NPOA Report No. 91-2
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SHORT TERM EFFECTS OF AIRCRAFT OVERFLIGHTS ON OUTDOOR RECREATIONISTS IN THREE WILDERNESSES

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Prepared by:

BBN Systems and Technologies Corporation
21120 Vanowen Street
Canoga Park, CA 91303

Prepared for:

Forest Service, U.S. Dept. of Agriculture
National Park Service, U.S. Dept. of the Interior

NPS-DSC Contract No. CX-2000-9-0026
Work Order No.10

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Foreword

This report was prepared under National Park Service Contract CX-2000-9-0026 as part of an interagency program conducted by the Department of the Interior National Park Service (NPS) and by the U.S. Department of Agriculture Forest Service. The effort described in this report began 14 May 1990 under Work Order 10. The wording of portions of this report reflect modifications made at Government request.

Abstract

This report describes an on-site social survey of the short term effects of aircraft overflights on visitors to three Forest Service wildernesses. Two prior reports (Fidell, Tabachnick, and Silvati, 1990a and 1990b) contain the detailed rationale for this study. A companion report (Tabachnick, Fidell, Silvati, Knopf, Gramann, and Buchanan, 1991) describes a related telephone interview study. These studies were undertaken principally to support preparation of a Forest Service report to Congress mandated by Section 5(a) of Public Law 100-91.

Three Forest Service wildernesses were purposively selected for study on the basis of two primary and five secondary criteria. The major criteria were levels of visitor use and aircraft overflight exposure. Wildernesses were also selected to provide a range of ambient sound levels, ecotypes, visitor activities, day and overnight use, and exposure to helicopters as well as fixed wing aircraft. Interviewing was conducted during peak visitor seasons at three wildernesses (Golden Trout in California, Cohutta in Georgia, and Superstition in Arizona). Attempts were made to exhaustively interview visitors during the data collection periods in each wilderness.

Personal interviews of visitors and extensive acoustic measurements were conducted simultaneously. Visitors were interviewed individually and in groups by means of a short, verbally administered questionnaire. A total of 920 interviews was completed: 185 in Golden Trout, 343 in Cohutta and 392 in Superstition Wildernesses. The lowest completion rate was 96%. No reliable differences were observed between visitors who granted interviews and those who did not.

Respondents in the three wildernesses were similar in gender distribution, degree of overall enjoyment of their visits, and intention to return to the wilderness. Respondents interviewed in different wildernesses differed with respect to all other variables investigated, including age distribution, size of group, number of previous visits, activities, aspects of their visits they liked most and least, type of aircraft noticed, annoyance due to the sight and sound of aircraft, and type of aircraft found most annoying to hear.

Despite difficulties in estimating recreationists' personal noise exposure, it was possible to construct a relationship between estimated aircraft noise exposure and annoyance due to the sound of aircraft. This relationship was stronger than that observed between self-reports of observed number of aircraft overflights and annoyance, and that between exposure to aircraft and reported overall enjoyment. Annoyance due to aircraft

noise, although closely related to exposure, was not reliably predictable from a set of nonaircraft-related items.

Noticeability of aircraft was not related to visitor activities. Once they noticed aircraft, visitors who engaged in water- or stock-related activities tended to be more annoyed by aircraft overflights than visitors who did not engage in these activities.

Overall enjoyment of visits to wildernesses was unrelated to any other variable, as was intention to revisit the wilderness. Because virtually all respondents reported that they enjoyed their visits and intended to return, such measures offer little opportunity to assess the impact of aircraft overflights on recreationists.

These results indicate that annoyance is a more practical measure of the impact of aircraft overflights on recreationists than more global measures of satisfaction or behavioral intent. Current means of measuring exposure cannot, however, support the precise yet cost-effective estimates of dosage-response relationships needed for management purposes.

1. Introduction

This chapter describes the contents and organization of this report.

This report describes the goals and methods of a field study of short term reactions to aircraft overflights of outdoor recreationists in three designated wildernesses. The report also describes administration of on-site interviews, acoustic measurements, data analyses, and results of analyses.

The context and rationale for Public Law 100-91 studies may be found in Fidell (1990) and Fidell, Tabachnick, Knopf, Gramann, and Buchanan (1991). Chapter 2 of this volume reviews the goals and rationale of the study. Chapter 3 describes site selection, questionnaire development, and administration of on-site interviews. Chapter 4 describes data analyses and results. Chapter 5 presents dosage-response analyses. Chapter 6 presents supplementary analyses. Chapter 7 summarizes findings, notes limitations of the current study, and recommends future study. A glossary of technical terms is provided for readers' convenience.

2. Background

This chapter summarizes the goals and rationale of this study.

2.1 Goals of Study

2.1.1 Fundamental Goal

The fundamental goal of this study was production of information to support the Forest Service's preparation of a report to Congress on "what, if any, adverse impacts to wilderness resources are associated with overflights of National Forest System wilderness areas" (Section 5(a), Public Law 100-91). This legislative language is both clear and restrictive: it does not, for example, instruct the Forest Service to produce policy decisions about aircraft overflight management, nor to conduct basic research to increase understanding of factors which might or might not mediate adverse effects of aircraft overflights on visitors to wildernesses.

The information of interest for this study was further limited to that necessary to document potential adverse effects of aircraft overflights on wilderness visitors, not on other wilderness resources. The information most helpful for attaining the fundamental goal is a quantitative dosage-response relationship between aircraft noise exposure and the prevalence of annoyance engendered among outdoor recreationists by such exposure.[1] Among the benefits of such a relationship are:

- consistency with established practice for characterizing aircraft overflight impacts on communities;
- comparability of findings with a large body of existing information; and
- simple and readily interpretable summary statements.

[1]Further discussion of the importance of dosage-response relationships derived from community studies of the effects of transportation noise may be found in Fidell (1979) and Fidell, Barber, and Schultz (1991).

2.1.2 Secondary Goals

Collection of information in support of goals other than the fundamental one described above may be useful for inferring:

- Relationships between aircraft noise exposure and the prevalence of one or more behavioral or non-specific attitudinal indices of wilderness visitor response, such as likelihood of non-return and global satisfaction with a visit;
- Relationships between visibility of aircraft and the prevalence of either specific or non-specific indices of wilderness visitor response;
- Development of information which may aid long term understanding of effects of aircraft overflights on wilderness visitors; and
- Development of information to aid in design and conduct of subsequent studies for ancillary purposes.

2.2 Rationale for Assessment of Short Term Reactions to Overflights

For reasons discussed elsewhere (Fidell et al. 1990a and Fidell, Green, and Sneddon, 1990) the most intense impacts of overflights on outdoor recreationists are likely to be the ones that occur during and shortly after exposure. They are also the reactions most suitable for linking directly and reliably to exposure by means of a quantitative dosage-response relationship. Short term impacts of overflights are also worth assessing because they permit analyses of issues of economic, managerial, regulatory, and theoretical interest. For example, they permit evaluation of the usefulness of the "equal-energy hypothesis"[2] for predicting responses to noise exposure under outdoor recreational circumstances.

Given that interviewing immediately upon occurrence of an overflight is impractical with presently available technology[3], short-term reactions are also difficult to accurately and reliably record. Retrospective self-reports of immediate reactions solicited days or

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[2]The equal-energy hypothesis holds that the effects on people of magnitude and duration of noise exposure are directly compensatory, such that people are indifferent between the annoyance of exposure to small numbers of high level sounds of short duration and sounds of longer duration but compensatingly lower level or greater number.

[3]Miniaturized, computer-based instrumentation for simultaneous monitoring of individual response and noise exposure may be available for use in future studies.

weeks after exposure may be unreliable for several reasons, including decay of reactions over time, rationalization, imperfect recall, and the actions of mediating variables such as social interactions. Even intrusive methods such as participant observation cannot necessarily be relied upon to yield accurate assessments of prompt responses to overflights (cf. Fidell, Barber, and Schultz, 1991).

Information about short term reactions to aircraft overflights may be collected in several ways. A controlled personal (face-to-face) interview was preferred for present purposes to diary and other methods for several reasons:

- Since no real time measurements of personal exposure can be linked directly to diary entries, there is little advantage to seeking per-event responses to questionnaire items;
- Outdoor recreationists are often unable to report their locations with useful accuracy;
- Making written diary entries may impose a greater burden on the time of outdoor recreationists than a short, structured personal interview;
- The instruction to attend to overflights and record reactions to them in diary entries may call specific attention to the purpose of the study and thus bias responses; and
- There is no practical means of monitoring compliance with instructions, controlling the order of questioning, or verifying the time of entries or identity of respondents.

2.3 Specific Hypotheses of Study

This section lists the hypotheses tested by this study along with the questionnaire items which permit tests of each hypothesis.

1. The prevalence of respondents' overall enjoyment of wilderness visits and their intention to return for future visits diminishes as aircraft overflight exposure increases and as annoyance due to aircraft overflights increases. (Questionnaire items 3, 3A, 4, 4A, 10, 10A, 11, and 11A).
2. Audibility has a more adverse impact on wilderness recreationists than visibility of aircraft. (Questionnaire items 10, 10A, 11, and 11A).
3. Most respondents exposed to aircraft overflights during their visits notice them. (Questionnaire item 8).
4. Most respondents exposed to aircraft overflights during their wilderness visits are annoyed by them. (Questionnaire item 10).

5. The presence of aircraft is cited as the least liked aspect of visits to wildernesses with aircraft overflight activity. (Questionnaire item 6).

6. Respondents who cite the presence of aircraft as the least liked aspect of wilderness visits are less likely to report an intention to return. (Questionnaire items 3 and 6).

7. The prevalence of noise-induced annoyance among respondents is predictable from aircraft noise exposure. (Questionnaire item 10A).

8. The prevalence of annoyance due to aircraft noise or sight increases with an increase in reported number of aircraft noticed. (Questionnaire items 9A, 10, 10A, 11, and 11A).

9. The number of aircraft noticed by respondents is associated with aircraft exposure. (Questionnaire item 9A).

10. Recreationists in wilderness settings are less tolerant of aircraft noise exposure than people in residential settings. (Questionnaire items 10 and 10A).

11. Aircraft which produce high noise levels have a greater adverse impact on respondents than aircraft which produce lower noise levels. (Questionnaire items 10, 10A, and 10B).

12. Duration of visit, as a surrogate for aircraft overflight exposure, predicts noise-induced annoyance. (Questionnaire items 1, 10, 10A, and background information recorded upon conclusion of questionnaire).

13. Respondents who cite aircraft-related reasons for intending not to revisit report less overall enjoyment of their visits. (Questionnaire items 3, 3A, 4, and 4A).

14. Noticeability and adverse impacts of aircraft overflights are related to the type of activity in which wilderness recreationists engage at the time of exposure to aircraft overflights. (Questionnaire items 7, 8, 10, 10A, 11, and 11A).

15. Reported annoyance due to aircraft noise is unrelated to demographic and other nonacoustic variables. (Questionnaire items 2A, 3, 4, 4A, 7, and 10).

3. Method

This chapter describes procedures and techniques for stratifying and selecting wildernesses and for conducting on-site interviews. The questionnaires and accompanying forms used to conduct on-site interviews may be found in Appendix A.

3.1 Selecting Wildernesses

3.1.1 Selection Criteria

Wildernesses were purposively selected for study on the basis of levels of aircraft noise exposure and visitor use. An additional criterion for areas with high noise exposure was the type of overflight: (1) low-altitude, high-speed (i.e., military) aircraft and (2) other overflights (i.e., nonmilitary). The former differ in their characteristic noise signatures and potential impacts from those of other types of overflights.

Figure 3-1 shows how wildernesses were stratified on noise exposure and visitor use. Wildernesses first were separately rank ordered by estimated aircraft overflight exposure and grouped into three strata: high, medium, and low. Within the high exposure stratum, areas were ranked by estimated noise exposure due to military overflights alone and then divided into areas with high and low military noise exposure. This produced two substrata for the high noise stratum. Within each of the resulting four noise strata, wildernesses were ranked by amount of visitor use, in units of recreation visitor days (RVDs). Three substrata of visitor use were formed for each overflight exposure stratum, yielding a total of twelve strata. The high visitor use substrata included wildernesses with more than 40,000 RVDs per year. The medium visitor use substrata included wildernesses with 10,000 to 40,000 RVDs per year. The low visitor use substrata included wildernesses with fewer than 10,000 RVDs per year. Further details of the sampling strategy is contained in Tabachnick, Howe, and Fidell (1990).

The following considerations also affected site selection:

- inclusion of areas of both high and low levels of ambient noise;
- inclusion of three ecotypes (arid, coniferous forest, and deciduous forest);
- opportunities for soliciting opinions from both hikers and stock users;
- survey of both day-use and overnight visitors; and

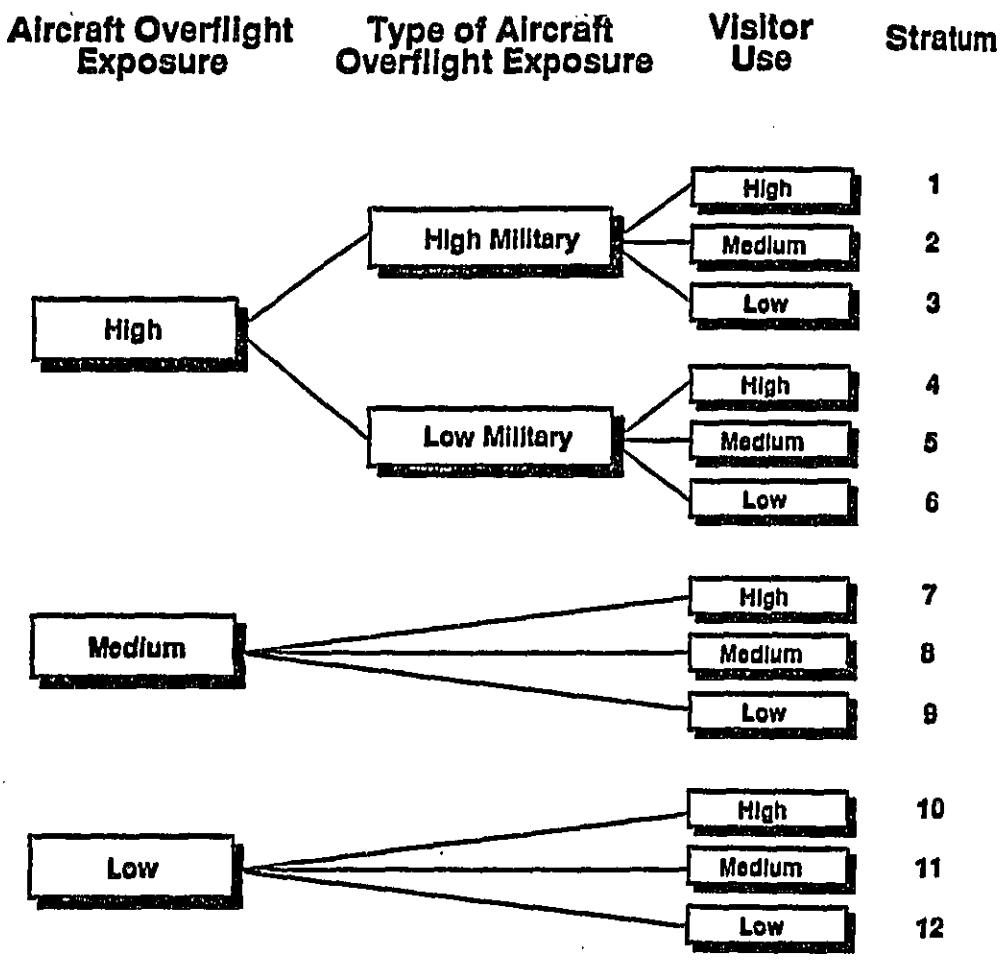

Figure 3-1: Stratification Plan for Sampling Visitor Reactions in Forest Service Wildernesses.

- inclusion of areas exposed to helicopter as well as fixed wing overflights.

3.1.2 Sites for Questionnaire Administration

The current study was intended primarily to develop a dosage-response relationship between noise exposure and visitor reaction. Costs of extensive noise measurement dictated a small, purposive sample of a few highly constrained sites. Desirable site characteristics included considerable variability in noise exposure, with at least some periods of high exposure, combined with the greatest possible visitor use. Since responses were measured soon after exposure, even high noise sites were expected to provide quiet periods. Sites were therefore chosen within the strata of Figure 3-1 characterized by high and medium overflight exposure and high visitor use (strata 1, 4 and 7).

Three sites were purposively selected upon Forest Service review of the wildernesses within the three strata. Appendix B expands on the rationale for purposive rather than random selection of wildernesses, and cites limitations to generalizability of results due to selection of a limited number of sites.

Table 3-1 shows sites judged suitable for on-site interviewing and accompanying place measurements of noise exposure. Superstition Wilderness in Arizona lies within the first stratum (high exposure to both military and nonmilitary overflights with high visitor use). Cohutta Wilderness in Georgia lies within the stratum characterized by high nonmilitary overflight exposure and high visitor use. Golden Trout Wilderness in California lies within the stratum of medium overflight exposure (primarily by military aircraft) with high visitor use. A total sample of 800 respondents from the three wildernesses was sought, composed of 300 visitors in each of the Superstition and Cohutta Wildernesses and 200 visitors in the Golden Trout Wilderness (in which visitor use was more widely dispersed and more difficult to sample). It was anticipated that all interviewing could be completed within 10 days at Cohutta and Superstition Wildernesses and within 15 days at the Golden Trout Wilderness.

Table 3-1: Wildernesses Selected for On-site Interviews

Wilderness	Visitor Use (RVDs)	Stratum
Superstition	98200	1
Cohutta	77300	4
Golden Trout	69600	7

3.2 Sampling of Respondents

Attempts were made to exhaust rather than sample the population of potential respondents at the three wildernesses. This strategy was adopted in preference to random sampling of visitors because relatively small numbers of visitors were expected at any one interviewing site over the period of time during which extensive noise measurements were possible. Random selection of interviewing days or times of day was likewise impractical and unwarranted, inasmuch as sporadic noise exposure was not expected to vary systematically with time. In general, there were too few visitors expected at most sites to omit any potential respondents from the sample.

Sampling was restricted for reasons of cost and practicality to the season with highest expected visitor usage at each site. Off-season study periods would yield too few interviews to be cost-effective and would not yield information about reactions to the most prevalent overflight environment.

3.3 Organization of Questionnaire

Requirements for construction of a questionnaire that balances conflicting design requirements as discussed in detail by Fidell et al. (1990b) led to a simple, focused and brief interview instrument. The instrument reproduced in Appendix A focuses on cumulative effects of noise exposure rather than effects of individual overflights because the elapsed time between overflight exposure and interviewing was expected to range from several hours to a day or more. Two versions of the questionnaire, differing only in minor variations in wording of items, were prepared for trail head and trail camp interviews.

The description of questionnaire items below follows the organization of the coding forms reproduced in Appendix A. Since the questionnaire was intended for face-to-face administration, the interviewer was able to record certain information about the respondent without direct questioning (e.g., time of interview, number of people in party, etc.), thereby reducing the duration of the interview and the burden on respondents' time.

The first item asked respondents for the date and time of the start of their visit. (An answer sheet provided to respondents incorporated a calendar as an aid in answering.) The second item sought information about the number of previous visits to the wilderness. The third item was included to permit evaluation of the likelihood of non-return as a potential overflight impact. The fourth item sought information about the specific concern of Public Law 100-91 for "impairment of visitor enjoyment".

Item 5 was included not only for its own sake (and incidentally to provide an opportunity for spontaneous mention of aircraft overflights as a favored aspect of a recreational experience), but also as an introduction to Item 6. This item was included to provide perspective on the relationship between aircraft flyovers and other disfavored aspects of outdoor recreational experiences.

Item 7 sought information used to associate exposure to aircraft overflights with specific recreational activities, some of which might differ in sensitivity to interference by overflights. A site-specific schematic map of the instrumented portion of the wilderness was shown to respondents to attempt to clarify geographic locations and place names.

Item 8 made the first explicit mention of aircraft. The interview was concluded at this point for respondents who did not recall noticing any aircraft. Item 9 solicited information from respondents who reported noticing aircraft about the types of aircraft they had noticed. Item 10 sought information about the dependent variable of greatest

interest for construction of a dosage-response relationship. Item 11 sought information about the visual intrusiveness of overflights. Questions about annoyance were posed in two parts: a screening question asking whether respondents were annoyed or bothered, followed by a query about degree of annoyance for those who were annoyed. This strategy avoids the awkward phrasing of a single question administered verbally.

Response codes were developed to support the immediate goals of the current study. Verbatim responses were also recorded, however.

3.4 Interviewing Procedures

An interviewer's training manual (Appendix C) detailed the interviewing process and provided information about (1) procedures for group administration of the questionnaire, (2) answers to anticipated questions of respondents, (3) coding respondents' answers at the conclusion of the interview, and (4) recording data in field logs. Identical questionnaires were administered at each of the three wildernesses throughout daylight hours. On-site interviewing was administered (1) at two camp sites and four trail heads within the Golden Trout Wilderness, (2) at two campsites within the Cohutta Wilderness, and (3) at two trail heads within the Superstition Wilderness. A total of 20 interviewers conducted interviews at these sites.

Interviewing sites were located near areas in which acoustic measurements were made. In general, trails expected to be overflown were divided into segments corresponding to several hours' hike each. A noise monitor was located in each segment, out of view of the trail. Interviewers were stationed at the boundaries of instrumented areas to conduct interviews with visitors traveling in each direction. For example, outbound respondents (those exiting a wilderness upon completion of a visit) were typically interviewed at a trail head, while inbound respondents (those proceeding into a wilderness) were typically interviewed hours to days into their visits.

Group administration of the on-site interview utilized interview answer sheets (also found in Appendix A) which provided boxes for respondents to mark for multiple choice items as well as spaces for open ended responses. At the conclusion of an interview, respondents were asked to check boxes on the answer sheet indicating gender and age. Additional information (including time and date of interview, party size, and interview location) was recorded by the interviewer. Answers to completed interviews were coded as soon as practicable to facilitate data entry. All coded responses were entered into a computerized database at a support site and transmitted electronically to off-site computers.

Site-specific arrangements were devised for soliciting interviews and measuring the exposure of visitors other than hikers (e.g., people on stock trips, picnickers, etc.). Field personnel also maintained logs of numbers, aircraft types, and times of occurrence of overflights observed during the course of data collection to complement the acoustic measurements.

3.5 Site Specific Procedures

3.5.1 Interviewing and Acoustic Measurement Procedures for Golden Trout Wilderness

Interviewing and noise monitoring sites in the Golden Trout Wilderness were identified on the bases of a site visit and information provided by the Forest Service's Tule River Ranger District.

Usage figures derived from 1989 Wilderness Permits indicate that the Forks of the Kern (the confluence of the Little Kern and the Kern Rivers in Section 5 of Range 33 E, Township 20 South, at approximately 36 degrees, 8 minutes North latitude and 118 degrees 25 minutes West longitude) is one of the most frequently visited areas of the Golden Trout Wilderness. The area, at approximately 4800' elevation, is a semi-arid mixed coniferous forest in the rain shadow of the Western Divide. The Flatiron plateau some 2000' above the Forks is more heavily forested. As shown schematically in Figure 3-2, the most heavily used trails in the area include 32E20 from Trail Head 137 (Lloyd Meadows), 32E12 from Trail Head 138 (Jerkey Meadow), and 33E01 from Trail Head 139 (Lewis Camp).

Visitors to the Golden Trout Wilderness entering from Trail Head 137 include horseback riders, hikers, and day-use anglers.[4] The Sequoia National Forest surrounding the Golden Trout Wilderness also provides opportunities for seasonal white-water rafting and rock climbing, but participation in such activities is relatively small compared with participation in other recreational activities. The gradients of the Kern and Little Kern rivers are generally too steep to permit swimming or forms of boating other than white-water rafting. Lower Pyles Camp is located at the outer range of travel for unmounted day use visitors willing to descend a steep 24" wide trail, but is visited by backpackers hiking through the Kern River Canyon, especially on a system of looping trails which they may enter or exit from any of the above-noted trail heads.

[4]No hunting season coincided with the interviewing period.

