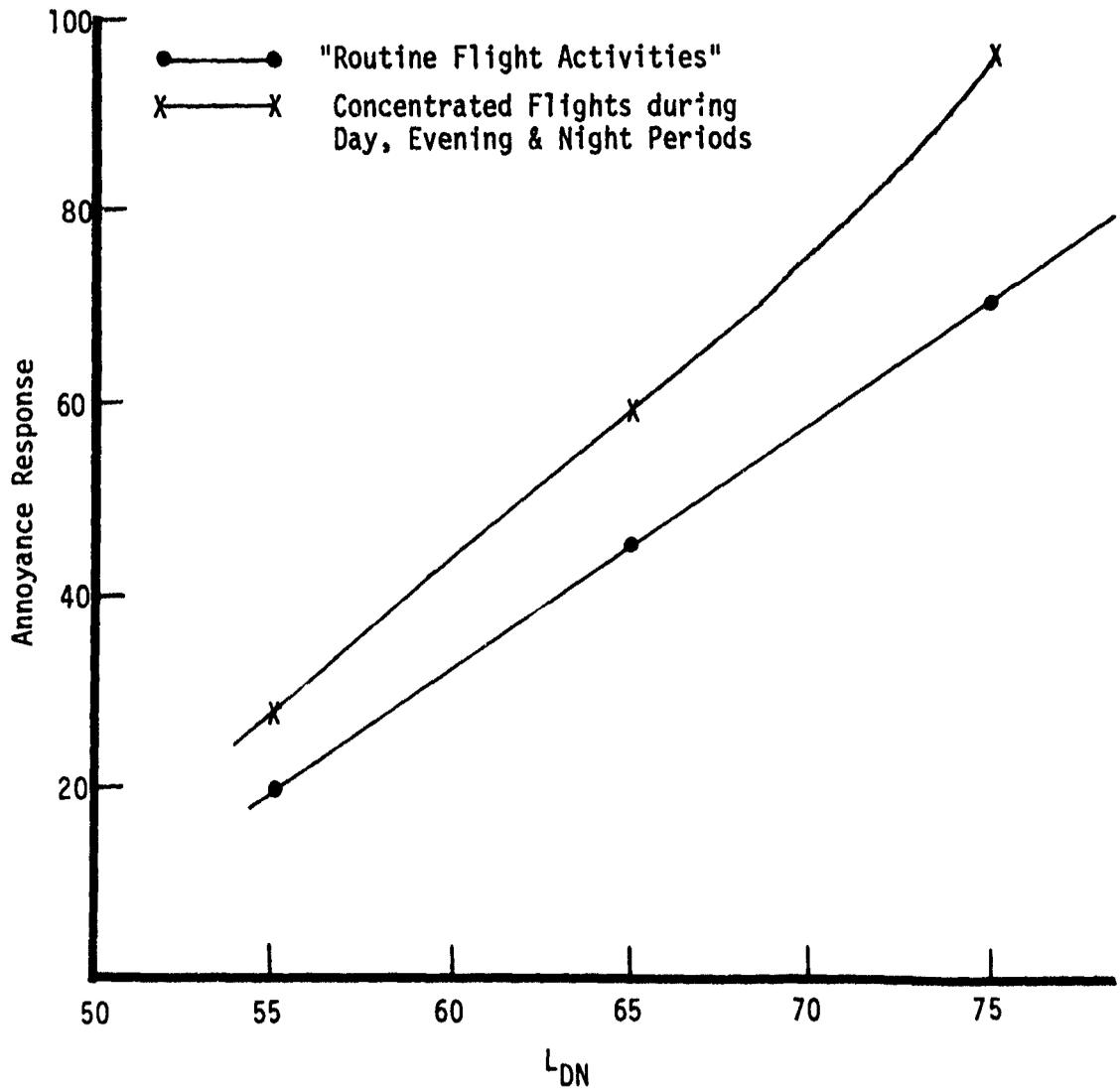


Figure 40. Gussed Results for Quantifying "Non-Routine" Flight Activities

#### DEPENDENT MEASURES

Two dependent measures would be employed. One measure would involve magnitude estimation ratings of the 15 experimental conditions relative to the standard condition. The second dependent measure would involve a category scale rating of the just experienced twenty-four-hour noise condition using a four-point scale such as the following:

Rate the preceding twenty-four hours of aircraft flyovers as:

- \_\_\_\_\_ Highly annoying
- \_\_\_\_\_ Moderately annoying
- \_\_\_\_\_ Slightly annoying
- \_\_\_\_\_ Not at all annoying

Then ratings would be obtained by telephone during the 10:00 - 10:30 p.m. period (end of a 24-hour noise condition on Monday through Friday evenings.)

## CONCLUDING OBSERVATIONS

For the most part, the results are descriptive in nature in that the quantity of noise complaints at various AF Bases is not sufficient to track noise measurement approaches. At one base there is a concentration of complaints from an area that is, at times, heavily impacted by takeoff noise but other noise complaints for that AF Base are widely scattered. The  $L_{DN}$  for this area is estimated at greater than 70 dB and noise attenuation properties of the housing is low. Thus, it is not surprising that there is a concentration of noise complaints. Some of the following concluding observations are contained in the body of this report while others are interpretations of the descriptive material:

- In comparison to noise complaints received by commercial airports, the number of noise complaints received at AF Air Bases is unusually low. Some larger commercial airports have received more than 1000 complaints per year (Ref. 1 & 3) while the largest number received during any one year for the AF Bases studied was less than 150. After spending some 144 million dollars to purchase noise impacted residential areas, one commercial airport continues to receive some 300 noise complaints per year.<sup>1</sup>
- As would be expected, some AF Base communities reflect higher noise impact than do others. Based on all of the twenty-one AF Bases contacted, TAC aircraft result in greater numbers of complaints to aircraft operations than do SAC or MAC aircraft.
- There is evidence that complaints to Air Force aircraft operations is decreasing.
- All AF Bases studied have effective programs for working with complainants. This may be a partial explanation for the overall decrease in noise complaints. Constancy of personnel for working with complainants is an aid in developing an effective program.
- Some 95% of the complaints examined could be attributed to noise from aircraft operations (flyover and ground runup noise), low flying

---

<sup>1</sup>Personal communication from Walter V. Collins, Noise Abatement Officer, City of Los Angeles Department of Airports.

aircraft, or sonic boom noise.

- There was evidence that a nighttime correction to the method for measuring noise impact is required.
- There were sufficient complaints to ground runup noise to conclude that it should be included in noise measurement programs at AF Bases.
- Using complaint data as a dependent measure, there is evidence that a correction to the  $L_{DN}$  measurement methodology is required for sporadic or non-routine aircraft activities.
- Approximately equal numbers of noise complaints were received from men and women. Thus, for interview and other types of studies aimed at determining community response to Air Force aircraft noise, it is desirable to include equal numbers of men and women in the studies.

## REFERENCES

1. Little, J.W., 1967, A Preliminary Preview of the Community Complaints about Aircraft Noise for the New York International Airport Area, The Boeing Company Report No. D6-17099
2. Anon, Sonic Boom, A public affairs handbook prepared by: SAC Directorate of Information, Offutt AFB, Nebraska 68113
3. Anon, February 1969, An Analysis of Port of New York Authority Complaint Records
4. Mabry, J.E. and Sullivan, B.M., March 1978, Commercial Airport Operations and Community Noise Criteria, Report No. FAA-RD-78-36
5. MAN-Acoustics & Noise, Inc., November 1975, Establishing Noise Criteria for Residential Living in Areas Surrounding Commercial Aviation Airports, Report No. FAA-RD-75-211