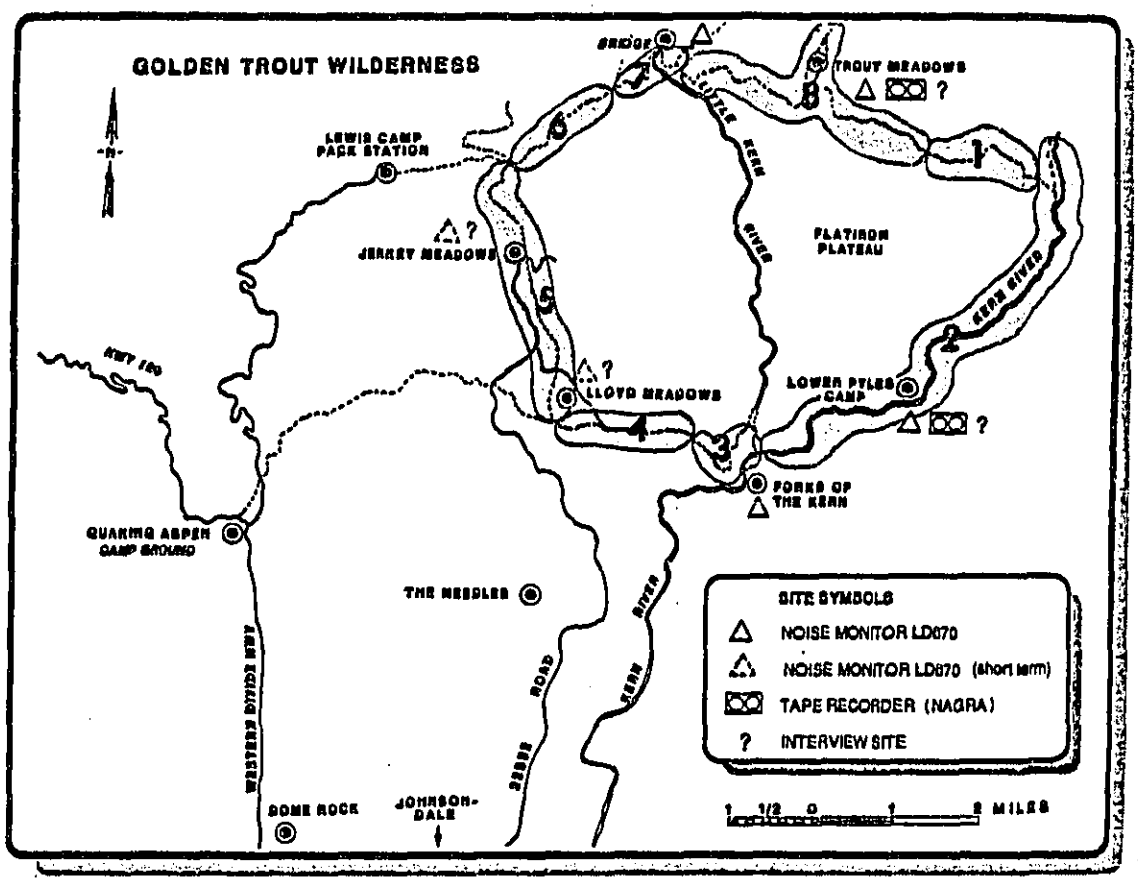

Figure 3-2: Schematic Map of Southern Portion of Golden Trout Wilderness

Data from the National Forest System Visitor Permit Analysis Report show that 1522, 972, and 265 visitors registered at the Lloyd Meadows, Jerkey Meadow, and Lewis Camp Trail Heads, respectively, in 1989. Roughly a third more visitors are believed to enter the wilderness without permits. The average group size entering these trail heads was 4.7.

3.5.1.1 Interviewing Sites

The following interviewing sites were chosen:

1. Trout Meadows
2. Lewis Camp Trail Head
3. Jerkey Meadow Trail Head
4. Lloyd Meadows Trail Head
5. Lower Pyles Camp

Pairs of interviewers were stationed continuously at Sites 1 and 5, located the better part of a day's hike from the Lewis Camp and Lloyd Meadows Trail Heads, respectively. Each pair spent two or more consecutive nights at these sites on a staggered rotation schedule. These interviewers contacted respondents traveling inbound from trail heads during the course of their visits. A single interviewer was stationed at each of the trail head interviewing sites. The latter interviewers contacted outbound respondents concluding their visits to the Golden Trout Wilderness.

3.5.1.2 Acoustic Measurement Sites

Golden Trout Wilderness is regularly overflown by fixed and rotary wing military aircraft from Edwards Air Force Base and from China Lake Naval Air Station, as well as by National Guard aircraft from Fresno Air Terminal. Flight profiles and tracks for military aircraft vary greatly with missions, from low altitude high speed test flights to higher altitude training missions. Night operations by military aircraft occur regularly. The wilderness is also overflown by high altitude commercial traffic, and occasionally by general aviation aircraft.

According to the Tule River Ranger District, a principal route of flight of military aircraft in the Golden Trout Wilderness in the vicinity of the Forks of the Kern is from North to South. F/A-18, A-6, and other military aircraft were observed during a preliminary visit on generally southbound courses taking them over Trout Meadows (Section 8 of Range 33 East, Township 19 South), the Flatiron plateau and the Forks of the Kern. These low altitude overflights are visible from higher elevations and lightly forested portions of the areas of interest.

Four aircraft noise monitoring locations were identified along a North-South axis extending from Trout Meadows to the Forks of the Kern. These measurement positions were as follows:

1. Trout Meadows
2. West Bank of the Kern River approximately two miles above the Forks
3. Forks of the Kern
4. Vicinity of Little Kern suspension bridge

3.5.2 Interviewing and Acoustic Measurement Procedures for Cohutta Wilderness

A preliminary site visit was made to the Cohutta Wilderness during which two interviewing sites were visited and several acoustic measurement sites were identified.

Information derived from 1989-1990 trail registries maintained at four trail heads indicate that the Hickory Creek, Conasauga River and Beech Bottom trails (as shown schematically in Figure 3-3) are among the most frequently visited areas of the 37,000 acre Cohutta Wilderness. Two of the most heavily used campsite destinations on these trails are the Brayfield Clearing (approximately three miles from the Hickory Creek Trail Head at approximately 1800' elevation on the western side of the wilderness, at about 84 degrees 37.5 minutes West longitude and 34 degrees 53 minutes North latitude in Georgia) and the Beech Bottom campground (approximately 2.5 miles from the Beech Bottom Trail Head at approximately 1700' elevation on the northern side of the wilderness, at about 84 degrees 37.3 minutes West longitude and 34 degrees 59 minutes North latitude in Tennessee).

3.5.2.1 Interviewing Sites

The following interviewing sites were identified during the course of the site visit:

1. Brayfield Clearing
2. Beech Bottom

Pairs of interviewers were stationed continuously at Sites 1 and 2, located approximately two hours' hike downhill from their respective trail heads. Each pair spent two or more consecutive nights at these sites on a staggered rotation schedule. Interviewers at these camps contacted respondents while in the campgrounds or as they arrived at the campgrounds.

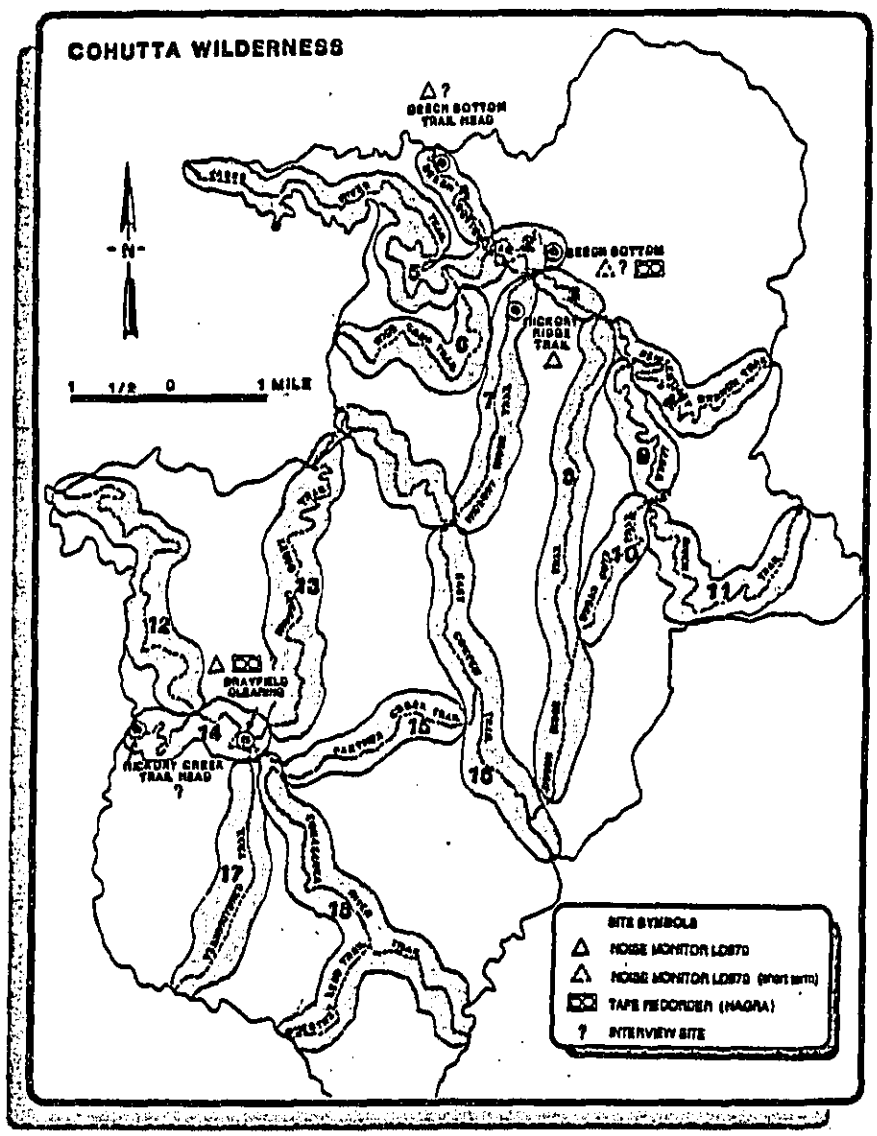

Figure 3-3: Schematic Map of Cohutta Wilderness

Visitors to these areas were primarily day users (anglers, picnickers, and hikers) and short duration campers. The wilderness provides limited opportunities for horseback riding and no opportunities for boating.

3.5.2.2 Acoustic Measurement Sites

Most high altitude commercial air traffic overflies the Cohutta Wilderness en route to and from Hartsfield International Airport in Atlanta, GA. Numerous aircraft overflights at levels on the order of 50 dBA were observed during the site visit, generally separated by intervals of only a few minutes. Both high altitude overflights by jets and lower altitude propeller-driven overflights were audible for periods of tens of seconds above ambient levels in the range of approximately 40-50 dBA. Aircraft are not visible throughout much of the Cohutta Wilderness because of the nearly-complete forest canopy and ridge-and-valley topography. Onset times for aircraft overflights were typically on the order of 5 dB/s or less. Ambient levels as high as 80 dBA in the immediate vicinity of streams rendered many of these overflights inaudible or audible for only brief periods of time in portions of the wilderness.

Since levels produced at ground level by high altitude overflights varied relatively little throughout the Cohutta Wilderness, the principal selection criterion for acoustic measurement sites was absence of wind and water noise. The following aircraft noise monitoring sites were identified during the course of the site visit:

1. Beech Bottom
2. Brayfield Clearing
3. Hickory Ridge Trail approximately 300' above Jacks River

3.5.3 Interviewing and Acoustic Measurement Procedures for Superstition Wilderness

A preliminary site visit was made to the Superstition Wilderness during which two interviewing sites were visited and several acoustic measurement sites were identified.

Information provided by the Forest Service's Mesa Ranger District indicated that approximately 45% of wilderness usage starts at Peralta Trail Head (located in Section 29 of Range 9 E, Township 1 North, at approximately 33 degrees 22 minutes North latitude and 111 degrees 20 minutes West longitude) with trails leading to Dutchman's Mine, Fremont Saddle, and Weaver's Needle. The second highest use trail head (attracting about 32% of usage) is First Water (located in Township 2 North, at approximately 33 degrees 28 minutes North latitude and 111 degrees 26 minutes West longitude) with

access to Black Mesa and Battleship Mountain. Figure 3-4 shows the locations of these trail heads and sites schematically.

The 160,000 acre wilderness is dominated by rocky terrain of volcanic ash sparsely covered by Sonoran desert scrub vegetation. Elevation at the First Water and Peralta Trail Heads is approximately 2400' MSL. Much of the commonly visited portion of the wilderness is relatively flat with the exception of trails along ridges and to Fremont Saddle at approximately 3500' MSL.

Wilderness usage is primarily day-use hiking, rock climbing, and picnicking although seasonal hunting is also popular. The wilderness provides few opportunities for swimming, fishing, or boating, and only limited opportunities for stock-related activities.

3.5.3.1 Interviewing Sites

Peralta and First Water trail heads were the two interviewing sites identified during the site visit. The rocky terrain and lack of water precluded establishment of base camps inside the wilderness. Two interviewers were stationed at each trail head during weekdays and four on weekends to interview all potential respondents upon conclusion of their visits. No respondents were interviewed during the course of their visits.

3.5.3.2 Acoustic Measurement Sites

According to information supplied by Williams Air Force Base, aircraft departing Runway 30 fly near the First Water and Peralta Trail Heads approximately five minutes after takeoff. Aircraft transiting this portion of Superstition Wilderness generally follow one of two flight profiles:

- Low Altitude - Aircraft are typically at 1000' AGL, at 300- 350 knots and an intermediate power setting (exhaust gas temperature of 500 - 550° C)
- High Altitude - Aircraft are typically between 9,000' and 14,000' MSL at about 350 knots in a higher (but not afterburning) power setting (exhaust gas temperature on the order of 650° C)

Approximately 125 operations per weekday follow the high altitude departure profile from Runway 30 at Williams Air Force Base. Far fewer follow the low altitude departure profile. All but a few of these military operations are training flights in T-38s in daylight hours. Weekend operations, generally far fewer in number, are composed largely of transient aircraft.

High altitude commercial, single engine propeller planes, and occasional helicopters also overfly portions of Superstition Wilderness.

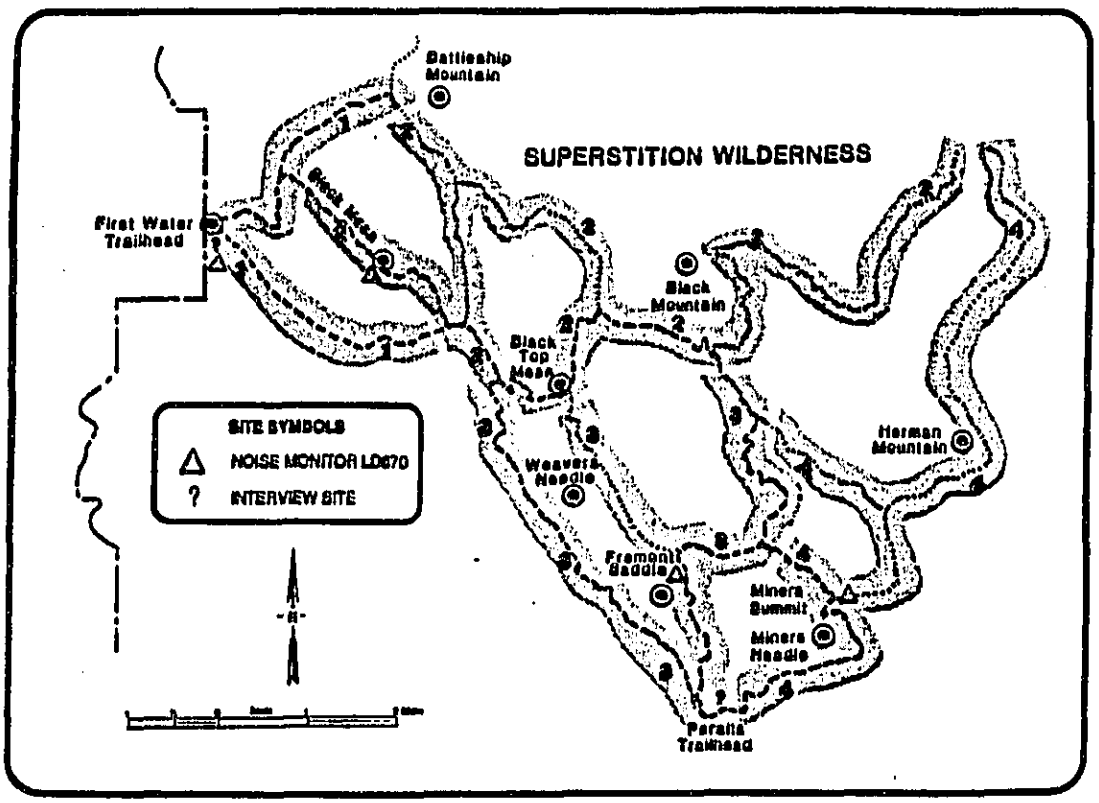

Figure 3-4: Schematic Map of Superstition Wilderness

Automated noise monitors were stationed to characterize long term average sound levels at the following four locations:

1. Fremont Saddle
2. Vicinity of Peralta Trail Head
3. Black Mesa
4. Vicinity of First Water Trail Head

3.6 Nature of Acoustic Measurements in Three Wildernesses

Two types of place-oriented acoustic measurements were made in the three wildernesses.[5] The first type was continuous automated measurement of long term average A-levels. The second type was short term spectral measurement of ambient noise and aircraft flyover noise. These measurements were supplemented by at-ear spectral measurements of indigenous and nonindigenous sounds.

A-weighted measurements were time-tagged to allow comparisons with nonacoustic information about overflights and interview data. Since automated, single channel measurements could not be relied upon to distinguish noise of high altitude aircraft flyovers from the ambient noise at some sites, wideband analog recordings were made at intervals throughout daylight hours. These data were collected to support analyses which discriminate aircraft overflights from ambient levels on the basis of correlation of sound pressure levels in adjacent low frequency one-third octave bands.

3.6.1 Automated Long-Term Acoustic Measurements

Long term measurements were made using Larson-Davis Model 870 noise monitors with accompanying tripod mounted, wind screen protected microphones approximately five feet above ground level. These were configured to record 1) equivalent noise levels during 15 minute intervals, 2) equivalent noise levels during 24-hour periods, and 3) a measure of the distribution of noise events in terms of sound pressure levels exceeding preset threshold values. The monitors stored sound pressure levels, durations of events, and complete time histories of all events exceeding the preset thresholds. Threshold

[5]All measurements were made in accordance with standard practice as described, for example, by Dunholter, Mestre, Harris, and Cohn (1989).

values were set at 65 dBA in Golden Trout Wilderness and 50 dBA in Superstition Wilderness. Threshold values were not established for measurements collected in the Cohutta Wilderness since prominent discrete events were absent from the near continuous stream of relatively low (acoustic) level overflights.

3.6.2 Short-Term Acoustic Measurements

Short-term measurements were made using Nagra IV-SJ two-channel tape recorders. Recordings were edited in the field to separate noise of aircraft overflights from ambient noise for comparative spectral analyses. The recordings were made using 1/2 inch B&K Model 4155 tripod mounted electret microphones equipped with windscreens. Measurement positions were camouflaged approximately 100 m from trails.

3.6.3 At-Ear Measurements

Acoustic measurements of ambient sound, aircraft overflights, and self-noise of hikers and horseback riders were made using a specially designed helmet and Nagra SN miniature tape recorder with at-ear microphones enclosed in windscreens.

3.6.4 Supporting Logs

Interviewers and supporting staff kept logs of aircraft overflights and weather conditions. Logs of aircraft overflights were kept in Golden Trout and Cohutta Wildernesses to aid in matching automatic acoustic measurements of overflights to observed overflights and visitor responses. Logs of weather conditions were also kept in Golden Trout and Cohutta Wildernesses to aid in interpreting potential differences between visual and auditory detection of aircraft overflights due to cloud cover.

An additional log recorded information about visitors who refused to grant interviews (nonrespondents). This information was limited to that which could be observed by interviewers: apparent age, gender, size of party, date and time of approach.

4. Results

This chapter describes analyses of responses to questionnaire items and analyses of acoustic measurements.

Section 4.1 is a narrative overview describing responses to each questionnaire item. Tables for this section are consolidated in Appendix D. Inferential analyses were pre-planned and simulated in full prior to data collection. Section 4.2 addresses relationships among questionnaire items. Figures and Tables for Section 4.2 are consolidated in Appendix E. Section 4.3 provides detailed analyses of both automated long term measurements and short term spectral measurements of ambient noise. Figures and Tables for Section 4.3 are consolidated in Appendix F.

These results describe visitor reactions and noise exposure at three specific wildernesses. Due to limitations regarding external validity discussed elsewhere (see Appendix B and Section 7.2), generalization of findings should be undertaken with caution.

4.1 Analysis of Responses in Three Wildernesses

The overall response rate (the number of completed interviews divided by the number of contact attempts) of 96% varied little from wilderness to wilderness. Of the 954 visitors approached in all three wildernesses, 920 granted interviews yielding usable data. A discriminant function analysis was conducted to test differences between respondents and nonrespondents on the basis of wilderness visited (coded into two dichotomous variables), apparent age, gender, party size, time of day and day of week (weekends vs. weekdays). No reliable differences were observed between visitors who participated and refused participation in the study, $F_{(7, 946)} = 1.37, p > .05$.

Appendix Tables D-1 through D-14 show percentages of recreationists responding in each category of each questionnaire item for all three wildernesses. These data are described briefly below.

Gender:

As seen in Table D-1, male respondents outnumbered female respondents by about 3:1. A test of the association between wilderness and gender distribution shows no

differences in rates among the three wildernesses, $\chi^2_{(2, N = 914)} = 5.11, p > .004$.[6]

Age:

The three wildernesses differed significantly in distribution of age of respondents, $\chi^2_{(6, N = 912)} = 84.93, p < .004$. As can be seen in Table D-2, respondents from the Superstition Wilderness tended to be older than those from either Golden Trout or Cohutta Wildernesses.

Group Size, Intention to Return, and Overall Enjoyment:

Sizes of visitor groups differed reliably among the three wildernesses, $\chi^2_{(6, N = 920)} = 74.08, p < .004$, with very large parties more common in Superstition Wilderness (Table D-3). Superstition Wilderness also experienced more repeat visits than either Cohutta or Golden Trout Wildernesses, as seen in Table D-4, $\chi^2_{(6, N = 900)} = 30.55, p < .004$. However, Table D-5 shows that the pattern of intended future visits did not vary by wilderness, with virtually all visitors planning to return, $\chi^2_{(4, N = 849)} = 4.46, p > .004$. The degree of enjoyment reported by respondents also did not differ among wildernesses, as shown in Table D-6, $\chi^2_{(8, N = 899)} = 7.48, p > .004$.

Liked Most/Least:

The three wildernesses differed in factors that respondents reported as liking most (Table D-7). Scenery was more often mentioned in Superstition Wilderness as most liked, while activity-related factors were more prominent in Golden Trout Wilderness, $\chi^2_{(16, N = 915)} = 138.46, p < .004$. Examples of other factors which were reported as most liked included being in wilderness, proximity to river, uncrowded, outdoors, trees and water, weather, and well marked trails. Differences were also noted in factors liked least (Table D-8), $\chi^2_{(16, N = 890)} = 119.06, p < .004$. Visitors to the Superstition Wilderness were more likely to report disliking nothing. Insects were reported as the least-liked factors in Golden Trout and Cohutta Wildernesses (but not in Superstition Wilderness), and weather was a more often disliked factor in Golden Trout Wilderness. Examples of other factors which were reported as least liked included poor water, dust, hiking, no fish, heavy packs, snakes, and cactus needles. Aircraft-related dislikes were mentioned as the least favored aspect of their visits by less than 1% of respondents in all three wildernesses.

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[6]This and subsequent χ^2 analyses reported in this section are conducted at $\alpha = .004$ to compensate for inflated Type I error rate due to multiple testing.

Activity:

Since multiple responses were allowed for visitor activities, simple χ^2 comparisons of visitor activities among wildernesses were not appropriate. However, Table D-9[7] shows that water-related activities (fishing and swimming) were often reported by visitors to Golden Trout Wilderness. Swimming was also reported as an activity in Cohutta Wilderness. Horseback riding was more frequently reported in Golden Trout than in the two other wildernesses.

Noticeability:

Separate χ^2 analyses for the noticeability of each type of aircraft were conducted to test differences among wildernesses. As seen in Table D-10, respondents noticing high altitude aircraft varied from 22% in Cohutta Wilderness to about 40% in Golden Trout and Superstition Wildernesses, $\chi^2_{(2,\ N\ =\ 920)} = 33.72$, $p < .001$. While 41% of respondents in Golden Trout Wilderness reported noticing helicopters, only 2% or less noticed them in the other two wildernesses, $\chi^2_{(2,\ N\ =\ 920)} = 256.90$, $p < .001$. Low flying jet (i.e., military) aircraft were also noticed by more respondents in Golden Trout Wilderness (45%) than in the other two wildernesses (5%), $\chi^2_{(2,\ N\ =\ 920)} = 213.85$, $p < .001$. Small propeller aircraft were reportedly noticed by 32% of visitors to Superstition Wilderness, 20% of visitors to Cohutta Wilderness, and 12% of visitors to Golden Trout Wilderness. This difference among wildernesses was a statistically reliable one: $\chi^2_{(2,\ N\ =\ 920)} = 30.95$, $p < .001$. Although few respondents reported noticing "other" aircraft, the difference among wildernesses was unlikely to have arisen by chance alone, $\chi^2_{(2,\ N\ =\ 920)} = 16.44$, $p < .001$. Eight percent of the respondents in Golden Trout Wilderness, 5% of respondents in Cohutta Wilderness, and 1% of respondents in Superstition Wilderness reported noticing other aircraft.

Annoyance of Sight/Sound:

Statistically reliable ($p < .004$) differences were observed among wildernesses in reported annoyance due to both the sight and sound of aircraft for all respondents who were interviewed, and also for those who reported noticing aircraft. Overall, respondents in the Golden Trout Wilderness were more annoyed by noise of aircraft than respondents in the other two wildernesses, $\chi^2_{(8,\ N\ =\ 904)} = 71.53$ (Table D-11). Additionally, respondents who noticed aircraft in Golden Trout Wilderness were more annoyed by

[7]The activities coded in this table are directly applicable to *a priori* hypotheses regarding masking of aircraft noise. The "other" category therefore contains activities such as hiking and picnicking which were not directly pertinent to stated hypotheses and thus were not coded.

noise of aircraft than those respondents who noticed aircraft in the other two wildernesses, $\chi^2_{(8,\ N\ =\ 527)} = 58.24$ (Table D-11). Respondents in the Golden Trout Wilderness were more annoyed by the sight of aircraft than respondents in the other two wildernesses, $\chi^2_{(8,\ N\ =\ 895)} = 73.86$ (Table D-12). Further, respondents who noticed aircraft in the Golden Trout Wilderness were more annoyed by the sight of aircraft than respondents who noticed aircraft in the other two wildernesses, $\chi^2_{(8,\ N\ =\ 518)} = 53.48$ (Table D-12).

Type of Aircraft:

Tables D-13 and D-14 show the type of aircraft reported as most annoying to hear and see, respectively, among respondents who noticed more than one type of aircraft. Statistically reliable differences were observed among wildernesses both in the most annoying type of aircraft to hear, $\chi^2_{(6,\ N\ =\ 59)} = 63.21$, $p < .004$, and to see, $\chi^2_{(4,\ N\ =\ 26)} = 26.00$, $p < .004$. In Golden Trout Wilderness helicopters and low flying jet aircraft were reported as most annoying to see and hear, while in Superstition Wilderness small private aircraft were considered most annoying. In Cohutta Wilderness, high altitude jets were reported as most annoying to hear. No respondents reported seeing more than one type of aircraft in Cohutta Wilderness so there was no basis for determining which was more annoying to see.

Number of Aircraft:

Table D-15 tallies the hourly average number of each type of aircraft noticed among those who noticed each type of aircraft. As can be noted in the table, more high altitude jets were noticed in Superstition than Cohutta or Golden Trout Wildernesses, while more small aircraft were noticed in Cohutta and Superstition than Golden Trout Wildernesses. χ^2 comparisons among wildernesses are inappropriate because of multiple responding.

4.2 Analysis of Relationships among Questionnaire Items

Planned loglinear multiway frequency analyses and an analysis of variance investigated relationships among several of the questionnaire items. These were supplemented by a discriminant function analysis to predict annoyance due to aircraft noise.

4.2.1 Differences in Aircraft-Induced Annoyance Among Wildernesses

A 3 x 2 x 2 loglinear multiway frequency analysis was performed to investigate relationships among three variables: (1) wilderness (Golden Trout, Cohutta, and Superstition), (2) reported annoyance due to seeing aircraft, or (3) reported annoyance due to hearing aircraft. Each of the latter two variables was dichotomized into "yes" and "no" categories. This analysis is capable of evaluating the significance of any difference between the number of respondents in each wilderness who were annoyed by hearing aircraft but not annoyed by the seeing aircraft.

All three two-way associations, but not the three-way, were required to adequately model the observed frequencies, with likelihood ratio goodness-of-fit $\chi^2_{(2,\ N\ =\ 793)} = 5.47$, $p = .06$. (Note that the better the fit of the model to the observed frequencies, the smaller the χ^2 value and the larger the p value.) Table E-1 shows cell frequencies for all combinations of categories of response for the three categorical variables. As seen in Table E-2, reliable associations were found between wilderness and annoyance due to aircraft noise, wilderness and annoyance due to sight of aircraft, and between the two types of annoyance.

A strong relationship was found between annoyance due to sight and annoyance due to sound of aircraft, $\phi = .43$ (out of a greatest possible $\phi = .64$). Most respondents (91%) were annoyed by neither the sound nor sight of aircraft. Of those who were annoyed by the sound of aircraft, 32% were also annoyed by the sight of aircraft. However, among those not annoyed by the sound of aircraft, only 2% were annoyed by the sight of aircraft.

Relationships between wilderness and annoyance were more modest; $\phi = .19$ for the association between wilderness and annoyance due to aircraft noise and $\phi = .22$ for the association between wilderness and annoyance due to the sight of aircraft. Annoyance due to aircraft noise ranged from 25% of Golden Trout respondents through 12% of Cohutta respondents to 8% of Superstition respondents. Respondents reported less annoyance due to sight of aircraft in all wildernesses: 16% of Golden Trout respondents, 2% of Cohutta respondents, and 4% of Superstition respondents.

4.2.2 Activity and Noticeability of Aircraft

A 2 x 2 x 2 x 3 loglinear multiway frequency (logit) analysis was performed to assess whether respondents noticed aircraft as a function of participation in water-related activities and stock-related activities and the wilderness visited. The wilderness visited was included as a control for exposure to aircraft overflights. Although some of the individual associations met statistical criteria for reliability, an adequate model was unattainable. Thus, the data fail to support the hypothesis that water-and/or stock-related activities affect the degree to which recreationists notice aircraft.

4.2.3 Enjoyment and Aircraft-Induced Annoyance

As seen in Tables D-6, D-11, and D-12, judgments of trip enjoyment and aircraft-induced annoyance were so highly skewed as to preclude planned parametric multiple regression analysis. Instead, a 3 x 2 x 2 loglinear multiway frequency (logit) analysis was conducted to investigate reported trip enjoyment (trichotomized into three levels: less than very enjoyable, very enjoyable, and extremely enjoyable), as a function of annoyance due to sound and sight of aircraft (both dichotomized into those who were not at all annoyed and those who were annoyed in any degree). The analysis showed no statistically reliable relationship between enjoyment and either measure of aircraft-induced annoyance. Only the relationship between two types of annoyance, as described in Section 4.2.1, was reliable.[8]

4.2.4 Noise-Induced Annoyance and Type of Aircraft

A one-way between-subjects analysis of variance tested annoyance due to aircraft noise as a function of the type of aircraft found most annoying to hear, among 58 respondents who noticed more than one type of aircraft and were annoyed by aircraft noise. As seen in Table E-3, a moderately strong and reliable relationship was found ($F_{(3, 54)} = 8.01$, $p < .05$, $\eta^2 = .30$). Thus, almost one-third of the variance in noise annoyance was associated with type of aircraft. (This analysis assumes that a generic judgment of annoyance to aircraft noise can be generalized to the type of aircraft reported to be most annoying.) Table E-4 shows means, standard deviations, and samples sizes for the four groups representing types of aircraft reported to be most annoying:

[8]A planned factorial multivariate analysis of variance that included factors liked least as an independent variable was abandoned because only seven respondents cited aircraft as a least-liked factor.

helicopters, low flying jet aircraft, small private airplanes and high altitude jet aircraft[9].

Planned pairwise comparisons, with Newman-Keuls adjustment for inflated Type I error, show that annoyance associated with exposure to high altitude and small private aircraft differed from that associated with low flying jet aircraft and helicopters. As seen in Table E-5, respondents showed no reliable difference in degree of annoyance between high altitude jets and small private aircraft, but they did report low flying jet aircraft and helicopters to be significantly more annoying than either of the two former types of aircraft. No reliable difference in annoyance was noted between low flying jets and helicopters.

4.2.5 Intention to Revisit

A 2 x 2 x 2 loglinear multiway frequency (logit) analysis assessed relationships among three variables: intent of respondents to revisit the wilderness as a function of any degree of reported annoyance due to seeing and hearing aircraft. Aside from the association between annoyance due to sight and sound of aircraft noted in Section 4.2.1, no statistically significant association was found between intention to revisit and aircraft-induced annoyance. A model incorporating wilderness as a predictor showed that the failure to find differences in intention to revisit as a function of annoyance was consistent across wildernesses. The latter analysis revealed differences between wildernesses in annoyance due to both sight and sound of aircraft, as noted in Section 4.2.1.

A two-way χ^2 analysis revealed no reliable association between intention to revisit the wilderness and three categories of least liked factors: aircraft-related, nonaircraft-related, and no reported least-liked factor. For those responding in all three categories of least liked factors, over 98% intended to return.

A planned analysis of variance to assess the relationship between degree of enjoyment and intention to return was abandoned upon discovery that only nine respondents who provided responses on both variables did not intend to return. Not one of the 920 respondents cited aircraft-related reasons for intention not to return.

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[9]To maintain adequate sample size, the foregoing analysis combined responses over the three wildernesses. However, as noted in Section 4.1, types of aircraft noticed differed significantly among wildernesses.

4.2.6 Annoyance by Activity

A 5-way (2 x 2 x 2 x 2 x 3) loglinear multiway frequency analysis investigated relationships among annoyance due to both hearing and seeing aircraft (both dichotomized as not at all annoyed vs. annoyed to any degree) and whether respondents engaged in water- or stock-related activities (each also dichotomized as respondents who did and did not engage in those activities)[10]. In addition, wilderness visited was incorporated as a 3-category variable in the multiway frequency analysis to control for relationships among wilderness, exposure, and activities engaged in. Preliminary screening revealed that none of the four associations of interest was statistically reliable: annoyance due to aircraft sight or sound and engaging in either stock- or water-related activities. The only reliable relationships were those between 1) types of activities, 2) types of annoyance, 3) wilderness visited and activities, and 4) wilderness visited and annoyance.

4.2.7 Predictability of Annoyance from Nonacoustic Variables

A direct discriminant function analysis was conducted to investigate whether any nonacoustic variable could be used to predict annoyance of overflights. A set of nine demographic and activity predictor variables included wilderness (coded into two variables: Golden Trout vs. the other two sites and Cohutta vs. the other two sites), number of previous visits, intent to revisit, degree of enjoyment of visit (coded into three levels as described in Section 4.2.3), sex, age group, participation in stock-related activity, and participation in water-related activity. This set of predictors reliably discriminated between respondents who were and were not annoyed by aircraft noise, $F_{(9, 797)} = 4.32$, $p < .05$, but accounted for only a small proportion of variance in group separation, $\eta^2 = .05$.

The only predictor variable which significantly predicted annoyance was whether the wilderness visited was Golden Trout, $F_{(1, 797)} = 17.11$, $p < .005$. However, the wilderness visited is indirectly associated with aircraft overflights, since visitors to Golden Trout were exposed to higher levels of aircraft noise, as noted in Section 5[11].

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[10]This analysis replaces a planned multivariate analysis of variance (MANOVA). The MANOVA was precluded by the highly skewed distribution of annoyance due to sight of aircraft, which was originally intended to be a continuous dependent variable.

[11]Wilderness was included as a variable in this analysis to control for exposure.

Table E-6 shows bivariate correlations among predictors in the discriminant function analysis, with wilderness coded into two dichotomous variables. Using a correction recommended by Larzelere and Mulaik (1977) to compensate for multiple testing, only five of the correlations are reliably different from zero: (1) the spuriously high correlation among wildernesses created by the coding scheme; (2) three relationships between wilderness visited and activities engaged in; and (3) the relationship between age group and the number of previous visits. Visitors to Golden Trout Wilderness were more likely to engage in both water- and stock-related activities as seen in Table D-9. As expected, older visitors reported greater numbers of previous visits.

4.3 Analysis of Acoustic Measurements

4.3.1 Automated Long-Term Sound Level Measurements

More than 2,000 hours of automated, A-weighted sound level measurements were made in the three wildernesses. Figures F-1, F-2, and F-3 show A-weighted time histories of contiguous 15-minute epochs of L_{eq} values throughout the period of measurement in each wilderness. Figure F-1 shows that starting at daybreak, sound levels in the Golden Trout Wilderness increased from overnight lows to about 45 dBA, and then decreased some 15 to 20 dBA at night. The range of observed 15-minute L_{eq} values was nearly 85 dB: from 22.2 dB (minimum) to 106.0 dB (maximum) during the course of the measurements. The latter values were observed during thunderstorms.

The diurnal pattern of 15-minute L_{eq} epochs in the Cohutta Wilderness was quite different. As seen in Figure F-2, daytime sound levels were about 20 dBA lower than nighttime levels, due in large part to nocturnal animal noise (tree frogs). The range of observed 15-minute L_{eq} values (about 80 dB) was quite similar to that observed in the Golden Trout; from a minimum of 25.5 dB to a maximum of 106.1 dB.

The diurnal pattern of 15-minute epochs of L_{eq} values in the Superstition Wilderness was much less regular than that of either of the other wildernesses. Sound levels in successive epochs fluctuated within a small range throughout the day and night. As seen in Figure F-3, daytime sound levels usually varied from about 30 to 40 dBA, while nighttime levels varied from about 25 to 40 dBA. The range of 15-minute L_{eq} values was less than 55 dB; from 19.7 dB (minimum) to 73.1 dB (maximum).

Table F-1 displays typical day (0700 - 2000) and night (2000 - 0700) values of L_{eq} as well as Day-Night Average Sound levels of the ambient levels at all measurement

stations in the three wildernesses. These estimates are not affected by noise of known aircraft overflights. Noise produced by thunder and nocturnal animals were also omitted from these estimates of ambient levels because such sounds are atypical of most (day-use) visitors' noise exposure.

4.3.2 Short-Term Measurements of Ambient Noise

Forty-six hours of wideband analog recordings were made in the three wildernesses. The recordings included ambient sound as well as 61 aircraft overflights in Golden Trout Wilderness, 170 overflights in Cohutta Wilderness, and 58 overflights in Superstition Wilderness. Typical sound spectra for ambient sound levels (free of aircraft flyovers, human activity, and wind artifacts) were developed for each wilderness. A typical short-term time history of ambient levels in Golden Trout Wilderness is shown in Figure F-4. Temporal fluctuations were due largely to wind and animal activity. A similar time history for nighttime ambient in the Cohutta Wilderness, Figure F-5, documents ambient sound levels on the order of 60 dBA. A short-term time history of ambient levels in Superstition Wilderness, Figure F-6, shows consistently lower levels.

Figure F-7 compares typical spectral shapes of ambient sound in each wilderness. The variations in spectral shapes are associated with differences in ecotypes, amount of animal activity, and wind-induced noise. As seen in Figure F-7, the ambient spectrum of a coniferous forest (Golden Trout Wilderness) with moderate wind has a concentration of energy around 630 Hz and a peak level of 39 dBA. The spectrum of a dense deciduous forest (Cohutta Wilderness) with slight wind shows a similar concentration of energy around 630 Hz, a level of 27 dBA during the day, and an abrupt increase in bands above 1 kHz due to animal noise at night. The ambient spectrum in a desert (Superstition Wilderness) shows little energy in frequency bands greater than 400 Hz. The average A-levels of ambient sound in these three wildernesses differ by 30 dBA.

4.3.3 Short-Term Measurements of Typical Aircraft Overflights

Figures F-8 to F-12 are time histories which show the effect of various types of aircraft flyovers on ambient levels in each wilderness. These include a high altitude jet (Figure F-8) and a low flying helicopter (Figure F-9) in Golden Trout Wilderness, a T-38s (Figure F-10) and a twin engine prop plane (Figure F-11) in Superstition Wilderness, and a high altitude jet (Figure F-12) in Cohutta Wilderness.

The first four of these A-weighted time histories document elevated sound levels

throughout the duration of the flyovers with eventual declines to levels typical of ambient noise. The time history of a high altitude overflight in Figure F-12, recorded in the Cohutta Wilderness, shows only a slight elevation of ambient levels despite the clear audibility of the event.

4.3.4 Short-Term At-Ear Measurements

Analyses of at-ear recordings of ambient sounds and self-noise of a hiker in Golden Trout Wilderness are shown in Figures F-13 and F-14. While sound levels measured at a stationary hiker's ear differed little from those measurable at a nearby fixed microphone location, the self-noise of an active hiker produced an increase in temporal variability and level. The increase in L_{eq} due to hiking is on the order of 13 dB.

Figure F-15 shows a time history of levels heard at a hiker's ear when overflown by a propeller plane. The L_{eq} for the period including the overflight was 12 dB greater than that of the self-noise of the hiker.

Additional examples of sound level recordings made at ears of wilderness recreationists are seen in Figures F-16 and F-17. The average level of an at-ear recording of horseback riders (Figure F-16) differed little from that of the at-ear recording of a hiker. The time history of a low altitude, high speed F/A-18 overflight as heard at-ear (Figure F-17) shows both an abrupt onset and high absolute levels.

5. Analyses of Dosage-Response Relationships

This Chapter presents additional analyses of dosage-response relationships.

The questionnaire administered in the three wildernesses (cf. Appendix A) was not designed to elicit reports of reactions to specific aircraft overflights, nor was the present study designed to record either personal noise exposure or immediate responses to overflights. Efforts to synthesize a dosage-response relationship for short term reactions to overflights were further complicated by uncertainty about each visitor's cumulative noise dose. A chief source of this uncertainty was visitors' inability to accurately reconstruct their travels at the time of interview. Visitors to wildernesses commonly lose detailed track of time, so that few are able to remember accurately when they have been in particular places. Without accurate information about times at which visitors were in the vicinity of measurement stations, estimates of their exposure to individual aircraft noise events could not be made with confidence.[12]

Since a dosage-response relationship for short term reactions to overflights could not be inferred by summing individual event exposure estimates, analyses were conducted to relate annoyance to wide area, long term exposure estimates. Table 5-1 estimates DNL values of visitors' total noise exposure and their ambient noise exposure for the time period of interviewing in the three wildernesses. The table also summarizes the prevalence of annoyance in the three wildernesses. DNL values were estimated for each wilderness by averaging data from all measurement stations.

These estimates omit the influence of nocturnal animal noise for Cohutta Wilderness, since day use visitors (the bulk of all respondents) were not present in the wilderness to experience this exposure. The estimates should not be viewed as values of ambient levels, but rather as exposures likely to be experienced by most visitors to these wildernesses. Separate estimates are provided for DNL values uninfluenced by overflights and DNL values associated with aircraft activity. Note that overflights do not control long term noise exposure in either the Cohutta or Superstition Wildernesses.

Figure 5-1 shows the relationship between the current data and an empirically derived dosage-response relationship between the prevalence of annoyance in residential settings and exposure to transportation noise (Fidell et al., 1991). The values of DNL plotted on the abscissa are those associated with aircraft activity in the three wildernesses.

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[12]These uncertainties precluded a thorough test of the applicability of the equal energy hypothesis in outdoor recreational circumstances.

Table 5-1: Prevalence of Annoyance and Estimated Cumulative Exposure

	% Highly Annoyed	% Annoyed (any degree)	Ambient L_{dn}	Total L_{dn}	Total - Ambient L_{dn}
Golden Trout	12	25	47 dB	52 dB	5 dB
Cohutta	2	12	52	53	+1
Superstition	1	8	38	39	+1

The relationship overestimates the prevalence of annoyance in Cohutta Wilderness, but underestimates it in Golden Trout. The relationship is undefined for DNL values below 45 dB, and thus makes no prediction about the prevalence of annoyance in Superstition Wilderness.

Figure 5-2 shows the relationship between the current data and a theoretically derived dosage-response relationship between the prevalence of annoyance in residential settings and exposure to general transportation noise (Green and Fidell, 1991). The slope of this curve is that of the growth of loudness with sound level. The position of the curve on the abscissa, which reflects the aggregate influence of nonacoustic factors on annoyance judgments, is given by a decibel-like quantity known as D^*. D^* may be thought of as a DNL value above which people describe themselves as highly annoyed. D^* is calculated as the displacement of the theoretical curve along the abscissa which yields a least-squares fit.

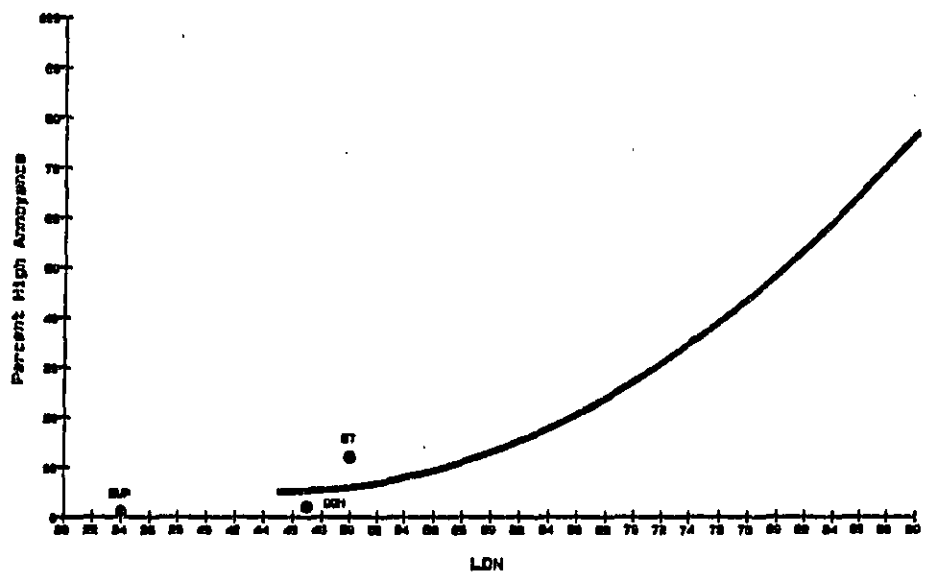

Figure 5-1: Prevalence of Annoyance in Three Wildernesses in Relation to Empirical Dosage-Response Relationship for Residential Exposure

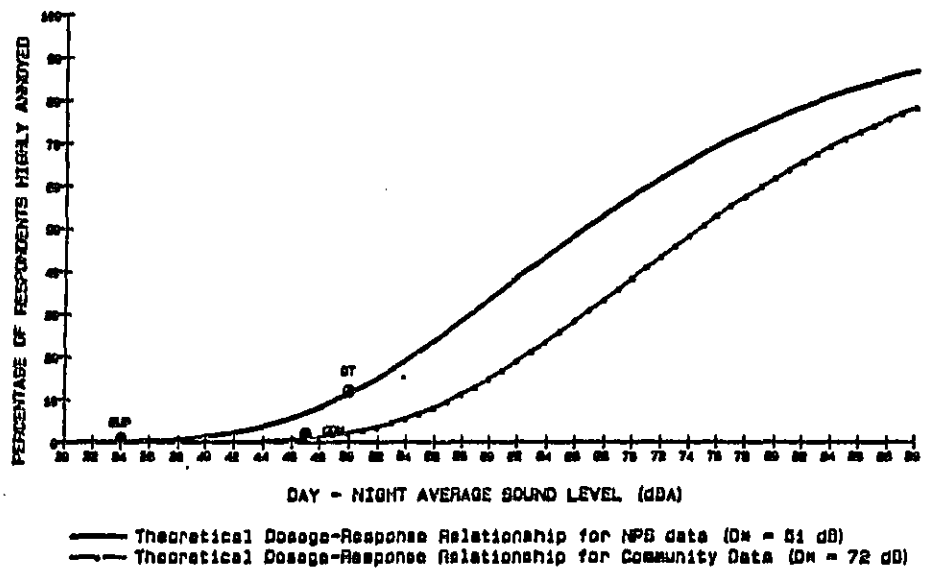

Figure 5-2: Prevalence of Annoyance in Three Wildernesses in Relation to Theoretical Dosage-Response Relationship for Residential Exposure

The mean value of D^* for a large body of residential annoyance studies is 72 dB. The value which yields the best fit to the current data set (61.2 dB) is approximately 10 dB lower. This implies that respondents engaged in outdoor recreation in Forest Service wildernesses describe themselves as highly annoyed by an order of magnitude less aircraft noise exposure than they are willing to tolerate in a residential setting.

6. Supplementary Analyses of Annoyance and Visit Enjoyment Data

Tables for this Chapter are consolidated in Appendix G.

Several additional analyses of the predictability of annoyance were conducted. These alternatives explored the predictability of annoyance and visitor enjoyment by several independent variables, including 1) maximum overflight sound levels, 2) amount of time spent in wilderness, and 3) reported number of aircraft noticed.

6.1 Predictability of Annoyance from Maximum Overflight Levels

Analysis of noise levels produced by individual overflights at Golden Trout Wilderness revealed 24 overflights that could be reliably associated with particular overflights by near-simultaneous time of occurrence at multiple monitors and/or logging locations. Average maximum A-weighted levels for these 24 events (Table G-1) ranged in level from 68.4 to 98.2 dBA. These levels represent the arithmetic averages of maximum A-weighted levels over the durations of events recorded by one or more noise monitors.

The 184 visitors interviewed in Golden Trout were divided into two groups: (1) 34 visitors who were present in the wilderness during at least one of the 24 overflights and who also reported noticing aircraft[13], and (2) 93 visitors who were not present in the wilderness during any of those overflights (the latter respondents are nonetheless likely to have been exposed to other aircraft overflights which were either of lower level or not verified through multiple recordings). The 57 respondents who were present in the wilderness during the 24 overflights but did not notice aircraft were omitted from the analysis since they most likely were in a section of the wilderness in which the overflight was inaudible.

Thus respondents who were exposed to high level overflights formed one group, while respondents who were not exposed to high level overflights formed the second

[13]Because of the large size of the wilderness and lack of information about respondents' positions at specific times, visitors to the wilderness at the time of a particular aircraft overflight may not have actually heard it.

group. This scheme for grouping respondents permits a conservative test of the hypothesis that wilderness visitors subjected to more intense levels of aircraft overflight exposure report greater levels of annoyance due to aircraft noise.

An analysis of variance reported in Table G-2 (in which homogeneity of variance is not assumed) showed significantly less annoyance on the part of those who were not exposed to a known high level overflight, $F_{(1, 47)} = 115.43$, $p < .05$, $\eta^2 = .55$. That is, more than half of the variance in judgments of annoyance was associated with probable exposure to one or more aircraft overflights of high noise level. Table G-3 shows differences in mean annoyance due to aircraft noise for those who were and were not exposed to one or more high level overflights.

A similar analysis of variance for annoyance due to aircraft noise was performed for exposed vs. non-exposed visitors to one or more of 14 overflights identified in the Superstition Wilderness. Maximum A-weighted levels averaged over all measurement stations for these 14 events (Table G-4) ranged from 51 to 72.3 dBA. Eighty-three visitors who could not have been exposed to any of these events (because they were not in the wilderness at the time) comprised the nonexposed group. Twenty-eight visitors who were in the wilderness at the time of the overflights and who reported noticing aircraft formed the exposed group. The respondents who were in the wilderness at the time of the overflights but who did not report noticing aircraft were omitted from this analysis (as they were from the parallel analysis of Golden Trout respondents).

The analysis of variance (using separate variances for each group) described in Table G-5 showed significantly less annoyance reported by visitors who had not been exposed to at least one overflight ($F_{(1, 28)} = 120.44$, $p < .05$, $\eta^2 = .75$). Three-fourths of the variance in annoyance was associated with probable exposure to high level overflight events. Table G-6 shows average differences in annoyance between visitors who were exposed and visitors who were not exposed to at least one high level overflight in Superstition Wilderness.

The substantial proportion of variance accounted for in these two conservative analyses suggests a strong relationship between aircraft overflight exposure and annoyance due to aircraft noise.

6.2 Prediction of Overall Enjoyment

Enjoyment of visit was investigated as a function of noise exposure to test the hypothesis that visitors exposed to one or more overflights might report their visits as less enjoyable. For Golden Trout and Superstition Wildernesses, visitors who were and were not exposed to 24 and 14 verified overflights, respectively, formed exposure groups, as described in Section 6.1. Since most visitors expressed considerable enjoyment, the three lowest enjoyment categories were combined, forming three levels of enjoyment: less than very enjoyable, very enjoyable, and extremely enjoyable. An analysis of variance showed no statistically reliable difference in the transformed measure of enjoyment between lower and higher exposure groups, $F_{(1, 140)} = 2.01, p > .05$. In the Superstition Wilderness, however, those exposed to one or more of the 14 overflights reported slightly *greater* enjoyment of their visits than those not so exposed, $F_{(1, 108)} = 12.94, p < .05, \eta^2 = .11$. On the average, those not exposed to these overflights reported an average overall enjoyment of 2.0 (very enjoyable), while those probably exposed reported an average enjoyment level of 2.4 (mid way between very and extremely enjoyable).

6.3 Relationship between Annoyance and Duration of Visit Prior to Interview

Amount of time spent in the wilderness prior to interview can also serve as a substitute for overflight exposure, since exposure increases with duration of visit. The correlation between duration of visit prior to interview in Golden Trout Wilderness and annoyance due to aircraft noise, $r_{(182)} = .22, p < .004$[14], indicated that only about 5% of the variance in annoyance is predictable from amount of time in the wilderness prior to interview. For Cohutta Wilderness, only daylight hours contributed to the measure of time in the wilderness, since few visitors remained overnight and because fewer overflights occurred during late night hours. The correlation in Cohutta Wilderness between duration of visit and annoyance, $r_{(341)} = .17, p < .004$, indicated that only about 3% of the variance in annoyance was predictable from this crude measure of exposure. No statistically reliable relationship between time in the wilderness and annoyance due to aircraft noise was observed in the Superstition Wilderness.

Correlations between duration of wilderness visit and enjoyment of visit were also

[14]Because of the large number of correlations computed to investigate dosage-effect relationships, each is tested at $\alpha = .004$ to maintain a Type I error rate less than 5%.

investigated to determine whether this substitute for exposure might simply reflect general dissatisfaction as a function of length of stay. These correlations did not reliably differ from zero in any of the wildernesses. Substantial correlations were observed between duration of wilderness visit and number of aircraft noticed: e.g., $r_{(183)} = .62, p < .004$ for Golden Trout Wilderness. As expected, correlations were lower in the other wildernesses, but still reliable at the .004 level of significance: $r_{(390)} = .41$ for Superstition Wilderness and $r_{(341)} = .30$ for Cohutta Wilderness.

6.4 Relationship between Annoyance and Number of Aircraft Noticed

Correlations between annoyance due to noise and sight of aircraft and number of aircraft noticed (of each type and all types considered together) are shown in Table G-7 for visitors who noticed aircraft. No relationship accounted for even 10% of the variance in annoyance due to aircraft noise. Moreover, none of the relationships between number of aircraft noticed and visual annoyance was statistically reliable. Corresponding correlations among all visitors, including those who noticed no aircraft, are shown in Table G-8. These correlations were also modest, with the strongest relationship accounting for 16% of the variance in annoyance due to aircraft noise.

7. Conclusions, Limitations and Recommendations

As discussed in greater detail in Appendix B, generalization of inferences drawn from this study to other wildernesses must be made with care because of the purposive selection of study sites. Generalizability is also limited by the uniqueness of some wildernesses. Finally, since some of the analyses were conducted on combined data from three wildernesses, not all results apply equally to each wilderness.

It should also be noted that the three wildernesses were chosen specifically for their relatively high expected levels of aircraft overflight exposure. It is thus possible that these results reflect a level of impact on visitors that is greater than that produced system-wide.

On the other hand, it is also conceivable that interviewing in wildernesses with relatively high visitor use might have lead to underestimation of overflight impacts. For example, it is possible that high visitor density might have lessened the salience of aircraft noise as an irritant to visitors. In the current study, Golden Trout Wilderness had the fewest visitors spread over the greatest area, but was the one in which visitors reported the greatest annoyance due to the sound of aircraft. Golden Trout was also the wilderness with the highest noise levels from individual aircraft.

7.1 Summary of Principal Findings

As qualified in Section 7.2 and Appendix B, the major findings of the present study of outdoor recreationists' short term reactions to aircraft overflights in three wildernesses may be summarized as follows.[15]

1. Little evidence was found that overflights diminished respondents' overall enjoyment of their wilderness visits, nor their intention to return for additional visits. (See Hypothesis 1 of Section 2.3 and analyses in Sections 4.2.3, 4.2.5, and 6.2.)

2. The most significant impact of aircraft overflights on respondents was associated with the noise exposure they create. Respondents were more strongly annoyed by aircraft noise (25% annoyed to any degree in the worst

[15]At the end of each finding a reference is provided for the hypothesis to which the finding relates, and for the section(s) of the report which support and further explain or qualify the finding.

case) than by the visibility of aircraft or their condensation trails (16% in the worst case). (See Hypothesis 2 of Section 2.3 and analyses in Sections 4.1, and 4.2.1.)

3. Aircraft overflights of the Cohutta Wilderness were audible to all respondents, but less than half of the respondents (48%) reported noticing aircraft during their visits. It is not possible to determine whether visitors to the Golden Trout and Superstition Wildernesses were actually exposed to aircraft noise, due to the nature of the place-oriented noise measurements and the types of flight operations in the study areas. (See Hypothesis 3 of Section 2.3 and analyses in Section 4.1).

4. The majority of respondents were not annoyed by noise of overflights (75-92%) among the three wildernesses studied. A minority was slightly or moderately annoyed by noise of aircraft (7-12%), and a smaller minority (1-12%) was highly annoyed by noise of aircraft overflights. (See Hypothesis 4 of Section 2.3 and analyses in Section 4.1.)

5. Although overflights annoyed some respondents, other aspects of wilderness visits, such as inadequate trail maintenance, crowding, insects and weather were much more frequently cited as the least liked feature of visits. Fewer than 1% of the respondents in the three wildernesses spontaneously mentioned aircraft noise or other aircraft-related issues as aspects of their visits that they liked least. (See Hypothesis 5 of Section 2.3 and analyses in Section 4.1).

6. The prevalence of aircraft noise-induced annoyance among respondents was predictable from physical measurements of noise exposure, despite the imprecision of the physical measures. (See Hypothesis 7 of Section 2.3 and analyses in Chapter 5 and Section 6.1).

7. Reactions to overflights were better predicted from imprecise physical measures of noise exposure (approximate $r = .80$) than from self-reports of numbers of aircraft noticed (maximum $r = .30$). (See Hypotheses 8 and 9 of Section 2.3 and analyses in Sections 6.1 and 6.4).

8. A theory-based interpretation of the reactions of respondents to aircraft noise exposure in three wilderness settings suggests that they may be approximately 10 dB less tolerant of noise than in residential settings. (See Hypothesis 10 of Section 2.3 and analyses in Chapter 5).

9. Aircraft which typically produce greater noise levels (low flying jets and helicopters--usually military aircraft) were reported to be more annoying than small propeller driven aircraft and high altitude jet transports. (See Hypothesis 11 of Section 2.3 and analyses in Section 4.2.4).

10. Duration of visit was not strongly related to noise-induced annoyance ($r = 0$ to .22). (See Hypothesis 12 of Section 2.3 and analyses in Section 6.3).

11. Most visitors highly enjoyed their visits, intended to return, and did not report the presence of aircraft as the least liked aspect of the wilderness visited. Thus, analyses of relationships among these variables was precluded. (See Hypotheses 6 and 13 of Section 2.3 and analyses in Sections 4.1, 4.2.3, and 4.2.5).

12. Noticeability of aircraft and annoyance produced by them were found to be unrelated to the type of activity wilderness recreationists were engaged in at time of exposure to aircraft noise. (See Hypothesis 14 of Section 2.3 and analyses in Sections 4.2.2 and 4.2.6.)

13. Demographic and other nonacoustic variables, including group size, number of previous visits, age, sex, overall enjoyment, etc., did not account for statistically significant amounts of variance in reactions of respondents to overflights. (See Hypothesis 15 of Section 2.3 and analyses in Sections 4.1 and 4.2.7).

7.2 Limitations and Recommendations for Further Study

7.2.1 External Validity

Generalizability of the current findings to other wildernesses within the Forest Service Wilderness Preservation System is limited. While the sites selected for this study are believed to be as meaningful a subset as any three that might have been selected, any study limited to three sites suffers limited external validity. The obvious remedy is a study incorporating far more wildernesses, randomly selected from strata constructed to represent all wilderness and visitor characteristics of interest. Such a study is not feasible without more cost-effective methods for measuring both dose and visitor response data. Further, the number of stratification criteria is limited by the size of the entire population of wildernesses (approximately 350).

7.2.2 Modification of Data Collection

No precise measurement of noise doses experienced by visitors was affordable in the current study. As the independent variable of central interest, visitors' noise exposure should be estimated with as much precision as is affordable in future studies. Place measurements in large wildernesses do not necessarily reflect noise exposure experienced by mobile visitors who may pay scant attention to their precise locations at specific times during sometimes lengthy visits. While it might be possible to devise questionnaire items

which allow visitors to reconstruct their visits, it would be unwise to rely on measures so dependent on visitor recall and ex post facto reconstruction task. Place measurements are most useful at sites of limited extent (such as vista points) where all visitors present at a given time experience very similar exposure.

Dosimetric devices which automatically measure personal exposure in real time merit consideration in future studies, as do automated global positioning system instruments. Detailed postdiction of exposure through geoinformation systems may also produce useful noise exposure estimates in some situations. Other methods of measuring real time exposure, such as direct observation of visits, are less likely to improve on wide area measurements. Attention must also be paid to quantifying the relationship between overflight noise, the self-noise of outdoor recreationists engaging in various activities, and indigenous sound levels.

7.2.3 Modification of Survey Instrument

Other than the wording of the question regarding location, experience with the current questionnaire suggests no major revisions for future interviewing. Concern that the filter question about noticing aircraft might have eliminated from further questioning some respondents who heard but did not see aircraft can be alleviated by expanding the item to indicate that a positive response is appropriate for aircraft seen or heard.

A checklist is an alternative approach to evaluating the relative salience of aircraft overflights to visitors. The list would include aircraft noise as one item which respondents could select as affecting their visits. This approach would ensure that all respondents considered aircraft overflights to have been part of their visit. However, the particular list in which aircraft is embedded can create biases, since any item in the list is emphasized while any item left out is de-emphasized. The longer the list, the less prominent any one item becomes. Such biases are avoided by an open-ended question about aspects of the visit liked least.

7.2.4 Further Statistical Analysis

No additional analyses of the current data set are recommended. The imprecision of noise exposure measurements precludes estimation of a noise dosage for each respondent, a procedure that would better allow inference of dosage-response relationships between noise exposure and annoyance. Inference of dosage-response relationships should nonetheless remain a basic goal of future studies conducted by other means.

Acknowledgments

The authors are grateful to Mr. William Diesman of the USDA Forest Service Tule River Ranger District for assistance during the site visit to the Golden Trout Wilderness, to Messrs. William Black, Robert Carr, and John Jones for assistance during the site visit to Cohutta Wilderness, and to Mr. Gregory Hansen of the USDA Forest Service Mesa Ranger District for his assistance during the site visit to Superstition Wilderness. Ms. Kelly Parker assisted in the data analysis. Portions of this report paraphrase that of BBN Report 7286.

The authors also thank Dr. Lawrence Hartmann and Messrs. William Makel and Robin Harrison of the USDA Forest Service for the suggestions and guidance they provided during the course of this project.

Glossary

1 Definitions of Key Terms

Since a number of terms used in this report have both colloquial and technical meanings, it is important to avoid burdening technical uses of these terms with excess baggage. The following clarifications are provided to minimize confusion between colloquial and technical meanings of audibility-related and other terms, and to avoid imputation of political, economic, or other motives to technical uses of these terms.

The term "signal" is a technical one applied to any physically describable, information-bearing event. A meaningful sound, for example, can be considered as an acoustic signal. The term "stimulus" is sometimes used loosely in psychological jargon as a synonym for "signal". Its use is deprecated for present purposes, because the effective "stimulus" produced by a signal can only rarely be described in physical terms.

"Sound" is a term used colloquially to describe any audible signal. The technical definition of sound which corresponds most closely to this colloquial use is "a propagating fluctuation in atmospheric pressure". The latter definition intentionally omits any reference to the origin of the pressure fluctuation, its audibility by any observer, anyone's opinions about the pressure fluctuation, any political or economic consequences of the existence of the pressure fluctuation, etc.

"Noise" is a term used colloquially to characterize "unwanted" sound. This characterization obscures by whom and for what reasons a sound is unwanted. A more forthright definition of the term as it is used colloquially is "sound that somebody considers too inconvenient or too expensive to control". The non-evaluative and neutral technical definition of noise is "a signal lacking information of interest".

The terms "ambient noise" and "background noise" are used to characterize sound created by ongoing continuous processes in any measurement environment, in order to distinguish such sound from that produced by specifiable sources of interest. The word "noise" is used in its non-evaluative, technical sense in the terms "ambient noise" and "background noise". Inclusion of the word "noise" in the phrase "ambient noise" carries no implications about the desirability or undesirability of sound energy. The technical terms ambient noise and background noise are sometimes used roughly synonymously with the legislative term "natural quiet" when applied to sounds of indigenous origin in unpopulated areas.

In colloquial use, "audibility" is the ability of a human observer to hear a sound, either in the presence or absence of other sounds. In acoustic terms, audibility is a continuous scalar quantity calculated as the bandwidth-corrected quotient of the means of two distributions of sound levels: one referred to as the distribution of noise alone, and one referred to as the distribution of signal plus noise. Audibility is conventionally expressed in the scalar (dimensionless) unit d'.

It follows from the above definitions that use of the technical term "ambient noise distribution" to describe the distribution of sounds of indigenous origin in a wilderness setting does not imply any pejorative value judgments about the processes generating such sounds or their desirability for any purpose. Likewise, technical descriptions of the acoustic emissions of an aircraft overflying a wilderness as a "signal" does not imply any favorable value judgments about the desirability or appropriateness of such sounds.

2 Definitions of Other Terms

The terms in the remainder of this Glossary are defined in the sense in which they are used in the body and appendices of this report, not necessarily in their broadest sense.

α: Type I error rate (q.v.).

β: Symbol for standardized regression coefficient (q.v.)

χ^2: A family of statistical tests evaluating the either relationships among categorical variables or the goodness-of-fit of a model to observed data.

ϕ: Index of association between two categorical variables.

η^2: Proportion of variance in the dependent variable accounted for by an independent variable or interaction among independent variables.

μPa: Abbreviation for microPascal, a millionth of a Newton per square meter. μPa is the conventional reference pressure for measurement of airborne acoustic signals, and is assumed for all units in decimal notation in this document unless otherwise noted.

AGL: Abbreviation for "above ground level", one of two common (see also MSL).

A-level: Sound level expressed in units to which A-weighting has been applied (q.v.).

Analysis of variance: A statistical technique for assessing differences among groups (classified on one or more independent variables) on a continuous (dependent) variable.

Audibility: Bandwidth-adjusted signal to noise ratio.

A-weighted sound level: A single number index of a broadband sound that has been subjected to the A-weighting network (q.v.).

A-weighting network: A frequency-equalizing function intended to approximate the sensitivity of human hearing to sounds of moderate sound pressure level.

***B*:** Symbol for regression coefficient (q.v.).

Between-subjects: In analysis of variance, a research design in which different cases are in each category of the independent variable(s).

Covariate: Variable for which statistical control or adjustment has been made.

d': Pronounced d-prime, a continuous scalar quantity calculated as the bandwidth-corrected quotient of the means of two distributions of sound levels, the distribution of signal plus noise and the distribution of noise alone.

D^*: An expression of the average noise level in a community necessary to produce reports of a consequential degree of annoyance (inferred from DNL and the proportion of the population reporting high annoyance).

dB: Abbreviation for decibel.

dBA: Abbreviation for A-weighted sound level; use of alternative symbol, dB(A), is deprecated.

dB/s: Symbolic representation of decibels per second.

decibel: The unit for expressing the product of a constant (usually 10 or 20) and the logarithm to the base 10 of the ratio of a quantity of interest to a reference quantity.

Dosage-response relationship: A plot of the relationship between some measure of exposure (dose) plotted on the abscissa (horizontal axis) and some measure of behavior, attitude, or disease state (response) plotted on the ordinate (vertical axis).

***F*:** A statistical test of the ratio of systematic variance (variability associated with

known sources) to error variance (variability due unknown or unmeasured sources). Subscripted values in parentheses are degrees of freedom associated with the two sources of variance, and are based on numbers of groups, measures, and cases.

Goodness-of-fit: A measure of how well a model fits observed data, evaluated as χ^2, in which lower values denote better fit.

Interaction: In analysis of variance, modification of the effect of one independent variable by one or more other independent variables.

Logistic Regression: A statistical technique for assessing prediction of a categorical variable by a set of variables that may be continuous or categorical, or mixed.

Logit Analysis: A form of multiway frequency analysis (q.v.) in which one categorical variable is considered the dependent variable while the remaining categorical variables are considered predictors.

Loglinear multiway frequency analysis: A statistical technique for assessing associations among categorical variables, in which a linear model of the logarithm of expected cell frequencies is formed.

Main effect: In analysis of variance, differences in means among levels of one independent variable, ignoring or adjusting for all other independent variables.

Multivariate analysis of variance: A statistical technique for assessing differences among groups (classified on one or more dimensions) on a set of continuous (dependent) variables.

MOA: Military Operating Area.

Multiple-correlation analysis: (see Multiple regression analysis)

Multiple regression analysis: A statistical technique for assessing the prediction of one continuous or dichotomous variable (the dependent variable) from a set of other continuous or dichotomous variables (the independent variables).

MSL: Abbreviation for "mean sea level", one of two common references for specification of aircraft altitude (see also AGL).

MTR: Military Training Route.

nm: Nautical mile (6076 feet)

NPS: U.S. Department of Interior National Park Service.

p <: The probability that the finding is due to chance variation in the sample rather than some systematic relationship in the population is less than some quantity, such as 5%.

Prevalence: Number of people sharing an attitude at any defined point or period of time.

r: Index of bivariate correlation, the association between two continuous variables. The subscripted value in parentheses represents the degrees of freedom, calculated as the number of cases minus the number of measures (2).

R: Index of multiple correlation, the Pearson product-moment correlation between observed scores on the dependent variable and those predicted by multiple regression analysis.

Regression analysis: A statistical technique for assessing the prediction of one variable (the dependent variable) from another (the independent variable) as well as the correlation between the two variables.

Regression coefficient: A weight applied to an independent (predictor) variable to produce optimum prediction of a dependent (criterion) variable). See standardized regression coefficient.

RVD: Abbreviation for recreation visitor day.

Signal to Noise Ratio: The relative level (in dB) of some characteristic of a signal (e.g., its rms value) and the corresponding characteristic of a distribution of noise.

Sound pressure: A fluctuating pressure superimposed on the static pressure by the presence of sound.

Sound pressure level: In decibels, 20 times the logarithm to the base 10 of the ratio of the time-period, root-mean-square sound pressure, in a stated frequency band, to the standard reference sound pressure--20 micropascals (20 μPa).

Standard multiple regression analysis: A form of multiple regression analysis in which all independent variables enter the prediction equation simultaneously, and the contribution of each independent variable to prediction is assessed after statistically controlling for all other independent variables.

Standardized regression coefficient: A regression coefficient which has been standardized to a dimensionless unit, often referred to as a β weight.

Type I error: Declaring a relationship among variables to exist in the population when in fact it does not.

Type II error: Failing to declare a relationship among variables to exist in the population when in fact it does.

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Appendix A
Questionnaire for On-site Administration

This Appendix contains two versions (differing only in minor wording changes) of the questionnaire used for face-to-face administration to respondents. The trail head version was used as an exit questionnaire whereas the trail camp version was used as an in-wilderness questionnaire. The questionnaire is organized into three formats and appears in this Appendix accordingly: (1) a coding form (one for each version of the questionnaire) which displays both the questions and responses, and was used for entry into the interview database, (2) an interviewer form (one for each version of the questionnaire), which supplies questions for administering the questionnaire and other interviewer instructions and (3) an interview answer sheet (identical for the two questionnaire versions), which was completed by each group member during the interview.

Shaded areas on the coding forms contain the actual wording of items administered to respondents. Instructions to interviewers are rendered in italics. The category labeled "Refused" is reserved for explicit refusal of respondents to reply to a given item. "Not Ascertained" is recorded for items which are inapplicable because of questionnaire branching, or items which are not asked of respondents due to initial refusals.

A.1 Trail Head Version of Questionnaire

The questionnaire reproduced below was administered to recreationists concluding their wilderness visits. The coding form is followed by the interviewer form.

PRIVACY ACT STATEMENT:

Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be associated with you or anyone in your group.

Information to be Recorded Immediately after Interview	
Information	**Code**
Wilderness Code	
Interviewer Code	
Date of Interview	/ /
Time of Interview (24 hour format)	
Interview Location	
Number of People in Party	
Age Group	☐ 19 or younger ☐ 20-39 ☐ 40-59 ☐ 60 or older
Sex	☐ Male ☐ Female

QUESTION 1: WHAT DATE AND TIME DID YOU START THIS VISIT TO THE <place name> WILDERNESS?	
Verbatim:	
Codes	**Response**
Date	/ /
Time (24 hour format)	
70	Don't Know
80	Refused
90	Not Ascertained

Public reporting burden for this collection of information is estimated to average [illegible] minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Department of Agriculture, Clearance Officer, OIRM, Room [illegible], Washington, D.C. [illegible]; and to the Office of Management and Budget, Paperwork Reduction Project (OMB# [illegible]), Washington D.C. [illegible].

OMB Approval #: [illegible] Expires [illegible] [illegible]

QUESTION 2: WAS THIS YOUR FIRST VISIT TO THE <place name> WILDERNESS?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If YES, ask item 3 next. If NO, ask:	
QUESTION 2A: About how many times have you visited the <place name> Wilderness in the past 5 years?	
Codes	**Response**
0	Last visit was more than five years ago
☐1 ☐2 ☐3 ☐4 ☐5 ☐6	1 to 6 times
7	7 or more times
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 3: DO YOU PLAN TO VISIT THE <place name> WILDERNESS AGAIN WITHIN THE NEXT 5 YEARS?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If YES, ask item 4 next. If NO, ask:	
QUESTION 3A: Why don't you plan to visit the <place name> Wilderness again?	
Verbatim:	
Codes	**Response**
1	Combination of Aircraft and Non-Aircraft Related
2	Non-Aircraft Related
3	Aircraft Related
4	Didn't Intend To
5	Not Planning to Visit Within the Next Five Years
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 4: DID YOU ENJOY YOUR VISIT?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, ask Item 5 next. If YES, ask:	

QUESTION 4A: Would you say that your visit was slightly enjoyable, moderately enjoyable, very enjoyable or extremely enjoyable?	
Codes	**Response**
1	Slightly
2	Moderately
3	Very
4	Extremely
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 5: WHAT DID YOU LIKE MOST ABOUT YOUR VISIT?	
Verbatim:	
Codes	**Response**
0	Nothing Liked
1	Peace and Quiet
2	Scenery
3	Being Alone
4	Having Fun
5	Being with Friends
6	Activity-Related
7	Relaxation
8	Other, Non-Aircraft Related
9	Other, Aircraft Related
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 6: WHAT DID YOU LIKE LEAST ABOUT YOUR VISIT?	
Verbatim:	
Codes	**Response**
0	Nothing Disliked
1	Inadequate Trail Maintenance
2	Crowding
3	Weather
4	Aircraft Noise
5	Other Noise
6	Insects
7	Other, Aircraft Related
8	Other, Non-Aircraft Related
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 7: DID YOU <each activity name> DURING THIS VISIT?				
Activity	**Site No.**	**Date**	**Start Time**	**End Time**
Been Horseback Riding				
Gone Hunting				
Gone Rock Climbing				
Other: _____ _____ _____				
Don't Know				
Refused				
Not Ascertained				

QUESTION 8: DID YOU NOTICE ANY AIRCRAFT DURING YOUR VISIT?	
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, End Interview. *If YES, Ask Item 9 Next.*	

QUESTION 9: WHAT TYPE(S) OF AIRCRAFT DO YOU RECALL NOTICING?
Verbatim:

QUESTION 9A: How many <aircraft type> did you notice?					
Codes	Response	Number Noticed	Don't Know	Refused	Not Ascertained
1	High Flying Jets				
2	Helicopters				
3	Low Flying Jets				
4	Small Private Airplanes				
5	Other Aircraft				

QUESTION 10: WERE YOU BOTHERED OR ANNOYED BY AIRCRAFT NOISE DURING YOUR VISIT?	
Codes	**Response**
0	No (Not at all)
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, ask item 11. If YES, ask:	
QUESTION 10A: Were you slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by aircraft noise?	
Codes	**Response**
1	Slightly Annoyed
2	Moderately Annoyed
3	Very Annoyed
4	Extremely Annoyed
70	Don't Know
80	Refused
90	Not Ascertained
If more than 1 type of aircraft was noticed, then ask:	
QUESTION 10B: Which type of aircraft was most annoying to hear?	
Verbatim:	

QUESTION 11: WERE YOU BOTHERED OR ANNOYED BY SEEING AIRCRAFT DURING YOUR VISIT?	
Codes	**Response**
0	No (Not at all)
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, conclude interview. If YES, ask:	
QUESTION 11A: Were you slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by seeing aircraft?	
Codes	**Response**
1	Slightly Annoyed
2	Moderately Annoyed
3	Very Annoyed
4	Extremely Annoyed
70	Don't Know
80	Refused
90	Not Ascertained
If more than 1 type of aircraft was noticed, then ask:	
QUESTION 11B: Which type of aircraft was most annoying to see?	
Verbatim:	

Minimal Greeting: Hello, I'm an interviewer helping with a Forest Service survey of visitors to the <place name> Wilderness. We would greatly appreciate a little of your time to answer a few questions. *(Hand out clipboards and make sure that respondents don't page through the questionnaire or talk among themselves.)*

QUESTION 1: WHAT DATE AND TIME DID YOU START THIS VISIT TO THE <place name> WILDERNESS? (pg.1)

QUESTION 2: WAS THIS YOUR FIRST VISIT TO THE <place name> WILDERNESS? (pg.2)

If NO, ask:

QUESTION 2A: About how many times have you visited the <place name> Wilderness in the past 5 years? (pg.2)

QUESTION 3: DO YOU PLAN TO VISIT THE <place name> WILDERNESS AGAIN WITHIN THE NEXT 5 YEARS? (pg.3)

If NO, ask:

QUESTION 3A: Why don't you plan to visit the <place name> Wilderness again? (pg.3)

QUESTION 4: DID YOU ENJOY YOUR VISIT? (Bottom, pg.3)

If YES, ask:

QUESTION 4A: Would you say that your visit was slightly enjoyable, moderately enjoyable, very enjoyable or extremely enjoyable? (pg.3)

QUESTION 5: WHAT DID YOU LIKE MOST ABOUT YOUR VISIT? *(Please write the one aspect of your visit you liked the most.)* (pg.4)

QUESTION 6: WHAT DID YOU LIKE LEAST ABOUT YOUR VISIT? *(Please write the one aspect of your visit you liked the least.)* (Bottom, pg.4)

QUESTION 7: DID YOU <each activity name> DURING THIS VISIT? (Map, pg.5)
(On page 5 you'll find a map. We are interested in what you've done during the visit in the shaded areas of the map. I'll mention several activities. If you've done any of these, please mark with an X where you've done them. Also please write the name of the activity, the date and the approximate start and end times.

The activities of interest are: HORSEBACK RIDING (and other stock-related activities), SWIMMING, BOATING, FISHING, HUNTING, and ROCK CLIMBING. [If the above activities have not been done, probe for HIKING, PICNICKING, and CAMPING.])

PRIVACY ACT STATEMENT: Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be associated with you or anyone in your group.

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QUESTION 8: DID YOU NOTICE ANY AIRCRAFT DURING YOUR VISIT? (pg.6)
If NO or DON'T KNOW, ask the respondents to put their clipboards down for a moment.
If YES, ask :

QUESTION 9: WHAT TYPE(S) OF AIRCRAFT DO YOU RECALL NOTICING? *(Do not probe for any particular aircraft type.)* (Bottom, pg.6)

QUESTION 9A: How many <aircraft type> did you notice? (pg.7)
(Ask for HIGH FLYING JETS, HELICOPTERS, LOW FLYING JETS, and SMALL PRIVATE AIRPLANES. Write zero if you did not notice any aircraft.)

QUESTION 10: WERE YOU BOTHERED OR ANNOYED BY AIRCRAFT NOISE DURING YOUR VISIT? (pg.8)

If YES, ask:

QUESTION 10A: Were you slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by aircraft noise? (pg.8)

If you noticed more than one type of aircraft:

QUESTION 10B: Which type of aircraft was most annoying to hear? (Bottom, pg.8)

QUESTION 11: WERE YOU BOTHERED OR ANNOYED BY SEEING AIRCRAFT DURING YOUR VISIT? (pg.9)

If NO or DON'T KNOW, ask respondents to put their clipboards down for a moment.
If YES, ask:

QUESTION 11A: Were you slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by seeing aircraft? (pg.9)

If you noticed more than one type of aircraft:

QUESTION 11B: Which type of aircraft was most annoying to see? (Bottom, pg.9)

BEFORE CONCLUDING: Please go to the last page of the interview answer booklet and fill out the information there. (pg.10)

Closing: Thank you for your participation in this study. Your opinions will help manage wilderness resources. I would like to ask your cooperation in not discussing this interview with other people you may meet during the remainder of your visit.

A.2 Trail Camp Version of Questionnaire

The questionnaire reproduced below was administered to recreationists during their wilderness visits. The coding form is followed by the interviewer form.

PRIVACY ACT STATEMENT:

Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be associated with you or anyone in your group.

Information to be Recorded Immediately after Interview	
Information	**Code**
Wilderness Code	
Interviewer Code	
Date of Interview	/ /
Time of Interview (24 hour format)	
Interview Location	
Number of People in Party	
Age Group	☐ 19 or younger ☐ 40-59 ☐ 20-39 ☐ 60 or older
Sex	☐ Male ☐ Female

QUESTION 1: WHAT DATE AND TIME DID YOU START THIS VISIT TO THE <place name> WILDERNESS?	
Verbatim:	
Codes	**Response**
Date	/ /
Time (24 hour format)	
70	Don't Know
80	Refused
90	Not Ascertained

Public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Department of Agriculture, Clearance Officer, OIRM, Room 404-W, Washington, D.C. 20250, and to the Office of Management and Budget, Paperwork Reduction Project (OMB# 0596-0113), Washington D.C. 20503.

OMB Approval #: 0596-0113 Expires: 03/31/97

QUESTION 2: IS THIS YOUR FIRST VISIT TO THE <place name> WILDERNESS?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If YES, ask Item 3 next. If NO, ask:	

QUESTION 2A: About how many times have you visited the <place name> Wilderness in the past 5 years?	
Codes	**Response**
0	Last visit was more than five years ago
☐1 ☐2 ☐3 ☐4 ☐5 ☐6	1 to 6 times
7	7 or more times
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 3: DO YOU PLAN TO VISIT THE <place name> WILDERNESS AGAIN WITHIN THE NEXT 5 YEARS?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If YES, ask Item 4 next. If NO, ask:	

QUESTION 3A: Why don't you plan to visit the <place name> Wilderness again?	
Verbatim:	
Codes	**Response**
1	Combination of Aircraft and Non-Aircraft Related
2	Non-Aircraft Related
3	Aircraft Related
4	Didn't Intend To
5	Not Planning to Visit Within the Next Five Years
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 4: HAVE YOU ENJOYED YOUR VISIT SO FAR?	
Codes	**Response**
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, ask Item 5 next. If YES, ask:	

QUESTION 4A: Would you say that your visit has been slightly enjoyable, moderately enjoyable, very enjoyable or extremely enjoyable?	
Codes	**Response**
1	Slightly
2	Moderately
3	Very
4	Extremely
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 5: WHAT HAVE YOU LIKED MOST ABOUT YOUR VISIT SO FAR?	
Verbatim:	
Codes	**Response**
0	Nothing Liked
1	Peace and Quiet
2	Scenery
3	Being Alone
4	Having Fun
5	Being with Friends
6	Activity-Related
7	Relaxation
8	Other, Non-Aircraft Related
9	Other, Aircraft Related
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 6: WHAT HAVE YOU LIKED LEAST ABOUT YOUR VISIT SO FAR?	
Verbatim:	
Codes	**Response**
0	Nothing Disliked
1	Inadequate Trail Maintenance
2	Crowding
3	Weather
4	Aircraft Noise
5	Other Noise
6	Insects
7	Other, Aircraft Related
8	Other, Non-Aircraft Related
70	Don't Know
80	Refused
90	Not Ascertained

QUESTION 7: HAVE YOU <each activity name> DURING THIS VISIT?				
Activity	Site No.	Date	Start Time	End Time
Been Horseback Riding				
Gone Hunting				
Gone Rock Climbing				
Other: _____ _____ _____				
Don't Know				
Refused				
Not Ascertained				

QUESTION 8: HAVE YOU NOTICED ANY AIRCRAFT DURING YOUR VISIT?	
0	No
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, End Interview. *If YES, Ask Item 9 Next.*	

QUESTION 9: WHAT TYPE(S) OF AIRCRAFT DO YOU RECALL NOTICING?
Verbatim:

QUESTION 9A: How many <aircraft type> did you notice?					
Codes	Response	Number Noticed	Don't Know	Refused	Not Ascertained
1	High Flying Jets				
2	Helicopters				
3	Low Flying Jets				
4	Small Private Airplanes				
5	Other Aircraft				

QUESTION 10: HAVE YOU BEEN BOTHERED OR ANNOYED BY AIRCRAFT NOISE DURING YOUR VISIT?	
Codes	**Response**
0	No (Not at all)
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, ask item 11. If YES, ask:	
QUESTION 10A: Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by aircraft noise?	
Codes	**Response**
1	Slightly Annoyed
2	Moderately Annoyed
3	Very Annoyed
4	Extremely Annoyed
70	Don't Know
80	Refused
90	Not Ascertained
If more than 1 type of aircraft was noticed, then ask:	
QUESTION 10B: Which type of aircraft was most annoying to hear?	
Verbatim:	

QUESTION 11: HAVE YOU BEEN BOTHERED OR ANNOYED BY SEEING AIRCRAFT DURING YOUR VISIT?	
Codes	**Response**
0	No (Not at all)
1	Yes
70	Don't Know
80	Refused
90	Not Ascertained
If NO, conclude interview. If YES, ask:	
QUESTION 11A: Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by seeing aircraft?	
Codes	**Response**
1	Slightly Annoyed
2	Moderately Annoyed
3	Very Annoyed
4	Extremely Annoyed
70	Don't Know
80	Refused
90	Not Ascertained
If more than 1 type of aircraft was noticed, then ask:	
QUESTION 11B: Which type of aircraft was most annoying to see?	
Verbatim:	

Minimal Greeting: Hello, I'm an interviewer helping with a Forest Service survey of visitors to the <place name> Wilderness. We would greatly appreciate a little of your time to answer a few questions. *(Hand out clipboards and make sure that respondents don't page through the questionnaire or talk among themselves.)*

QUESTION 1: WHAT DATE AND TIME DID YOU START THIS VISIT TO THE <place name> WILDERNESS? (pg.1)

QUESTION 2: IS THIS YOUR FIRST VISIT TO THE <place name> WILDERNESS? (pg.2)

If NO, ask:

QUESTION 2A: About how many times have you visited the <place name> Wilderness in the past 5 years? (pg.2)

QUESTION 3: DO YOU PLAN TO VISIT THE <place name> WILDERNESS AGAIN WITHIN THE NEXT 5 YEARS? (pg.3)

If NO, ask:

QUESTION 3A: Why don't you plan to visit the <place name> Wilderness again? (pg.3)

QUESTION 4: HAVE YOU ENJOYED YOUR VISIT SO FAR? (Bottom, pg.3)

If YES, ask:

QUESTION 4A: Would you say that your visit has been slightly enjoyable, moderately enjoyable, very enjoyable or extremely enjoyable? (pg.3)

QUESTION 5: WHAT HAVE YOU LIKED MOST ABOUT YOUR VISIT SO FAR? *(Please write the one aspect of your visit you have liked the most.)* (pg.4)

QUESTION 6: WHAT HAVE YOU LIKED LEAST ABOUT YOUR VISIT SO FAR? *(Please write the one aspect of your visit you have liked the least.)* (Bottom, pg.4)

QUESTION 7: HAVE YOU <each activity name> DURING THIS VISIT? (Map, pg.5)
(On page 5 you'll find a map. We are interested in what you've done during the visit in the shaded areas of the map. I'll mention several activities. If you've done any of these, please mark with an X where you've done them. Also please write the name of the activity, the date and the approximate start and end times.

The activities of interest are: HORSEBACK RIDING (and other stock-related activities), SWIMMING, BOATING, FISHING, HUNTING, and ROCK CLIMBING. [If the above activities have not been done, probe for HIKING, PICNICKING, and CAMPING.])

PRIVACY ACT STATEMENT: Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be connected with you or anyone in your group.

OMB Approval #: 0596-0132 Expires: 06/31/01

QUESTION 8: HAVE YOU NOTICED ANY AIRCRAFT DURING YOUR VISIT? (pg.6)
If NO or DON'T KNOW, ask the respondents to put their clipboards down for a moment.
If YES, ask :

QUESTION 9: WHAT TYPE(S) OF AIRCRAFT DO YOU RECALL NOTICING? *(Do not probe for any particular aircraft type.)* (Bottom, pg.6)

QUESTION 9A: How many <aircraft type> did you notice? (pg.7)
(Ask for HIGH FLYING JETS, HELICOPTERS, LOW FLYING JETS, and SMALL PRIVATE AIRPLANES. Write zero if you did not notice any aircraft.)

QUESTION 10: HAVE YOU BEEN BOTHERED OR ANNOYED BY AIRCRAFT NOISE DURING YOUR VISIT? (pg.8)

If YES, ask:

QUESTION 10A: Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by aircraft noise? (pg.8)

If you noticed more than one type of aircraft:

QUESTION 10B: Which type of aircraft was most annoying to hear? (Bottom, pg.8)

QUESTION 11: HAVE YOU BEEN BOTHERED OR ANNOYED BY SEEING AIRCRAFT DURING YOUR VISIT? (pg.9)

If NO or DON'T KNOW, ask respondents to put their clipboards down for a moment.
If YES, ask:

QUESTION 11A: Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by seeing aircraft? (pg.9)

If you noticed more than one type of aircraft:

QUESTION 11B: Which type of aircraft was most annoying to see? (Bottom, pg.9)

BEFORE CONCLUDING: Please go to the last page of the interview answer booklet and fill out the information there. (pg.10)

Closing: Thank you for your participation in this study. Your opinions will help manage wilderness resources. I would like to ask your cooperation in not discussing this interview with other people you may meet during the remainder of your visit.

A.3 Interview Answer Sheets

The interview answer sheets used in group administration of the questionnaire follow.

Interview Answer Sheet

PRIVACY ACT STATEMENT:

Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be associated with you or anyone in your group.

Question 1 (Please write your answer below. The calendar below may help with the date.)

Date____/____/____

Time_____ ☐ AM ☐ PM

NOVEMBER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

OMB Approval #: 0704-0132 Expires: 05/31/91 rev 11/1/90 10/31

Code: Date: Time: Interviewer: Number in Party:

Question 2 (Please check one of the boxes below)		
☐ YES	☐ NO	☐ Don't Know

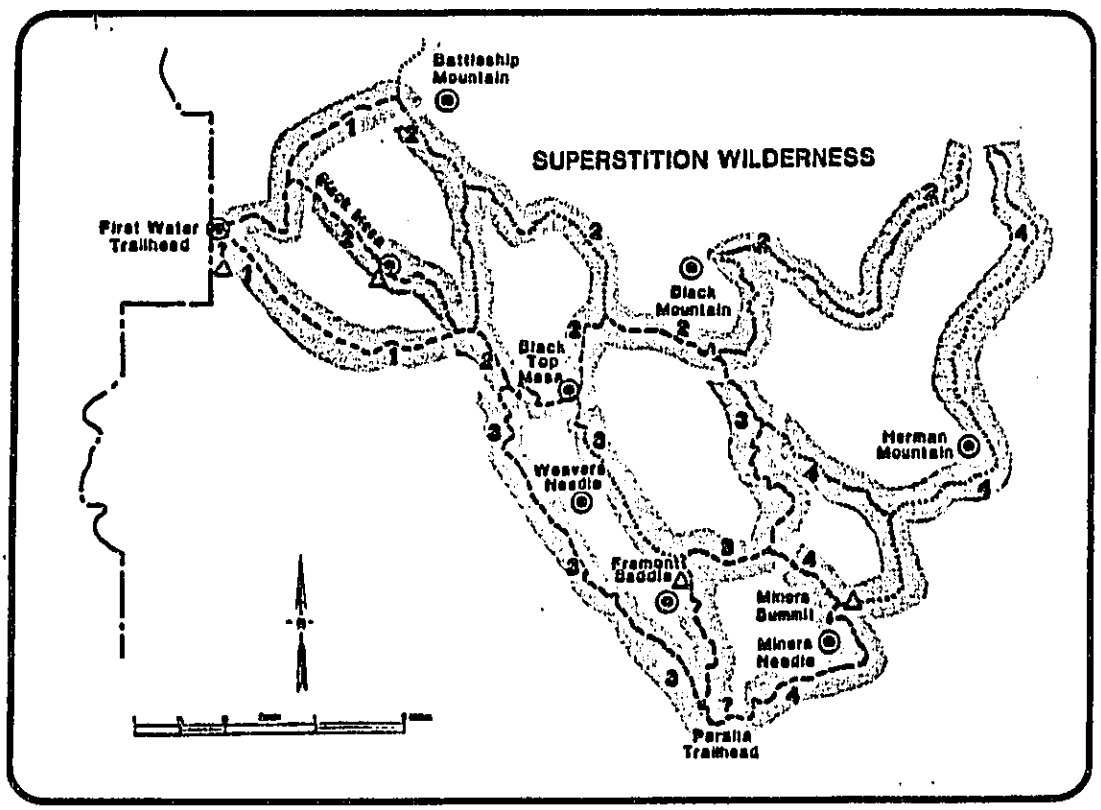
Question 2A (If you checked NO above, please check one of the boxes below)		
☐ 1	☐ 4	☐ 7 or more
☐ 2	☐ 5	☐ Last visit was more than five years ago.
☐ 3	☐ 6	☐ Don't Know

Question 3 (Please check one of the boxes below)
☐ YES ☐ NO ☐ Don't Know
Question 3A (If you checked NO above, please write your answer below)

Question 4 (Please check one of the boxes below)	
☐ YES ☐ NO ☐ Don't Know	
Question 4A (If you checked YES above, please check one of the boxes below)	
☐ Slightly enjoyable	☐ Very enjoyable
☐ Moderately enjoyable	☐ Extremely enjoyable
☐ Don't Know	

Question 5 (Please write your answer below)

Question 6 (Please write your answer below)


SUPERSTITION WILDERNESS
Battleship Mountain
First Water Trailhead
Black Mesa
Black Mountain
Black Top Mesa
Herman Mountain
Weavers Needle
Fremont Saddle
Miners Summit
Miners Needle
Peralta Trailhead

Question 8 (Please check one of the boxes below)		
☐ YES	☐ NO	☐ Don't Know

Question 9 (Please write your answer below)

Question 9A (Please write your answers below)		
Response	Number Noticed	Don't Know
High Flying Jets		
Helicopters		
Low Flying Jets		
Small Private Airplanes		
Other Aircraft		

Question 10 (Please check one of the boxes below)
☐ YES ☐ NO ☐ Don't Know
Question 10A (If you checked YES above, please check one of the boxes below)
☐ Slightly Annoyed ☐ Moderately Annoyed ☐ Very Annoyed ☐ Extremely Annoyed ☐ Don't Know
Question 10B (If you noticed more than one type of aircraft, then please write your answer below)

Question 11 (Please check one of the boxes below)
☐ YES ☐ NO ☐ Don't Know
Question 11A (If you checked YES above, please check one of the boxes below)
☐ Slightly Annoyed ☐ Moderately Annoyed ☐ Very Annoyed ☐ Extremely Annoyed ☐ Don't Know
Question 11B (If you noticed more than one type of aircraft then please write your answer below)

Please complete the following information:	
☐ Male ☐ Female	
☐ 19 or younger ☐ 20-39	☐ 40-59 ☐ 60 or older

Thank you for your time.

Appendix B
Basis for Purposive Selection of Wildernesses

The present study was the first large scale effort to associate objective measures of aircraft noise exposure with outdoor recreationists' responses. The goal of generalization of findings to all wildernesses was therefore not accorded as great a priority as the goal of determining whether such an association could be established at all.[16] Since randomization of site selection is a measure undertaken to enhance generalizability, random selection was not attempted. Randomization was also less than desirable for other reasons:

- Limitation of study to three sites implied that no more than one site from each of three strata be chosen. Random selection of a single site within a stratum serves no useful statistical purpose, since variation within strata cannot be estimated on the basis of a single measurement unit. Thus, useful random selection from three strata would require that at least six sites be visited, a level of effort beyond the scope of the current study.
- Random selection of a single site from each stratum poses a risk of selecting a set of sites with similar levels of natural quiet, ecotypes, activities, and time patterns of visits. Consideration of site characteristics other than those on which stratification is based interferes with random selection. One remedy is to form more strata. This strategy requires that far more sites be selected.

Practical considerations thus dictated a choice of sites based on knowledge of characteristics of individual wildernesses and familiarity with sites offering the greatest likelihood of successful measurement of aircraft overflight noise and visitor responses.

A study of this nature, with interviews conducted on trails expected to produce the greatest numbers of visitors at only three wildernesses, thus lacks full external validity. Since sites could not be chosen to meet all of the characteristics of interest for either the wildernesses or visitor uses, and since random selection of wildernesses or users was not affordable, the results of this study are not fully generalizable to all Forest Service wildernesses. Nevertheless, the current sampling strategy provides as reasonable a sample of wilderness visitors as possible within current constraints. The three sites selected cover the anticipatable range of important differences among wildernesses. This range could not have been achieved by any non-purposive site selection.

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[16]This is a common strategy in exploratory studies. By way of analogy, consider how the first astronauts to land on the moon must have been instructed to collect samples of rocks to return to earth. Their instructions were almost certainly not to close their eyes and select rocks at random, but rather to collect at least one sample of each different kind of rock they encountered.

Appendix C
Interviewer Training Manual

This appendix contains instructions provided to interviewers for conducting onsite interviews, logging aircraft overflights and weather conditions, and operating acoustic monitoring equipment.

C.1 Instructions for Interviewers

C.1.1 Your Job

Your job is to conduct on-site interviews as carefully and as accurately as possible. It is essential that all interviewers follow the same procedures for interviewing so that all respondents are treated identically. Please note that speed is not the major concern. You are expected to work quickly, but never at the expense of accuracy. Always take enough time to make sure that all respondents understand every question.

The interviewing procedures described in this section of the manual are reiterated during training sessions. You may not be able to obtain help concerning this material while you are out in the wilderness; therefore, it is important that you understand these instructions completely before leaving for your interview site.

After each interview, you should carefully code respondents' answers. If you do not have time immediately after the interview (because you are beginning another interview), then enter the interviewer code, date, time, location, and party size information at the bottom of the respondent's Interview Answer Sheet in the spaces provided. You can then complete the Coding Form at another time.

C.1.2 Interviewing Technique

The fundamental principle of interviewing is objectivity. You as the interviewer must not influence the respondents' opinions in any way. From the first interview in the morning until the last interview of the evening, you must speak clearly and courteously, you must appear alert and interested, and you must remember that the respondent is volunteering his or her time to help you.

You must never allow your conversation with a respondent to be anything other than correct and neutral. For instance, do not be short tempered with argumentative respondents; do not reply sarcastically to hostile respondents; do not engage in casual conversation with talkative respondents; do not be impatient with respondents who take a long time to answer questions; and so on. In addition, sharing of answers between respondents within groups should be discouraged.

The questions are worded carefully to avoid suggesting that a particular answer is desired. It is crucial that you pose the questions to the respondents in the same objective manner. You must not permit your own views or those of other respondents to whom you have talked to influence your tone of voice, manner of questioning, or any other aspect of the interview.

Remember that the questions should be asked in a sincere and interested manner. Do not simply read the questionnaire items -- instead, ask the questions as you would in a conversation with an acquaintance. Convey to the respondent (through your attitude) that you are truly concerned about his or her opinion. These points will be discussed further during the training sessions.

C.1.3 Qualifying Respondents

We are interested in the opinions of all visitors who are at least 12 years old and who have not been previously interviewed. If you cannot estimate the age of a child, ask either the child or the parent. Although we are interested in obtaining as many interviews as possible, do not interview a child who seems unable to answer the questions by himself/herself. If you observe (during the interview) that a respondent is unable to answer the questions without extensive help from other group members, note this fact on the questionnaire when the person is finished. Interview only those visitors who are leaving the wilderness. Visitors who are beginning their trips will be interviewed later.

C.1.4 Recording Non-Interview Contacts

If you cannot persuade a visitor (or a group of visitors) to be interviewed, you should record this information on the Non-Interview Contacts Log. Note that a person who refuses to answer one or more items, after agreeing to be interviewed is not in the same category as a person who refuses to be interviewed at all. Instructions for handling refusals that occur after an interview has started are located in the section entitled "Coding the Interview Answer Sheet".

All of the following information should be entered into the Non-Interview Contacts Log:

1. Entry #: Use one entry per person.
2. Date: Date of the attempted interview (DD/MM/YY).
3. Age: Estimate the age of the non-respondent. When recording age you should be precise enough so that someone can easily convert your entry into one of the following categories: 19 and younger, 20-39, 40-59, or 60 and older. Thus, an entry that says "around 40" is not an acceptable entry. Instead, the entry should specify that the respondent is a little under 40, or a little over 40.
4. Sex: Write "M" for male, "F" for female, or "don't know" (if you can't tell the person's gender).
5. Size of group: Record the total group size, including adults who have agreed to be interviewed, as well as children of any age. The same number should appear for each person in the group who refuses to be interviewed. For example, consider a group consisting of three adults and two children (ages eight and thirteen). Suppose that the thirteen year-old child and one of the adults agreed to be interviewed. Since the eight year-old doesn't qualify as a potential respondent, that leaves the other two adults as non-interview contacts. You would make two entries in the Non- Interview Contacts Log -- one for each of these two adults -- and both entries would have "5" as the "size of group".
6. Reason: Record the reason that the visitor gives for refusing to participate in the study.

C.2 Conducting the Interview

You will be administering questions contained in the Trail Head Interviewer Form throughout the interview. This section and the next provide the information that you will need to use the Interviewer Form to obtain interviews.

(Note: Do not interview before 7:00 AM or after dark.)

Approach the potential respondents and read the introduction at the top of the Interviewer Form (this introduction is required for all interviews). The introduction says "Hello, I'm an interviewer helping with a Forest Service survey of visitors to the Superstition Wilderness. We would greatly appreciate a little of your time to answer a few questions."

Do not wait for the potential respondents to think of reasons not to be interviewed (the interview itself could well take less time than a conversation about why the respondents don't have time to answer the questions).

Show your letter of introduction (located in your personal binder) if you think it will help you to start the interview.

It may be helpful to reassure the respondents that the questions are impersonal and will not take much time. (See "Recommended Answers to Frequently Asked Questions" for help with responses to common objections.)

You may also read the Privacy Act Statement (located on the first page of the Interview Answer Sheet) to respondents as necessary. It reads: "Your participation in this survey is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others who will not be surveyed, your cooperation is extremely important. The answers you provide are confidential, and will be summarized so that they cannot be associated with you or anyone in your group."

After agreeing to be interviewed, each respondent should be handed a clipboard, a pencil, and an Interview Answer Sheet. (Although you will occasionally encounter individual hikers, you will usually find that wilderness visitors travel in groups.)

It is very important to tell all respondents that they should not discuss questions or answers amongst themselves, that they should not interact with one another during the interview, and that they should not look ahead in the Answer Sheet.

You can convey these instructions by saying: "Before I ask you these questions, I want to emphasize that we are interested in your individual opinions. So, please don't talk about the questions or answers with your friends. Also, please do not look ahead in the Answer Sheets."

C.2.1 Asking the Questions

It is important that each respondent be asked exactly the same questions. Therefore, you should not deviate from the wording provided on the Interviewer Form, and you should avoid re-phrasing the questions unless it is absolutely necessary (that is, you should only re-phrase a question if you are certain that the respondent does not understand the question as asked, even after you have repeated it). Similarly, for each question, the respondent must select one of the response categories provided on the Interview Answer Sheet.

If a respondent asks about the Burden Hours Statement (located on the last page of the Interview Answer Sheet), tell him/her that since this questionnaire is approved by the government, it must contain this statement.

On the following pages, each question is shown as it appears in the Coding Form. (Remember, you will be reading the questions from the Interviewer Form. The respondent will be writing his/her answers on the Interview Answer Sheet, which you will use to complete the Coding Form after the interview is over.) The various response categories, as well as explanations and details pertaining to each question, are also provided. You should familiarize yourself with these explanations before you arrive at the interview site.

QUESTION 1: WHAT DATE AND TIME DID YOU START THIS VISIT TO THE SUPERSTITION WILDERNESS?

Notes about Question 1: We're interested in knowing when the respondents entered the Superstition Wilderness. We're NOT interested in knowing when respondents first thought of the trip, when they left their homes, or when they arrived in the Phoenix area. Be aware that the shaded area on the map that accompanies Question 7 is only part of the area which makes up the Superstition Wilderness. Show respondents a map of the area if they are unsure of the wilderness boundaries. REMEMBER: respondents should never be allowed to go back to change an answer.

QUESTION 2: IS THIS YOUR FIRST VISIT TO THE SUPERSTITION WILDERNESS?

If Yes ask Question 3. If No, ask Question 2A next:

About how many times have you visited the Superstition Wilderness in the past five years?

Notes about Questions 2 and 2A: We're interested only in whether this is a respondent's FIRST visit to the Superstition Wilderness. We're NOT interested in whether this is their first visit to Arizona, to the Tonto National Forest, etc. In Question 2A, when counting the number of times that they have visited before, respondents should NOT include the current visit.

QUESTION 3: DO YOU PLAN TO VISIT THE SUPERSTITION WILDERNESS AGAIN WITHIN THE NEXT 5 YEARS?

If Yes, ask Question 4 next. If No, ask Question 3A next:

Why don't you plan to visit the Superstition Wilderness again?

Notes about Questions 3 and 3A: For Question 3A, you should instruct respondents to write only a few key words. Incomplete sentences are fine because we are interested in key phrases.

QUESTION 4: HAVE YOU ENJOYED YOUR VISIT SO FAR?

If Yes, ask Question 4A next: If No, ask Question 5 next.

Would you say that your visit has been slightly enjoyable, moderately enjoyable, very enjoyable or extremely enjoyable?

Notes about Questions 4 and 4A: Respondents should be told that "not sure" should be marked as "don't know" in Question 4. For Question 4A, tell respondents to choose the single category that best describes the way that they feel (they cannot check more than one category, and they cannot make a new category). If a respondent is unsure about the definition of "enjoyed", tell him/her that it means "had a good time".

QUESTION 5: WHAT HAVE YOU LIKED MOST ABOUT YOUR VISIT SO FAR?

Notes about Question 5: Respondents may select only one aspect of their visit; we're not asking for long list of everything that they've liked. If respondents have not liked anything, instruct them to write "nothing liked". Do not tell them to leave it blank -- a blank space will be coded "90" (not ascertained); whereas, "nothing liked" will be coded as "0". Do NOT probe for "What else did you like . . . "

QUESTION 6: WHAT HAVE YOU LIKED LEAST ABOUT YOUR VISIT SO FAR?

Notes about Question 6: Respondents may select only one aspect of their visit; we're not asking for long list of everything that they've disliked. If respondents have not disliked anything, instruct them to write "nothing disliked". Do not tell them to leave it blank -- a blank space will be coded "90" (not ascertained); whereas, "nothing disliked" will be coded as "0".

QUESTION 7: HAVE YOU <each activity name> DURING THIS VISIT?

Notes about Question 7: For this question only, the respondents can discuss their trip as a group and provide one group answer. Only one respondent from the group needs to mark his or her map. The interviewer should read from the list of activities. If the

respondents haven't engaged in any of the activities, then you should probe for hiking, picnicking, and camping. It is very important that the interviewer help the group to produce accurate answers. It is important that the following information is noted on the map: the date, beginning and ending times, and location of EACH activity. If the group has had an extended visit, and can only recall the last part of the trip, make a note of this on the map (for example, "only last 5 days out of 10 day stay recorded"). Two tables have been provided for this question in case extra space is required for coding.

QUESTION 8: HAVE YOU NOTICED ANY AIRCRAFT DURING YOUR VISIT?

If Yes, Ask Question 9 Next. If No, End Interview.

Notes about Question 8: "Aircraft" is to be interpreted as broadly as possible, including contrails, balloons, and hang gliders. However, satellites are NOT aircraft. (Do NOT volunteer the names of any type of aircraft at this point in the interview. If the respondent asks you to confirm that a particular airborne object is an aircraft, you may respond.)

This question marks a separation point between those who have and those who have not, noticed any aircraft during their visit. If a respondent has NOT noticed any aircraft, then his/her interview is over; ask the respondent to put his/her clipboard down for a moment, but do not tell him/her that the interview is over. Continue the interview for those who answered "yes".

QUESTION 9: WHAT TYPE(S) OF AIRCRAFT DO YOU RECALL NOTICING?

QUESTION 9A: How many <aircraft type> did you notice?

Notes about Questions 9 and 9A: For Question 9, we're looking for spontaneous (unprompted) citations of specific aircraft types. Some respondents might have difficulty answering this question. Refrain from giving any clues. Tell respondents who are having difficulty that they should do their best. If respondents seek clarification about "types of aircraft", tell them "we'll get to that in a moment". For question 9A, tell respondents to write "0" (zero) if they did not notice a particular type of aircraft. If the respondents don't know whether they saw a particular type or not, they should check "don't know". Remember, respondents cannot go back and change their answer to Question 9 once you have read the categories in Question 9A.

QUESTION 10: HAVE YOU BEEN BOTHERED OR ANNOYED BY AIRCRAFT NOISE DURING YOUR VISIT?

If Yes, ask Question 10A next:

Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by aircraft noise?

If more than 1 type of aircraft was noticed, then ask Question 10B next:

Which type of aircraft was most annoying to hear?

If No, ask Question 11 next.

Notes about Questions 10, 10A, and 10B: We are interested specifically in the annoyance due to NOISE produced by aircraft. Remind respondents that they should check only one of the four categories provided (they cannot check more than one category, and they cannot create a new category).

QUESTION 11: HAVE YOU BEEN BOTHERED OR ANNOYED BY SEEING AIRCRAFT DURING YOUR VISIT?

If Yes, ask Question 11A next:

Have you been slightly annoyed, moderately annoyed, very annoyed, or extremely annoyed by seeing aircraft?

If more than 1 type of aircraft was noticed, then ask Question 11B next:

Which type of aircraft was most annoying to see?

If No, conclude interview.

Notes about Question 11: Again, remember that "aircraft" is to be interpreted very broadly (including contrails, balloons, and hang gliders, but excluding satellites). Remind respondents that they should check only one of the four categories provided (they cannot check more than one and they cannot create a new category). Before concluding the interview, ask respondents to turn to the last page and fill in the gender and age information.

C.2.2 Recommended Answers to Frequently Asked Questions

Many respondents will agree to be interviewed right away. Some, however, will ask you for information about the survey before agreeing to answer the questions. When answering potential respondents' questions, your goals should be: 1) to provide as little extraneous information as you can while remaining polite, and 2) to try to start the interview immediately after supplying such information. A list of commonly asked questions with appropriate answers follows. You should be able to recite these answers from memory.

Q: Who's doing this survey?

A: This survey is being conducted for the United States Department of Agriculture (USDA) Forest Service. (If pressed further: I don't know much more about the arrangements, but I think you'll see that the questions are pretty straightforward and non-personal.)

Q: Why is this study being done?

A: The study is being done to collect information about people's opinions about wilderness areas and wilderness conditions. (If pressed further: The Forest Service will use this information to help manage wilderness resources.)

Q: What will be done with my answers to your questions?

A: Information from this study will be used to help make decisions about wilderness management. Your answers will be combined with those of other people who have visited wildernesses. The information will treated statistically only. Your answers won't be identifiable with you individually, or with your group, in any analyses of the data.

Q: Why are you interviewing me?

A: You were selected because you're visiting this wilderness, and your opinions are important for our research. They're important because we want to have complete data, and interviewing people who have not visited wildernesses wouldn't provide the needed information.

Q: I don't have the time right now.

A: I have only a few questions. Your opinion is important and this survey will help manage wilderness resources.

Q: I don't know enough to give you good answers.

A: It's not what you know that counts; your opinions are what's important. Q: I resent the way that question is worded.

A: The people who designed the study made up these questions; I'm just asking the questions exactly as they're written. We have to ask everyone same questions so that we can compare their answers meaningfully.

Q: I'd rather not answer that question.

A: Of course, you don't have to answer. I'm only trying to get your opinion because the study is more accurate when we can count everyone's opinions. (If respondent objects further, mark the question "Refused".)

Q: Where else are you conducting this survey?

A: We're conducting this survey in several different wildernesses throughout the country. I'm not sure exactly where they are located.

Q: What are you measuring (referring to visible sound equipment)?

A: We're measuring wind, humidity and temperature, as well as ambient noise.

Q: I won't answer your questions until I find out more.

A: I think that you'll see from the questions themselves what this study is about, but if you don't want us to count your opinion, we would like to thank you for your time anyway.

Q: How can I find out how the study comes out?

A: This study's findings will be summarized in a report to Congress; it will be a public document.

These answers will satisfy most respondents. However, a small number of people may wish to know more than you are permitted to reveal. You must use your judgment at this point. (The first option) is to show the letter from the Forest Service. Respondents can copy the name and phone number provided on the letter on a piece of paper provided by the interviewer. The second option is to give up, and record the contact as a refusal (remember to record it in the Non-Interview Contacts Log). If it appears that further discussion will not lead to an interview, or that an unreasonable amount of time would be

needed to cajole a potential respondent into granting an interview, this might be the only feasible option. If you decide that the contact is a refusal, thank the respondent for his/her time nonetheless, and politely say goodbye. It may be necessary to talk to this same person at a later date, and we want to be certain that we have given the respondent no cause to think that we have been abrupt or discourteous. Even if the respondent has been unpleasant, remember that you must remain polite.

C.2.3 Concluding the Interview

End the interview by saying: "Thank you for your participation in this study. Your opinions will help manage wilderness resources. I would like to ask your cooperation in not discussing this interview with other people you may meet during the remainder of your visit." Politely resist further requests for information about the nature of the survey. Wait for the respondents to leave first. Upon concluding the interview, we want the respondent to feel flattered that we value his/her opinion.

Important Note: IMMEDIATELY after the interview is concluded, you should write the following information in the spaces provided at the BOTTOM of the first page of the Interview Answer Sheet: Your interviewer code, the date, time (24-hour format), and location of the interview, and the number of people in the group. Later, when the Interview Answer Sheet is coded, this information can easily be transferred to the Coding Form.

C.3 Coding the Interview Answer Sheet

If the interview has been completed, and no other respondents are arriving, the Interview Answer Sheet should be coded immediately. Since the Coding Forms will be used for data entry, it is extremely important that all information is transferred carefully and coded accurately. In addition, it is your responsibility to provide complete Coding Forms. Thus, if the respondent has provided incomplete information on the Interview Answer Sheet, you must translate this into a format that can be entered into the database.

Once an Interview Answer Sheet has been coded, it should be stapled to the Coding Form (with the Coding Form on top).

Most of the first box on the Coding Form can be completed by transferring the interviewer code, date, time, location, and group size from the bottom of the Interview

Answer Sheet. The wilderness code has been pre-coded; the Age Group and Sex can be copied from the last page of the Interview Answer Sheet. Note that the "location" refers to the number from the Wilderness Map (1, 2, 3, or 4) in which you conducted the interview, or the name of the area in which you conducted the interview if you were located outside of the numbered regions. In addition, for "number of people in party", count only those people who considered themselves to be a member of the group. Thus, even if two groups combined before you contacted them, count the size of each group separately. Remember to count all of the people in the group, including those too young to be interviewed and those (if any) who refused to be interviewed.

Coding of most questions is self-explanatory; nevertheless, some general guidelines, as well as clarification of a few specific questions, are provided here. Additional help can be obtained from one of the more experienced interviewers.

- All legible answers to open-ended questions should be transferred from the answer sheet to the "verbatim" box on the coding sheet. The answer should be copied word-for-word (not including spelling errors), even if part of the information might not appear useful for coding purposes. Code illegible answers as "not ascertained". Circle the response in the right column, as well as its matching code in the left column.
- When coding "yes/no" answers be aware that "yes" is always first on the Interview Answer Sheet, whereas "no" is always first on the Coding Form. Therefore, you must take extra care to be certain that "no" is coded as "0" and that "yes" is coded as "1".
- The "refused" category should be coded only if the respondent refuses to answer any particular question during the course of the interview. In contrast, if the respondent refuses to finish the entire questionnaire, code the first question he/she refused to answer as "refused," but code the remaining questions as "not ascertained."
- The "not ascertained" category should be coded if:
    - the respondent did not answer the question;
    - the question is left blank because the instructions did not require an answer (i.e., was skipped);
    - the interviewer accidentally forgot to ask the question;
    - the answer is illegible; or
    - the question is the second, or subsequent, question following the respondent's refusal to finish the interview.
- Question 1: Take care to correctly translate the time into the 24-hour format.

- Question 2A: Code the exact number of visits if the respondent has visited six or fewer times.
- Question 3A: Write the entire answer in the verbatim box. If the response contains a mixture of reasons relating to both aircraft and non-aircraft conditions, code number 1 should be circled. Any response that does not allude to aircraft in any way should be coded as "non-aircraft related" (code 2). If the response given consists solely of aircraft-related conditions, then code 3 ("aircraft related") should be circled.
- Question 5 and 6: Only the first response should be coded, regardless of how many responses are given and what they are.
- Question 7: You must code this question completely and resolve any ambiguity caused by the respondents markings on the map. If the group has not engaged in a particular activity, leave the corresponding box blank on the coding form. Otherwise, indicate on the coding form where the activity occurred (use the numbers on the map) and the beginning and ending times. If respondents have volunteered information about activities other than those listed, these activities should be coded as "other." Again, remember to translate the time indicated by the respondents to 24-hour format.

C.4 Logging Aircraft Overflights

Interviewers must record information about aircraft overflights unless you are interviewing (don't miss interviewing opportunities in order to record aircraft overflight information). This information will be used in conjunction with data collected by the noise monitors. Overflights on one day, at one site, should be recorded consecutively on the Overflight Log until the page is full. A new page should be used for every new day and every new site. All of the following information should be entered into the Overflight Log:

1. Date: Write the date of the overflight (MM/DD/YY).
2. Site No.: Write the number from the area map which corresponds to your location. If the location is outside of the numbered areas, write the name of the area.
3. Wilderness Area: Write the code and name of the wilderness (not a site within the wilderness).
4. Sheet No. # of #: Number the sheets consecutively (i.e. 1, 2, 3, . . .). Before stapling the stack together, count the total number and put that number on every sheet, after the word "of".

5. Start time: Look at your digital watch and record the hour, minute and second that the airplane was first audible. It will obviously be difficult to record the exact time that the plane was first heard, but you should try your best. You should NOT record overflights while you are in the middle of an interview. This might bias the answers by making the respondents aware that airplane noise is a factor of interest. Remember: all interviewers should synchronize their watches before they depart.

6. End time: Record the hour, minute, and second at which you could no longer hear the plane.

7. Type of aircraft: If you can see the aircraft, record its type as either a helicopter, a high- altitude commercial plane, a low-flying private plane, or a fast, low-flying military jet. If it is a military jet, use the aircraft silhouettes on page 28 to help you judge its type. If you can see the aircraft, but cannot tell which type it is, write "unknown." If you cannot see the airplane due to cloud cover, or because trees or rocks block your view, write a question mark (?).

8. Direction of flight: You should be oriented at all times. When you record the direction of the flight, you should record the direction (north, south, east, or west) in which the plane is flying (not the direction from which it is coming). If you cannot tell the direction of flight, write a question mark (?).

9. Approximate altitude: Write "low" if the aircraft is below a ridge or only a few degrees off of the horizon. If you have to crane your neck to look up at the aircraft, write "high."

C.5 Logging Weather Conditions

This log should be kept by all interviewer teams (one log per team.) The weather measurements should be taken approximately once every hour, unless you are interviewing (don't miss interviewing opportunities in order to obtain weather readings). All of the following information should be entered into the Weather Conditions Log:

1. Site No.: Write the number from the area map that corresponds to your location. If the location is outside of the numbered areas, write the name of the area.

2. Wilderness Area: Write the code and name of the wilderness (not a site within the wilderness).

3. Sheet No. # of #: Number the sheets consecutively (i.e. 1, 2, 3, . . .).

Before stapling the stack together, count the total number and put that number on every sheet, after the word "of".

4. Date: Write the date of the recording (MM/DD/YY).
5. Time: Record the exact time at which measurements are taken; use the 24-hour format.
6. Dry bulb temperature: This is the standard temperature which is recorded simultaneously with the wet bulb temperature on a psychrometer. The psychrometer should lie flat in the shade and the motor should run for at least 2 minutes before reading the temperatures.
7. Wet bulb temperature: This is also measured on the psychrometer. See number 6 above.
8. Wind speed: The wind speed is measured on a wind meter. The meter is held up against the wind, and the speed is read off the scale. Record the approximate average wind speed, not the peak.
9. Wind direction: Note the wind direction (north, south, east, or west). Record the direction from which the wind is blowing (the wind should be blowing in your face as you take the reading).
10. Cloud cover: If the sky is blue and there are no clouds, write "no clouds." If it is completely clouded, write "clouded." If there are some clouds, write "partially clouded." In this column, you should also note fog or rain.

C.6 Operation of Noise Monitoring Devices

The interviewers must maintain the monitoring equipment located close to the interviewing sites. A schedule will be made to indicate who should maintain the equipment located away from the interviewing sites. Detailed instructions explaining how to change batteries, change tapes and download information will be given prior to departure. What follows is a brief description of the two devices and the tasks associated with each.

C.6.1 NAGRA Tape Recorder

The Nagra should be positioned so that it attracts the least possible attention. Interviews should, if possible, be conducted away from the Nagra and any visible microphones, cables, etc. Keep the Nagra covered and in the shade.

Information to record on the tape box (an example of a completed tape box is fastened to the lid of each Nagra):

- Name: Write the interviewer code and name of the person changing the tape.
- Tape number: Number tapes consecutively beginning with number 1 on the first day of recording. Precede the number with the initials of the Nagra's location. For example, a Nagra located at Fremont Saddle would produce tapes which have been labeled FS1, FS2, FS3, etc.
- Job NPS WO 10 #06471: This indicates: National Park Service, Work Order 10, and BBN job number 06471. This information will be the same for all tapes.
- Date: Write the date of the recording (MM/DD/YY).
- Beginning time: Write the time when the recording started using 24-hour format (HH/MM/SS).
- Number of flyovers: When the tape is changed, write on the box how many flyovers were recorded on the tape.

Information to annotate on the tape (A list of all of these items is taped to the lid of each Nagra) should include all information written on tape box with the addition of the following:

- Calibration - Calibration tone (dB), Attenuator settings, and Meter level;
- Measurement Data - Attenuator settings;
- Weather - Sky (clear, partly clouded, overcast, etc.), Wind (take a reading from the wind meter), and Temperature (take a reading from the psychrometer);
- Information to be recorded only by the first team using the Nagra (A sheet containing this information will be taped to the lid of each Nagra) - Name of system, Microphone (Type and Serial No.), Calibrator (Type and Serial No.), Recorder (Type and Serial No.).

C.6.2 Larson-Davis 870

The LD 870 is an automatic noise monitor which operates continuously. Once the memory is full, the information must be transferred to a portable PC. Downloading needs to be performed periodically; check on the remaining memory capacity approximately every two days. The LD 870 provides information both about battery capacity and about how much memory is left. Every time the computer is downloaded and/or batteries are changed, the calibration and threshold settings should be checked. Information on the field set up and laptop data collection follow.

Field Set Up

- Open the case and verify that the large orange battery in the case is plugged into the DC port of the 870. (The DC port is the hole on the back of the 870 that has a single pin sticking up.)
- Turn on the power by pressing the button in the lower left corner of the 870.
- Check the system's status by pressing SHIFT, and then SYSTEM (note: any command on the 870 that is written in blue must be preceded by the blue shift key; however, the keys need not be pressed simultaneously). This provides information on battery status (75% - 210% is normal operating range), temperature, etc. Pressing ON always returns you to main menu.
- Put the metal ring onto the cable, feed the cable through the hole in the side of the 870, and attach the rubber grommet.
- Set up the microphone on the tripod; attach the cable to the microphone.
- Begin the calibration procedure by pressing SHIFT, and then CAL. The calibration window and the word "[Off]" should appear. Place the pistonphone on the microphone in such a way that it stays on by itself (you may have to put the pistonphone on the ground and then stick the microphone into it). Verify that the pistonphone is on the middle setting, and then press NEXT twice. The word "[CHANGE]" should appear. Press ENTER, which will cause the system to be calibrated. If the calibration is successful, the word "Done" will appear.
- Remove the pistonphone and cover the microphone with the windscreen.
- Press the SLM key. The SLM-a window should appear. The machine is now ready to start taking measurements.
- Press the RS key to start data collection. The number on top should be responsive to sound. Don't forget to shut the lid. Remember that reset all will delete all data (but not the set up) in the 870. Do not "reset all" unless you're sure that all of the data has been collected properly.

Data collection with the laptop computer

Once the memory is full, the data must be dumped into the laptop computer. This process consists of connecting the 870 to the laptop, and then calling up the collection program.

- Open the lid of the 870 and press the RS key. (stops the monitor from taking more data)
- Connect the 870 to the laptop using the 9 pin RS232 cable (one end of the cable is labeled "laptop," the other end is labeled "LD 870").
- Turn on the laptop and type cd\870-SWL. (changes the directory to 870-SWL)
- Type: 870. (causes the Larson Davis menu to appear)
- Press return. (selects DATA RETRIEVAL)
- Press ALT D. (causes the data collection menu to appear)
- Use the arrow keys to select Read Data From Model 870; press return.
- Type in the name of the file to be dumped; press return. (Use the following format for naming files: four letters indicating the location, followed by four numbers indicating the date. For example, FRSA1202 indicates Fremont Saddle on December 2nd.)
- Press SHIFT TAB twice; press return. (selects "ok" and begins the process of dumping the data into the laptop)
- When the dumping process is complete, press F10 to exit the program.
- Copy the file onto a floppy: put a floppy into the external drive, type copy filename.870 a:, and press return. (Note: replace "filename" with the name of the file that you just created; for example: copy FRSA1202.870 a:). Don't forget to label the floppy.
- IMPORTANT! Before shutting down the laptop, type SHIP to protect the hard drive. Turn off the laptop and disconnect the cable.

Appendix D
Distribution of Responses to Questionnaire Items

This Appendix contains all Tables from analyses of responses to questionnaire items as discussed in Section 4.1 of this document.

Table D-1: Percentage of Male and Female Respondents

Sex of Respondent				
Sex	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Female	25.9	19.5	28.6	26.5
Male	73.5	79.5	71.4	72.4
Not recorded	0.7	1.1	0.0	1.0

Note: From last item.

Table D-2: Percentage of Respondents by Age

Age of Respondent				
Age	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Under 20	24.8	28.6	25.9	21.9
20-39	43.8	42.2	54.8	34.7
40-59	21.5	21.6	18.1	24.7
60 and Over	9.0	5.4	0.9	17.9
Not recorded	0.8	2.2	0.3	0.8

Note: From last item.

Table D-3: Percentage of Respondents by Party Size

Number of People in Party				
Party Size	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
1-2	35.4	29.2	36.2	37.8
3-4	21.2	27.6	22.4	17.1
5-10	26.4	39.5	28.3	18.6
Over 10	17.0	3.8	13.1	26.5
Not recorded	0.0	0.0	0.0	0.0

Note: From interview cover sheet.

Table D-4: Percentage of Respondents by Number of Prior Visits Within the Past Five Years

Number of Prior Visits				
Response	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
None	39.2	50.3	42.0	31.6
1-2	16.8	14.1	18.1	16.8
3-6	19.9	19.5	19.5	20.4
7 or more	22.0	13.5	18.4	29.1
Don't Know	0.5	0.5	0.3	0.8
Refused	0.0	0.0	0.0	0.0
Not Ascertained	1.6	2.2	1.7	1.3

Note: From Items 2 and 2A.

Table D-5: Percentage of Respondents by Intended Future Visits

Intended Future Visits				
Response	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Intend to visit again	91.2	89.2	90.4	92.9
No intended future visits, nonaircraft related reasons	1.0	0.5	1.2	1.0
No intended future visits, aircraft related reasons	0.0	0.0	0.0	0.0
No intended future visits, combination of nonaircraft and aircraft related reasons	0.0	0.0	0.0	0.0
Never intended to visit again	0.1	0.5	0.0	0.0
Not planning to visit within the next five years	0.0	0.0	0.0	0.0
Don't know	7.4	9.2	7.9	6.1
Refused	0.0	0.0	0.0	0.0
Not ascertained	0.3	0.5	0.6	0.0

Note: From Items 3 and 3A.

Table D-6: Percentage of Respondents by Degree of Enjoyment

Enjoyment of Visit				
Response	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Not enjoyable	1.4	1.1	2.3	0.8
Slightly enjoyable	2.0	2.2	2.0	1.8
Moderately enjoyable	9.6	9.7	9.6	9.4
Very enjoyable	51.8	51.9	47.5	55.6
Extremely enjoyable	32.9	33.0	35.9	30.4
Don't Know	0.9	1.1	1.2	0.5
Refused	0.0	0.0	0.0	0.0
Not ascertained	1.4	1.1	1.5	1.5
MEAN	3.2	3.2	3.2	3.2
STANDARD DEVIATION	0.8	0.8	0.9	0.7

Note:
1. From Items 4 and 4A.
2. Coding for means and standard deviations is on a scale of 0 (Not enjoyable) to 4 (Extremely enjoyable).

Table D-7: Percentage of Respondents by Most Liked Aspect of Visit

Liked Most About Visit				
Response	Percentage			
	All Sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Nothing Liked	0.5	0.0	0.3	1.0
Peace and Quiet	6.2	4.9	8.2	5.1
Scenery	33.3	20.0	21.9	49.5
Being Alone	2.2	5.4	2.0	0.8
Having Fun	0.1	0.0	0.3	0.0
Being with Friends	1.4	0.5	2.3	1.0
Activity-Related	14.9	31.4	12.8	8.9
Relaxation	0.7	0.0	1.2	0.5
Other, non-aircraft related	40.2	37.8	49.9	32.9
Other, aircraft related	0.0	0.0	0.0	0.0
Don't Know	0.1	0.0	0.3	0.0
Refused	0.0	0.0	0.0	0.0
Not ascertained	0.4	0.0	0.9	0.3

Note: From Item 5.

Table D-8: Percentage of Respondents by Least Liked Aspect of Visit

Liked Least About Visit				
Response	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Nothing Disliked	26.0	9.7	25.9	33.7
Inadequate Trail Maintenance	7.6	3.2	8.7	8.7
Crowding	6.8	5.9	7.3	6.9
Weather	5.0	11.4	5.5	1.5
Aircraft Noise	0.2	1.1	0.0	0.0
Other Noise	2.2	2.2	3.5	1.0
Insects	6.0	11.4	9.9	0.0
Other, Aircraft Related	0.7	1.1	0.3	0.8
Other, Non-aircraft related	42.3	50.8	37.9	42.1
Don't Know	0.7	0.0	0.3	1.3
Refused	0.0	0.0	0.0	0.0
Not ascertained	2.6	3.2	0.6	4.1

Note: From Item 6.

Table D-9: Percentage of Respondents Participating in Each Activity

Activities Engaged in by Respondents (Multiple Responses Permitted)				
Activity	Percentage			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
Fishing	10.8	33.0	11.1	0.0
Boating	0.0	0.0	0.0	0.0
Swimming	15.8	27.0	27.7	0.0
Rock Climbing	3.5	2.2	4.7	3.1
Horseback Riding	7.8	28.1	2.6	2.8
Hunting	0.0	0.0	0.0	0.0
Other	75.9	34.1	72.0	99.0
Don't Know	0.0	0.0	0.0	0.0
Refused	0.0	1.3	0.0	0.0
Not Ascertained	0.0	1.0	0.0	0.0

Note: From Item 7.

Table D-10: Percentage of Respondents by Types of Aircraft Noticed

Response	Type of Aircraft Noticed			
	Percentage (Multiple Responses Permitted)			
	All sites (N = 920)	Golden Trout (N = 185)	Cohutta (N = 343)	Superstition (N = 392)
None	41.0	26.5	52.2	38.0
High Altitude Jet	33.3	39.5	21.6	40.6
Helicopter	9.6	40.5	2.0	1.5
Low Flying Jet	13.0	45.4	4.7	5.1
Small Private Airplane	23.6	11.9	20.4	31.9
Other	4.0	8.1	5.0	1.3
Don't Know	0.8	0.5	0.6	1.0
Refused	0.1	0.5	0.0	0.0
Not ascertained	0.0	0.0	0.0	0.0

Note: From Items 8 and 9A.

Table D-11: Degree of Annoyance Due to Aircraft Noise

Annoyance by Aircraft Noise								
Response	Percentage							
	All sites		Golden Trout		Cohutta		Superstition	
	All resp. (N=920)	Resp. noticing A/C (n=535)	All resp. (n=185)	Resp. noticing A/C (n=134)	All resp. (N=343)	Resp. noticing A/C (n=162)	All resp. (N=392)	Resp. noticing A/C (n=239)
Not at all annoyed	87.3	76.8	74.6	64.2	88.3	72.8	92.3	86.6
Slightly annoyed	5.0	8.6	4.3	6.0	6.7	14.2	3.8	6.3
Moderately annoyed	4.1	7.1	8.1	11.2	3.5	7.4	2.8	4.6
Very annoyed	1.6	2.8	5.4	7.5	0.6	1.2	0.8	1.3
Extremely annoyed	1.8	3.2	7.0	9.7	0.9	1.9	0.3	0.4
Don't Know	0.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Refused	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Not ascertained	0.0	1.5	0.0	1.5	0.0	2.5	0.0	0.8

Note: From Items 10 and 10A.

Table D-12: Degree of Annoyance Due to Sight of Aircraft

Annoyance by Sight of Aircraft								
Response	Percentage							
	All sites		Golden Trout		Cohutta		Superstition	
	All resp. (N=920)	Resp. noticing A/C (n=535)	All resp. (n=185)	Resp. noticing A/C (n=134)	All resp. (N=343)	Resp. noticing A/C (n=162)	All resp. (N=392)	Resp. noticing A/C (n=239)
Not at all annoyed	94.4	87.1	84.4	74.6	97.9	92.6	95.9	90.4
Slightly annoyed	1.8	3.2	2.2	3.0	0.9	1.9	2.6	4.2
Moderately annoyed	1.7	3.0	4.3	6.0	0.6	1.2	1.5	2.5
Very annoyed	0.8	1.3	3.2	4.5	0.3	0.6	0.0	0.0
Extremely annoyed	1.3	2.2	5.9	8.2	0.3	0.6	0.0	0.0
Don't Know	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refused	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Not ascertained	0.0	3.2	0.0	3.7	0.0	3.1	0.0	2.9

Note: From Items 11 and 11A.

Table D-13: Most Annoying Type of Aircraft to Hear Among Respondents Noticing More than One Type of Aircraft

Type of Aircraft Most Annoying to Hear				
Response	Percentage			
	All sites (n = 59)	Golden Trout (n = 38)	Cohutta (n = 11)	Superstition (n = 10)
High Altitude Jet	16.9	5.3	63.6	10.0
Helicopter	11.9	18.4	0.0	0.0
Low Flying Jet	47.5	73.7	0.0	0.0
Small Private Airplane	23.7	2.6	36.4	90.0
Other	0.0	0.0	0.0	0.0
Don't Know	0.0	0.0	0.0	0.0
Refused	0.0	0.0	0.0	0.0
Not ascertained	0.0	0.0	0.0	0.0

Note: From Item 10B.

Table D-14: Most Annoying Type of Aircraft to See Among Respondents Noticing More than One Type of Aircraft

Type of Aircraft Most Annoying to See				
Response	Percentage			
	All sites (n = 59)	Golden Trout (n = 38)	Cohutta (n = 11)	Superstition (n = 10)
High Altitude Jet	1.7	2.6	0.0	0.0
Helicopter	16.9	26.3	0.0	0.0
Low Flying Jet	18.6	28.9	0.0	0.0
Small Private Airplane	5.1	0.0	0.0	30.0
Other	1.7	2.6	0.0	0.0
Don't Know	0.0	0.0	0.0	0.0
Refused	0.0	0.0	0.0	0.0
Not ascertained	55.9	39.5	100.0	70.0

Note: From Item 11B.

Table D-15: Average Number of Aircraft Noticed per Hour

Number of Each Type of Aircraft Noticed per Hour (Multiple Responses Permitted)								
Response	All Sites (n = 535)		Golden Trout (n = 134)		Cohutta (n = 162)		Superstition (n = 239)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
High Altitude Jet	0.27	0.53	0.09	0.31	0.21	0.48	0.40	0.61
Helicopter	0.01	0.05	0.03	0.06	0.01	0.06	0.00	0.03
Low Flying Jet	0.04	0.20	0.06	0.21	0.06	0.29	0.02	0.08
Small Private Airplane	0.10	0.21	0.01	0.02	0.15	0.30	0.13	0.17
Other	0.01	0.08	0.02	0.10	0.02	0.11	0.01	0.04

Note: From interview cover sheet and Items 1 and 9A.

Appendix E
Figures and Tables for Relationships Among Questionnaire Items

This Appendix contains Figures and Tables discussed in Section 4.2 of this document.

Table E-1: Frequencies of Annoyance Due to Sound and Sight of Aircraft and Wilderness

Annoyed by sight of aircraft?	Annoyed by sound of aircraft?	Wilderness			Subtotal	TOTAL
		Golden Trout	Cohutta	Super-stition		
No	No	135	301	352	788	867
	Yes	20	35	24	79	
Yes	No	3	2	10	15	52
	Yes	26	5	6	37	
TOTAL		184	343	392	919	919

Note: From Items 10 and 11.

Table E-2: Loglinear Model of Associations among Wilderness and Annoyance Due to Sound and Sight of Aircraft

Effect	Partial χ^2	p	u
Noise by Sight	89.27	< .05	.43
Wilderness by sound	14.99	< .05	.19
Wilderness by sight	21.28	< .05	.22
Wilderness by sight by sound	5.47	n.s.	N/A

Note: From Items 10 and 11.

Table E-3: Analysis of Variance of Noise-Induced Annoyance for Four Aircraft Types

Source	SS	df	MS	F	p	η^2
Aircraft type	22.73	3	7.58	8.01	< .05	.30
Error	53.00	56	0.97			
TOTAL	75.73	60				

Note: From Items 9A, 10, 10A, and 10B.

Table E-4: Average Annoyance Due to Aircraft Noise for Four Types of Aircraft Among Respondents Noticing More Then One Type of Aircraft

Descriptors	Most Annoying Aircraft to Hear			
	High altitude jet	Helicopter	Military	Small private
Means	1.20	3.14	2.62	1.86
Standard deviations	0.42	1.07	1.12	0.86
Number responding	10	7	29	14

Note: 1. From Items 9A, 10, 10A, and 10B.
2. Certain types of aircraft may not be noticed in certain Wildernesses.
3. Coding for means and standard deviations is on a scale of 0 (Not at all annoying) to 4 (Extremely annoying).

Table E-5: Newman-Keuls Comparisons of Differences in Noise Annoyance

	Military	High altitude jet	Heli-copter
High altitude jets	*		
Helicopter	n.s.	*	
Small private	*	n.s.	*

* $p < .05$

Note: From Items 9, 10, 10A, and 10B.

Table E-6: Correlations among Predictors

Pooled Within-Group Correlations								
Variables	1	2	3	4	5	6	7	8
2	-.38*							
3	-.11	-.07						
4	-.00	-.03	.11					
5	.01	.03	.16	.10				
6	-.07	.03	-.12	.04	.11			
7	-.06	-.20	.22*	.05	.12	.12		
8	.36*	-.14	.16	.03	.12	.01	.07	
9	.27*	.24*	-.05	-.05	.09	-.05	-.15	-.02

*$p < .05$, corrected for multiple testing.

Notes: 1. From Items 2, 2A, 3, 3A, 4, 4A, 7, 10 and last item.

2. Variables:

1 = Golden Trout vs. other two Wildernesses

2 = Cohutta vs. other two Wildernesses

3 = Number of times Wilderness visited

4 = Intention to revisit (no or yes)

5 = Rating of trip enjoyability (3 levels)

6 = Sex

7 = Age group

8 = Whether engaged in stock-related activities

9 = Whether engaged in water-related activities

Appendix F
Acoustic Data Analysis Figures

This Appendix contains Figures and Tables discussed in Section 4.3 of this document.

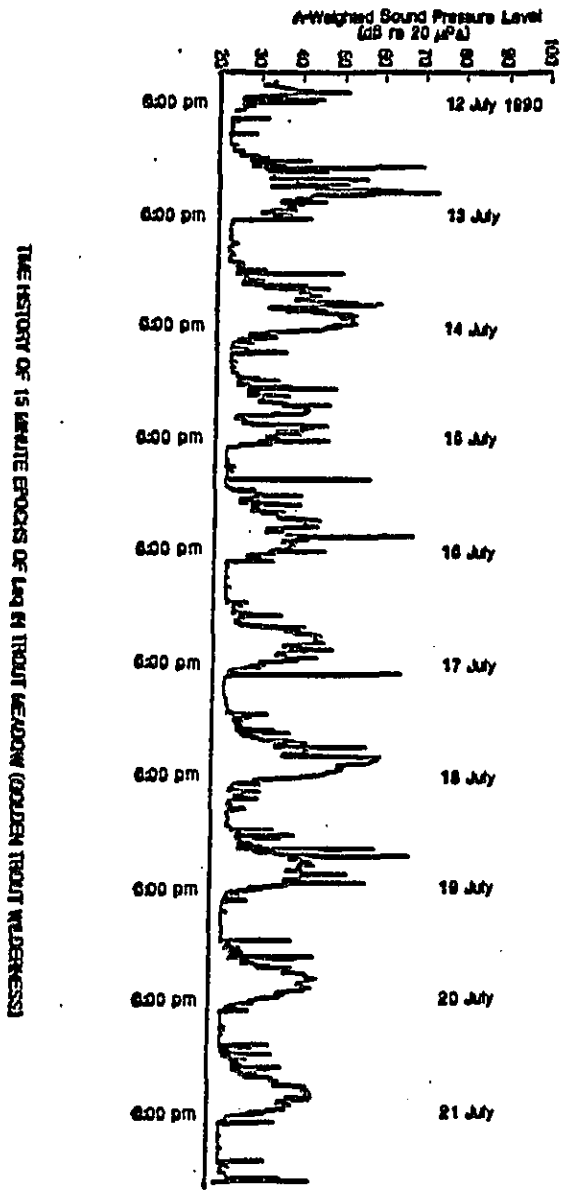

Figure F-1: Long Term Time History of 15 Minute Epochs of Ambient Levels in Golden Trout Wilderness

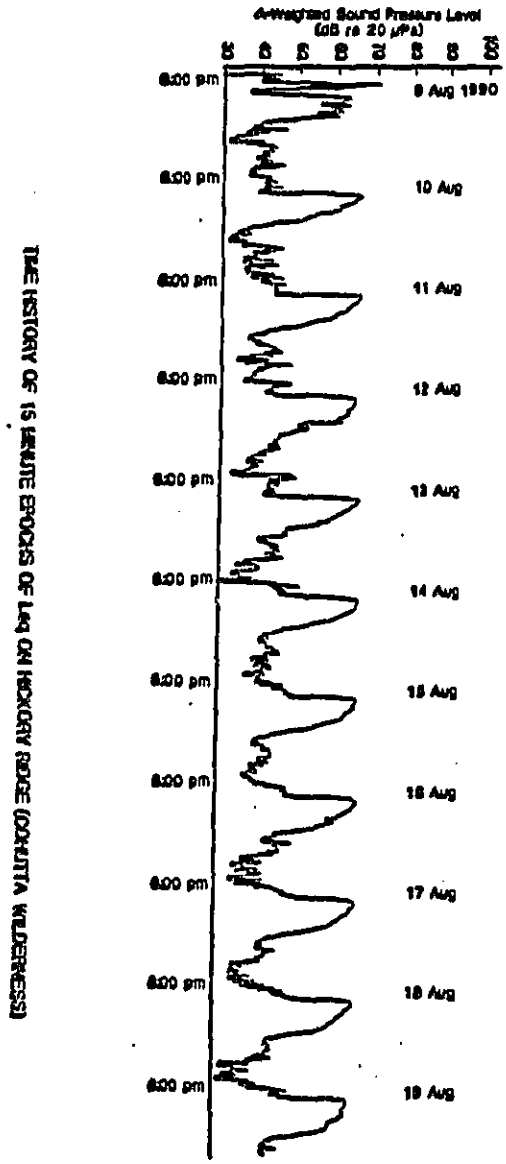

Figure F-2: Long Term Time History of 15 Minute Epochs of Ambient Levels in Cohutta Wilderness

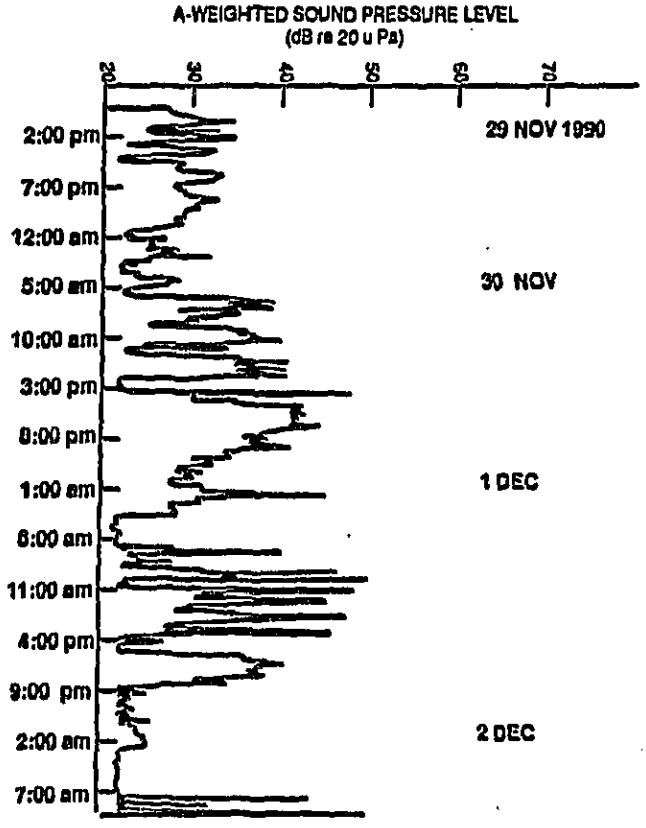

Figure F-3: Long Term Time History of 15 Minute Epochs of Ambient Levels in Superstition Wilderness

Table F-1: Values of L_{eq} and L_{dn} Representative of Visitor's Exposure to Ambient Levels in the Three Wildernesses

Representative 15-minute sound levels in Golden Trout Wilderness			
	L_{eq} (day)	L_{eq} (night)	L_{dn}
Trout Meadow	42 dB	23 dB	40 dB
Little Kern Bridge	38	32	40
Lower Pyles	48	48	54
Forks of the Kern	47	47	53

Representative 15-minute sound levels in Cohutta Wilderness			
	L_{eq} (day)	L_{eq} (night)	L_{dn}
Hickory Ridge	44 dB	44 dB	50 dB
Brayfield Clearing	43	43	49
Beech Bottom	52	52	58

Representative 15-minute sound levels in Superstition Wilderness			
	L_{eq} (day)	L_{eq} (night)	L_{dn}
First Water	33 dB	33 dB	39 dB
Fremont Saddle	35	26	35
Peralta Trailhead	42	35	43
Black Mesa	29	29	35

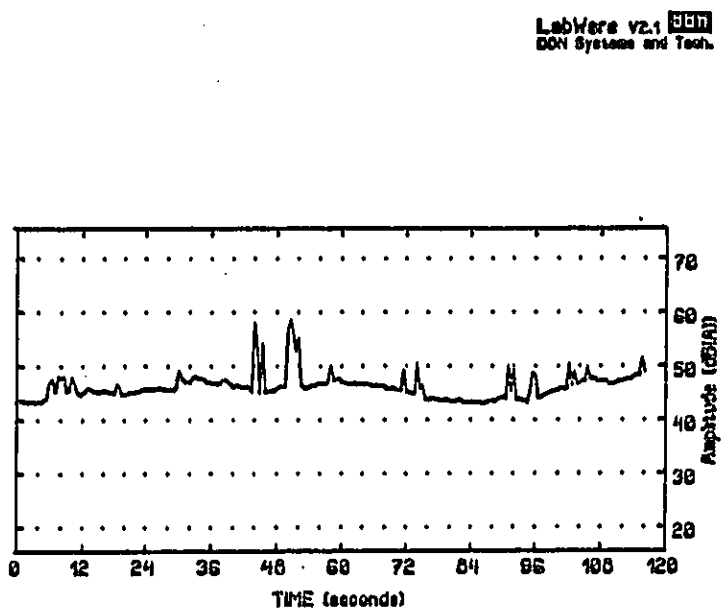

Figure F-4: Short-Term Time History of Ambient Levels in Golden Trout Wilderness

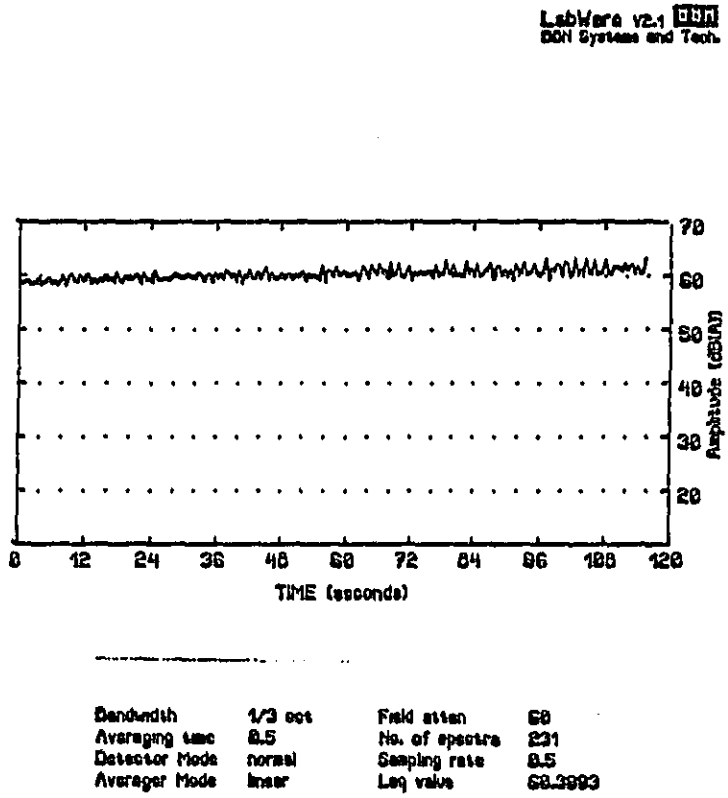

Figure F-5: Short-Term Time Histories of Ambient Levels in Cohutta Wilderness

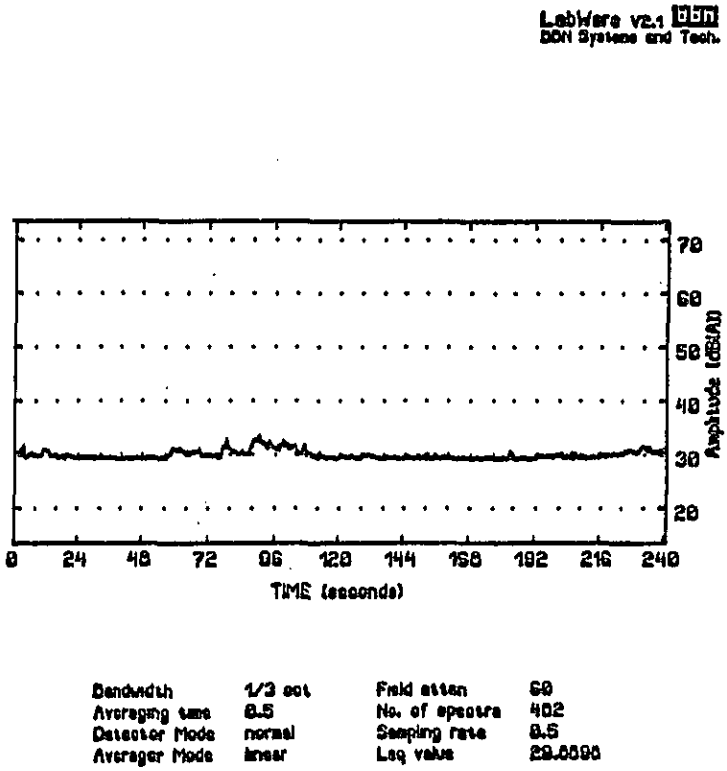

Figure F-6: Short-Term Time Histories of Ambient Levels in Superstition Wilderness

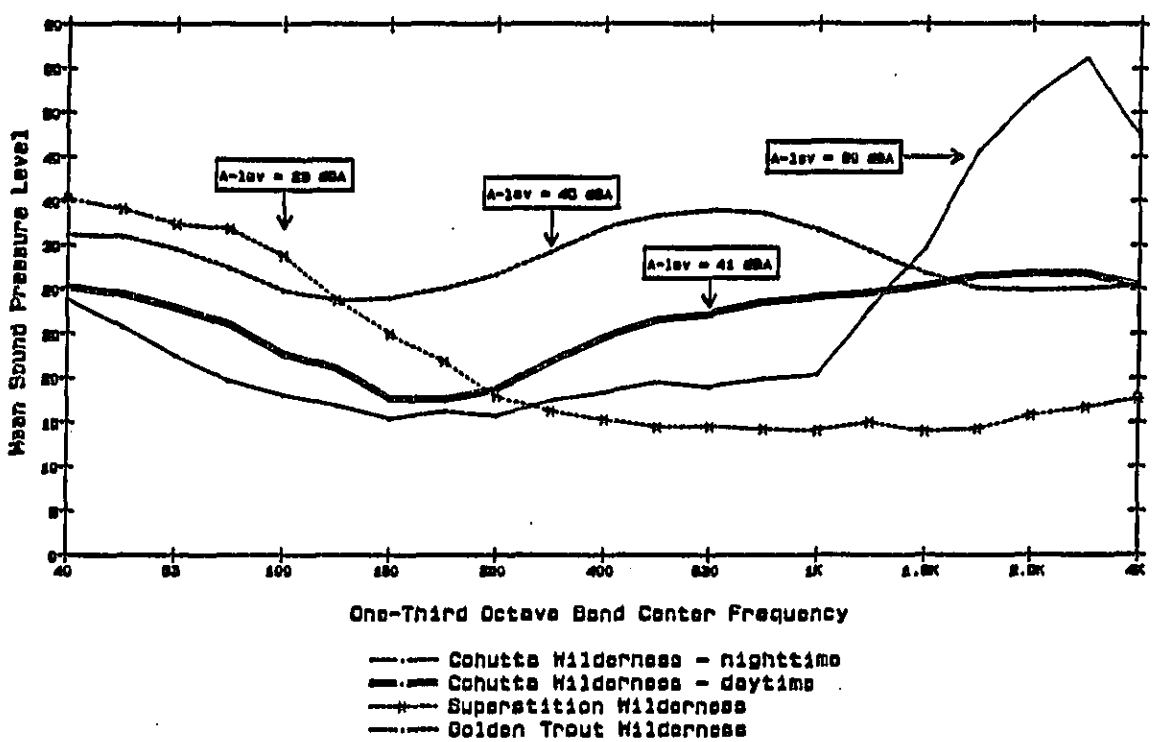

Figure F-7: Comparison of Typical Ambient Spectra for Three Wildernesses

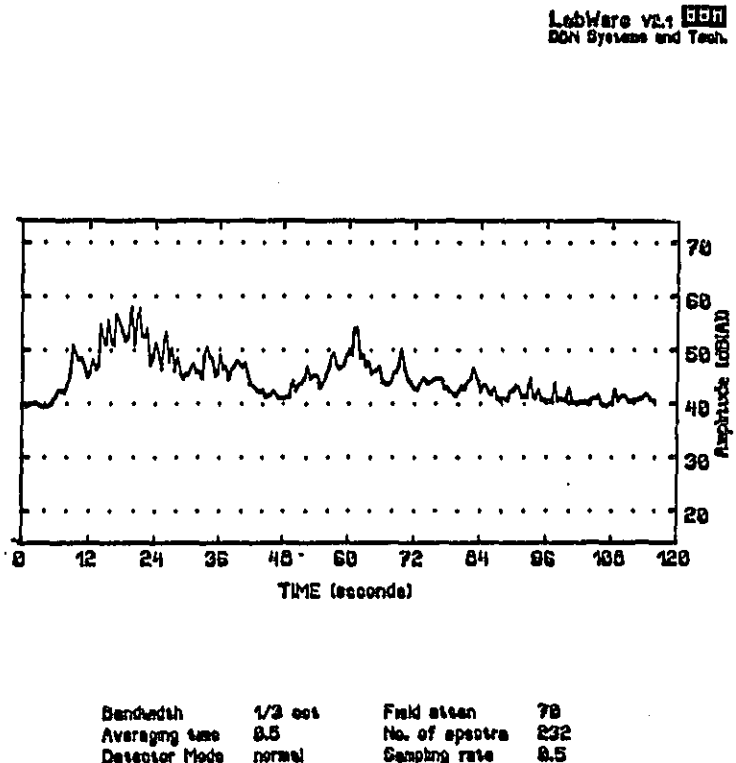

Figure F-8: Time History of High Altitude Flyover in Golden Trout

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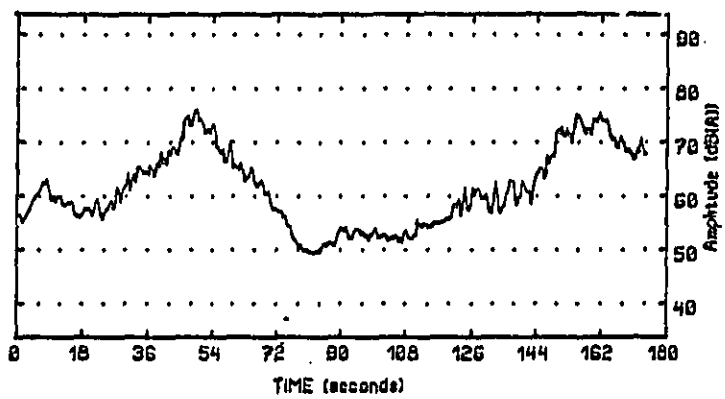
BBN Systems and Tech.



Bandwidth	1/3 oct	Freld atten	70
Averaging time	0.5	No. of spectra	340
Detector Mode	normal	Sampling rate	0.5
Averager Mode	linear	Leq value	66.6961

Figure F-9: Time History of Low Flying Helicopter in Golden Trout

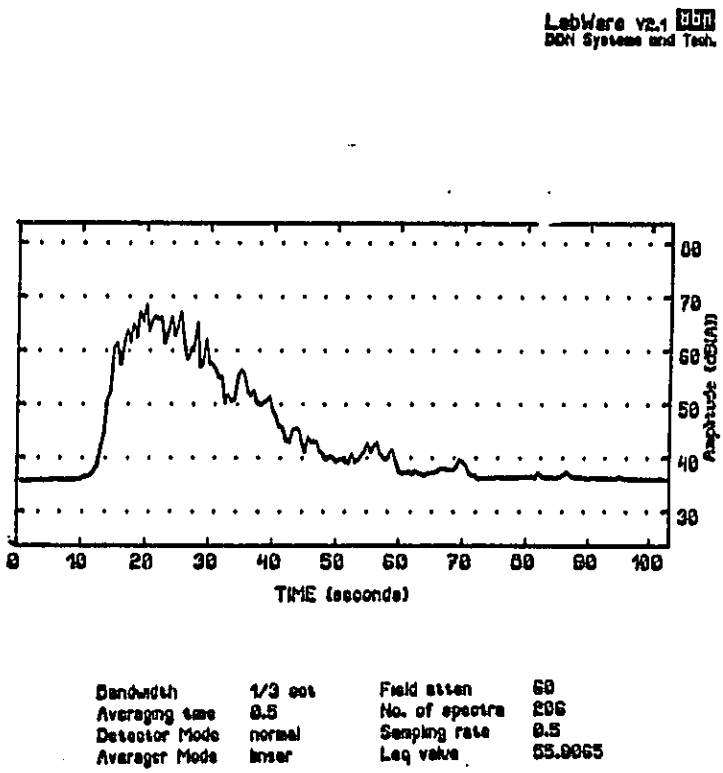


Figure F-10: Time History of T-38s Flyover in Superstition

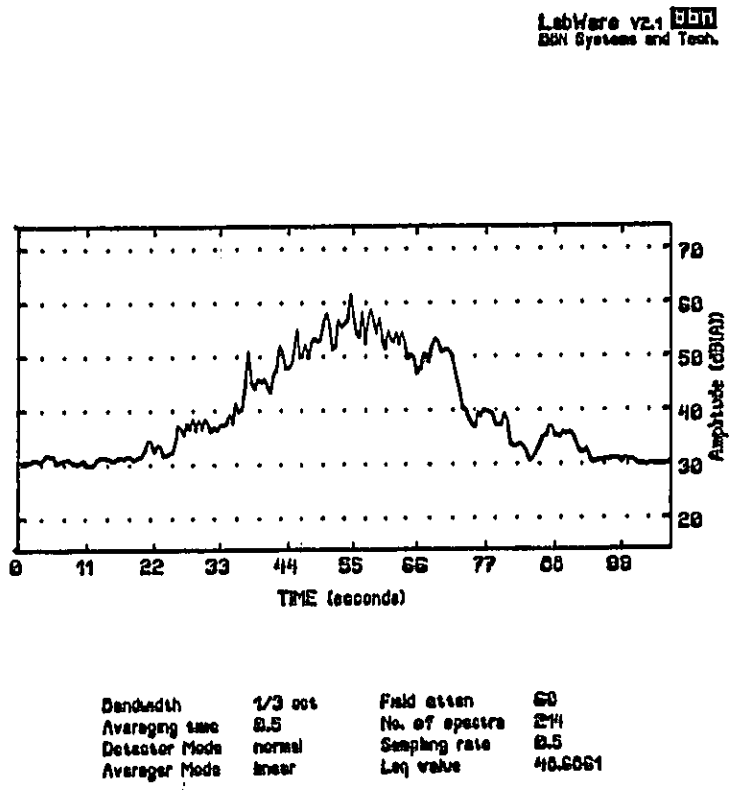


Figure F-11: Time History of Prop Plane in Superstition

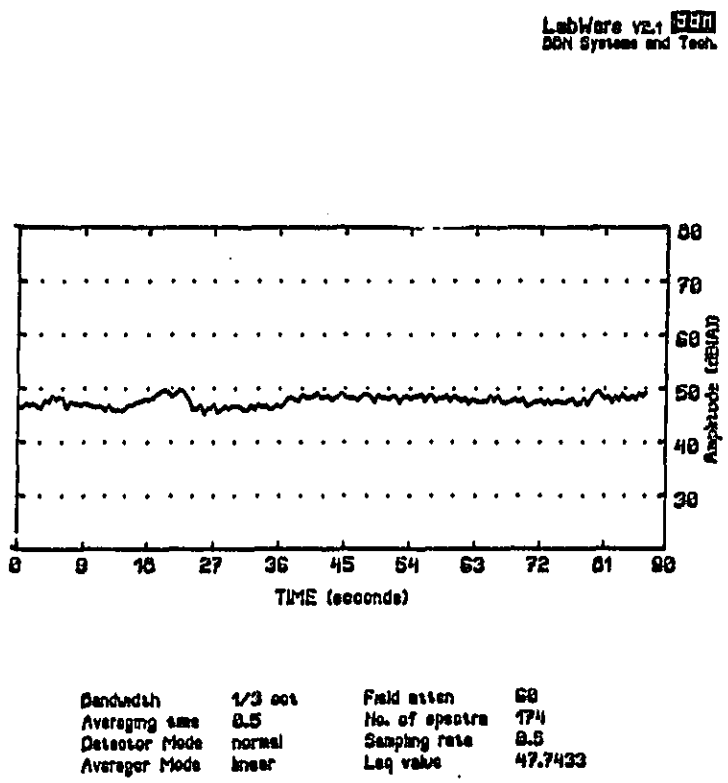


Figure F-12: Time History of High Altitude Commercial Flyover in Cohutta

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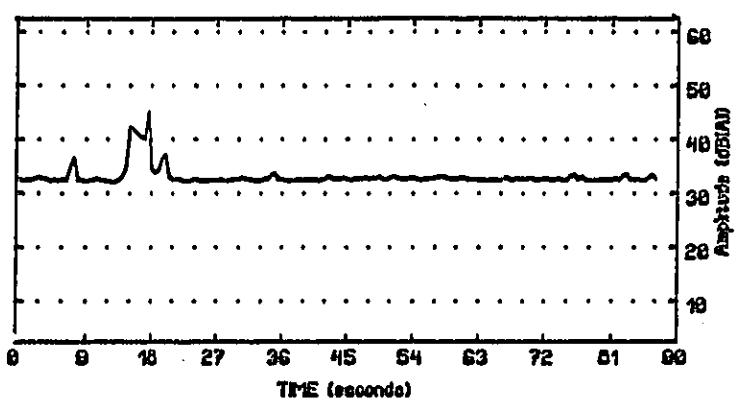
BBN Systems and Tech.



Bandwidth	1/3 oct	Field atten	120
Averaging time	6.5	No. of spectra	174
Detector Mode	normal	Sampling rate	6.5
Averager Mode	linear	Leq value	33.7543

Figure F-13: Time History of Ambient Sound Recorded At-Ear

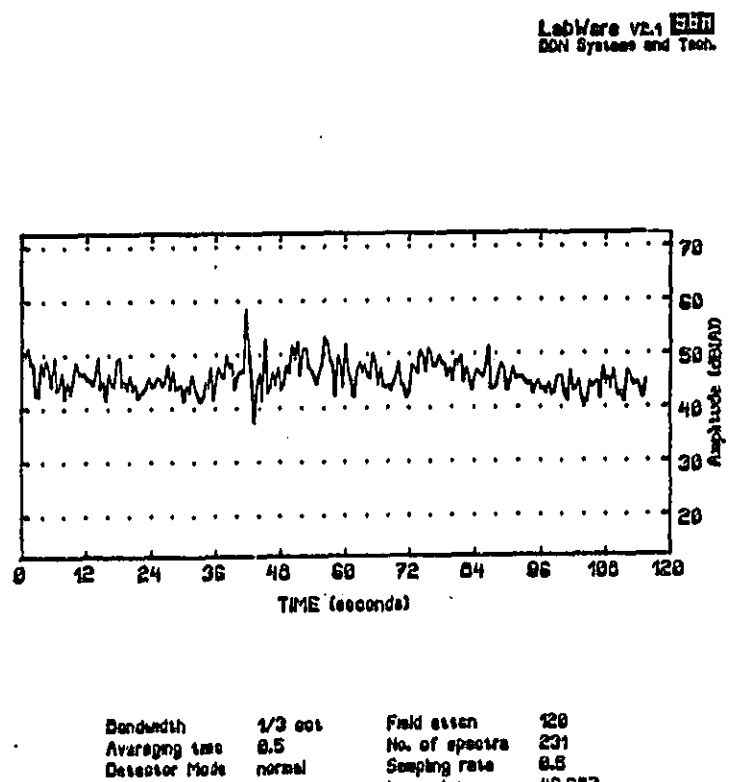


Figure F-14: Time History of Self-Noise Recorded At-Ear

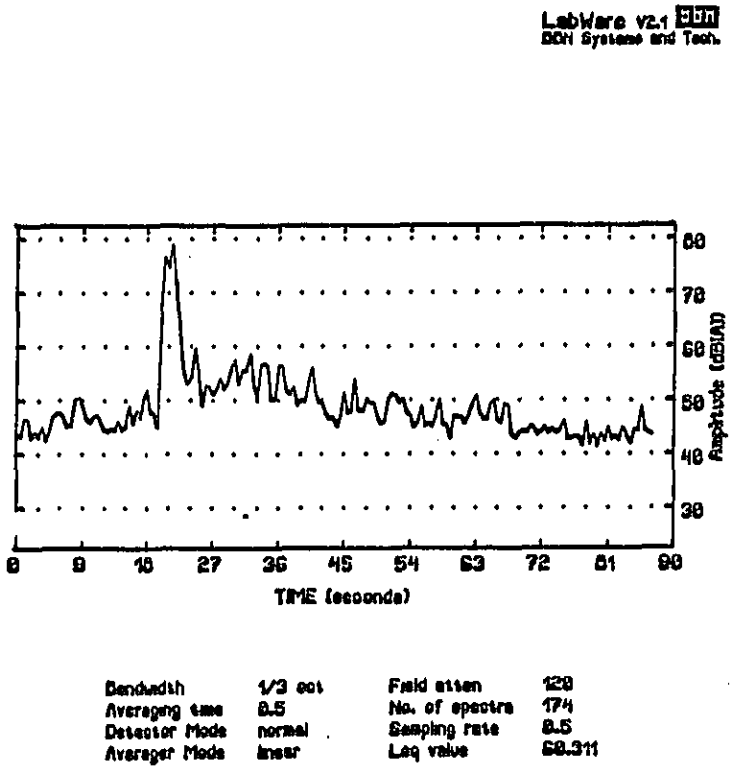


Figure F-15: Time History of Self-Noise and Propeller Plane Recorded At-Ear

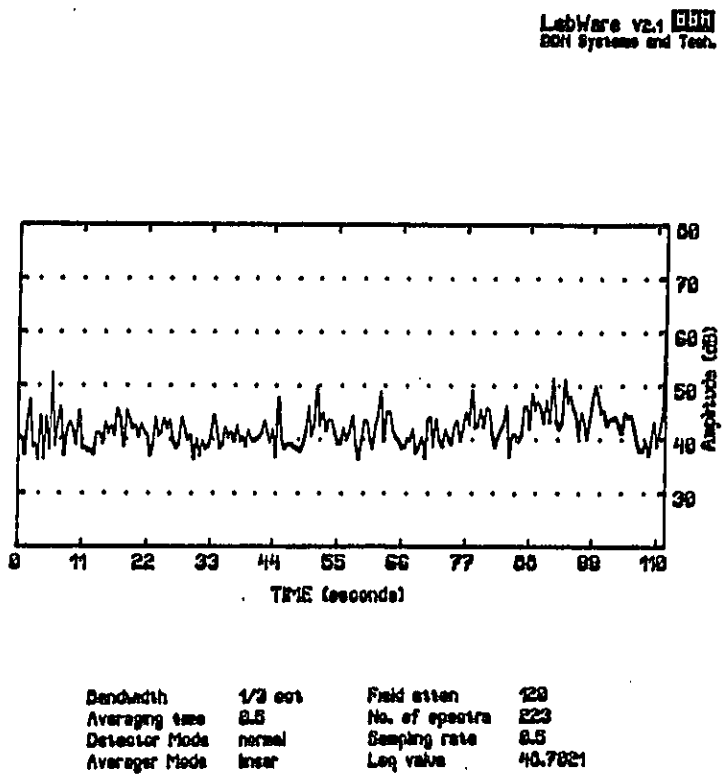


Figure F-16: Time History of Sound Levels Heard by Horseback Riders Recorded At-Ear

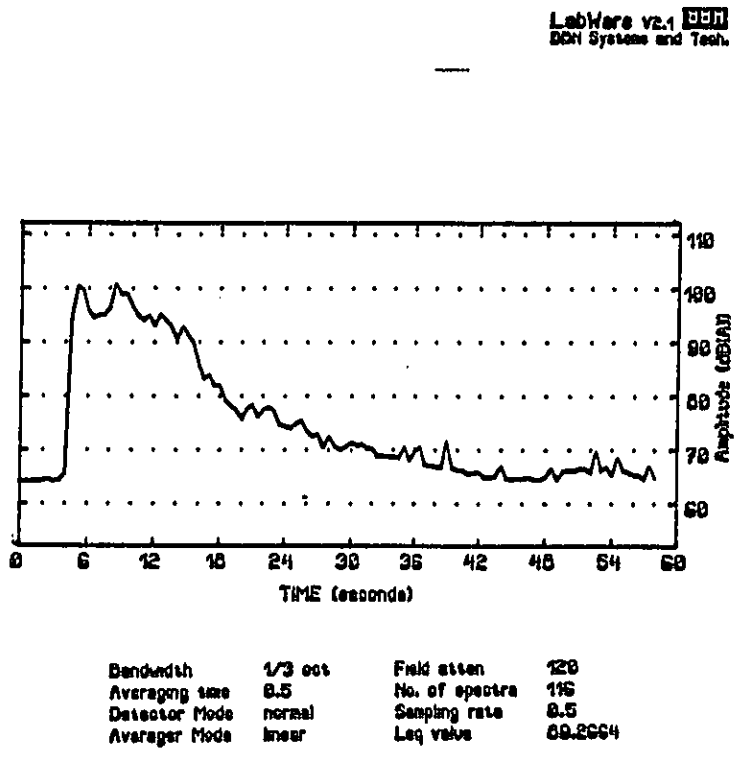


Figure F-17: Time History of F-18 Flyover Recorded At-Ear

Appendix G
Tables for Chapter 6

This Appendix contains Tables supporting supplementary analyses of annoyance and visit enjoyment data discussed in Chapter 6.

Table G-1: Estimate of Maximum A-weighted Levels of 24 Discrete Aircraft Events in Golden Trout Wilderness

Golden Trout Wilderness Aircraft Events		
Date	Time	Average LMax
07/09/90	10:07:15	88.8
07/09/90	10:54:50	90.8
07/09/90	10:56:57	87.1
07/09/90	14:15:25	68.4
07/09/90	15:14:39	97.7
07/09/90	15:22:30	81.9
07/10/90	8:14:01	71.3
07/10/90	10:12:31	89.6
07/11/90	1:56:15	70.7
07/11/90	9:02:33	69.5
07/11/90	9:18:46	89.6
07/12/90	1:21:28	90.5
07/12/90	11:49:25	73.4
07/12/90	14:05:55	80.6
07/12/90	22:00:40	73.3
07/13/90	1:33:52	93.7
07/13/90	13:27:01	98.2
07/16/90	3:43:00	76.8
07/17/90	1:32:00	79.1
07/17/90	10:37:22	74.4
07/19/90	15:20:40	71.4
07/19/90	17:26:41	80.3
07/20/90	9:35:30	79.5
07/20/90	14:45:50	84.1

Table G-2: Analysis of Variance of Annoyance Rating for Visitors Exposed and Not Exposed to One or More High Level Overflights in Golden Trout Wilderness

Source	SS	df	MS	F	p	η^2
Exposure	139.216	1	139.216	153.43[1]	<.05	.55
Error	113.398	125	2.413			
Total	252.514					

[1] Using test in which variances not assumed to be equal, $F(1, 47) = 115.43$.

Table G-3: Mean Annoyance due to Aircraft Noise for Visitors Exposed and Not Exposed to Overflights in Golden Trout Wilderness

	Nonexposed	Exposed
Mean	0.312	2.676
Standard Deviation	0.859	1.173
Sample Size	93	34

Note: Annoyance scale ranges from 0 (not at all annoyed) to 4 (extremely annoyed)

Table G-4: Estimated Maximum A-weighted Levels of 14 Discrete Aircraft Events in Superstition Wilderness

Superstition Wilderness Aircraft Events		
Date	**Time**	**Average LMax**
11/30/90	9:00:31	72.3
11/30/90	11:55:30	53.2
11/30/90	13:29:59	58.0
11/30/90	13:33:12	55.2
11/30/90	13:45:20	69.5
11/30/90	14:18:07	59.3
11/30/90	14:56:41	72.2
11/30/90	15:49:26	60.3
11/30/90	16:11:38	66.3
11/30/90	16:36:57	63.7
12/01/90	2:54:59	56.3
12/01/90	8:34:44	60.5
12/01/90	13:42:30	51.0
12/02/90	8:35:41	62.6

Table G-5: Analysis of Variance of Annoyance of Visitors Exposed and Not Exposed to Overflights in Superstition Wilderness

Source	SS	df	MS	*F*	*p*	η^2
Exposure	59.811	1	59.811	331.51[1]	<.05	.75
Error	19.666	109	0.180			
Total	79.477					

[1] Using test in which variances not assumed to be equal, F(1, 28) = 120.44.

Table G-6: Mean Annoyance due to Aircraft Noise for Visitors Exposed and Not Exposed to Overflights in Superstition Wilderness

	Nonexposed	Exposed
Mean	0.024	1.714
Standard Deviation	0.154	0.810
Sample Size	83	28

Note: Annoyance scale ranges from 0 (not at all annoyed) to 4 (extremely annoyed)

Table G-7: Correlations between Annoyance Due to Aircraft and Number of Aircraft Noticed, Among Respondents who Noticed Aircraft

Correlations - Golden Trout (n = 134)		
Aircraft Type	Type of Annoyance	
	Noise	Sight
High Altitude Jet	.12	.10
Helicopter	.16	.17
Low Flying Military Aircraft	.24	.07
Small Private Airplane	.13	.06
Other	.04	.18
All Aircraft Combined	.24	.17

Correlations - Cohutta (n = 158)		
Aircraft Type	Type of Annoyance	
	Noise	Sight
High Altitude Jet	.25 *	.06
Helicopter	-.05	-.04
Low Flying Military Aircraft	.09	-.05
Small Private Airplane	.27 *	.07
Other	.00	-.04
All Aircraft Combined	.30 *	.05

* $p < .004$ (with familywise $\alpha < .05$).

Table G-7, Continued

Correlations - Superstition (n = 239)		
	Type of Annoyance	
Aircraft Type	Noise	Sight
High Altitude Jet	-.04	-.10
Helicopter	.20 *	-.03
Low Flying Military Aircraft	-.08	-.08
Small Private Airplane	.16	.01
Other	.04	-.03
All Aircraft Combined	.03	-.08

* $p < .004$ (with familywise $\alpha < .05$).

Table G-8: Correlations between Annoyance Due to Aircraft and Number of Aircraft Noticed

Correlations - Golden Trout (n = 184)		
Aircraft Type	Type of Annoyance	
	Noise	Sight
High Altitude Jet	.24 *	.19
Helicopter	.26 *	.24
Low Flying Military Aircraft	.36 *	.17
Small Private Airplane	.19	.11
Other	.09	.21
All Aircraft Combined	.38 *	.28 *

* $p < .004$ (with familywise $\alpha < .05$).

Correlations - Cohutta (n = 343)		
Aircraft Type	Type of Annoyance	
	Noise	Sight
High Altitude Jet	.36 *	.12
Helicopter	.00	-.02
Low Flying Military Aircraft	.14	-.02
Small Private Airplane	.37 *	.12
Other	.08	.00
All Aircraft Combined	.40 *	.12

* $p < .004$ (with familywise $\alpha < .05$).

Table G-8, Continued

Correlations - Superstition (n = 390)		
	Type of Annoyance	
Aircraft Type	Noise	Sight
High Altitude Jet	.06	-.01
Helicopter	.21 *	-.02
Low Flying Military Aircraft	-.04	-.04
Small Private Airplane	.24 *	.08
Other	.06	-.02
All Aircraft Combined	.13	-.01

* $p < .004$ (with familywise $\alpha < .05$).